



Bangladesh–India Friendship Power Company Limited
(A Joint Venture of BPDB, Bangladesh and NTPC Ltd., India)

Environmental Impact Assessment of Coal Transportation for the Proposed 2X660 MW Coal Based Maitree Super Thermal Power Project at Rampal, Bagerhat, Bangladesh

Volume II: Main Report

January, 2018



Environmental Impact Assessment

of

Coal Transportation for the Proposed 2X660 MW
Coal Based Maitree Super Thermal Power Project
at Rampal, Bagerhat, Bangladesh

Volume II: Main Report

Acknowledgements

The Center for Environmental and Geographic Information Services (CEGIS), a Public Trust under the Ministry of Water Resources, is indebted to Bangladesh-India Friendship Power Company (Pvt) Limited (BIFPCL) for awarding the contract of “***Environmental Impact Assessment of Coal Transportation for the proposed 2x660 MW Maitree Super Thermal Power Project***” to CEGIS.

CEGIS is grateful to Mr. Monowar Islam ndc, Secretary, Ministry of Power, Energy and Mineral Resources (MoPEMR) and Chairman, BIFPCL for his exceptional leadership. CEGIS expresses its gratitude to Mr. Engr. Md. Khaled Mahmood, Chairman, Bangladesh Power Development Board (BPDB) for his continuous inspiration and support in all respects. CEGIS is also thankful to Mr. Naresh Anand, Managing Director, Bangladesh-India Friendship Power Company (Pvt) Limited (BIFPCL) for his direction and guidance. CEGIS appreciates the support and assistance of Mr. U. K. Bhattacharya, Former Managing Director, BIFPCL, Mr. Nabendu Lodh, Deputy General Manager, BIFPCL and Prateek Srivastav, Deputy General Manager (QA&I), BIFPCL.

CEGIS is also grateful for the contribution of the field officials of different Government and Non-Government organizations for sharing their ideas and views on the attitudes of the local people towards the Project and existing problems of the study area as well as their suggestions in solving the problems.

Last but not the least, the study team appreciates and acknowledges the concerns and perceptions of local people regarding the Project and their active participations during field visit.

Responses of Comments of Department of Environment (DoE), Dhaka on EIA of Coal Transportation (Comments in Bengali¹ Translated into English)

Vide Memo No. PA/Chharpatra/5532/2016/473
Meeting held on 14th September, 2017 at DoE, Dhaka

[Hosted by DoE and participated by BPDB, BIFPCL, CEGIS & other Relevant Agencies]
And further meeting on 06.12.2017 and 24.01.2018 at DoE

Sl. No.	Comments	Responses	Action Taken
1	2. Ka	<p>Since the proposed project site is adjacent to the Sundarbans Ecologically Critical Area (ECA) and UNESCO declared the Sundarbans as a World Heritage site, its impact on the above mentioned sites, assessed property value and measures to be taken for mitigations may be discussed at length and added to the main report as a separate Chapter. Moreover, a proposal to form an independent monitoring team to monitor the environmental aspects of the Project in line with an international monitoring system should be included in the EIA report.</p> <ul style="list-style-type: none"> • Legal aspect and applicability of Environmental Conservation Act (ECA) and Ecologically Critical Area (ECA) have been flagged and mentioned in Table 2-1 and para- 36-46 (Chapter 2; page: 2-7 to 2-9). Ecologically Critical Area Management Rules-2016 is mentioned in para-59 (Chapter- 2) of Volume- II: Main Report. • Legal bindings for protection of Ecologically Critical Areas and the Sundarbans World Heritage sites are mentioned in Section 2.5.2 (Chapter- 2) of Volume- II: Main Report. • UNESCO World Heritage Convention-1972 is mentioned in para- 123 (Chapter- 2; page: 2-21) of Volume- II: Main Report. • Baseline condition of the major and ecologically significant elements of the Sundarbans Reserve Forest is elaborately described in Section 7.8.2 (Chapter 7; page: 7-63) of Volume- II: Main Report. • Baseline condition of significant eco-elements 	<p>In regards with value assessment of the Property, Strategic Environmental Assessment (SEA) considering the Outstanding Universal Value (OUV) of the Property is being taken up by the MoEF, Government of Bangladesh.</p> <p>It is understood that the Govt of Bangladesh will take appropriate actions in line with the findings of SEA study on OUV of WHS (Refer para-75, page no. 2-13).</p> <p>During EIA of Coal Transportation the following impacts were identified and considered for impact assessment on the WHS and the Sundarbans as a whole. (Refer Table 9-1 in page 9-43 to 9-79 of Volume- II: Main Report).</p> <p>[Note: Alphabetic symbol 'A' denotes impacts during Feasibility and Design Phase; 'B' denotes impacts during Implementation Phase; and 'C' denotes impacts during Operation and Maintenance Phaes]</p> <p>C5- Coal dust may affect the vegetation and wildlife of the</p>

¹ Scanned copy of Comments of DoE is appended just below this table.

Sl. No.	Comments	Responses	Action Taken
		<p>of the Property is described under the heading of World Heritage Site in para 566 (Chapter 7; page: 7-71) of Volume- II: Main Report.</p> <ul style="list-style-type: none"> • Baseline condition of ECA is described in para 569 (Chapter 7; page: 7-72) of Volume- II: Main Report. • Possible impacts of Coal Transportation on the Sundarbans adjacent to coal transportation route have been elaborately described in Para 732 in section 9.8.4 (Chapter 9; page: 9-94) of Volume- II: Main Report. • Refer Chapter 9, under "Mitigation and Enhancement measures" of Volume- II: Main Report. • Strict maintenance of National and International standard has been suggested in relevant sections of the EIA report of Volume- II: Main Report. • Formation of an Independent monitoring agency has been suggested in Section 11.5.4 (Chapter 11; page: 11-5) and in Chapter 12 (page:12-1) of Volume- II: Main Report. • Moreover, an Independent Monitoring Committee comprising representatives from relevant stakeholders may be formed by the Ministry of Environment and Forest (MoEF) to review and scrutinize the quarterly monitoring reports prepared by Independent Monitoring Agency has been suggested (Refer Chapter 12, page 12-2 of Volume II: main Report). 	<p>Sundarbans and World Heritage Site;</p> <p>C6- Water quality deterioration due to increase in shipping may impact fish and shrimp growth, on which livelihood of local communities depend on.</p> <p>C7- Increase in shipping, coal transshipment, and coal transport can increase collision induced risk and subsequent spillage</p> <p>C9- Generation of noise from vessels and tran-shipper may affect surrounding environment and wildlife including resident and migratory birds.</p> <p>C10- Increased lighting from ships/barges can create disturbances to the surrounding wildlife</p> <p>C11- Contamination risk from effluents (residue of ballast water, bilge water, oil, lubricant, garbage, domestic waste, food and kitchen waste, coal leachate, sewage, etc.) from ships.</p> <p>C12- Pollution from ships may affect aquatic habitats and reduce fish and crustacean production and recruitment.</p> <p>C13- Enhanced maritime traffic may have impact on dolphins, fish, and crustaceans.</p> <p>C15- Movement of bulk carriers and class lighterage carrying coal and limestone may generate wave on sea and inland water that might cause erosion along seashore and riverbank.</p> <p>C16- Erosion caused by vessel wakes results in excessive sedimentation in the deep pools where larger</p>

Sl. No.	Comments	Responses	Action Taken
			<p>fishes and dolphins congregate for feeding and as refuge areas.</p> <p>C17- Movement of foreign vessels can risk of invasion of alien species. Alien species might come through ballast water, hull-fouling, and by contract of vessel body, these species may compete with native species and therefore threaten biodiversity of the Sundarbans and their abundances.</p> <p>C18- Movement of coal and limestone vessels and transshipment process may have impacts on the surrounding the Sundarbans Ecosystem (including, terrestrial wildlife, aquatic fauna and nearby World Heritage Site).</p> <p>C19- Impact of gaseous emissions from vessels and tran-shipper on ambient air quality</p> <p>C20. Accumulation of fugitive coal dust and coal spills on riverbed during loading and unloading by tran-shipper at the mooring area.</p> <p>C22. Impact of coal dust emissions from unloading and loading and lighterage transport on biodiversity of the Sundarbans. Fugitive coal dust can coat mangrove leaves and reduce photosynthesis in the Sundarbans.</p> <p>C25. Discharge of contaminants through spills; discharge of coal to water bodies will release Polycyclic Aromatic Hydrocarbons (PAHs) into aquatic environment.</p> <p>C28. Risk of oil spill due to the collision between coal</p>

Sl. No.	Comments	Responses	Action Taken
			<p>vessel and oil tanker.</p> <p>C29. Risk of coal vessel sinking due to structural or mechanical failure and spilling oil and fuel into river.</p> <p>C30. Risk of Collision, grounding impact during low visibility and fog conditions.</p> <p>C31. Risk of collision and grounding due to tidal conditions.</p> <p>It is pertinent to mention that the nearest tip of World Heritage Site from the Coal Transportation Route is about 3.5 km.</p> <p>SoundPlan software were used to simulate the scenario where noise from transshipment of coal from Capesize vessels along with other sources including mother vessel, lighterage vessel and other vessels has been captured. The predicted noise level at the selected receivers are presented in the Table 9-5 and Figure 9-3 (day time) and Figure 9-4 (night time) of Volume- II: Main Report. The resultant noise level is found to be lower than the standard limit of Noise Control Rules, 2006 of Government of Bangladesh. It is also been seen from the graph that the resultant noise level dies down to 20-40 dBA at a distance 1 km from the route and practically the impact of noise level at the tip of WHS is almost nil. [See <i>additional comments-response on noise after this table</i>]</p> <p>The air quality modelling study have been conducted by using CALPUFF model which is one of the state-of-art technologies suitable for long distance complex</p>

Sl. No.	Comments	Responses	Action Taken
			<p>prediction of ground level concentration with the changing scenarios. [See additional comments-response on CALPUFF software after this table]</p> <p>The cumulative impact of all major emission sources in the air-shed is assessed. To assess the foreseeable future condition and account for an increase in pollution from brick fields, and increase in road and marine vessel traffic, projected data for 2030 is used for modelling. The emissions and input parameters for brick fields, road and vessel traffic is given respectively in Table 10-1, Table 10-2 and Table 10-3. Volume- II: Main Report.</p> <p>Table 10-4 shows the predicted maximum ground level 1-hr and annual averaging values of Nox for the cumulative case. The predicted values are within the National Bangladesh standards and WBG guidelines. Volume- II: Main Report.</p> <p>For SO₂ the predicted maximum ground level 24-hr and annual concentrations are given in Table 10-10. The table shows that the maximum predicted SO₂ concentrations for the cumulative case are well within the Bangladesh Ambient Air Quality Standards and the predicted 24-hr averaging value is within WB/IFC interim target-1 (Page 10-11) of Volume- II: Main Report.</p> <p>Table 10-8 shows the predicted maximum ground level 24-hr and annual concentrations for PM10. As can be seen from the table,</p>

Sl. No.		Comments	Responses	Action Taken
				<p>there is a marginal increase in maximum predicted levels for 24-hr and annual averaging from the project case to the cumulative case. The predicted concentrations are within the Bangladesh National standards and the predicted 24-hr average concentration meets WBG interim target-1 for 24-hr averaging and interim target-1 for annual averaging (Page 10-11) of Volume- II: Main Report.</p> <p>Table 10-6 of Volume- II: Main Report shows the predicted maximum ground level 24-hr and annual concentrations for PM_{2.5}. As can be seen from the table, there is an increase in maximum predicted levels for 24-hr and annual averaging from the project case to the cumulative case. The maximum predicted concentrations are within the Bangladesh National standards and the predicted 24-hr average concentration meets WBG interim target-1.</p> <p>Increased inland water transport through the Passur River is not going to increase significantly (only three vessels in two days), moreover ash produced by the Maitree Power Plant shall be sold to nearby cement industries, the requirement of importing the ash from India will be largely reduced as such the net increment of vessels in the designated route will be almost nil, hence impact on Bio-diversity on the Sundarbans is expected to be negligible.</p>
2	2. Kha.	Since the proposed project shall pass through the	Ramsar site regulations are mentioned in the EIA Report. Refer Chapter 2,	In 2015 the Contracting Parties identified the effective conservation and

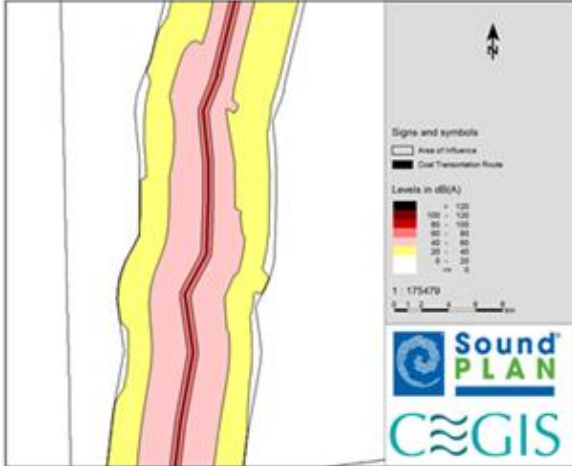
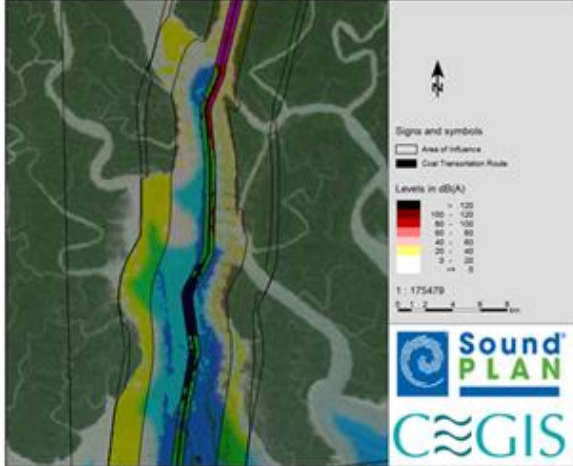
Sl. No.		Comments	Responses	Action Taken
		Sundarbans Reserve Forest and the Sundarbans reserve forest is Ramsar site, it is necessary to mention Ramsar site regulations in this EIA report.	Page 2-20 of Volume- II: Main Report.	<p>management of the Ramsar Site. The Plan calls for efforts to enable the participation of stakeholders, including indigenous peoples and local communities.</p> <p>The ecological character of a Site is fundamental. The Convention focuses on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) to stem the progressive encroachment on and loss of Wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific and recreational value.</p> <p>Many Ramsar Sites are also protected under national schemes or regional systems. Some are also inscribed on the World Heritage List under the UNESCO World Heritage Convention.</p> <p>The study has identified the aquatic flora and fauna of the wetland ecosystem of the study area, which covers the whole coal transportation route through the Sundarbans as well as the WHS area. Local and global status of the fauna has been checked based on IUCN Red List. Accordingly critical habitat assessment as per IFC Performance Standard Guidelines has been done for the fauna which are Critically Endangered and/or Endangered Species (Page no. 9-139) of Volume- II: Main Report. Impact assessment was done considering the ecological character of the study area and subsequent Environmental Management Plan was delineated.</p>
3	2. Ga	Baseline information provided in the EIA study report of 1320	Baseline information of main plant EIA report and that of the coal	Continuous monitoring of the study area are being undertaken and still going on.

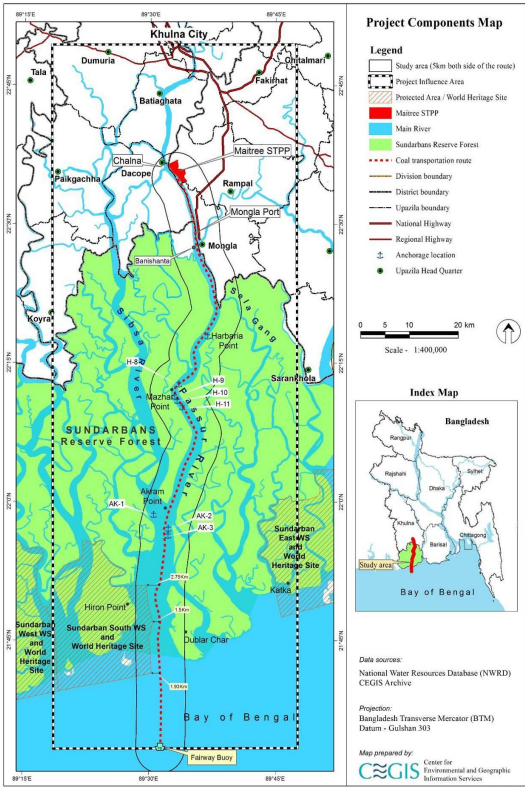
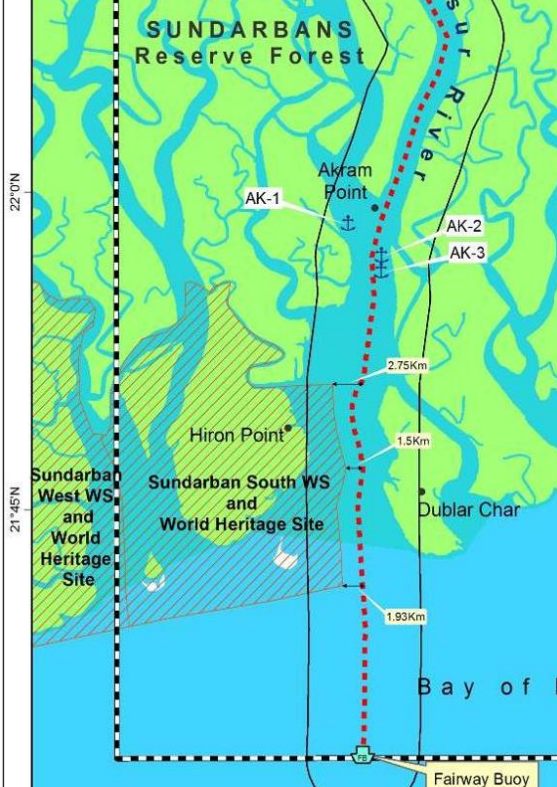
Sl. No.	Comments	Responses	Action Taken
		<p>MW Rampal coal based Power plant should be similar to that provided in the EIA report of coal transportation for the Maitree Super Thermal Power Plant (MSTTP).</p> <p>transportation EIA report are almost similar or identical. These two EIAs were done at a gap of about 5 to 6 years using two different modelling software. In case if some data of the two EIAs differ with one another then this may be due to time gap, use of different modelling software, contemporary atmospheric condition, etc.</p> <p>The air quality modelling study in the EIA of Coal Transportation have been conducted by using CALPUFF model which is one of the state-of-art technologies suitable for long distance complex prediction of ground level concentration with the changing scenarios. CALPUFF is more sophisticated and a refined regulatory model recommended and approved by USEPA.</p>	<p>Thirteen (13) such quarterly monitoring reports have been prepared and submitted to various relevant agencies including DoE where baseline are continuously updated.</p> <p>The monitored ambient air quality is summarized in Table 7-3 by broad head by season and one time data for January, 2016 is shown by the sampling location in Table 7-4 of Volume- II: Main Report and results are annexed in Annex 7-1 of Volume- III: Annexure.</p>
4	2.Gha	<p>If for some reason the present air quality mentioned in the report increases then what are the actions that will be taken should have been mentioned in the EIA Report.</p> <p>The present values of criteria pollutants are mostly well below the Bangladesh Standard and World Bank's Interim Target (IT-1) as well as Guidelines of IFC Standard. Air quality impact for Project implementation case as well as cumulative case through a sophisticated model (CALPUFF) study, which shows negligible impact for both Project case and cumulative case, described in detail in Chapters 9, 10 and 11 has been studied under this assignment. However, in any case if there is any evidence of increasing trend of air pollution from the analysis of continuous air monitoring report being submitted to DoE, it may suggest additional suitable mitigation measures required to be adopted for coal transportation for</p>	-

Sl. No.		Comments	Responses	Action Taken
			Ramplal Power Plant but also for lot of many other vessels and transshipment activities in the route.	
5	2. Uma	Alternative route for coal transportation can be included in case if the main route cannot be used due to some problems.	Refer to Alternative Analysis Chapter 5 of EIA Report (Volume- II: Main Report) where elaborate alternative route study has been delineated.	A detailed alternative analysis of three alternative routes was delineated in weighted score method (refer Table 5-1, Page 5-7) of Volume- II: Main Report. Scores were given based on the Physical, Biological and socio-economical consequences due to vessel movement through the studied routes.
6	2. Cha	An emergency Response plan mentioning Response Group with Responsible person should be included to handle emergency that if occurs during coal transportation.	<p>This issue has been considered in the study and presented in the report. Refer Section 11.9.4: Emergency Response Plans in Volume II- Main Report and a detailed “Emergency Preparedness and Response Plan” presented in Annex 11-4 in Volume III- Annexure. (Page 139)</p> <p>A MOA has been signed between BIFPCL & MPA on 16.08.2017, where MPA to form an Emergency Preparedness and Response Group (EPRG), headed by Member (H&M), MPA, may take note of it. (Refer Annexure 11-5, Page 155 of Volume –III, Annexure).</p>	<p>A detailed possible Emergency event due to coal transportation has been identified and its probability, response/action and principal response agencies have been delineated in Annexure 11-4 in page 139 of Volume III.</p> <p>However, a National Oil Spill Contingency Plan (NOSOP) has been formulated as the country has seen multiple cases of spillage situation which prompts the country and the region to setup a detailed framework and guidelines for all agencies, organization and stakeholders concerned that must be active in responding to spillage events and combatting marine pollution, leading in remedial action and prevention in the long-term under the guidance of MPA.</p> <p>The preparation of a National Oil Spill Contingency Plan is, therefore, necessary to identify the national capabilities and resources in order to establish an organizational structure to combat marine pollution so that focal points and lead agencies are identified and guided effectively (Refer para-931, page no. 11-27).</p>
7	2. Chha	The mitigation approaches of the negative impacts on the habitat of animals,	The mitigation approaches of the negative impacts are mentioned in Table 11-3: Mitigation Plan.	The Passur River, designated route of MPA, has been operating for last 60 years and sailing of ships and

Sl. No.		Comments	Responses	Action Taken
		biodiversity, fish, environment and ecology causing from the movement of vessels should be mentioned.	Issues are mentioned specifically in C7, C9, C10 and C11 of Volume- II: Main Report.	barges are coming and going from MPA. The river mainly functions as a longitudinal migratory route of good number of brackish water fish species. They usually breed in the tributaries and distributaries commonly known as creeks of the Sundarbans. The creeks also function as nursery grounds of the resident and non-resident fish species, and also having high recruitment potential (Section 7.9.6 in page no. 7-87). The management of fisheries resources in SRF from a technical point of view was started in 1989 with the restriction of fishing in 18 canals in all four ranges to accelerate fish breeding (FAO, 1994) (Section 7.9.9 in page no. 7-91). Canals are shown in Figure 7-49 in page 7-92 of Volume- II: Main Report. The Passur river also functions as an important corridor of cetaceans like dolphins. These are all habituated with activities currently occurring through the river. No disturbances to aquatic fauna along the river are reported so far from the local people and officials. Only three (03) additional modern and IMO approved vessels will be added to the existing vessel load of the river in two (02) days. Therefore, impact on aquatic fauna from coal transportation is found negligible.
8	2. Ja	Vessels used for coal transportation should be IMO certified. Coal transportation should be less during night time, thus focus should be given on this.	<ul style="list-style-type: none"> • All vessels including both mother and lighterage vessels will follow the IMO & MARPOL convention as applicable and all vessels are self-contained. Ref. Chapter 9, page 9-49 of Volume- II: Main Report. • Night time vessel movement will be avoided wherever practical Ref: Chapter-9, Page 9-49 of Volume- II: Main Report. 	-

Additional Comments on Noise and justification of CALPUFF software:

Comments	Response
<p>How far distance of WHS from the coal transportation route? Is it same as designated route of MPA? Justify the distance of WHS is safer from the coal transportation with respect of Noise propagation? Identify it in the model generated image?</p>	<p>Coal will be transported through the same route following by the MPA for last sixty years. The selected route in coherence with the MPA designated route is about 3.5 km distance from the nearest point of the WHS (Refer Figure 3-1 of Volume II: Main Report)). It is located safer distance from the coal transportation route. The sound of marine vessels will nearly be decayed within 500-700m when sail through during transportation period. The distance of terrestrial area of WHS from the MPA designated route are shown in following figure. From the SoundPlan output figure (Refer Figure 9-5 and Figure 9-6 of Volume II: Main Report) it is observed that intensity of sound level is about 40-20 dB(A) at a distance about two (02) km from the transportation route towards the WHS.</p>
	

Comments	Response
 <p>Project Components Map</p> <p>Legend</p> <ul style="list-style-type: none"> Study area (5km both side of the route) Project Influence Area Protected Area / World Heritage Site Main River Sundarbans Reserve Forest Coal transportation route Division boundary District boundary Upazila boundary National Highway Regional Highway Anchorage location Upazila Head Quarter <p>Index Map</p> <p>Map prepared by: CEGIS Center for Environmental and Geographic Information Services September 2016</p>	 <p>SUNDARBANS Reserve Forest</p> <p>Akram Point</p> <p>AK-1</p> <p>AK-2</p> <p>AK-3</p> <p>2.75Km</p> <p>1.5Km</p> <p>1.93Km</p> <p>Hiron Point</p> <p>Sundarbans West WS and World Heritage Site</p> <p>Sundarbans South WS and World Heritage Site</p> <p>Dublar Char</p> <p>Bay of Bengal</p> <p>Fairway Buoy</p>
<p>Why CALPUFF is used as a dispersion modeling in compare to AERMOD air dispersion modeling?</p>	<p>CALPUFF is also a state-of-art air dispersion modeling system, USEPA recommended and wide use modeling software. The advantages of CALPUFF is that it can adopt the fumigation effects, over water effects in the modeling process over AERMOD. Therefore, it is recommend to use CALPUFF at the projects falling under coastal zone.</p> <p>For air dispersion modeling, a grid of 50x150Km has been considered in order to capture all the sensitive locations (including WHS) and sources. However, CALPUFF is suited better for this project. A study has been conducted by Gulia S., et. al. 2015 entitled "Performance evaluation of CALPUFF and AERMOD dispersion models for air quality assessment of an industrial complex" of the Journal of Scientific & Industrial Research, Vol. 74 PP 302-307.</p>

Comments Sheet of DoE on EIA Report of Coal Transportation

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
পরিবেশ অধিদপ্তর
পরিবেশ ভবন, ই/১৬ আগারগাঁও
শেরে বাংলানগর, ঢাকা-১২০৭
www.doc.gov.bd

নং- পঅ/স্বা/পঅ/১৫০২/২০১৬/৪৭৩

২৭/০৬/১৪২৪ বঙ্গাব্দ
তারিখ- ০২/১০/২০১৭ খ্রিস্টাব্দ

বিষয়ঃ বাংলাদেশ ইন্ডিয়া ফ্রেজারীপ পাওয়ার কোম্পানী লিঃ কর্তৃক বাস্তবায়িতব্য Coal Transportation for the proposed Maitree Super Thermal Power Plant প্রকল্পের জন্য দাখিলকৃত পরিবেশগত প্রভাব সমীক্ষা প্রতিবেদনের উপর গত ১৪/০৯/২০১৭ তারিখে অনুষ্ঠিত জনমত পর্যালোচনা সভার কার্যবিবরণী।

সভাপতি : মোঃ রইছউল আলম মন্ডল, মহাপরিচালক, পরিবেশ অধিদপ্তর।
স্থান : চামেলী সভা কক্ষ।
তারিখ : ১৪ সেপ্টেম্বর ২০১৭ খ্রিঃ।
সময় : সকাল ১০:৩০ টা।
উপস্থিতি : পরিশিষ্ট-ক।

সভার শুরুতে উপস্থিত সকলকে স্বাগত জানিয়ে সভাপতি সভার কার্যক্রম শুরু করেন। তিনি প্রথমেই সভার উদ্দেশ্য ও প্রেক্ষাপট সংক্ষিপ্তভাবে তুলে ধরেন এবং আলোচ্য প্রকল্পের ইআইএ প্রতিবেদনের সাথে সংশ্লিষ্ট স্টেকহোল্ডারদের সভায় উপস্থিত হওয়ার জন্য ধন্যবাদ জানান।

২। এ পর্যায়ে উক্ত প্রকল্পের ইআইএ প্রতিবেদন প্রণয়নকারী প্রতিষ্ঠান সিইজিআইএস কর্তৃক ইআইএ প্রতিবেদনের উপর Powerpoint Presentation উপস্থাপন করা হয়। উক্ত উপস্থাপনায় রামপাল বিন্যাস কেন্দ্রের জন্য Coal Transportation এর ফলে পরিবেশ ও প্রতিবেশের উপর সম্ভাব্য প্রভাবসহ আনুষঙ্গিক বিষয়াদি বিস্তারিতভাবে তুলে ধরা হয়। সেইসাথে সম্ভাব্য সকল প্রকার প্রভাব মোকাবেলায় প্রশমনমূলক ব্যবস্থাদিসহ পরিবেশবান্ধব প্রতিকারমূলক ব্যবস্থাসমূহেরও বিস্তারিত বর্ণনা দেওয়া হয়। উপস্থাপনা শেষে সভায় উপস্থিত সকলকে মতামত প্রদানের জন্য উনুজ্ঞ আলোচনায় অংশগ্রহণের আহবান জানানো হয়। সভায় উপস্থিত সংশ্লিষ্ট স্টেকহোল্ডারগণ ইআইএ প্রতিবেদনের উপর নিম্নোক্ত বক্তব্য, মতামত ও পরামর্শ তুলে ধরেন।

ক) আলোচ্য প্রকল্পের অবস্থান যেহেতু সুন্দরবন ইসিএ এলাকা এবং ইউনেস্কো ঘোষিত সুন্দরবন ওয়াশ্ব হেরিটেজ সাইটের পাশে সেক্ষেত্রে উক্ত প্রকল্পের জন্য সুন্দরবনের উপর কি প্রভাব পড়তে পারে, Properties এর Value Assessment করা এবং তা প্রশমনের জন্য কি কি ব্যবস্থা গ্রহণ করা যেতে পারে তার জন্য বিস্তারিত বর্ণনা দিয়ে আলাদা একটা অধ্যায় যোগ করা যেতে পারে। উক্ত প্রকল্পের পরিবেশগত দিক মনিটরিং করার জন্য ইন্টারন্যাশনাল স্ট্যান্ডার্ড এর মনিটরিং সিস্টেম ফলো করা এবং সেজন্য একটি টিম গঠনের বিষয়টি ইআইএ প্রতিবেদনে অন্তর্ভুক্ত করা যেতে পারে।

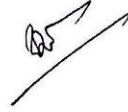
খ) যেহেতু উক্ত প্রকল্প সুন্দরবন রিজার্ভ ফরেস্ট এ এবং রিজার্ভ ফরেস্ট যেহেতু রামসার সাইট, সেক্ষেত্রে রামসার সাইটের যেসব রেকর্ডেশন আছে তা উক্ত প্রতিবেদনে উল্লেখ করা যেতে পারে।

- গ) ১৩২০ মেগাওয়াট রামপাল কয়লা ভিত্তিক বিদ্যুৎ কেন্দ্রের ইআইএ প্রতিবেদনে প্রদত্ত Baseline Information এর তথ্যের সাথে Coal Transportation for the proposed Maitree Super Thermal Power Plant প্রকল্পের Baseline Information এর তথ্য সামঞ্জস্যপূর্ণ হওয়া উচিত বলে মতামত প্রদান করা হয়।
- ঘ) প্রতিবেদনে Ambient Air Quality বর্তমানে যা দেখানো হয়েছে যদি কোন কারণে তা বেড়ে যায় সেক্ষেত্রে তা রোধ করার জন্য কি কি ব্যবস্থা নেয়া হবে তা প্রতিবেদনে উল্লেখ করা যেতে পারে।
- ঙ) Coal Transportation এর জন্য বিকল্প পথের ব্যবস্থা রাখা যেতে পারে যাতে প্রধান যে পথে কয়লা আনা হবে সে পথে যদি কোন কারণে কোন সমস্যা দেখা যায় তাহলে বিকল্প পথে যাতে Coal Transport করা যায় সে বিষয়টি অন্তর্ভুক্ত করা যেতে পারে।
- চ) Coal Transportation এর সময় যদি কোন দুর্ঘটনা ঘটে সেক্ষেত্রে তার জন্য Emergency Response Plan থাকতে হবে এবং সেজন্য Response Group তৈরি করতে হবে যেখানে Responsible Person করা হবে তা উল্লেখ করা যেতে পারে।
- ছ) Vessel এর চলাচলের জন্য সেখানে জলজ প্রাণীর আবাসস্থল, জীববৈচিত্র্য, মৎসকূল, পরিবেশ ও প্রতিবেশের উপর যে প্রভাব পড়বে তা প্রশমনের ব্যবস্থা বিস্তারিতভাবে উল্লেখ করা যেতে পারে।
- জ) Coal Transportation এ যেসব Vessel ব্যবহার করা হবে তা যাতে IMO Certified হয় সে বিষয়ে সভায় মতামত প্রদান করা হয়। রাতে Coal Transportation এর কার্যক্রম যতটা সম্ভব কম করা যায়, সেদিকে লক্ষ্য রাখা যেতে পারে।

৩। সভাপতি এ পর্যায়ে আলোচ্য প্রকল্পের ইআইএ প্রতিবেদনের উপর সভায় উপস্থিত বিভিন্ন সংস্থা থেকে আগত প্রতিনিধিদের লিখিত মতামত আগামী ০৭ (সাত) কর্মদিবসের মধ্যে পরিবেশ অধিদপ্তরে প্রেরণের জন্য অনুরোধ জানান।

৪। সভায় বিস্তারিত আলোচনার পর নিম্নরূপ সিদ্ধান্তসমূহ গৃহীত হয়ঃ

- ক) সভায় উপস্থিত বিভিন্ন স্টেকহোল্ডারগণ উক্ত ইআইএ প্রতিবেদনের উপর তাদের লিখিত মতামত আগামী ৭ (সাত) কর্মদিবসের মধ্যে পরিবেশ অধিদপ্তরে প্রেরণ করবে।
- খ) আলোচ্য প্রকল্পের অবস্থান যেহেতু সুন্দরবন ইসিএ এলাকা এবং ইউনেস্কো ঘোষিত সুন্দরবন ওয়াস্ট হেরিটেজ সাইটের পাশে সেক্ষেত্রে উক্ত প্রকল্পের জন্য সুন্দরবনের উপর কি প্রভাব পড়তে পারে, Properties এর Value Assessment করা এবং তা প্রশমনের জন্য কি কি ব্যবস্থা গ্রহণ করা যেতে পারে তার জন্য বিস্তারিত বর্ণনা দিয়ে ইআইএ প্রতিবেদনে আলাদা একটা অধ্যায় যোগ করতে হবে। এছাড়া, উক্ত প্রকল্পের পরিবেশগত দিক মনিটরিং করার জন্য ইন্টারন্যাশনাল স্ট্যান্ডার্ড এর মনিটরিং সিস্টেম ফলো করা এবং সেজন্য একটি টিম গঠনের বিষয়টি ইআইএ প্রতিবেদনে অন্তর্ভুক্ত করতে হবে।
- গ) আলোচ্য প্রকল্পটি সুন্দরবন রিজার্ভ ফরেস্ট এর ভিতর দিয়ে যাবে এবং সুন্দরবন রিজার্ভ ফরেস্ট যেহেতু রামসার সাইট, সেক্ষেত্রে রামসার সাইটের যেসব রেগুলেশন আছে তা উক্ত ইআইএ প্রতিবেদনে উল্লেখ করতে হবে।
- ঘ) ১৩২০ মেগাওয়াট রামপাল কয়লা ভিত্তিক বিদ্যুৎ কেন্দ্রের ইআইএ প্রতিবেদনে প্রদত্ত Baseline Information এর তথ্যের সাথে Coal Transportation for the proposed Maitree Super Thermal Power Plant প্রকল্পের ইআইএ প্রতিবেদনে উল্লেখিত Baseline Information এর তথ্য সামঞ্জস্যপূর্ণ হতে হবে।
- ঙ) ইআইএ প্রতিবেদনে Ambient Air Quality বর্তমানে যা দেখানো হয়েছে যদি কোন কারণে তা বেড়ে যায় সেক্ষেত্রে তা রোধ করার জন্য কি কি ব্যবস্থা নেয়া হবে তা প্রতিবেদনে উল্লেখ করতে হবে।




১) Coal Transportation এর জন্য বিকল্প পথের ব্যবস্থা রাখা যাতে পারে যাতে প্রধান যে পথে কয়লা আনা হবে সে পথে যদি কোন কারণে কোন সমস্যা দেখা যায় তাহলে বিকল্প পথে যাতে Coal Transport করা যায় সে বিষয়টি ইআইএ প্রতিবেদনে অন্তর্ভুক্ত করতে হবে।

২) Coal Transportation এর সময় যদি কোন দুর্ঘটনা ঘটে সেক্ষেত্রে তার জন্য Emergency Response Plan থাকতে হবে এবং সেজন্য Response Group তৈরি করতে হবে যেখানে Responsible Person করা হবে তা উল্লেখ করতে হবে।

৩) Vessel এর চলাচলের জন্য সেখানে জলজ প্রাণীর আবাসস্থল, জীববৈচিত্র্য, মৎসকূল, পরিবেশ ও প্রতিবেশের উপর যে প্রভাব পড়বে তা প্রশমনের ব্যবস্থা ইআইএ প্রতিবেদনে বিস্তারিতভাবে উল্লেখ করতে হবে।

৪) Coal Transportation এ যেসব Vessel ব্যবহার করা হবে তা যাতে IMO Certified হয় সে বিষয়ে ইআইএ প্রতিবেদনে উল্লেখ করতে হবে। এছাড়া, রাতে Coal Transportation এর কার্যক্রম যতটা সম্ভব কম করা যায়, সেদিকে লক্ষ্য রাখার বিষয়টি ইআইএ প্রতিবেদনে অন্তর্ভুক্ত করতে হবে।

পরিশেষে আর কোন আলোচ্যসূচি না থাকায় উপস্থিত সম্মানিত সদস্যগণকে ধন্যবাদ জানিয়ে সভাপতি সভার সমাপ্তি ঘোষণা করেন।


(মোঃ রইছুল আলম মর্শল)
মহাপরিচালক
পরিবেশ অধিদপ্তর
ফোনঃ ৮১৮১৮০০

বিতরণ (জ্যেষ্ঠতার ভিত্তিতে নয়):

- ১। উপাচার্য, বাংলাদেশ প্রকৌশল বিশ্ববিদ্যালয় (বুয়েট), ঢাকা
- ২। অতিরিক্ত সচিব (পরিবেশ), পরিবেশ ও বন মন্ত্রণালয়, বাংলাদেশ সচিবালয়, ঢাকা
- ৩। মহাপরিচালক, বাংলাদেশ পানি উন্নয়ন বোর্ড, ওয়াশিংটন ডিসি, মতিঝিল বা/এ, ঢাকা
- ৪। চেয়ারম্যান, বাংলাদেশ অভ্যন্তরীণ নৌ-পরিবহন কর্তৃপক্ষ, বিআইডব্লিউটিএ ভবন, ১৪১-১৪৩, মতিঝিল বা/এ, ঢাকা
- ৫। মহাপরিচালক, সমুদ্র পরিবহন অধিদপ্তর, বিআইডব্লিউটিএ ভবন, ১৪১-১৪৩, মতিঝিল বা/এ, ঢাকা
- ৬। প্রধান বন সংরক্ষক, বন অধিদপ্তর, বন ভবন, আগারগাঁও, ঢাকা
- ৭। মহাপরিচালক, মৎস্য অধিদপ্তর, সেগুন বাগিচা, রমনা, ঢাকা
- ৮। চেয়ারম্যান, মংলা বন্দর কর্তৃপক্ষ, মংলা
- ৯। পরিচালক, পানি ও বন্যা ব্যবস্থাপনা ইপিটিটিউট, বুয়েট, ঢাকা
- ১০। কান্ট্রি রিভ্রোজেক্টটিভ, আইইউসিএন বাংলাদেশ কান্ট্রি অফিস, বাড়ী ১৬, রোড ২/৩, বনানী, ঢাকা-১২১৩
- ১১। পরিচালক (প্রাঃ সংঃ ব্যঃ) ও আহবায়ক, পরিবেশগত ছাড়পত্র বিষয়ক কমিটি, পরিবেশ অধিদপ্তর, সদর দপ্তর, ঢাকা
- ১২। পরিচালক, পরিবেশ অধিদপ্তর, খুলনা বিভাগীয় কার্যালয়, খুলনা
- ১৩। পরিচালক (বায়ুমান ব্যবস্থাপনা/পরিবেশগত ছাড়পত্র), পরিবেশ অধিদপ্তর, সদর দপ্তর, ঢাকা
- ১৪। উপ-পরিচালক (প্রাকৃতিক সম্পদ ব্যবস্থাপনা), পরিবেশ অধিদপ্তর
- ১৫। উপ-পরিচালক/অফিস প্রধান, পরিবেশ অধিদপ্তর, বাগেরহাট জেলা অফিস, বাগেরহাট
- ১৬। জনাব মোঃ শাহজাহান, প্রাক্তন অতিরিক্ত মহাপরিচালক, পরিবেশ অধিদপ্তর, ঢাকা
- ১৭। ব্যবস্থাপনা পরিচালক, বাংলাদেশ-ইভিয়া ফ্রেডশীপ পাওয়ার কোম্পানী লিঃ, ইউনিক হাইটস (১৭ তলা), ১১৭ কাজী নজরুল ইসলাম এভিনিউ, ইস্কাটন, ঢাকা-১২১৭।

Responses of Comments of Mongla Port Authority (MPA) on EIA Report for Coal Transportation of Rampal Power Plant

Vide Memo No. 18.14.0158.427.14.04.2017-105 dated 18 September, 2017

Meeting held on 14th September, 2017 at DoE, Dhaka

[Hosted by DoE and Participation from BPDB, BIFPCL, CEGIS & other Relevant Agencies]

And further meeting on 06.12.2017 and 24.01.2018 at DoE

Sl. No.	Described in EIA Report (Volume II: Main Report)	Comments of MPA	Action Taken
01.	Page: 4-34, Para-368 90% of the Capital Dredging will be required for yearly maintenance dredging.	According to study report, maintenance dredging will be required about 40% to 60% of Capital Dredging. But practically, the required maintenance dredging is about 20% to 30% of Capital Dredging (MPA, 2017).	Revised accordingly. Refer para- 364 in Chapter 4, page no. 4-35.
02.	Page: 4-35, Para-370Outer bar is approximately 60 kilometer of which about 38 kilometer has a draft restriction of 7 meter for smooth operation of vessels. Mongla Port Authority plans to dredge the section to increase its navigational draft to 8.5 meter. A channel of width 200 meter has been considered for safe entrance and manoeuvring of vessels. The dredging requirement has been assessed on the basis on the recent hydrographic chart/maps of Mongla Port Authority (surveyed in 2013) taking the design draft of the ongoing dredging program under consideration. Figure 4-10 present alignment and location of the dredging. It is estimated that the required dredging volume is around 4.35 million m ³ for a required draft of 8.5 m at initial stage. An EIA study was conducted by the MPA for the stretch along the Outer Bar, which is approved by the DoE on 25 August, 2013. The study suggested the Swatch of No Ground as dredged spoil disposal site using hopper dredger.	The length of Outer Bar area is about 16.5 km in which only about 11 km has draft restriction of more than 8.5 m draft vessel. Mongla Port Authority is planning to dredge this area, i.e., about 11 km at a width of 600-900 m. All dredged materials will be disposed at deep sea which is outside of Swatch of No Ground.	Revised accordingly. Refer para- 366 in Chapter 4, page no. 4-37.
03.	Page: 4-36, Para-371the maintenance dredging would be 90% of Capital Dredging.....	According to study report, maintenance dredging will be required about 40% to 60% of Capital Dredging. But practically, the required maintenance	Revised accordingly. Refer para- 364 in Chapter 4, page no. 4-35.

Sl. No.	Described in EIA Report (Volume II: Main Report)	Comments of MPA	Action Taken
		dredging is about 20% to 30% of Capital Dredging (MPA, 2017).	
04.	Page: 5-12, Para- 386 Mongla Port fairway buoy falls outside the jurisdiction of Mongla Port, hence does not require vessel charges for mother vessel.	Mongla Port limit has started from Fairway Buoy. Mother vessels which anchor a Fairway Buoy will be imposed charges as per tariff of Mongla Port.	Revised accordingly. Refer para- 382 in Chapter 5, page no. 5-11.
05.	Page: 5-14, Para- 390 Harbaria/Mazhar point anchorage is the outer anchorage of Mongla Port located at a distance of around 16 NM from Power plant jetty. It has draft of around 8 meter.	Harbaria anchorage allows to anchor the vessels of 7.5-11 m draft. But Mazhar Point anchorage allows more than 11 m draft vessels. Due to draft restriction of Outer Bar, presently maximum 8.5 m draft vessel can berth.	Revised accordingly. Refer para- 386 in Chapter 5, page no. 5-13.
06.	Page: 7-30, Para- 475 (ii) inland water way (Mongla Port to Chalna) which is maintained by the BIWTA.	The channel (Inland Waterway) between Mongla Port to Chalna also falls within the jurisdiction of Mongla Port, which is maintained by the MPA.	Revised accordingly. Refer para- 471 in Chapter 7, page no. 7-30.
07.	Page: 7-42, Para- 499 Available draft in the fairway buoy ranges from 6.00 meter to 8.50 meter.	Available draft in the Fairway Buoy ranges from above 20 m to 25 m.	Revised accordingly. Refer para- 497 in Chapter 7, page no. 7-42.
08.	Page: 7-42, Para- 502 The shoals along the outer bar in the southern section of 20 kilometre restrict entrance of larger vessels of above 20,000 dwt.	The shoals along the Outer Bar in the southern section of about 11 km restrict entrance of larger vessels of above 8.5 m draft.	Revised accordingly. Refer para- 497 in Chapter 7, page no. 7-42.
09.	Page: 7-42, Para- 504 Available water depth at Harbaria Anchorage is 8 meter. As the channel proceeds, the depth further decreases from Harbaria to Port Jetty ranging between 4.00 meter to 5.50 meter.	Available water depth at Harbaria Anchorage is ranging between 7.5 m to 12.0 m. As the channel proceeds, the depth further decreases from Harbaria to Port Jetty ranging between 4.0 m to 5.5 m.	Revised accordingly. Refer para- 499 in Chapter 7, page no. 7-42.
10.	Page: 7-51, Para- 533 In this respect the following three development projects to Mongla Port were considered: <ul style="list-style-type: none"> On-going Project for dredging at the harbor area in the Passur channel to facilitate berthing of 7.5 m draft ships at port jetty and mooring buoy (volume 35.11 lac cum). On-going Project for dredging at the outer bar in the Passur channel aiming at increasing navigability at outer bar to facilitate easy access and 	<ul style="list-style-type: none"> Completed Project for dredging at the harbor area in the Passur channel to facilitate berthing of 7.5 m draft ships at Port jetty and mooring buoy (volume 35.11 lac cum). Planned Project for dredging at the Outer Bar in the Passur channel aiming at increasing 	Revised accordingly. Refer para- 528 in Chapter 7, page no. 7-50.

Sl. No.	Described in EIA Report (Volume II: Main Report)	Comments of MPA	Action Taken
	<p>manoeuvring of more than 9 meter draft ships at anchorage area (volume 43.53 lac cum).</p> <ul style="list-style-type: none"> Planned Project for Capital Dredging from jetty no. 9 to 13 km upstream of the Passur channel with the objective of development of navigability up to 13 km upstream in the river route to ensure smooth and safe movement of vessels bound for coal power plant at Rampal, Bagerhat. 	<p>navigability at Outer Bar to facilitate easy access and manoeuvring of more than 10.5/11 m draft ships at anchorage area (volume 103.95 lac cum).</p> <ul style="list-style-type: none"> Ongoing Project for Capital Dredging from Jetty no. 9 to 13 km upstream of the Passur channel with the objective of development of navigability up to 13 km upstream in the river route to ensure smooth and safe movement of vessels bound for coal power plant at Rampal, Bagerhat. 	

Responses of Comments of Bangladesh Water Development Board (BWDB), Dhaka on EIA of Coal Transportation

Vide Memo No. Chief Planning/1028 dated 1 November, 2017
Meeting held on 14th September, 2017 at DoE, Dhaka

[Hosted by DoE and Participation from BPDB, BIFPCL, CEGIS & other Relevant Agencies]
And further meeting on 06.12.2017 and 24.01.2018 at DoE

Sl. No.	Comments	Responses	Action Taken
1	River bank erosion is a very common phenomenon in our country. Movement of bulk carries and class lighter-age carrying coal and limestone along the Passur route may generate wave on sea and inland water which may exaggerate erosion along seashore and riverbank. Provision for monitoring river bank erosion and responsibility of the implementing authority for mitigation measures may be included in the report.	<ul style="list-style-type: none"> Issue of erosion and accretion is addressed/described in different places of the EIA report where applicable. Refer Section 7.5.4, in Para- 460 to 463 and in Table 5-1 and in Figure 7-16 of Volume- II: Main Report. a. [As far as the erosion rate are concerned, erosion of the Passur River is approximately equal to the rate of accretion on the other bank. The downstream portion of the river from Hiron point became narrower in 2010 than 1984 and 1997 due to accretion. The extent of right bank-line reduces approximately 700 m to 1.4 km compared to the bank-lines of 1984 while the change is about 800 m to 1.5 km at the left bank.] Impact of erosion during operation of coal transport vessel and others is mentioned in Table 9-1 at C-15 & C-16 in Chapter 9 of Volume- II: Main Report. Mitigation measures are prescribed in in Table 9-1 at C-15 & C-16 in Chapter 9 of Volume- II: Main Report. 	Erosion and accretion are being monitored continuously through quarterly monitoring mission at strategic locations (i.e., Hiron Point, Akram Point, Mongla Port, Harbaria and Project Jetty Site area) of the entire coal transportation route.
2	Location of dredged spoil disposal sites are proposed by consultation the local people around the project area and these locations are primarily government acquired land or private land interested to fill the property. Undertaking may be asked from local land owners regarding their interest to fill the property to avoid future disputes. A detail plan of dredged material management may be included in the report.	<ul style="list-style-type: none"> The coal transportation route along the Passur River from Fairway Buoy to Rampal Power Plant is under the jurisdiction of the Mongla Port Authority (MPA). They are managing the route for decades and taking necessary action as required. Dredged material management is being managed by MPA. This EIA report only presented the findings of the studies conducted by MPA under the 	-

Sl. No.	Comments	Responses	Action Taken
		caption of “Feasibility Study for Dredging of Passur River from Mongla Port to Rampal Power Plant” in 2015 and “EIA study of dredging of Outer Bar” in 2013. Subsequently a further study is being undertaken on revised ToR given by DoE. • Dredging related issues were not in the purview of the current study, only relevant issues were collected from the mentioned reports and appended accordingly in Para-364 to 367 of Volume- II: Main Report.	
3	Impact of dredging on tributaries and distributaries of Passur River and its mitigation measures may be provided in the report.	• As dredged material management are being managed by respective authorities, dredging related issues were not in the purview of the current study.	-
4	Everyday a lot of vessels and carrier will be moved for coal transportation through the Passur River. Due to accidental occurrence, the river water can be contaminated. In that case, emergency mitigation plan may be created for mitigation measures or emergency unit may be created to minimize the problem.	This issue has been considered in the study and presented in the report. Refer Section 11.9.4: Emergency Response Plans in Volume II- Main Report and “Emergency Preparedness and Response Plan” presented in Annex 11-4 in Volume III- Annexure. It is pertinent to mention here that inland water transport through the Passur River for Maitree STPP is not going to increase significantly (only three vessels in two days), moreover ash produced by the Maitree Power Plant shall be sold to nearby cement industries, the requirement of importing the ash from India will be largely reduced as such the net increment of vessels in the designated route will be almost nil.	

Responses of Comments of Ministry of Fisheries and Livestock on EIA Report for Coal Transportation of Rampal Power Plant

Vide Memo No. 33.00.0000.136.14.030.14-(Second Part) 253

Meeting held on 14th September, 2017 at DoE, Dhaka

[Hosted by DoE and participated by BPDB, BIFPCL, CEGIS & other Relevant Agencies]

And further meeting on 06.12.2017 and 24.01.2018 at DoE

Sl. No.	Location	Existing	Correction/Addition	Action Taken
01	Volume-I: Summary Report Chapter-10, Page-27 Para-07 Cumulative Impact on Biodiversity	Increased inland water transport through the Passur River may increase the potential of collision and injury of dolphins.	The statement might be rephrased as follows: Increased inland water transport through the Passur River may increase the potential of collision and injury of dolphins and will negatively impact the aquatic biodiversity, including finfish and crustaceans.	Amended the statement as "Increased inland water transport through the Passur River is not going to increase significantly (only three vessels in two days), hence the potential of collision and injury of dolphins may not be significant and adversely affect the aquatic biodiversity, including finfish and crustaceans. Even collision with dolphins has not been reported (discussions were held with concerned authorities, fishermen association, vessel owner association, etc.) yet with the present movement of vessels." Refer Page- 27 of the Volume I: Summary Report.
02	Volume-I: Summary Report Chapter-11, Table: Mitigation/Enhancement Measures: Page-33 Issues-A4	"Due to frequent movement of vessel illegal fishing and catching of post larvae (PL) will be discouraged as such, fish	Department of Fisheries does not agree with this statement. Frequent movement of vessel will indeed disrupt the shrimp post larvae (PL) production. Statement may be replaced as	Only two vessels in three days shall sail due to coal transportation i.e., about 500 vessels (mother and lighterage

Sl. No.	Location	Existing	Correction/Addition	Action Taken
		production will be increased in the wild.”	follows: “Due to Frequent movement of coal transportation vessel ecosystem of the river will be disrupted and water temperature may be increased. As a result natural breeding and nursery ground will be degraded, fish and shrimp will cause decline in production.”	vessel) in a year. However, as ash produced by the Maitree Power Plant shall be sold to nearby cement industries, the requirement of importing the ash from India will be largely reduced as such the net increment of vessels in the designated route will be almost nil. Accordingly, the referred para is amended as “Due to frequent movement of vessel illegal fishing and catching of post larvae (PL) will be discouraged as such, fish production will be increased in the wild. If regular monitoring demonstrates disruption of habitat due to coal transportation vessel and corresponding decline of shrimp and fish production, necessary measures need to be undertaken to address the issue.” Refer Table 9-1 and Table 11-3 in Impact A4 of Volume II: Main Report and in Page 33 of Volume I: Summary Report.
03	Volume-I: Summary Report Chapter-11, Table: Mitigation/Enhanceme	Since catching of fish and post larvae will be discouraged during operation of	Seemingly it's not a scientifically acceptable statement. This statement may be replaced as follows:	Amended the statement as “Since catching of fish and post larvae will be

Sl. No.	Location	Existing	Correction/Addition	Action Taken
	nt Measures: Page-47 Issues-C3	the project, as such the production of shrimp and fish will increase in the area.	Necessary measures need to be undertaken to address the alternative livelihood opportunities of the affected fisher's community.	discouraged during operation of the project, as such, the production of shrimp and fish will increase in the area. If regular monitoring demonstrates decline of shrimp and fish production, necessary measures need to be undertaken to address the issue." Refer Table 9-1 in Impact C3 of Volume II: Main Report and in Page 47 of Volume I: Summary Report.

Responses of Comments of Bangladesh Inland Water Transport Authority (BIWTA), Dhaka on EIA of Coal Transportation

Vide Memo No. 18.11.0000.185.14.3708.15 533 dated 1 November, 2017
Meeting held on 14th September, 2017 at DoE, Dhaka

[Hosted by DoE and Participation from BPDB, BIFPCL, CEGIS& other Relevant Agencies]
And further meeting on 06.12.2017 and 24.01.2018 at DoE

Sl. No.	Comments	Responses	Action Taken
1	In order to transport legal commodities using Indo-Bangla inland riverine route, there exist an agreement since 1972 under the title "Protocol on Inland Water Transit and Trade between Bangladesh and India". Under this protocol using water vessels coal, cement producing raw materials like fly ash, machineries and other commodities are being transported from Kolkata of India to Bangladesh through the river route of Angtihar-Sheikbaria-Chalna-Mongla-Ghashiakhali channel. On an average, about 20/25 number of water vessels sail daily through this Channel. Considering its impacts on ecological and environmental balance, BIWTA gives its consent to the voyages of these water vessels through the channel under certain conditions. In this context the followings are to be noted.		
1.1	During the movement of water vessels the conservation of the Sundarbans ecological environment is to be ensured.	<ul style="list-style-type: none"> • Environmental Impact assessment and mitigation plan were delineated in Chapter 9. Existing information from the technical documents coal sourcing study air quality assessment; noise level assessment; inland water transport assessment; baseline biodiversity assessment; government databases; and field study also contribute to this section. • In addition, the Consultant has also consulted with multiple stakeholders, expert/institute, local residents and community focused groups, general public, environmental groups, and the client to seek feedback on various issues of environmental and social concern. • Such environmental issues of concern include: • Air quality; • Bed material and marine environment; • Water resources; • Fish, fish habitat and 	

Sl. No.	Comments	Responses	Action Taken
		<p>species with status; and</p> <ul style="list-style-type: none"> • Vegetation and wildlife, and species with special status in the Sundarbans Reserve Forest. • The Socio-economic Effects Assessment describes the following socio-economic and socio-community topics and effects: • Noise and vibration effects; • Light effects; • Increased vessel traffic; • Disaster risk and emergency response; and • Effects on livelihood dependent on the Sundarbans. • The Health Effects Assessment, including Human Health and Ecosystem Health Assessment present the following issues in detail: • Health effects of coal dust • Health effects of fugitive dust/particulate matter • Impact Assessment Methodology • Potential environmental and social impacts were identified on the basis of the review of feasibility reports, field visits, environmental quality baseline monitoring, ecological and fisheries surveys, stakeholder consultations, air quality dispersion modelling using USEPA approved CALPUFF, and noise modelling using SoundPlan. • The study has identified the aquatic flora and fauna of the wetland ecosystem of the study area, which covers the whole coal transportation route through the Sundarbans as well as the WHS area. Local and global status of the fauna has been checked based on IUCN Red List. Accordingly critical 	

Sl. No.	Comments	Responses	Action Taken
		habitat assessment as per IFC Performance Standard Guidelines has been done for the fauna which are Critically Endangered and/or Endangered Species (Page no. 9-139) of Volume- II: Main Report. Impact assessment (Chapter 9 of Volume- II: Main Report) was done considering the ecological character of the study area and subsequent Environmental Management Plan (Chapter 11 of Volume II: Main Report) was delineated.	
1.2	It is to be ensured that goods carrying vessels of Power Plant project in no way causing any hindrance to PIWT&T Vessels.	Vessels of Maitree Power Plant project will follow the MPA guidelines and protocol thus ensuring the causing no hindrance to Protocol on Inland Water Transit & Trade (PIWT&T) Vessels (Refer para 517, page 7-48).	
1.3	Proper provision is to be kept to take appropriate measures to protect any damage or siltation of the channel due to any unwanted liquid or solid discharge from these vessels.	<ul style="list-style-type: none"> • All Vessels will follow applicable MARPOL Convention, Annex V on the Prevention of Pollution by Garbage from Ships, the IMO introduced new classification criteria to enable identification of substances harmful to the marine environment (HME) (Refer Chapter 11, page 11-60 of Volume II: Main Report). • Coal transportation shall be carried out using existing navigational route of the MPA. • A facility is to be developed in the MPA designated area for receiving the bilge for lighterage that will be calling at the plant jetty (Refer Chapter 11, page 11-62 of Volume II: Main Report). • MPA will ensure adequate port waste (solid and liquid) reception facilities and Ensure dry residues and/or the wash water that contains residues from an HME discharged at adequate port reception facilities. (An MOA 	

Sl. No.	Comments	Responses	Action Taken
		in this regard has been signed between BIFPCL & MPA on 16.08.2017) (Refer Annexure 11-5, Page 155 of Volume –III, Annexure).	
1.4	Emergency Response Plan developed to prevent any possible incident that may happen during Coal transportation should have a BIWTA representative in the response group.	As per the MOA signed between BIFPCL & MPA on 16.08.2017, MPA to form Emergency Preparedness and Response Group (EPRG), headed by Member (H&M), MPA, may take note of it. (Refer Annexure 11-5, Page 155 of Volume –III, Annexure).	

Responses of Comments of Forest Department (FD), Dhaka on EIA of Coal Transportation

Vide letter No. 22.01.0000.011(Pra:),4D-26(Part-7.2017/551, Dated 28/08/2017
Meeting held on 14th September, 2017 at DoE, Dhaka

[Hosted by DoE and Participation from BPDB, BIFPCL, CEGIS& other Relevant Agencies]
And further meeting on 06.12.2017 and 24.01.2018 at DoE

Sl. No.	Comments	Response	Action Taken
1.	Forest Department expresses different opinions on transshipment of coal at two locations inside the Sundarbans Reserve Forest (SRF) and also expresses the opinion on transshipment of coal outside the SRF.	<p>The EIA study of coal transportation for MSTPP has investigated at least three routes for transporting coal from the Fairway Buoy to MSTPP and three anchorage points for transshipping coal from mother vessel to lighterage vessel. The investigated routes are:</p> <p>Option- 1: Passur Channel: Fairway Buoy to Maitree STPP Jetty via Hiron Point-Akram Point-Harbaria-Mongla Port;</p> <p>Option- 2: Sibsa Channel: Fairway Buoy to Maitree STPP Jetty via Hiron Point-Akram Point-Chalna and through Sibsa-Dhaki-Chunkuri; and</p> <p>Option 3: Mongla-Ghasiakhali Channel: Fairway Buoy to Maitree STPP Jetty through Baleswar -Ghasiakhali- Mongla Nulla-Passur via Mongla Port. (Map is shown in Figure 5-1 in Volume- II: Main Report)</p> <p>Based on multi-criteria analysis considering 13 pertinent parameters of physical, biological and socio-economical aspects, it is found that Option- 1, i.e., the Passur Channel has scored highest (Refer Table 5-1 in Chapter 5 of Volume- II: Main Report), which have been used for last 60 years as maritime route and second largest port of Bangladesh (Mongla Port) operates. With the concurrence of Mongla Port Authority, there were three anchorage points identified for transshipping coal. These were: (i) Fairway Buoy at the Bay; (ii) Akram Point at the Passur Channel; and (iii) Mazhar Point (Harbaria) at the Passur Channel. All of the anchorage points possess merits and demerits in terms of data availability, natural calamity, tonnage, proximity to WHS, etc. Considering all pros and cons of mentioned factors (not inclusive) the study has suggested two transshipment points, i.e., Fairway Buoy and Mazhar Point for transshipment of coal for MSTPP. The points were selected considering less disturbances to the Sundarbans Reserve Forest. Harbaria is a regular anchorage of MPA. The anchorage at Mazhar Point, which is allowed by MPA for transshipment of coal of</p>	-

Sl. No.	Comments	Response	Action Taken
		<p>MSTPP is close to Harbaria and study suggested that there may be negligible impact on the Sundarbans ecosystem.</p> <p>The Akram Point was found less preferred as anchorage point for transshipment of coal since it is nearer to the World Heritage Site compared to the Mazhar Point and it becomes wavy and turbulent in the wet season.</p> <p>On the other hand, it is estimated that about 500 lighterage vessels need to be travelled all through the Sundarbans if Fairway Buoy is alone considered as an Anchorage Point. In that case, more emission is expected as smaller vessel emits more than that of larger vessel; more travel more susceptibility to accidental event; more release of bilge water and other contaminants. Mother vessel coming at Mazhar Point may erase all such problems at larger extent because only about (Mother Vessel: 117 + Lighterage Vessel: 292 = 409 vessels) vessels need to be sailed from Fairway Buoy to the MSTPP (Refer para- 403, page no. 5-17 of Volume II: main Report).</p> <p>Moreover, the protocol vessel coming from India (about 400 vessels) carrying ash sail through a part of the Passur Channel. Ash generated from the MSTPP may outweigh the ash demand of the cement factories at Mongla area mostly. In such case, vessel sailing through the Passur Channel will be reduced and in all practical purposes the reduction of protocol vessel with ash from India will compensate the additional voyage required for coal transportation. Thus net increase of vessels in the Passur Channel will be nil. This will be beneficial for the Outstanding Universal Value of the Sundarbans and its adjoining area (Refer para- 404, page no. 5-18 of Volume II: main Report).</p>	

Comments Sheet of Forest Department on EIA Report of Coal Transportation

১২/১১

বৃক্ষরোপণ করে যে
সম্পদক্ষণী হয় সে

বোর্ড হাঙ্গিনার নির্দেশ
অপবায়ু সহিষ্ণু বাংলাদেশ

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
বন সংরক্ষকের দপ্তর
কেন্দ্রীয় অঞ্চল, বন ভবন, মহাখালী,
ঢাকা-১২১২।

পত্র নং-২২.০১.০০০০.৬০১.২৯.০৮৯.১৭. ১২/১১

তারিখ: ১৭/১১/১১

প্রাপক: প্রধান বন সংরক্ষক
বাংলাদেশ, বন ভবন,
আগারগাঁও, ঢাকা।

দৃষ্টি আকর্ষণ: সহকারী প্রধান বন সংরক্ষক, সংস্থাপন ইউনিট।

বিষয়: বাংলাদেশ-ইন্ডিয়া ফ্রেডশীপ পাওয়ার কোম্পানী লিঃ কর্তৃক বাস্তবায়িতব্য Coal Transportation for the
proposed Maitree Super Thermal Power Plant প্রকল্পের জন্য দাখিলকৃত পরিবেশগত প্রভাব
সমীক্ষা (Environmental Impact Assessment) প্রতিবেদনের উপর মতামতসহ সভায় যোগদান
প্রসঙ্গে।

সূত্র : আপনার দপ্তরের পত্র নং-২২.০১.০০০০.০১১(প্রঃ).৪ডি-২৬(পার্ট-৭.২০১৭/৫৫১ তাং-২৮/০৮/২০১৭ ইং।

সম্মান সহকারে উপর্যুক্ত বিষয়ে জানানো যাচ্ছে যে, বিগত ১৪/০৯/২০১৭ ইং তারিখ মহাপরিচালক, পরিবেশ
অধিদপ্তরের সভাপতিত্বে অনুষ্ঠিত উপরোক্ত বিষয়ের সভায় উপস্থাপিত কয়লা পরিবহনের পরিবেশগত প্রভাব সমীক্ষায়
(EIA) সংরক্ষিত সুন্দরবনের মধ্যে দু'টি স্থান (আক্রমণ পয়েন্ট ও মাজাহার পয়েন্ট) ও সংরক্ষিত সুন্দরবনের বাহিরে
একটি স্থান (ফেয়ারওয়ে বয়া) কয়লা খালাসের স্থান হিসেবে প্রতিবেদনে (EIA) ও উপস্থাপনায় উল্লেখ করা হয়েছে
(কপি সংযুক্ত-১)।

উক্ত সভায় নিম্নস্বাক্ষরকারী সংরক্ষিত সুন্দরবনের মধ্যে দু'টি স্থানে কয়লা খালাসের বিষয়ে ভিন্নমত প্রকাশ করে
এবং সংরক্ষিত সুন্দরবনের বাহিরে কয়লা খালাস করার জন্য মতামত প্রকাশ করে। এখানে উল্লেখ্য যে, এতদবিষয়ে
সরকার কর্তৃক গৃহীত Strategic Environmental Assessment (SEA) এর সমীক্ষার ফলাফলের মাধ্যমে প্রাপ্ত
তথ্য মোতাবেক পরবর্তী প্রয়োজনীয় সিদ্ধান্ত গ্রহণ করা যেতে পারে।

বিষয়টি আপনার সদয় অবগতি ও প্রয়োজনীয় ব্যবস্থা গ্রহণের জন্য জানানো হলো।

বন সংস্থাপন ইউনিট
প্রোগ্রামার গণিত
১২/১১/১১
১২/১১/১১
১২/১১/১১

(জহির উদ্দিন আহমেদ)
উপ-প্রধান বন সংরক্ষক
কেন্দ্রীয় অঞ্চল,
বন ভবন, মহাখালী, ঢাকা
ফোনঃ ৮৮৩৪০৯৯
১২/১১/১১

Responses of Comments of Department of Environment (DoE), Khulna on EIA of Coal Transportation

Meeting held on 22nd March, 2017 at DoE, Khulna

[Participants from DoE (Khulna), BIFPCL and CEGIS]

Sl. No.	Comments	Responses	Action Taken
1	Is PDM output incorporated in the report?	Yes.	Kindly note Section 13.8 EIA Disclosure of Chapter 13. Refer page no. 13-16.
2	Was vessel traffic survey conducted?	Yes.	Kindly note Section 7.7.9 Movement of Mechanized Boats and Crafts of Chapter 7. A map showing vessel survey stations has been given in Figure 7-28. Refer page no. 7-48 to 7-49.
3	Environment friendliness of the tran-shipper including hopper, dust suppression system, etc.	Considered	Kindly note Section 4.6.2: Tran-shipper . This section deals with the environment friendliness of transhipper. Refer page no. 4-9.
4	Was Fisheries survey conducted? Reference should be contemporary.	Yes. Fisheries survey had been conducted for about three years. Regarding updating reference it is agreed.	Findings of fisheries survey are given in Sections from 7.9.2 to 7.9.6. Refer page nos. 7-75 to 7-86. The Section 7.9.5 Fish Diversity has been revised and accordingly reference has been updated as suggested. Refer page no. 7-78.
5	How Class vessel is defined?	Responded in the meeting and defined.	The vessel that follows international maritime rules and regulations, such as applicable IMO, IMSBC, MARPOL, etc. are popularly known as Class vessel.
6	The External Monitoring Agency (EMA) team should be trained up so that they can monitor the Project properly and also can interact with the Proponent.	EMA has been changed into Independent Monitoring Agency (IMA) as per the suggestion of DoE, Dhaka. As the Proponent generally award work to a competent authority, So they will have already capacity of monitoring.	The Section 11.5.4 External Monitoring Agency in Chapter 11 has been changed with Independent Monitoring Agency (IMA) as per the suggestion of DoE. Refer page no. 11-7. This issue is also considered in Summary Summary. Refer page no. I.
7	Treatment methodology of liquid waste and specification of ETP should incorporated in the EIA report.	Agreed.	Treatment methodology of liquid waste and specification of ETP have been given in EPC Contract Document. The methodology and specification is appended in Annex 11-5 under the Title of Water Treatment Systems and referred in Section 11.9.3. Refer page no. 11-23.
8	What is the source of water? Should mention in the EIA Report.	The Passur River with due treatment (Reverse Osmosis/ desalinization)	Section 3.5.4 Coal Terminal/ Plant Site Jetty. Refer page no. 3-5.

Sl. No.	Comments	Responses	Action Taken
9	World Heritage Site should be given emphasis.	Agreed.	Issue based concern for world heritage site (WHS) has been taken care in the following sections and tables: Section 2.10 Relevant International Legal Obligation: Refer page no. 2-19. UNESCO World Heritage Convention-1972 Section 5.1.3 Anchorage Points; Refer page no. 5-11. Section 7.2.6 Wind Speed and Direction; Refer page no. 7-6. Section 7.4 Ambient Noise Level; Refer page no. 7-16. Section 7.8.2 Hot Spots/Area of Conservation Significance; Refer page no. 7-60. Section 7.9.9 Regulations on Restricted Fishing Areas in the Sundarbans; Refer page no. 7-88. Table 9-1: Potential impacts and their significance; Refer page no. 9-4. Section 9.6 Environmental and Social Impacts during Feasibility and Design Phase; Refer page no. 9-72. Table 9-27: Habitat Identification as per IFC 2012 PS 6; Refer page no. 9-141. Table 9-29: Project Area Critical Habitat Screening Assessment; Refer page no. 9-146. Table 11-4: Mitigation Plan; Refer page no. 11-7. Etc.
10	Alternative Route selection score to be defined	Agreed.	Recast of alternative route selection matrix has been done as suggested in Table 5-1. Scores are given based on the importance. Refer page no. 5-7.
11	Justification of study area delineation	Justification of study area is already in the report in different sections (Section 3.3 Study/Project Influenced Area and Para 762).	Recast of Section 3.3 Study/Project Influenced Area is done with minor edit. Refer page no. 3-1.
12	Profile of vegetation should be based on updated reference	Agreed.	Reference has been updated with the EIA study of Gorai River Restoration Project conducted in 2012. Refer page no. 7-22.
13	The general features of the Passur channel should be improved.	Agreed.	The general features of the Passur River in Table 7-7 have been updated with 'Rivers of Bangladesh' of the BWDB, 2005 and 2012. Refer page no. 7-23.
14	Month of discharge data	Agreed.	Months of minimum and

Sl. No.	Comments	Responses	Action Taken
	should be mentioned with reference given in Table 7-7.		maximum discharge data have already mentioned and reference has been given below the Table 7-7. Refer page no. 7-23.
15	Show the locations of shoals in the Passur River.	Bathymetry maps have already been given in Figure 7-23 and 7-26. Refer page nos. 7-32 and 7-34.	-
16	Page 7-35. Wave height should be mentioned. This data should be updated.	Wave height data are already given in Section 7.5(C)	Updated data have also been given in same section with figure (Figure 7-26a) and source of information. Refer page no. 7-35.
17	Reference and standard of oil and grease should be given for Table 7-14.	Agreed. Reference was mentioned below the Table.	Standard for oil and grease for surface water has been incorporated. BCSIR has analyzed surface water sample for oil and grease for CEGIS and data given by them has been presented in the report as in the Table 7-14. Refer page no. 7-38.
18	High and low tide to be mentioned	This issue has been covered in a. Tidal Fluctuations of Section 7.5.4 Riverine and Estuarine Morphology; Refer page no. 7-25.	-
19	Interpretation of water quality issue should be provided in the report. How many sampling locations?	Agreed.	For Water quality interpretation please refer Section 7.6(f). For other quality parameters refer page no. 7-40 of this EIA report. There are 15 sampling locations from where water sampling is done.
20	Regarding river draft under Section 7.5.4: Riverine and Estuarine Morphology in sub-section b. River Draft in Para 475 The analysis indicates.....of the lighterage of 10,000 dwt.	This issue has already been covered in the EIA Study report of Dredging from Mongla Port to Project site jetty conducted by IWM for MPA. It is referred in Para 479 of this report. Refer page no. 7-33.	-
21	Regarding Para 478 It is necessary.....Maitree Coal based Power Plant.	Revised	Updated the statement in Para 478 based on the query. Refer page no. 7-33.

Responses of Comments of Department of Environment (DoE), Dhaka on EIA of Coal Transportation

Meeting held on 10th April, 2017 at CEGIS, Dhaka

[Participants from DoE (Dhaka), BPDB, BIFPCL and CEGIS]

Sl. No.	Comments	Responses/Remarks	Action Taken
1	The PSMP, 2010 has been referred in the EIA report of Coal Transportation. By this time, the Government has circulated the PSMP, 2016. So, The PSMP, 2016 should be considered in this EIA report.	Agreed.	The PSMP, 2016 has been considered in the EIA report of Coal Transportation and incorporated in page no. 1 in Volume- I: Summary Report and in Article no. 1.3 in Volume- II: Main Report. This issue is also reflected in power point presentation.
2	The 53 rd condition of the EIA approval letter states that “A separate EIA/morphological study shall have to be conducted for coal transportation and river dredging to develop sound environmental management plan towards conservation of ecosystem and biodiversity”. This EIA study is for Coal Transportation, what about EIA for Dredging? Clearly mention.	This issue has already been covered in relevant areas of the EIA report. Refer page nos. 1 in Vol- I: Summary Report and Section 4.7.1 at page no. 4-34 in Vol- II- Main Report and other relevant places.	-
3	Has this study followed the World Bank Group’s guidelines if so please mention it.	Chapter 2: Policy, Legal and Administrative Framework discusses relevant Operation Policies (OP) of World Bank and World Bank Group’s Guidelines. Refer page no. 2-27. EHS Guidelines, IFC 2007 were followed for criteria pollutants like SO _x , NO _x , PM _{2.5} , PM ₁₀ , etc. Refer Table 7-3, 7-4, etc. IFC Performance Standards (PS) on Environmental and Social Sustainability was followed for relevant issues. PS-4 Community Health, Safety, and Security (Refer page no. 9-15 of Volume II: Main Report), Critical Habitat Assessment under PS-6 ‘Biodiversity Conservation and	-

Sl. No.	Comments	Responses/Remarks	Action Taken
		Sustainable Management of Living Natural Resources'. Refer page no. 9-140 of Volume II: Main Report.	
4	Mention quantity of required coal per annum for the MSTPP.	The estimated maximum amount of coal required for the operation of MSTPP is about 4.7 million tons per annum. This study considers the worst case scenario considered 4.7 million tons of coal in air quality modeling and analysis.	Depending on operational conditions, the required coal may be reduced to 4 million tons annually. This will give easement to the air-shed. Refer page no. 1-1 of Volume II: Main Report.
5	Biological aspects should be given more emphasis in analyzing the alternatives of the route.	Agreed.	Revised and updated the Table 5-1: Alternative route selection of the EIA report as suggested. Refer page no. 5-7 of Volume II: Main Report.
6	In Table 5-1: Alternative route selection, the criterion 'Investment' should be more specific.	Agreed.	Updated the table in the EIA report as per suggestion. Refer page no. 5-8 of Volume II: Main Report.
7	Alternative analysis should be done for all five major components (mentioned in Chapter 3: Project Data Sheet and Chapter 4: Project Description).	Agreed. Alternative analysis for four major components out of five was already given in the EIA report in Article nos. 5.1.1 to 5.1.4. Refer page no. 5-1 of Volume II: Main Report.	Alternative analysis for the fifth one is added in Article no. 5.1.5 as Alternate Coal and Limestone Handling System in the EIA report as per suggestion.
8	Alternatives of dust suppression /control mechanism should be omitted from the EIA Report.	Agreed.	Updated section 5.1.6 as suggested. Refer page no. 5-16 of Volume II: Main Report.
9	The criteria of Alternative route selection should follow the order of Physical, Biological and Social indicators.	Agreed.	Updated the Table 5-1: Alternative route selection in the EIA report as per suggestion. Refer page no. 5-7 of Volume II: Main Report.
10	Justification of alternative anchorage point should be more specific and represented in a tabular form.	Agreed.	Updated in the EIA report as suggested. Kindly refer Table 5-2 in page no. 5-14 of Volume II: Main Report.
11	Justification of study area should be clearly spelled out.	This issue has already been covered in Article no. 3.3 in the EIA report. Refer page no. 3-1 of Volume II: Main Report.	-
12	The impact of lighting or beaming of vessel on sensitive receptors should be accounted in the report. Sensitivity of microbial and wildlife should be considered.	This issue has already been covered in relevant places. Refer page nos. 23, 40 & 67 in the Volume I: Summary Report and page nos. 8-8, 9-26, 9-50, 9-58, 9-77 and	-

Sl. No.	Comments	Responses/Remarks	Action Taken
		other relevant places of Volume II: Main Report.	
13	Is there any MPA directive on restriction of Ship lighting in Sundarbans area?	The Marine Safety Act requires that lights must be displayed from sunset to sunrise and in times of restricted visibility during daylight hours. Minimum ranges at which lights can be seen refer to conditions on a dark night with a clear atmosphere. The information in this chapter is based on the International Regulations for Preventing Collisions at Sea 1972 (COLREGS), Marine Safety Act and Marine Safety Regulations.	Annex 9-1: Vessel Navigation Lights. (Volume III: Annexures)
14	Disturbance of water body and associated ecosystem due to underwater noise produced from vessel movement for coal transportation and piling activities of jetty.	This issue has been covered in the EIA report. Refer page nos. 9-81, 11-56, and other relevant places. ECP 9: Protection of Fisheries in Annex 11-1 of Volume III: Annexures).	-
15	As the government policy is to increase load of Payra Port and decrease the load of the Mongla Port. Payra Port policy and projection on vessel movement should be made coherence with that of the Mongla Port Authority.	Subjected to the full-fledged operation of the Payra Port, it is expected that some traffic load of the Mongla Port will be diverted to the Payra Port. However, the Project has considered the worst case scenario for the vessel movement in the Passur River.	This article will be added in respective section of the EIA report of Coal Transportation as 'Footnote'.
16	Is there any additional monitoring points considered in the EIA of coal transportation which are being considered with respect to the monitoring points suggested in the approved EIA of MSTPP?	The monitoring points for environmental monitoring study of the MSTPP are so well distributed along the route that additional monitoring point(s) were not needed to be considered.	-
17	Efficiency of coal spillage and dust dispersion prevention should be quantified and mentioned in the EIA report. This is important for affirming the deposition of coal/dust on the river bed and distortion of the habitat.	Accumulation of coal dust in the transshipment point of coal will be periodically monitored. Based on the findings, mitigation measures will be carried out. However, the amount of spillage is so meager that it is not quantifiable.	-
18	A brief description about IMO, MARPOL, IMSBC, SOLAS, etc. conventions/guidelines should be incorporated in the EIA report of Coal	Agreed.	Brief description of relevant conventions for maritime vessel has been incorporated in Annex 1-3 captioned under "Brief

Sl. No.	Comments	Responses/Remarks	Action Taken
	Transportation.		Outline of the Conventions for Maritime Vessel” of the EIA report. In this regard, conventions like IMO, MARPOL, IMSBC and SOLAS are considered. in Volume- III: Annexures.
19	Institutional arrangement for the implementation of the EMP should be given in the EIA report by specifying their roles and responsibilities.	Institutional arrangement for the implementation of the EMP has been covered in detail by specifying the roles and responsibilities of the positions assigned. Refer Article 11.5 in page no. 11-2.	-
20	A brief description on spontaneous combustion of coal with reasons should be provided in the EIA report.	This issue has already been discussed in Articles 9.7.14 and 11.9.4. Refer page nos. 9-129 and 11-21 respectively.	-
21	Occupational Health and Safety issue should be considered in the EIA report for the construction phase of jetty and other civil works.	This issue has already been covered in Article no. 9.4 of Chapter 9 of EIA report. Refer impact no. B3 of Table 9-1 in page no. 9-12.	-
22	Draft revised Environmental Conservation Rules (ECR), 2017, Ecologically Critical Area (ECA) Rule, 2016 and Bangladesh Biodiversity Act, 2017 should be included in the Policy, Legal and Administrative Framework chapter.	Agreed.	Updated the EIA report as suggested by incorporating Draft ECR, 2017; ECA Rules, 2016; and Biodiversity Act, 2017. Refer Table 2-1 in page no. 2-3 and other relevant places.
23	Include Draft MoU with MPA and BIFPCL on Emergency Response Plan (ERP) in the EIA report.	Agreed.	A small write up will be included in main body mentioning the same.
24	Specification of appropriate Class Vessel, unloader, etc. should be included in the report with reference.	Detail specification of the lighterage vessel has not yet been finalized. However, it would be IMO certified. The specification of the unloader is already mentioned in EIA report. Refer page no. 4-17.	-
25	Keep harmony in writing chemical formula of criteria pollutants and should follow either NO _x or NO ₂etc.	Chemical formula of criteria pollutants have been written as where appropriate.	-
26	Speed limit for the vessels imposed by MPA should be incorporated in the EIA report.	Speed limits vary for different type of vessels and also limits may get revised with time. However, speed limits are mentioned in the Volume- I:	-

Sl. No.	Comments	Responses/Remarks	Action Taken
		Summary Report in page nos. lxxv, lxxv and lxxvi; in the Volume- II: Main Report in page nos. 8-14, 9-28.....etc.	
27	Quantification of spillage of coal and coal dust in percentages should be done and incorporated in the report.	Accumulation of coal dust in the transshipment point of coal will be periodically monitored. Based on the findings, mitigation measures will be carried out. However, the amount of spillage is so meager that it is not quantifiable.	-
28	Management Plan for noise, air quality, lighting/beaming, etc. should consider in the EIA report of coal transportation for protecting flora, fauna and wildlife.	<ul style="list-style-type: none"> • These issues have already been addressed in relevant places in the said EIA report. Refer Table 9-1, Articles 9.7.11, 9.7.12, 9.7.15, 9.7.16, 9.7.20. • Air Quality Management Plan is given in the EIA report on page no. 11-13 for implementation phase; on page no. 11-17 for operation phase and as EMP-Subplan 1 under Article 11.10.1 for both implementation and operation phases. • Noise Management Plan is given in the EIA report on page no. 11-14 for implementation phase and on page no. 11-29 for operation phase. • Lighting Plan is given on page no. 11-28 for operation phase. 	-
29	Mention Article or page no. about the write ups on Dolphin sanctuary, location of Batagur Baska (Turtle).	<ul style="list-style-type: none"> • Details about Dolphin sanctuary are given in Para- 564-566 under Article no. 7.8.2; visualized Dolphin sanctuary on Map in Figure 7-32 and 7-33. Refer page nos. 7-68 to 7-72 for Dolphin issues. • Matters regarding Batagur turtle have been discussed in Para- 561. Refer page no. 7-68. 	-
30	Institutional arrangement should specify roles and responsibilities of the positions so that EMP is implemented properly.	An Institutional Arrangement has been proposed in the EIA report defining roles and responsibilities of the positions assigned for the proper implementation of the	-

Sl. No.	Comments	Responses/Remarks	Action Taken
		EMP. Refer Article no. 11.5 in page no. 11-2.	
31	The title of the report should match with the approved ToR of DoE for Coal Transportation, i.e., title should be EIA instead of ESIA.	Agreed.	Updated the title of the report for Coal Transportation as well as inside the report where applicable as per suggestion.
32	Some responses of queries of the participants of the Public Disclosure Meeting (PDM) should be reviewed. Some observations (e.g., plantation, fly ash & bottom ash, etc.) which are not linked with this study can be omitted.	Agreed.	Updated the respective sections of the EIA report as per suggestion.
33	What is the basis of analogies regarding dolphin and fisheries; they are habituated in the Passur Channel as it is operating as vessel route for about 100 years.	Mechanized vessels are sailing in the Passur River for the decades. So far the knowledge we have gathered there is no report of accident of cetaceans/Dolphin with ship/vessel. According to the study captioned under "Abundance estimation of Ganges River dolphins (<i>Platanista gangetica gangetica</i>) and Irrawaddy dolphins (<i>Orcaella brevirostris</i>) using independent concurrent counts in waterways of the Sundarbans Mangrove Forest, Bangladesh" conducted by WCS for USAID in 2005. Quotation "This was despite indications of increasing threats to cetaceans in the area from incidental killing in gill net fisheries, destruction of fish-spawning habitat through mangrove deforestation, toxic contamination from large human population centers located upstream (e.g., Dhaka and Kolkata), non-selective catch of fish fingerlings and crustacean larvae in small mesh "mosquito nets" and increased vessel traffic (Reeves et al. 2003).	This issue has been addressed in Table 9-1. Refer page no. 9-6.
34	Harmonizing of spelling and rephrasing of Sundarbans as 'the Sundarbans'.	Agreed.	Updated as suggested in every case.
35	External Monitoring Agency	Agreed	Chapter 12 is revised

Sl. No.	Comments	Responses/Remarks	Action Taken
	(EMA) should be replaced with the Independent Monitor to be engaged by the Proponent. The duties and responsibilities of the Independent Monitor should be defined properly.		accordingly.
36	A budget for Independent Monitoring should be developed and responsibility should be given to the Proponent.	Covered in Chapter 12.	-
37	Executive summary should be replaced by Summary Report by providing relevant figures, tables, institutional arrangement, EMP matrix, etc.	Agreed.	Executive Summary has been separated from the Main Report as Volume- I and captioned as Summary Report.
38	Methodology in the Executive Summary should be avoided.	Agreed.	Updated as per suggestion.

Table of Contents

Acknowledgements	i
Responses of Comments of Department of Environment (DoE), Dhaka on EIA of Coal Transportation (Comments in Bengali Translated into English)	iii
Responses of Comments of Mongla Port Authority (MPA) on EIA Report for Coal Transportation of Rampal Power Plant	xix
Responses of Comments of Bangladesh Water Development Board (BWDB), Dhaka on EIA of Coal Transportation.....	xxiii
Responses of Comments of Ministry of Fisheries and Livestock on EIA Report for Coal Transportation of Rampal Power Plant	xxv
Responses of Comments of Bangladesh Inland Water Transport Authority (BIWTA), Dhaka on EIA of Coal Transportation.....	xxix
Responses of Comments of Forest Department (FD), Dhaka on EIA of Coal Transportation	xxxiii
Responses of Comments of Department of Environment (DoE), Khulna on EIA of Coal Transportation	xxxvii
Responses of Comments of Department of Environment (DoE), Dhaka on EIA of Coal Transportation	xli
Table of Contents	xlix
List of Tables.....	lix
List of Figures	lxiii
Abbreviations and Acronyms.....	lxvii
Glossary	lxxv
1 Introduction.....	1-1
1.1 Background	1-1
1.2 Rationale of the Project	1-3
1.3 Importance of the Project.....	1-3
1.4 Project Category and Regulatory Requirement	1-3
1.5 Brief Regulatory bindings of the Sundarbans Heritage	1-7
1.6 Objectives of the Study	1-7
1.7 Scope of EIA Study	1-8
1.8 Approach and Methodology	1-8
1.9 The EIA Team	1-12
2 Policy, Legal and Administrative Framework.....	2-1
2.1 Introduction.....	2-1

2.2	Requirement for Environmental Clearance Certificate	2-1
2.3	Conditions mentioned in the EIA approval letter for Rampal Power Plant Project.....	2-2
2.4	Relevant National Legal Requirements.....	2-2
2.5	Relevant Environmental and natural resources sector (Brief outlines of some regulations)	2-7
2.5.1	Pollution discharge management related legal framework.....	2-11
2.5.2	Legal bindings for protection of Ecologically Critical Areas and the Sundarbans World Heritage sites	2-12
2.6	Environmental and Energy Policy Guidance (Brief outlines of some policies).....	2-13
2.6.1	National Environment Policy-1992	2-13
2.6.2	Power System Master Plan, 2010.....	2-14
2.6.3	National Environment Management Action Plan 1995	2-14
2.7	Port and water ways transportation sector (Brief outlines of some laws)	2-16
2.8	Administrative and land acquisition sector (Brief outlines of some laws)	2-17
2.9	Health and safety sector (Brief outlines of some laws).....	2-18
2.10	Relevant International Legal Obligation	2-18
2.10.1	International Maritime Conventions, Protocols and Agreements applicable for coal transportation	2-22
2.11	Development Agency's Health, Environment and Safety Guidelines .	2-27
3	Project Data Sheet	3-1
3.1	Project Proponent.....	3-1
3.2	Project Location	3-1
3.3	Study/Project Influenced Area	3-1
3.4	Nature of the Project.....	3-1
3.5	Project Component	3-1
3.5.1	Mother Vessel	3-1
3.5.2	Transshipper.....	3-2
3.5.3	Ligherage/Smaller Vessel	3-2
3.5.4	Coal Terminal/ Plant Site Jetty	3-2
3.5.5	Coal and Limestone Transfer to Coal Stackyard	3-3
3.6	Project Activity.....	3-3
3.7	Associated Components (Navigability of the Passur Channel)	3-3

3.8	Project Schedule	3-4
4	Project Description.....	4-1
4.1	Project Objective	4-1
4.2	Project Significance to Country's Power Sector	4-1
4.3	Brief of Coal Transportation	4-1
4.4	Project Details.....	4-3
4.5	Land Requirement	4-7
4.6	Project Components.....	4-7
4.6.1	Mother Vessel or Bulk Carriers	4-8
4.6.2	Transhipper	4-9
4.6.3	Lighterage/Smaller Barge	4-11
4.6.4	Coal Terminal/Plant Site Jetty	4-12
4.6.5	Coal and Limestone Handling System.....	4-13
4.6.6	Employment Generation	4-32
4.6.7	Construction Philosophy of Coal/ Lime Stack Yard and Plant Jetty	4-32
4.6.8	Care for Environment during Jetty Construction	4-33
4.6.9	Role of EPC Contractor	4-33
4.7	Associated Components (Navigability of the Passur Channel)	4-34
4.7.1	Navigability of Passur Channel from Mongla Port to Plant Jetty ...	4-35
4.7.2	Navigability at Outer Bar	4-37
4.7.3	Navigability from Base Creek to Mongla Port.....	4-38
5	Analysis of Alternatives.....	5-1
5.1	Alternative Means of Carrying out the Project.....	5-1
5.1.1	Route Selection	5-1
5.1.2	Bulk Carrier Alternatives	5-9
5.1.3	Anchorage Points	5-11
5.1.4	Transshipment Process and Transshipper	5-14
5.1.5	Alternate Coal and Limestone Handling System.....	5-16
5.1.6	Dust Control	5-16
6	Detail Description of the Study Area	6-1
6.1	Introduction.....	6-1
6.2	Description of Satellite Image	6-1
6.3	Methodology of Image Analysis	6-3

6.4	Description of Land use Items	6-3
6.4.1	Agriculture Land	6-3
6.4.2	Permanent Fallow Land	6-3
6.4.3	Rural settlement with homestead vegetation.....	6-4
6.4.4	Forest	6-4
6.4.5	Road and Embankment	6-4
6.4.6	Industrial Area	6-4
6.4.7	Water bodies	6-4
6.4.8	Results.....	6-4
7	Environmental and Social Baseline.....	7-1
7.1	Introduction.....	7-1
7.2	Climate and Meteorology	7-1
7.2.1	Temperature.....	7-3
7.2.2	Rainfall	7-4
7.2.3	Sunshine Hours.....	7-5
7.2.4	Evaporation	7-5
7.2.5	Humidity	7-6
7.2.6	Wind Speed and Direction	7-6
7.3	Ambient Air Quality.....	7-8
7.4	Ambient Noise Level	7-16
7.4.1	Methodology of Noise Level Monitoring.....	7-16
7.4.2	Results of Noise Monitoring.....	7-17
7.5	Water Resources	7-21
7.5.1	Geomorphology.....	7-21
7.5.2	River System	7-22
7.5.3	Estuary System.....	7-25
7.5.4	Riverine and Estuarine Morphology	7-25
7.6	Water Quality.....	7-37
7.7	Vessel Traffic in Mongla Port and Channels	7-44
7.7.1	Condition of Fairway	7-44
7.7.2	Anchorage Points	7-44
7.7.3	Traffic Movement	7-45
7.7.4	Maritime Traffic.....	7-45
7.7.5	Movement of Lighter Vessels.....	7-46

7.7.6	Movement of Inland Vessels	7-48
7.7.7	Vessels of Bangladesh-India Protocol on IWT	7-48
7.7.8	Movement of other Vessels	7-49
7.7.9	Movement of Mechanized Boats and Crafts	7-49
7.7.10	Traffic Projection	7-52
7.7.11	Projection for Coal Transportation	7-58
7.8	Ecological Resources	7-59
7.8.1	Bio-ecological Zone (BEZ)	7-59
7.8.2	Hot Spots/Area of Conservation Significance.....	7-63
7.8.3	Alien Invasive Species of the Sundarbans	7-74
7.8.4	Jetty Construction Site Vegetation	7-75
7.9	Fisheries Resources	7-75
7.9.1	Habitat Description	7-75
7.9.2	Habitat Classification	7-78
7.9.3	Fish Catch and Effort	7-79
7.9.4	Fish Migration	7-80
7.9.5	Fish Diversity	7-81
7.9.6	Breeding and Nursery Ground	7-87
7.9.7	Dolphin-Fish Prey Interaction	7-90
7.9.8	Fisheries Management	7-90
7.9.9	Regulations on Restricted Fishing Areas in the Sundarbans	7-91
7.9.10	Fishing Community	7-93
7.10	Land and Agriculture Resources.....	7-93
7.10.1	Land Resources.....	7-93
7.10.2	Agro-Ecological Zone (AEZ)	7-93
7.10.3	Soil Quality	7-95
7.10.4	Agriculture Resources	7-96
7.10.5	Farming practices	7-96
7.10.6	Existing Cropping Pattern and intensity	7-97
7.10.7	Crop Production	7-97
7.10.8	Agricultural input use.....	7-98
7.11	Socio-Economic Environment	7-99
7.11.1	Administrative Bounding	7-99
7.11.2	Basic Demography.....	7-99

7.11.3	Occupation and Livelihood	7-101
7.11.4	Labour Market.....	7-104
7.11.5	Public Health and Piracy	7-104
7.11.6	Standard of Living	7-107
7.11.7	Poverty	7-108
7.11.8	Gender and Women	7-108
8	Hazard and Risk Identification and Management	8-1
8.1	Introduction.....	8-1
8.2	Hazard Assessment Process	8-1
8.3	Identification of Hazards.....	8-1
8.4	Hazard Consequence and Likelihood Scales.....	8-3
8.5	Developing Risk Matrix	8-4
9	Environmental Impact and Mitigation Measure	9-1
9.1	General	9-1
9.2	Impact Assessment Methodology	9-1
9.2.1	Impact Magnitude	9-2
9.2.2	Sensitivity of Receptor	9-2
9.3	Assessment of Environmental and Social Impacts	9-2
9.3.1	Feasibility and Design Phase	9-2
9.3.2	Project Implementation Phase.....	9-2
9.3.3	Operation and Maintenance Phase	9-3
9.4	Assessment of Impacts, Significance and Prescription of Measures....	9-3
9.5	Environmental Impacts of the Project.....	9-79
9.6	Environmental and Social Impacts during Feasibility and Design Phase...	9-79
9.6.1	Impacts on the Sundarbans due to Improper Route Selection (A1)	9-79
9.6.2	Impacts on Dolphins due to Improper Route Selection (A2)	9-80
9.6.3	Impacts on Turtle and Otter due to Improper Route Selection (A3)...	9-80
9.6.4	Impacts on Fish and Shrimp habitat due to Improper Route Selection (A4)	9-80
9.6.5	Compliance with MARPOL and IMSBC to Prevent Marine Impacts (A5)	9-81

9.7	Environmental and Social Impacts during Implementation Phase	9-81
9.7.1	Generation of Employment in the Project Area (B1)	9-81
9.7.2	Increased Economic Activity in the Project Area (B2)	9-82
9.7.3	Increased Risk of Accidents for Workers (B3)	9-82
9.7.4	Security Risks for Workers and Assets (B4)	9-83
9.7.5	Cultural Conflicts between Communities and Migrant Workforce (B6)	9-83
9.7.6	Risks of HIV/AIDS, STI and TB due to Outside Workers (B7).....	9-84
9.7.7	Health and Safety Risk for Communities due to Construction Sites (B9)	9-84
9.7.8	Safety Hazards for Children and Elderly People due to Increased Road Traffic (B11).....	9-85
9.7.9	Consumptive Water Requirement for Project Site People (B12) ..	9-85
9.7.10	Sewage/Solid Waste Facilities in the Labour Camp (B13)	9-86
9.7.11	Emissions of Dust and Air Pollution (B14)	9-86
9.7.12	Impact on Wildlife and Birds due to Increased Lighting (B15).....	9-87
9.7.13	Potential Risk of Soil and Water Contamination (B16)	9-87
9.7.14	Impacts on Aquatic Wildlife and Fisheries Habitats from Construction Activities (B18).....	9-88
9.7.15	Impact of Over pressure from Pile Driving On Marine Animals (B19)	9-88
9.7.16	Impact of Underwater Noise from Pile Driving on Riverine Animals (B20)	9-89
9.7.17	Risk of Dolphin Collision with Construction Vessels (B21)	9-90
9.7.18	Impact on Faunal Habitats (B23)	9-90
9.7.19	Risk from Increased Traffic (B26)	9-91
9.7.20	Noise and Vibration from Construction Equipment, Piling, Blasting and Vehicles (B27).....	9-92
9.7.21	Loss of Breeding Pools and Pans during Construction (B28)	9-92
9.8	Social Impacts during Operation and Maintenance (O&M) Phase	9-92
9.8.1	Generation of Employment in Project Area (C1)	9-92
9.8.2	Increased Economic Activity in Project Area (C2).....	9-93
9.8.3	Increased Shipping will Cause Disturbance to Fish and Post Larvae Catching (C3)	9-93
9.8.4	Increased Coal Carrying Vessels can Impact the Sundarbans and World Heritage Site (C5).....	9-94

9.8.5	Impact on Livelihoods (Forestry Products) from Increased Shipping (C7)	9-94
9.8.6	Pollution from and Risk of Marine Vessels due to Non-compliance (C8)	9-95
9.8.7	Impact of Noise on Surrounding Environment and Wildlife (C9)	9-96
9.8.8	Impact on Ambient Air Quality (including dispersion modeling) (C19)	9-105
9.8.9	Accumulation of Fugitive Coal Dust and Spills in River Environment (C20)	9-132
9.8.10	Impact of Fugitive Coal dust and Spills on Water Quality and Benthos (C21)	9-132
9.8.11	Impact of Coal dust on Surrounding Environment and Mangroves (C22)	9-133
9.8.12	Impact of Coal dust from Transshipment and Transfer Processes on Human Health (C23)	9-134
9.8.13	Discharge of Contaminants from Spills can release PAH's into Aquatic Environment (C25)	9-135
9.8.14	Risk of Spontaneous Coal Combustion during Transport (C27)	9-135
9.8.15	Risk of Oil Spill from Coal Vessel and Oil Tanker Collision (C28)	9-136
9.8.16	Risk of Coal Vessel Sinking (C29)	9-137
9.8.17	Risk of Collision, Grounding Due to Low Visibility (C30)	9-137
9.8.18	Risk of Collision, Grounding Due to Tidal Conditions (C31)	9-137
9.9	Critical Habitat Assessment	9-138
9.9.1	Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources	9-138
9.9.2	Habitat Survey	9-139
9.9.3	Critical Habitat Assessment	9-139
9.9.4	Preliminary Critical Habitat Assessment	9-159
9.9.5	Inference of Critical Habitat Assessment	9-159
9.9.6	Mitigation	9-160
10	Cumulative Impacts	10-1
10.1	Introduction	10-1
10.2	Cumulative Impacts on Air Quality	10-1
10.2.1	Cumulative Impacts on Aquatic Habitat	10-14
10.2.2	Cumulative Impacts on Biodiversity of the Sundarbans	10-15
11	Environmental Management Plan	11-1

11.1	Introduction.....	11-1
11.2	Objectives of EMP	11-1
11.3	Project Description	11-1
11.4	Inclusion of EMP in Contract Documents.....	11-2
11.5	Institutional Arrangements	11-2
11.5.1	BIFPCL Project Management Control and Commercial	11-2
11.5.2	Environmental, Health and Safety Unit, BIFPCL.....	11-2
11.5.3	Owner’s Engineer	11-5
11.5.4	Independent Monitoring Agency	11-5
11.5.5	EPC Contractors	11-5
11.5.6	Mongla Port Authority	11-5
11.6	Grievance Redress Mechanism	11-6
11.6.1	Local Grievance Redress Committee	11-8
11.6.2	Project Grievance Redress Committee.....	11-8
11.7	Environmental Code of Practices.....	11-8
11.8	Environmental Management Plans during Implementation	11-9
11.8.1	Site Preparation	11-9
11.8.2	Implementation/Construction Environmental Management Plans	11-9
11.8.3	Communication Plan	11-16
11.9	Operational Environmental Management Plans	11-17
11.9.1	Air Quality Management.....	11-17
11.9.2	Safety Measures of Coal Transportation	11-19
11.9.3	Run-off Management Plan	11-21
11.9.4	Emergency Response Plans.....	11-21
11.9.5	Lighting Plans	11-29
11.9.6	Noise Management Plan	11-30
11.9.7	Waste and water pollution management.....	11-31
11.10	EMP to Address Cumulative Impacts	11-32
11.10.1	Air Quality Management	11-33
11.10.2	Biodiversity Management Plan.....	11-37
11.11	Mitigation Plan	11-43
11.12	Budget for EMP	11-70
12	Environmental Monitoring Plan	12-1

12.1	Introduction.....	12-1
12.2	Compliance Monitoring	12-1
12.3	Independent Monitoring	12-1
12.4	Regulatory Monitoring	12-2
12.5	Implementation of Environmental Monitoring Plan	12-11
12.5.1	Responsible Agency	12-11
12.6	Performance Indicators	12-11
12.7	Reporting and Feedback Mechanism.....	12-11
12.8	Budget for Environmental Monitoring	12-12
13	Public Consultation and Information Disclosure.....	13-1
13.1	Background	13-1
13.2	Regulatory Requirements	13-1
13.2.1	Bangladesh Guidelines	13-1
13.3	Objective of the consultations	13-1
13.4	Consultation Methodology.....	13-2
13.4.1	Consultation Approach	13-2
13.4.2	Stakeholder identification	13-3
13.5	Consultation Outcomes	13-3
13.5.1	Informal consultations	13-3
13.6	Expert/Institution Consultation.....	13-6
13.7	Focus Group Discussion (FGD)	13-13
13.8	EIA Disclosure.....	13-15
14	Conclusions and Recommendations	14-1
14.1	Conclusions	14-1
14.2	Recommendations	14-2
	Reference.....	15-1

List of Tables

Table 1-1: Distance of the important features.....	1-4
Table 1-2: Team composition for the EIA Study	1-13
Table 2-1: National Legal provisions applicable to the proposed project for ensuring environmental protection	2-3
Table 2-2: Environmental pollution issues and related legal instruments	2-11
Table 2-3: Relevant Environment related International Convention and Treaties	2-19
Table 2-4: International maritime conventions, protocols and agreements relevant to the project	2-23
Table 2-5: World Bank Policies triggering for the proposed project	2-28
Table 4-1: Quality of the coal available in selected source country	4-2
Table 4-2: Summary of length and volume of dredging ¹	4-35
Table 5-1: Alternative route selection	5-7
Table 5-2: Comparative analysis of Anchorage Points.....	5-14
Table 6-2: Land covers classification of the study area	6-4
Table 7-1: Ambient Air Quality Sampling Locations	7-9
Table 7-2: Analysis procedure for Air quality monitoring parameters	7-10
Table 7-3: Average ambient air quality of different monitoring locations	7-12
Table 7-4: Ambient air quality measured in January, 2016 in the study area	7-13
Table 7-5: Details of ambient noise monitoring locations.....	7-17
Table 7-6: Summary of the ambient noise recorded in consecutive 10 Quarter monitoring sessions in 2014, 2015 & 2016	7-20
Table 7-7: General Features of the Passur River	7-23
Table 7-8: Estimated height water level in future at Mongla Port Station.....	7-29
Table 7-9: Sea level rise for SRES of AR4.....	7-29
Table 7-10: Projected SLR at the coast of Bangladesh	7-29
Table 7-11: Salinity level at different points along the route	7-37
Table 7-12: Concentrations of TC in river water	7-38
Table 7-13: Concentrations of Total Organic Carbon	7-39
Table 7-14: Analysis result of oil and grease in river water.....	7-39
Table 7-15: The concentrations of PAH in river water	7-40
Table 7-16: Analysis results of the selected surface water quality parameters	7-41

Table 7-17: Analysis results of the selected surface water quality parameters	7-43
Table 7-18: Cargo handled at Mongla Port.....	7-46
Table 7-19: Statistics of mother vessels and fuel used.....	7-46
Table 7-20: Movement of lighter vessel and fuel used	7-47
Table 7-21: Dimension of inland vessels	7-48
Table 7-22: Movement of vessels under Bangladesh-India IWT protocol	7-49
Table 7-23: Movement of other vessels through study area.....	7-49
Table 7-24: Movement of boats and crafts through study area (2015-16)	7-52
Table 7-25: Projection of traffic: mother vessel and lighter vessel.....	7-53
Table 7-26: Projected movement of vessels under Indo-Bangla IWT Protocol	7-55
Table 7-27: Projected movement of other vessels	7-55
Table 7-28: Projection of movement of boats and crafts through study area.	7-57
Table 7-29: Volume of fuel to be used annually for coal transportation	7-59
Table 7-30: Percentage of increase vessel for coal transportation.....	7-59
Table 7-31: Jurisdictional details of the three new dolphin sanctuaries.....	7-65
Table 7-32: Common floral species of SRF along 200m inside from Passur River	7-69
Table 7-33: Total catch in different gears in the sampling sites.....	7-79
Table 7-34: Site wise species diversity using Shannon–Weiner Index	7-82
Table 7-35: Site wise dominant species number	7-83
Table 7-36: Fish species status at regular catches.....	7-84
Table 7-37: Existing fisheries management and conservation rules in SRF....	7-91
Table 7-38: Soil quality of the Sundarbans Reserve Forest at different locations	7-95
Table 7-39: Existing major cropping pattern in the study area	7-97
Table 7-40: Cropped area and production of the study area	7-97
Table 7-41: Seeds, Labour, Fertilizer and Pesticides used in the study Area..	7-98
Table 7-41: Locations of the study area along with coverage of unions	7-99
Table 7-42: Demographic scenario of the study area	7-100
Table 7-44: Spatial distribution of primary occupation in different buffer areas	7-103
Table 7-45: Receive health facilities of OPD and Emergency at health complexes	7-104
Table 7-46: Common diseases in the study area	7-105

Table 7-47: Comprehensive knowledge of HIV and AIDS among young women ...	7-106
Table 8-1: Identification and sources of hazards	8-2
Table 8-2: Parameters for determining Risk/Impact Scale	8-3
Table 8-3: Criteria for determining likelihood of the potential risks	8-4
Table 8-4: Matrix of impact significance	8-4
Table 8-5: Hazard and Risk Ranking and Management Measures.....	8-6
Table 9-1: Potential impacts and their significance	9-4
Table 9-2: Generation of Noise from different sources in dBA	9-96
Table 9-3: Sensitive receivers with geo-coordinates	9-97
Table 9-4: Predicted noise level at selected receivers (Baseline Case).....	9-100
Table 9-5: Predicted noise level at selected receivers (Project Case)	9-101
Table 9-6: Predicted noise level at selected receivers	9-103
Table 9-7: Emission rate per year by source.....	9-106
Table 9-8: Major Point Source Emissions in the Project Area.....	9-110
Table 9-9: Major Area Sources in the Study Area	9-111
Table 9-10: Major Line-area Sources in the Study Area (Highway Traffic) ..	9-112
Table 9-11: Major Line-area Sources in the Study Area (Marine Vessels – Baseline).....	9-112
Table 9-12: Major Line-area Sources in the Study Area (Marine Vessels – Project Case)	9-112
Table 9-13: Summary of Meteorological Data Input to CALMET.....	9-113
Table 9-14: Location of Sensitive and Key Receptors	9-113
Table 9-15: Validation of ambient background concentrations at Hiron Point	9-114
Table 9-16: Converted Background Concentration Values.....	9-115
Table 9-17: Predicted Maximum Concentrations of NO ₂ (Baseline & Project Case)	9-116
Table 9-18: NO ₂ maximum GLC at Sensitive and Key Receptors.....	9-116
Table 9-19: Air Quality Modeling – CO (Baseline & Project Case).....	9-120
Table 9-20: Predicted maximum concentrations of PM _{2.5} (Baseline and Project Case)	9-121
Table 9-21: PM _{2.5} Concentration at Sensitive and Key Receptors	9-121
Table 9-22: Predicted maximum concentrations of PM ₁₀ (Baseline & Project Case)	9-124
Table 9-23: PM ₁₀ Concentration at Sensitive and Key Receptors.....	9-124

Table 9-24: Predicted maximum concentrations of SO ₂ (Baseline & Project Case)	9-128
Table 9-25: SO ₂ Concentration at Sensitive and Key Receptors	9-128
Table 9-26: Possible Species triggers for Critical Habitat	9-139
Table 9-27: Habitat Identification as per IFC 2012 PS 6	9-140
Table 9-28: Critical Habitat Criteria	9-142
Table 9-29: Project Area Critical Habitat Screening Assessment – Criteria 1 and 2 Critically Endangered or Endangered Species and Endemic and/or Restricted-range species	9-145
Table 9-30: Habitat-Impact Assessment Criteria	9-152
Table 9-31: Species-Impact Assessment Criteria	9-153
Table 9-32: Habitat Impact Assessment	9-155
Table 9-33: Species - Impact Assessment	9-157
Table 9-34: Habitat wise mitigation measures	9-160
Table 9-35: Species -Mitigation Measures	9-161
Table 10-1: Major Area Sources in the Project Area (2030)	10-1
Table 10-2: Major Line-area Sources in the Project Area (Highway Traffic- 2030).	10-1
Table 10-3: Major Line-area Sources in the Project Area (Marine Vessels – Project Case-2030)	10-1
Table 10-4: Predicted Maximum Concentrations of NO ₂ (Cumulative Case)...	10-2
Table 10-5: NO ₂ Concentration at Sensitive and Key Receptors	10-2
Table 10-6: Predicted maximum concentrations of PM _{2.5} (Cumulative Case)	10-5
Table 10-7: PM _{2.5} Concentration at Sensitive and Key Receptors	10-5
Table 10-8: Predicted maximum concentrations of PM ₁₀ (Cumulative Case) ..	10-8
Table 10-9: PM ₁₀ Concentration at Sensitive and Key Receptors	10-8
Table 10-10: Predicted maximum concentrations of SO ₂ (Cumulative Case)	10-11
Table 10-11: SO ₂ Concentration at Sensitive and Key Receptors	10-11
Table 11-1: Examples of noise ratings and equipment age	11-14
Table 11-2: Communication Plan Adopted for the Project	11-16
Table 11-3: Mitigation Plan	11-44
Table 11-4: Estimated cost of EMP	11-70
Table 12-1: Environmental Compliance Monitoring Plan	12-5
Table 12-2: Estimated cost of Monitoring	12-12
Table 13-1: Outcome of public consultations	13-4

Table 13-2: List of experts/institutions consulted and their opinions	13-7
Table 13-3: Opinion and suggestions of local communities	13-14
Table 13-4: Schedule of public disclosure meeting	13-16
Table 13-5: Comments and responses of Public Disclosure Meeting	13-19

List of Figures

Figure 1-1: The Passur River System and Potential Coal Transportation Route	1-2
Figure 1-2: Distance of important features from Fairway Buoy	1-5
Figure 1-3: Distance of important features from Mazhar Point (Harbaria)	1-6
Figure 1-4: Process followed in the EIA study	1-11
Figure 2-1: EIA approval process for the proposed Project	2-2
Figure 3-1: Study/Project influence area	3-2
Figure 3-2: Tentative schedule of jetty construction	3-5
Figure 4-1: Coal transportation route	4-5
Figure 4-2: Layout boundary	4-6
Figure 4-3: Flow diagram of the coal transportation Project activities	4-7
Figure 4-4: Different types of mother vessels	4-8
Figure 4-5: Floating transfer station	4-10
Figure 4-6: Environmental management in Transhipper	4-11
Figure 4-7: Various options for Jetty of 540 m x 30 m	4-13
Figure 4-8: Long profile of the proposed navigational draft.....	4-35
Figure 4-9: Proposed dredging alignment from plant jetty to Mongla and disposal sites	4-36
Figure 4-10: Proposed dredging alignment at Outer Bar.....	4-37
Figure 5-1: Alternative coal transportation routes	5-2
Figure 5-2: Bent points of Dhaki and Chunkuri rivers in the Sibsa route	5-3
Figure 5-3: Bents along the Sibsa route	5-5
Figure 5-4: Erosion along the Sibsa route	5-5
Figure 5-5: Handysize vessels	5-10
Figure 5-6: Anchorage points	5-12
Figure 6-1: Satellite image data of the study area Table 6-1: Band name and wavelength of each band	6-2

Table 6-1: Band name and wavelength of each band	6-3
Figure 6-2: Land use and land cover map of the study area	6-6
Figure 7-1: Climatic Zone of Bangladesh	7-2
Figure 7-2: Monthly maximum, minimum and average temperature (1991-2013)	7-3
Figure 7-3: Trend of annual maximum and minimum temperature (1991-2013)	7-3
Figure 7-4: Monthly maximum, minimum and average rainfall.....	7-4
Figure 7-5: Trend of annual rainfall (1991-2013)	7-4
Figure 7-6: Monthly maximum, minimum and average sunshine hour (2001- 2013)	7-5
Figure 7-7: Monthly maximum, minimum and average Evaporation (1993-2013)	7-6
Figure 7-8: Monthly maximum, minimum and average of relative humidity (1989-2013).....	7-6
Figure 7-9: Wind Rose at Power Plant Site	7-8
Figure 7-10: Site Photographs- Ambient Air Quality Monitoring	7-10
Figure 7-11: Sampling locations of physical parameters.....	7-14
Figure 7-12: Seasonal variation of criteria pollutants against standard.....	7-15
Figure 7-13: Seasonal variation of Noise level at different locations.....	7-21
Figure 7-14: Profile of vegetation along the geomorphic gradient.....	7-22
Figure 7-15: River system of the Sundarbans	7-24
Figure 7-16: Erosion and accretion map of the Passur River	7-26
Figure 7-17: Tidal water level fluctuation at Hiron point over time.....	7-27
Figure 7-18: Tidal water level fluctuation during monsoon period	7-27
Figure 7-19: Water Level variation at Mongla	7-28
Figure 7-20: Water level variation at Mongla (April- October)	7-28
Figure 7-21: Long profile of Passur River from Mongla Port to Chalna	7-30
Figure 7-22: Longitudinal section of Passur River from Mongla to Fairway Buoy	7-31
Figure 7-23: Bathymetric map and Cross sections of the Passur River	7-32
Figure 7-24: Tidal cycle at Hiron Point	7-33
Figure 7-25: Tidal Cycle at Mongla	7-34
Figure 7-26: Hydrographic Map of the Passur River System.....	7-35
Figure 7-26a: Wave height and direction of the Passur and the Bay of Bengal	7-36

Figure 7-27: Variation of Salinity in Passur River at Mongla, Bagerhat	7-38
Figure 7-28: Vessel survey stations.....	7-51
Figure 7-29: Bio-ecological zone showing the study area	7-60
Figure 7-30: Sampling locations of biological issues	7-62
Figure 7-31: Hot spots/protected areas along the proposed Coal Transportation Route	7-66
Figure 7-32: Dolphin distribution in Dhangmari wildlife sanctuary	7-67
Figure 7-33: Dolphin distribution in Chandpai wildlife sanctuary.....	7-68
Figure 7-34: Major floral composition of SRF along the study area	7-70
Figure 7-35: Important features along the coal transportation route.....	7-72
Figure 7-36: The productive and protective role of mangrove forest as goods and services	7-74
Figure 7-37: Fish habitat in the Passur River System.....	7-76
Figure 7-38: Fish habitat map of the study area.....	7-77
Figure 7-39: Life stage based habitat classification of fish species	7-78
Figure 7-40: Fish Production Trend and Production Share of the Sundarbans	7-80
Figure 7-41: Relative abundance of major migratory fish species in sampling sites	7-80
Figure 7-42: Migration extent of major migratory fish species in sampling sites	7-81
Figure 7-43: Regularly caught fish species	7-83
Figure 7-44: Site-wise fish species richness (FSR) in the Passur River System	7-85
Figure 7-45: Habitat distribution of different life stages of fish species, 2015-16	7-86
Figure 7-46: Composition of shellfish in different families from the Passur River	7-87
Figure 7-47: Hilsa fish breeding grounds.....	7-88
Figure 7-48: Abundance of Jatka fish.....	7-89
Figure 7-49: Fishing protected areas	7-92
Figure 7-50: Agro-Ecological Zones	7-94
Figure 7-51: Comparative pyramids of male-female school attendance	7-101
Figure 7-52: Employment status of the study area	7-102
Figure 7-53: Occupation status among the studied population	7-102
Figure 7-54: Spatial distribution of households without any secondary occupation	7-103

Figure 7-55: Percentage of women getting birth assistance during delivery	7-105
Figure 9-1: Predicted noise level at different sensitive receptors in day time (Baseline case)	9-99
Figure 9-2: Predicted noise level at different sensitive receptors in night time (Baseline Case).....	9-99
Figure 9-3: Predicted noise level in the selected locations in Day time (Scenario-I)	9-101
Figure 9-4: Predicted noise level in the selected locations in Night time (Scenario-I)	9-102
Figure 9-5: Predicted noise level in the selected locations in Day time (Scenario-II)	9-103
Figure 9-6: Predicted noise level in the selected locations in Night time (Scenario-II)	9-104
Figure 9-7: Metrological, Computational and Sampling Grid.....	9-108
Figure 9-8: Coal Transportation Route and Sources	9-109
Figure 9-9: Predicted NO ₂ Concentration – Baseline.....	9-118
Figure 9-10: Predicted NO ₂ Concentration – Project Case	9-119
Figure 9-11: Predicted PM _{2.5} Concentration- Baseline Case	9-122
Figure 9-12: Predicted PM _{2.5} Concentration – Project Case.....	9-123
Figure 9-13: Predicted PM ₁₀ Concentration – Baseline Case	9-126
Figure 9-14: Predicted PM ₁₀ Concentration – Project Case.....	9-127
Figure 9-15: Predicted SO ₂ concentration - Baseline	9-130
Figure 9-16: Predicted SO ₂ Concentration – Project Case	9-131
Figure 10-1: Predicted NO ₂ Concentration – Cumulative Case	10-4
Figure 10-2: Predicted PM _{2.5} Concentration – Cumulative Case	10-7
Figure 10-3: Predicted PM ₁₀ Concentration – Cumulative Case	10-10
Figure 10-4: Predicted SO ₂ Concentration – Cumulative Case	10-13
Figure 11-1: Proposed Institutional Structure for Implementation of EMP.....	11-4
Figure 11-2: Grievance Redress Mechanism	11-7
Figure 12-1: Locations of physical parameters monitoring	12-3
Figure 12-2: Locations of biological issues monitoring.....	12-4
Figure 13-1: Public Consultation Process	13-2
Figure 13-2: Participants in the Public Consultation Meetings.....	13-13
Figure 13-3: FGDs with affected communities in different places	13-15
Figure 13-4: Advertisement for PDMs at Mongla, Bagerhat and Khulna	13-17
Figure 13-5: Participation of participants in the PDM sessions	13-18

Abbreviations and Acronyms

AAQS	Ambient Air Quality Standards
APHA	American Public Health Association
AC	Alternate Current
ACF	Assistant Conservator of Forest
ACOP	Approved Code of Practice
ADB	Asian Development Bank
AE	Assistant Engineer
AEZ	Agro-ecological Zone
AIDS	Acquired Immuno Deficiency Syndrome
AM	Assistant Manager
ANSI	American National Standards Institute
AP	Action Plan/Affected Person
BAPA	Bangladesh Poribesh Andolon
BASD	Bangladesh Association for Sustainable Development
BBS	Bangladesh Bureau of Statistics
BCAS	Bangladesh Center for Advance Studies
BCDP	Bangladesh Cetacean Diversity Project
BDT	Bangladeshi Taka
BEZ	Bio-Ecological Zone
BHP	Brake Horsepower
BIFPCL	Bangladesh India Friendship Power Company Limited
BIWTA	Bangladesh Inland Water Transport Authority
BMD	Bangladesh Meteorological Department
BOD	Biochemical Oxygen Demand
BP	Bank Policy
BSMF	Bangladesh Sundarbans Mangrove Forests
BTM	Bangladesh Transverse Mercator
BWDB	Bangladesh Water Development Board
CAGR	Compound Annual Growth Rate
CAS	Catch Assessment Survey
CD	Chart Datum
CH ₄	Methane

CHA	Cargo Handling Agency
CE	Chief Engineer
CEAP	Construction Environmental Action Plan
CEGIS	Center for Environmental and Geographic Information Services
CFO	Chief Financial Officer
CHRO	Chief Human Resources Officer
CO	Carbon Monoxide
COD	Chemical Oxygen Demand
COPD	Chronic Obstructive Pulmonary Disease
CPO	Chief Procurement Officer
CPU	Central Processing Unit
CSC	Convention for Safe Containers
dB/dBA	Decibel
DC	District Commissioner
DG	Director General
DGFP	Directorate General of Family Planning
DM	Deputy Manager/De-Mineralized
DO	Dissolved Oxygen
DOC	Dissolved Organic Carbon
DoE	Department of Environment
DoF	Department of Fisheries
DOM	Director of Operation and Maintenance
DPHE	Department of Public Health Engineering
DWT	Dead Weight Tonnage
EA	Environmental Assessment
ECC	Environmental Clearance Certificate
ECA	Environment Conservation Act /Ecologically Critical Area
ECP	Environmental Code of Practice
ECR	Environment Conservation Rules
EGIS	Environmental and Geographic Information Services
EHS	Environmental Health and Safety
EHSU	Environmental Health and Safety Unit
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	Equipment Management System

EP	Equator Principles
EPC	Engineering, Procurement and Construction
EPFI	Equator Principles Financial Institution
ERG	Emergency Response Group
ERP	Emergency Response Plan
EMP	Environmental Management Plan
ESP	Electrostatic Precipitator
ETA	Estimated Time of Arrival
ETP	Effluent Treatment Plant
EXIM	Export-Import
FC	Floating Crane
FD	Forced Draft/Forest Department
FGD	Focus Group Discussion/Flue Gas De-sulphurization
FI	Financial Intermediary
FRAS	Fire Resistant Anti-Static
FSR	Fish Species Richness
FTS	Floating Transfer Station
FTV	Floating Transfer Vessel
FY	Fiscal Year
GHG	Green House Gas
GHS	Globally Harmonized System
GIS	Geographical Information System
GO	Government Organization
GoB	<i>Government of Bangladesh</i>
GPS	<i>Global Positioning System</i>
GRC	Grievance Redress Committees
GRM	Grievance Redress Mechanism
ha	Hectares
HH	Household
HIV	Human Immunodeficiency Virus
HME	Harmful to the Marine Environment
HMMSRP	Hazardous Materials Management and Spill Response Plan
HNS	Hazardous and Noxious Substances
HSD	High Speed Diesel
HSE	Health Safety Environment

HSW	Health and Safety at Work
IAPP	International Air Pollution Prevention
IBC	Intermediate Bulk Container
IDRG	International Data Responsibility Group
IEE	Initial Environmental Examination
IFC	International Finance Corporation
IFI	International Financial Institution
IMA	Independent Monitoring Agency
IMDG	International Maritime Dangerous Goods
IMO	International Maritime Organisation
IMSBC	International Maritime Solid Bulk Cargoes Code
IMR	Infant Mortality Ratio
INMARSAT	International Maritime Satellite Organization
I/O	Input/Output
IOPP	Institute of Packaging Professionals
IPCC	Intergovernmental Panel on Climate Change
IRT	Incident Response Team
ISO	International Organization for Standardization
ISPP	International Sewage Pollution Prevention
IUCN	International Union for Conservation of Nature
IWM	Institute of Water Modelling
IWT	Inland Water Transport
KHz	Kilo Hertz
KII	Key Informant's Interview
Km	Kilometer
KPa	Kilo Pascal
KV	Kilo Volt
KWh	Kilo Watt hour
LEL	Lowest Explosion Limit
LCS	Longest Common Subsequence
LGI	Local Government Institution
LGRC	Local Grievance Redress Committee
LL	Load Lines
LNG	Liquefied Natural Gas
LOA	Length Overall

LPG	Liquefied Petroleum Gas
MARPOL	Marine Pollution
MDS	Musculo-skeletal disorders
MEA	Multilateral Environmental Agreement
MEPC	Marine Environment Protection Committee
MEWP	Mobile Elevating Working Platform
MG	Mongla-Ghasiakhali
MHB	Materials Hazardous Only in Bulk
mm	Milimeter
MMI	Man Machine Interface
MMR	Maternal Mortality Ratio
MoEF	Ministry of Environment and Forest
MoPEMR	Ministry of Power, Energy and Mineral Resources
MoU	Memorandum of Understanding
MPA	Mongla Port Authority
MPI	Multidimensional Poverty Index
MSDS	Material and Safety Data Sheet
MW	Mega Watt
NAAQS	National Ambient Air Quality Standards
NAPA	National Adaptation Program of Action
NBSAP	National Biodiversity Strategy Action Plan
NCS	National Conservation Strategy
ND	Not Detectable
NE	North East
NEMAP	National Environment Management Action Plan
NEP	National Energy Policy
NF	Not Found
NGO	Non-Government Organization
NM	Nautical Mile
NOC	No Objection Certificate
NO _x	Oxides of Nitrogen
NTPC Ltd	NTPC Ltd
NW	North West
NWRD	National Water Resources Database
NT	Near Threatened

OE	Owner's Engineer
OHS	Occupational Health and Safety
OHSP	Occupational Health and Safety Plan
O&M	Operation and Maintenance
OP	Operational Policy
ORP	Oxidation Reduction Potential
OUV	Outstanding Universal Values
PAH	Polycyclic Aromatic Hydrocarbon
PAP	Primary Affected People
PCM	Public Consultation Meeting
PDM	Public Disclosure Meeting
PGRC	Project Grievance Redress Committee
PL	Post Larvae
PLC	Programmable Logic Control
PM	Particulate Matter
PMCC	Project Management Control and Commercial
PMU	Project Management Unit
POC	Particulate Organic Carbon
PP	Power Plant
PPE	Personal Protective Equipment
PPM	Parts Per Million
PPT	Parts per Thousand
PS	Performance Standard
PSMP	Power System Master Plan
PWC	Price Waterhouse Coopers
PWD	Public Works Datum
QM	Quarterly Monitoring
RCC	Reinforced Cement Concrete
RF	Reserve Forest
RIDDOR	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations
ROW	Right of Way
RPE	Respiratory Protective Equipment
RS	Remote Sensing
RSI	Repetitive Stress Injuries
SAR	Search and Rescue

SARP	Search and Rescue Plan
SCC	Site Clearance Certificate
SE	South East/Superintendent Engineer
SOLAS	Safety of Life at Sea
SOP	Standard Operating Procedure
SOPEP	Ship Oil Pollution Emergency Plan
SO _x	Oxides of Sulfur
SPM	Suspended Particulate Matter
SPS	Safeguard Policy Statement
SUL	Ship Unloaders
SPV/SPE	Special Purpose Vehicle/Entity
SRES	Special Report on Emissions Scenarios
SRF	The Sundarbans Reserve Forest
SLR	Sea Level Rise
SSWS/SWS	The Sundarbans South Wildlife Sanctuary
STD	Sexually Transmitted Disease
STI	Sexually Transmitted Infection
STCW	Standards of Training, Certification and Watchkeeping
SW	South West
SWL	Safe Working Load
TB	Tuberculosis
TC	Total Carbon
TDS	Total Dissolved Solid
TEPSCO	Tokyo Electric Power Services Company
TH	Total Hydrocarbon
t/h	Ton per Hour
TLV	Threshold Limit Value
TOC	Total Organic Carbon
ToR	Terms of Reference
TSS	Total Suspended Solid
U5MR	Under-Five Mortality Rate
UEL	Upper Explosive Limit
ULCC	Ultra Large Crude Carrier
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNO	Upazila Nirbahi Officer

USD	United States Dollar
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator
VHF	Very High Frequency
VLCC	Very Large Crude Carrier
VOC	Volatile Organic Compound
WARPO	Water Resources Planning Organization
WB	World Bank
WBG	World Bank Group
WCS	Wildlife Conservation Society
WEL	Workplace Exposure Limit
WHS	World Heritage Site
WQ	Water Quality

Glossary

<i>Aman:</i>	Group of rice varieties grown in the monsoon season and harvested in the post-monsoon season. This is generally transplanted at the beginning of monsoon from July-August and harvested in November-Dec. Mostly rain-fed, supplemental irrigation needed in places during dry spell.
<i>Aus:</i>	Group of rice varieties sown in the pre-monsoon season and harvested in the monsoon season. These are broadcasted/transplanted during March-April and harvested during June-July. Generally rain-fed, irrigation needed for HYV T. Aus.
<i>B:</i>	When preceding a crop means broadcast (B. Aus)
<i>Bazar:</i>	Market
<i>Boro:</i>	A group of rice varieties sown and transplanted in winter and harvested at the end of the pre-monsoon season. These are mostly HYV and fully irrigated, planted in December-January and harvested before the onset of monsoon in April- May.
<i>Jhupri:</i>	House which consist mud walls of 1.5 to 3.0 ft thickness, which carry the roof load. Earthen floor, thatch or CI sheets are used as roofing materials. . There is no monolithic joint between the wall and the roof.
<i>Khal:</i>	A drainage channel usually small, sometimes man-made. The channel through which the water flows. These may or may not be perennial.
<i>Kharif:</i>	Pre-monsoon and monsoon growing season. Cropping season linked to monsoon between March-October, often divided into kharif-1 (March-June) and kharif-2 (July-October).
<i>Kutcha:</i>	A house made of locally available materials with earthen floor, commonly used in the rural areas.
<i>Mauza:</i>	Smallest revenue geographic unit having Jurisdiction List (JL) number.
<i>Pucka:</i>	Well constructed building using modern masonry materials.
<i>Rabi:</i>	Dry agricultural crop growing season; mainly used for the cool winter season between November and February.
<i>T. Aman:</i>	When preceding a crop means transplanted (T. Aman).
<i>Upazila:</i>	Upazila is an administrative subdivision of a District.

1 Introduction

1.1 Background

1. The Environmental Impact Assessment (EIA) of coal transportation of the proposed 2 x 660 MW Maitree Super Thermal Power Project (Maitree STPP) has been prepared by addressing the alternative ways of conducting the project, stakeholder consultations, project descriptions (including coal transshipment, coal carriages, jetty construction, and unloading of coal at jetty and storages), indicating best possible options for various project components, describing the baseline condition of different environmental and social parameters for the selected alternative, impact and risk assessment for the valued environmental components, cumulative impact assessments of selected parameters, mitigation and enhancement measures of identified impacts, environmental management and monitoring, and stakeholder consultation. The Proponent of the Project is the Bangladesh–India Friendship Power Company (Pvt.) Limited (BIFPCL), a Joint Venture of Bangladesh Power Development Board (BPDB) and NTPC Ltd., India.
2. The Maitree Power Project will generate electricity using coal, imported from countries like: Indonesia, Australia, South Africa, etc. Maximum 4.7 million metric tons of coal will be transported and transshipped between Fairway Buoy and Maitree Power Project Jetty. Depending on operational conditions, the required coal may be reduced to 4.0 million tons annually.
3. A coal logistics study¹ was conducted by BIFPCL, which provides the technical insight into the coal transportation through the sea and inland transportation through the Passur River (**Figure 1-1**). The coal logistics study recommended three anchorage points for lightering of mother vessel during various seasons of the year depending on the stability and suitability of loading-unloading against wave condition. These are (i) Fairway Buoy for five months with higher capacity mother vessels (about 100,000 Dead Weight Tonnage- DWT); (ii) Akram Point on Sibsa for four to five months with about 42,000 - 45,000 DWT capacity vessel; and (iii) Harbaria for round the year with 26,000 – 32,000 DWT capacity vessel. Mother vessel will carry the coal for transportation from the source countries to the anchorage points and then by lighterage vessel of capacity about 10,000 DWT for further transportation up to the Maitree Power Project jetty.
4. BIFPCL has entered into a Contract Agreement with CEGIS on 31st January 2016 for conducting an EIA for the proposed Coal Transportation. This EIA study has been conducted based on national environmental regulations and policies and guidelines of development partners and following the approved ToR of the DoE (**Annex 1-1**).
5. As per the signed Contract, CEGIS has prepared a detailed methodology for conducting the EIA study and deployed a multidisciplinary team with relevant expertise. Several field visits have been made to conduct reconnaissance survey, collect primary data and hold consultations with various stakeholders. These field visits guided the team in obtaining institutional insights, secondary and primary data and information for assessing the possible impacts and risks of coal transportation.

¹ PWC (2015); Coal Logistics Study, Bangladesh-India Friendship Power Company Limited.

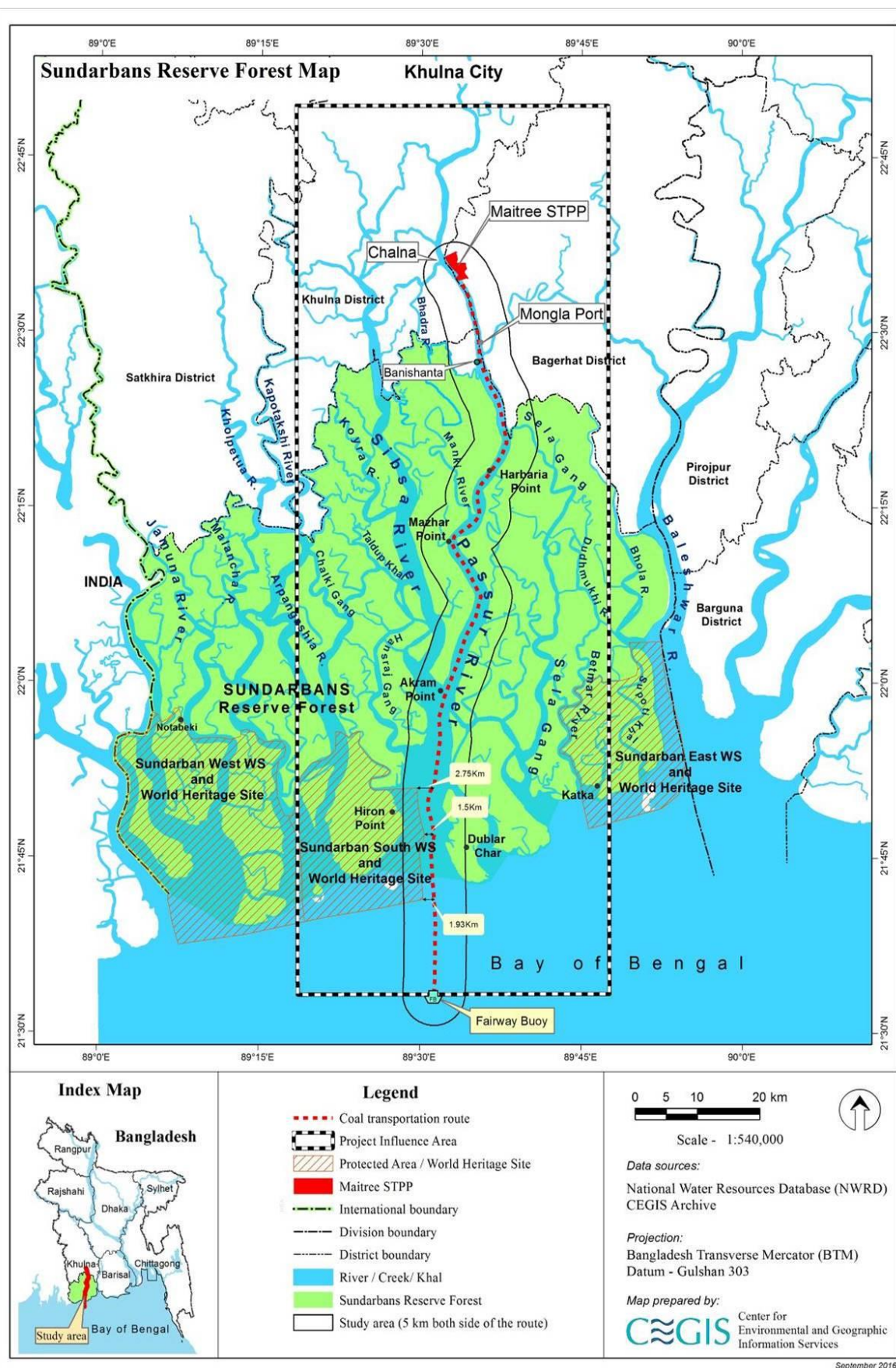


Figure 1-1: The Passur River System and Potential Coal Transportation Route

1.2 Rationale of the Project

6. This EIA study will facilitate the BIFPCL to obtain the environmental clearance from the Department of Environment (DoE) for the coal transportation, which was the 53rd Condition of Maitree Power Project EIA Approval Letter. The 53rd Condition states that “A separate EIA/morphological study shall have to be conducted for coal transportation and river dredging to develop sound environmental management plan towards conservation of ecosystem and biodiversity.” This EIA report is prepared to comply with the 53rd condition of the EIA study approval letter (**Annex 1-2**) in connection with the coal transportation. The technical aspects of the study are to maintain year-round uninterrupted coal supply chain for the Plant, to ensure environment friendly and cost effective transportation of coal considering the Sundarbans Reserve Forest (SRF), World Heritage Site (WHS), Ecologically Critical Area (ECA), RAMSAR Site, the Sundarbans South Wildlife Sanctuary (SSWC), Dolphin Sanctuaries, etc.

1.3 Importance of the Project

7. The proposed Maitree Power Plant will add 1,320MW electricity to the national grid that will improve the present electricity generation significantly and will accelerate national economic development. The coal transportation is an associated component of the coal based power plant, however, it is highly essential that coal carriage is reliable, safe and efficient. The cheapest means of coal transportation from overseas is the water way. So, the present project will indirectly help in industrial development after its implementation. Additionally, it will create employment opportunity to the local people, which will ultimately play an important role in poverty reduction and develop socio-economic condition of the area. Moreover, this coal based Power Plant will thereby play an important role in fuel diversification in electricity generation and reduce pressure on natural gas reserve which is the aim of the Power Sector Master Plan, 2010 of the Government of Bangladesh. The PSMP, 2016 has made a projection of fuel wise primary energy supply for the year 2041 as follows: share of natural gas 38%, oil 25%, coal 20%, nuclear power 9%, hydro-solar-wind power and others 0%, biofuel and waste 3% and power import 5%.

8. The EIA study has identified valued environmental components related to coal transportation and evaluated potential environmental impacts and risks, cumulative impacts on selected components, measures to address impacts and risks and cumulative impacts. The study also considered alternative means of carrying out the Project and stakeholder analysis. Preparation of a detail Environmental Management Plan (EMP) including mitigation measures for potential impacts and enhancement measures for environmental and social losses and potential risks due to coal transportation is expected to facilitate the planning and designing of the proposed Project in a more environment friendly manner so that implementation of the Project is environmentally benign and socially sound and beneficial. The EMP also considered a monitoring plan during construction and operation stages and institutional arrangements for implementing the EMP. A particular focus was given to develop an emergency preparedness and response plan and strengthen Mongla Port authority in human resources and necessary equipment to contain accidental events and disasters.

1.4 Project Category and Regulatory Requirement

9. The coal transportation is an essential component of the Maitree Power Project, which requires a detailed Environmental Impact Assessment (EIA) study. The EIA include

environmental management plan towards conservation of ecosystem and biodiversity, risk management, and institutional strengthening. The EIA study of coal transportation requires an Environmental Clearance Certificate (ECC) as per Section 12 of the Environment Conservation Act, 1995 (Amended Section 1 in 2010) and Environmental Conservation Rules, 1997 (Subsequent amendments in 2005) from DoE. Coal transportation which involves loading and unloading at transshipment point, transportation along the inland waterways, and unloading at Maitree Power Project Jetty. Project activities have the potential of causing 'significant adverse' environmental and social impacts and risks due to possible dispersion of coal dust, spillage of coal and oil, accidental events like collision with other vessels, and sinking of vessel by cyclone and storm surge. The impact sensitivity is assumed high as the whole transportation and trans-shipment activities will be occurring through the Mongla Port Authority's designated route, which passes through the Sundarbans, a reserve mangrove forest, having rich aquatic and terrestrial biodiversity. The route also passes through the ECA, RAMSAR site, beside the UNESCO World Heritage Site (WHS) at the Hiron Point and two Dolphin Sanctuaries, i.e., Dhangmari and Chandpai-Shela Gang.

10. Therefore, the trans-shipment activities and coal carriage will follow the regulatory requirements of ECA, RAMSAR Convention, WHS, Wildlife Conservation, Dolphin Sanctuary and others for avoiding induced environmental and social impacts and risks. Distances from the Fairway Buoy and Mazhar Points to the important features including Maitree Power Project are shown in **Figure 1-2** and in **Figure 1-3**. **Table 1-1** illustrates the distances of the important features from the anchorage points along and beside the transportation route and trans-shipment points.

Table 1-1: Distance of the important features

Sl. No.	Important Features	Approx. Aerial Distance (km)
Distances from the Fairway Buoy		
1	Akram Point	48 (26 NM)
2	Hiron Point	29 (16 NM)
3	World Heritage Site (SSWS)	18 (10 NM)
4	Dublar Char	24 (13 NM)
5	Mazhar Point	71 (38 NM)
6	Harbaria	83 (45 NM)
7	Mongla Port	102 (55 NM)
8	Maitree Power Plant (Maitree STPP)	115 (62 NM)
9	Khulna District HQ	142 (77 NM)
Distances from the Mazhar Point (Harbaria)		
10	Harbaria (Regular Anchorage Point of Mongla Port Authority)	13 (7 NM)
11	Mongla Port	32 (17 NM)
12	Maitree Power Plant	44 (24 NM)
13	Khulna District HQ	70 (38 NM)
14	Akram Point	23 (12 NM)
15	Hiron Point	43 (23 NM)
16	World Heritage Site (SSWS)	40 (22 NM)
17	Dublar Char	48 (26 NM)

Note: NM in parenthesis means Nautical Mile

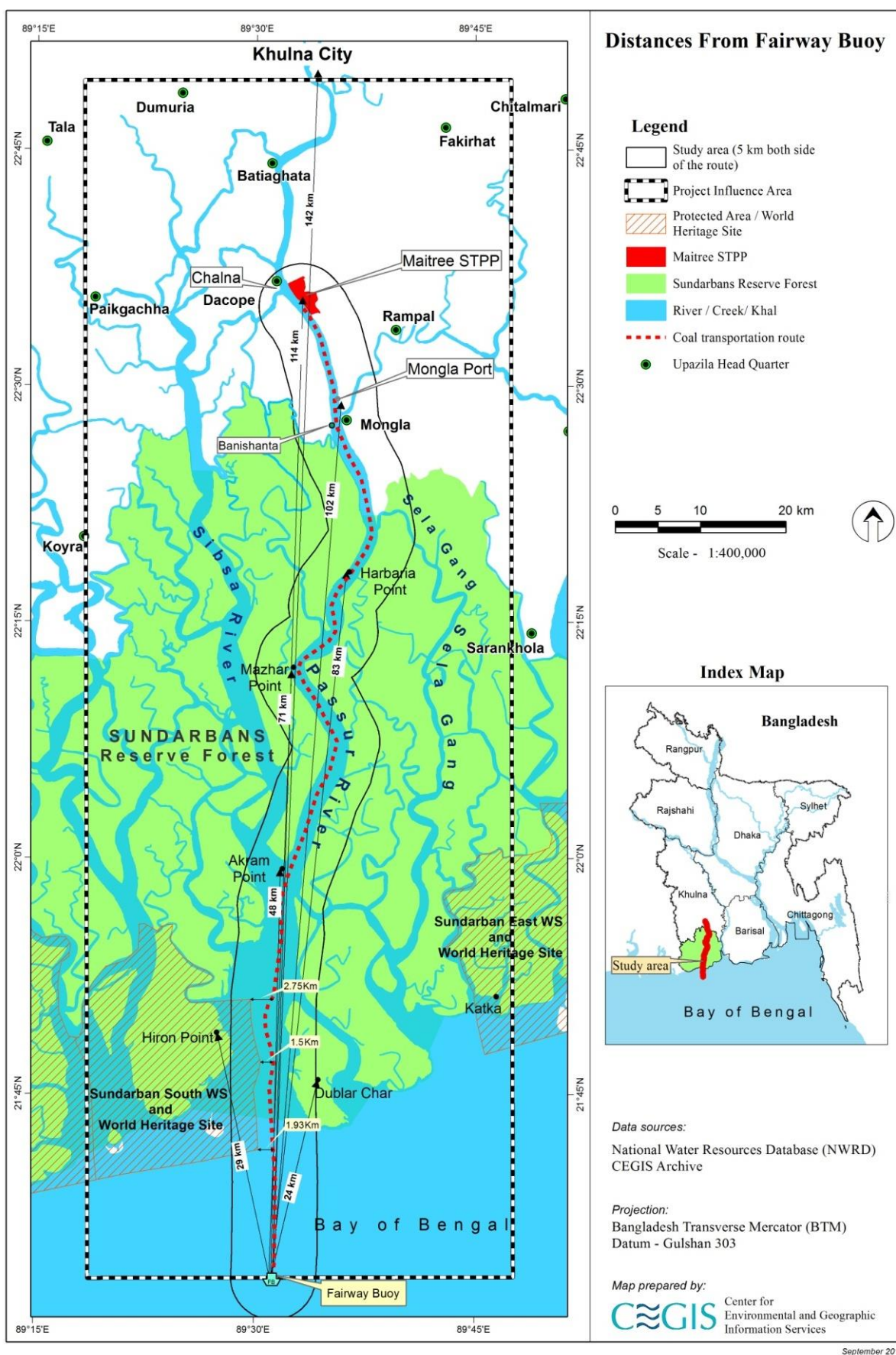
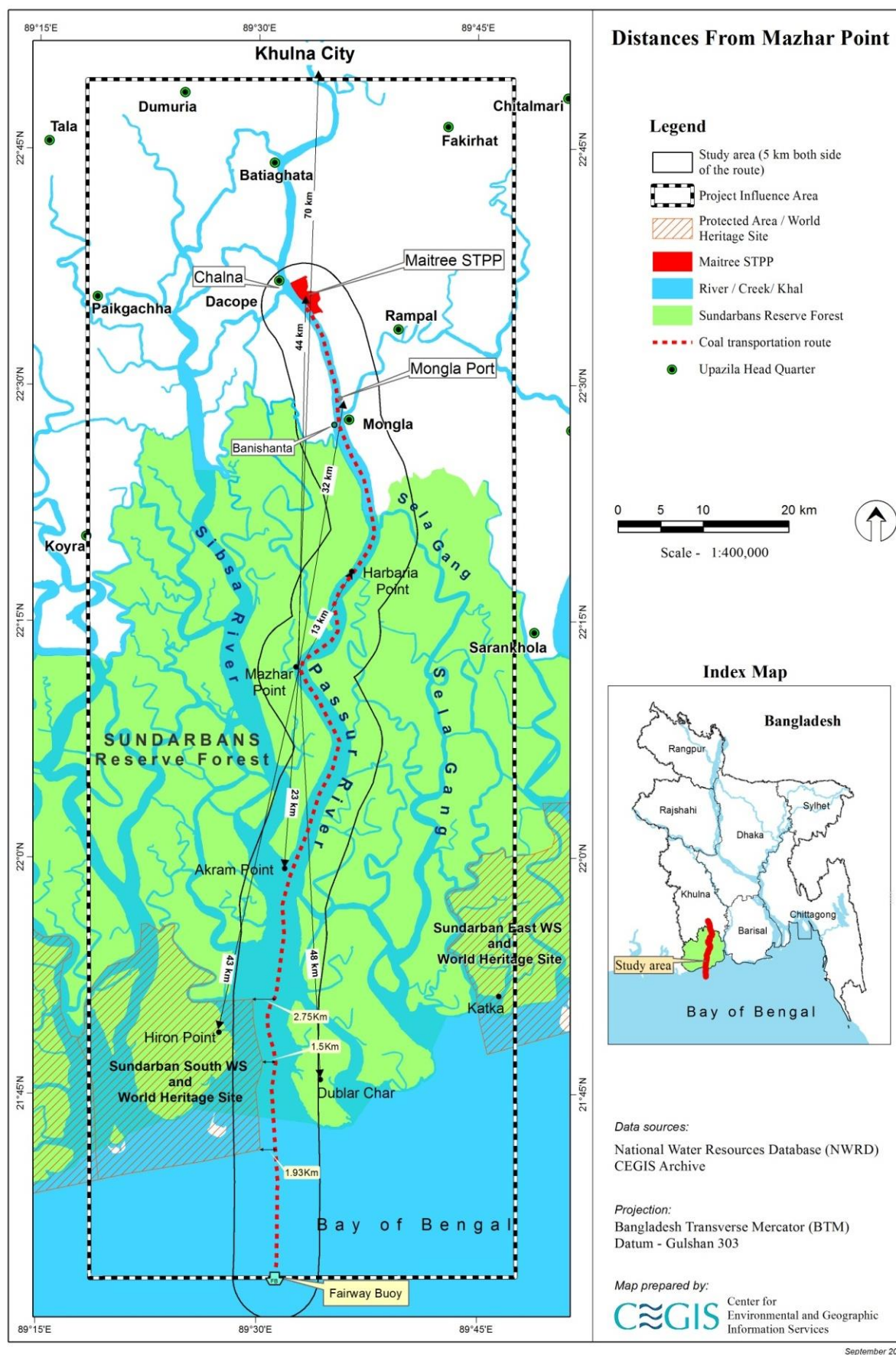


Figure 1-2: Distance of important features from Fairway Buoy



1.5 Brief Regulatory bindings of the Sundarbans Heritage

11. The Sundarbans is the largest mangrove forests in the world comprising an area of 6,017 km² of which 1,400 km² have been inscribed as World Heritage Site by the UNESCO in 1997. There are three seaward wildlife sanctuaries namely, (i) the Sundarbans West Wildlife Sanctuary, (ii) the Sundarbans South Wildlife Sanctuary, and (iii) the Sundarbans East Wildlife Sanctuary (**Figure 1-1**). The immense tidal mangrove of the Sundarbans Reserve Forest (Bangladesh) in reality is a mosaic of islands of different shapes and sizes, perennially washed by brackish water shrilling in and around the endless and mind-boggling labyrinths of water channels. The site supports exceptional biodiversity in its terrestrial, aquatic and marine habitats; ranging from micro to macro flora and fauna. The Sundarbans is of universal importance having conservation significance globally for the species include the Royal Bengal Tiger (*Panthera tigris tigris*), critically endangered; the Gangetic dolphin (*Platanista gangetica*), vulnerable, the Irrawaddy dolphin (*Orcaella brevirostris*), near threatened, estuarine crocodiles (*Crocodylus porosus*), endangered and the endemic river terrapin (*Batagur baska*), critically endangered. Its exceptional biodiversity is expressed in a wide range of flora; 334 plant species belonging to 245 genera and 75 families, 165 algae and 13 orchid species. It is also rich in fauna with 693 species of wildlife which includes, 49 mammals, 59 reptiles, 8 amphibians, 210 white fishes, 24 shrimps, 14 crabs and 43 mollusks species. The varied and colorful bird-life found along the waterways of the property is one of its greatest attractions, including 315 species of waterfowl, raptors and forest birds including nine species of kingfisher and the magnificent white-bellied sea eagle (UNESCO, 2016)¹. The regulatory bindings of the WHS include (i) no hunting of any wildlife, (ii) sailing of commercial vessel across the WHS is strictly prohibited, (iii) disposal of wastes and contaminants are prohibited. But tourist vessel is allowed with the condition of no hunting and no disposal of wastes. The Sundarbans is recognized as a RAMSAR site and as such the GoB has committed to “the conservation and wise use of wetlands bynational action and international co-operation as a means to achieving sustainable development”. The route is 1.5-2.75 km away from the outer boundary of the World Heritage Site. Since the coal would be transported through the MPA’s designated route, all the rules and regulations promulgated by the MPA would be followed.

1.6 Objectives of the Study

12. The overall objective of the study is to conduct the EIA of the Coal Transportation to comply with the requirements of the Government of Bangladesh (GoB)².

13. The specific objectives are to:

- i. Review the earlier reports, relevant to the present study.
- ii. Prepare an environmental baseline on the basis of the primary data collected under the ongoing Environmental Monitoring Program of Maitree Power Plant, being carried

¹UNESCO World Heritage Centre (2016), Sundarbans, <http://whc.unesco.org/en/list/798>, site visited on February, 2016.

² The GoB requires 2 stages environmental assessment as per the Environment Conservation Act 1995 and Environment Conservation Rule 1997: (i) initial environmental examination and site clearance; and (ii) environmental impact assessment and environmental clearance.

out by CEGIS and earlier EIA study, coal logistic study of PWC, India and other studies secondary data.

- iii. Identify environmental and other regulatory requirements of DoE, DoF, BIWTA, Mongla Port Authority, Navy, Coast Guard and other relevant organization within Bangladesh, and International Organizations (such as IMO), and conventions like MARPOL, SOLAS, IMSBC Conventions (**Annex 1-3**) on Facilitation of International Maritime Traffic, London, 1965, Load lines Convention, 1986 etc. and IFC performance standards, IFC General Environmental, Health, and Safety Guidelines for the Transportation of Hazardous Materials, UNESCO and RAMSAR.
- iv. Assess weather, sea conditions and other factors that limit the use of barges for coal transportation.
- v. Assess the potential environmental (biodiversity and ecosystem) impact of the proposed coal transportation and associated transshipment.
- vi. Prepare an Environmental Management Plan (EMP) to safely transport the coal from the transshipment point to the plant jetty. The EMP will prepare mitigation and enhancement measures for potential perceived impacts and enhancement measures for environmental and social losses and preparedness and response plan for potential risks due to coal transportation.

1.7 Scope of EIA Study

14. The scope of the study focuses on identifying and addressing key issues with an opportunity for participation of all parties including subject matter specialist of the relevant area. The major tasks identified during the process are as follows:

- Identifying available project related information, e.g., project location and area, cost, proposed design, construction time-frames, on-ground activities and resources (labor, materials and equipment) required;
- Defining the potential project influence area of the project (and thus the appropriate study area);
- Determining the framework or Terms of Reference (ToR) for carrying out the EIA study based on the initial assessment of potential impacts which may occur due to interaction between the project and resources/receptors (both environmental and social) in the area of influence, available data and data gaps.
- Reviewing relevant local and international legislative and regulatory framework applicable to the project;
- Developing and selecting alternatives to the project components and actions and in identifying the tasks to be considered in the EIA.

1.8 Approach and Methodology

15. This environmental impact assessment followed a number of steps and processes presented in **Figure 1-4**. The main steps are:

- Review of previous studies
- Harmonization of Environmental Safeguard Requirements of the Government and the World Bank Groups.

- Scoping, baseline environmental quality monitoring and ecological and fisheries surveys and finalization of the ToR for the EIA Study
- Screening of impacts and prioritization
- Expert consultations with scientific and professional community
- Conduct focus group discussions in project area
- Public consultation with affected population, local government bodies, public representatives, NGOs and business communities to introduce the project components and anticipated impacts.
- Prediction of impacts/risks and prepare mitigation/enhancement measures by field investigation, data analysis, and mathematical modelling.
- Integration of environment with engineer's design.
- Preparation of Draft EIA Report, Environmental Management and Monitoring Plan, and emergency response and environmental health and safety plan.
- Present Draft EIA Report in Public Consultation Meetings and disclosure in the BIFPCL, EXIM Bank, India and DoE websites for Public review and comments.
- Revise the Draft and update EIA Report, EMP, and emergency response and environmental health and safety plan based on comments by the BIFPCL Advisor, DoE, the EXIM Bank, India and the public at large.
- After incorporation of all comments, submit the Final EIA Report, EMMP, and emergency response and environmental health and safety plan to DoE and the EXIM Bank for Approval.
- Environmental auditing by assessing EIA process and feedback to future EIA Study
- Implement measures beyond compliance.

16. Initial step of an EIA is the collection of primary and secondary data. Reviews of available literature from various sources, interviews of experts and representatives of agencies and institutions, and consultation with local stakeholders and site visits are conducted to collect baseline information for the Project site as well as for the study area. Monitoring study data of Maitree Power Project have also been used for setting up baseline condition. Vessel survey has been done at seven locations for understanding the category of vessels are being plied through different routes connected with the Passur Channel and fuel consumption status. Dolphin survey has also been conducted to understand the abundance of dolphins and species. Investigate the WHS for knowing the floral and faunal conditions so that the study can relate the consequence of the project (if any) on such flora and wildlife. Important Environmental and Social Components (IESCs)/Valued Environmental Components (VECs) are identified through scoping session based on the physical investigation, expert consultations and dialogues with local stakeholders. Setting up of boundaries is an important step, as this takes into account elements such as geographical boundary, time horizon for alternative actions and the affected groups, etc. The bounding is done with reference to IECA/VEC which is covered under the scoping.

17. A number of methods have been used to conduct impact assessment for the EIA study. In this project, matrix methods by determining magnitude and sensitivity have been

used to identify significance of impacts of the proposed Project. Mitigation measures of the identified significant impacts have been suggested and a comprehensive Environmental Management Plan (EMP) has been proposed for the EIA study. The unresolved critical issues and resolution of issues have been discussed in the EMP.

18. The EIA report of the proposed Project has been prepared to fulfil the requirements of Environmental Conservation Rules (ECR) 1997, its subsequent amendment 2005 and Noise Pollution (Control) Rules, 2006. The report was developed based on field observations and consultation with various stakeholders. This study was initiated with collection of environmental and socio-economic data from secondary sources. The primary data and public opinions have been collected from the project site and the study area. However, most of the data, which were used for outlining baseline condition, are from secondary sources. Remotely sensed satellite images were procured, processed, verified with field condition (i.e., ground truthing) and interpreted for enrichment of this EIA study.

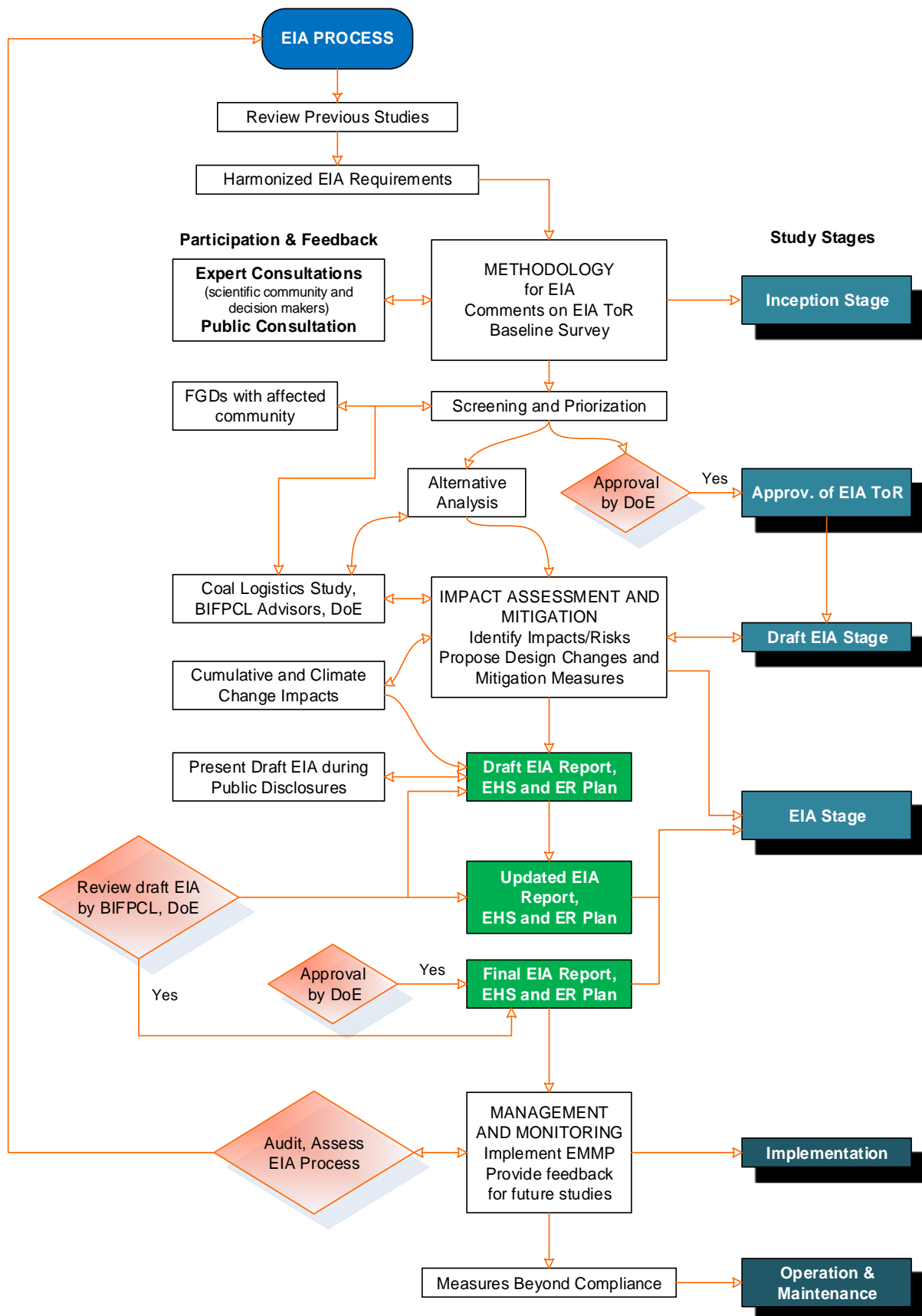


Figure 1-4: Process followed in the EIA study

19. The baseline has covered a detail description of the **physical environment, water resources, land resources, agriculture, fisheries, eco-systems** and **socio-economic** conditions including identification of problems in respect of resources management.

20. Field visits were carried out for data collection as well as conducting public consultation and disclosures as suggested in the EIA guidelines of the DoE. Baseline situation of soil and climatic conditions (temperature, rainfall etc.) were established through use of long term data that were at the disposal of different organizations like: Department of Environment (DoE), Forest Department (FD), Department of Fisheries (DoF), Mongla Port Authority (MPA), Bangladesh Inland Water Transport Authority (BIWTA), Bangladesh Inland Water Transport Corporation (BIWTC), Soil Resource Development Institute (SRDI), Bangladesh Water Development Board (BWDB), Department of Public Health and Engineering (DPHE), Bangladesh Meteorological Department (BMD) and Upazila Offices of different agencies. Furthermore, as part of baseline primary data on air quality, water quality, fisheries, and ecological information were collected from the field. Most of the social and economic data have been generated from the census reports of the Bangladesh Bureau of Statistics (BBS) and upper atmospheric data for three years (from 2013 to 2015) have been collected from Lakes Environmental Consultants Inc., Canada for using it in advanced modeling software, CALPUFF for air quality modeling. CEGIS's own database for different resource sectors, were also used in preparing the EIA report.

21. Data from secondary as well as primary sources on physical environment, water resources, land resources, agriculture, fisheries, eco-systems and socio-economic conditions have been collected for assessing environmental and social impact of the proposed project and developing the environmental management plan.

22. In the impact assessment, various modeling software/tools were used for predicting parameters of different aspects of the physical environment. For the prediction of air quality, United States Environment Protection Agency (US-EPA) regulatory model CALPUFF1 has been used for air quality assessment and for noise modeling, SoundPlan modeling software has been used.

1.9 The EIA Team

23. A multidisciplinary EIA team has been formed as defined in the ToR and proposed in the Technical Proposal with given allocation of time. The study team and their responsibilities including the role of two expatriate consultants as per the ToR, is presented in **Table 1-2**.

¹ CALPUFF is an advanced non-steady-state meteorological and air quality *modeling* system developed by Exponent scientists. It is designed for long-range analysis, more than 50 kilometers from the source, able to model accurately both simple and complex terrain, urban and rural areas, multiple point, line, area, and volume sources. CALPUFF can be used for assessing the impact of emissions 200-300 km from the source.

Table 1-2: Team composition for the EIA Study

Sl. No.	Name of Professional	Position Assigned
<i>International Professional</i>		
1	Dr. Masud Karim	Team Leader/Environment Impact Assessment Specialist
2	Mr. Navin Bindra	Environmental Modeling Specialist
<i>National Professional</i>		
3	Mr. Mohammed Mukteruzzaman	Project Leader/Fisheries Specialist
4	Mr. Md. Shahjahan	Deputy Team Leader and Senior Environmental Specialist
5	Mr. Md. Maqbul-E-Elahi	Hazard and Risk Management Specialist
6	Mr. Md. Sayedul Hoque Khan	Maritime Transportation (of Coal/Bulk) Specialist
7	Dr. Mahmud Husain	Sundarbans Forest Health Specialist
8	Ms. Taslima Islam	Environmental Law Specialist
9	Dr. Niamul Naser	Ecologist/Wild life and Biodiversity specialist
10	Dr. Dilruba Ahmed	Socio-economist
11	Dr. M. M. Awlad Hossain	RS & GIS Expert
12	Mr. Pronab Kumar Halder	Environmental Specialist

24. In addition to the members listed above, additional professionals listed below were also engaged in conducting the study.

Sl. No.	Name of Professional	Position Assigned
1	Mr. Malik Fida A Khan	Coal Transportation Adviser
	Mr. Md. Azizul Haque	Water Resources and Power Management Adviser
2	Mr. Jalal Ahmed Choudhury	Power Plant Expert
3	Mr. Syed Monowar Hussain	Transportation Expert
4	Mr. A T M Kamal Hossain	Morphologist
5	Mr. Md. Firoz Alam	Senior GIS Analyst
6	Mr. Md. Amanat Ullah	Ecologist
7	Mr. Zahid Hasan Dhali	Agricultural Specialist
8	Mr. Mushfiq Ahmed	Wildlife Specialist
9	Mr. Mohammad Saidur Rahman	RS Specialist
10	Mr. Mobasher Bin Ansari	Anthropologist
11	Mr. Arif Anwar	Senior Risk and Hazard Specialist
12	Ms. Deebea Farzana Moumita	Electrical Engineer
13	Ms. Sadeka Tasmin	Environmental Specialist
14	Mr. Hifzur Rahman	Junior Institutional Specialist
15	Mr. Md. Mutasim Billah	Water Quality Specialist
16	Mr. Redwan Hossain Jeshan	Risk and Hazard Specialist
17	Ms. Fatima Tuz Zohra	Junior Environmental Specialist
18	Ms. Faria-Tuz- Zahura	Junior Water Resources Engineer

2 Policy, Legal and Administrative Framework

2.1 Introduction

25. The Department of Environment (DoE) under the Ministry of Environment and Forest (MoEF) of Bangladesh looks after the environmental approval process. The key regulations which govern this process are: ECA, 1995 (including all amendments) and ECR, 1997 (including all amendments).

26. The ECR, 1997 provides the rules relevant to the declaration of ecologically-critical areas and restriction on the operations and process which can or cannot be carried out/initiated in the ecologically critical areas, securing of environmental clearance certificate, environmental quality standards, acceptable limits for discharges of waste, and environmental guidelines on pollution prevention. Overall, the ECA, (1995) and ECR, (1997) outline the regulatory mechanism to protect the environment in Bangladesh. In addition, there are also key regulatory frameworks relevant to the project which includes national regulations and also international treaties and conventions applicable for the project.

27. Therefore, for the purposes of this report, only those regulatory requirements which are relevant for this proposed project will be discussed.

2.2 Requirement for Environmental Clearance Certificate

28. According to Section 12 of ECA 1995, no industrial unit or project can be established or undertaken without securing an environmental clearance certificate (ECC) from the Director General, DOE. Based on ECR 1997, DOE has classified various development interventions according to the potential adverse environmental impacts for the purpose of issuing the ECC. This classification includes: (i) green, (ii) orange-A, (iii) orange-B, and (iv) red. Green categories are industries or projects considered to be relatively pollution-free, thus, no environmental study will be required while the Red categories are industries/projects which may cause significant adverse environmental impacts and therefore, require an initial environmental examination (IEE) and environmental impact assessment (EIA).

29. An ECC is issued by the DOE for all existing industrial units and projects, and to all proposed industrial units and projects under the Green category. For projects and industrial units classified as Orange-A, Orange-B, and Red, securing the ECC involves two steps: (i) issuance of Site Clearance Certificate (SCC), and then (ii) the ECC.

30. However, the proposed coal transportation project EIA study is initiated as a compliance requirement under Clause 53 of EIA approval letter issued for Rampal Coal Power Plant Construction Project, as the former EIA did not include adequate coal transportation route related study including alternatives of logistics.

31. Apart from the DOE compliance requirement for conducting an EIA study for the proposed project as stated above, this project also falls within “Red Category” as per DOE project categorization list (engineering works where the capital investment is more than BDT 1 million) and requiring an EIA as well.

32. However, the present initiative has been undertaken in response to the DoE compliance requirement for conducting an EIA for the proposed coal transportation project to secure approval from DoE. **Figure 2-1** shows the process of EIA approval for this project.

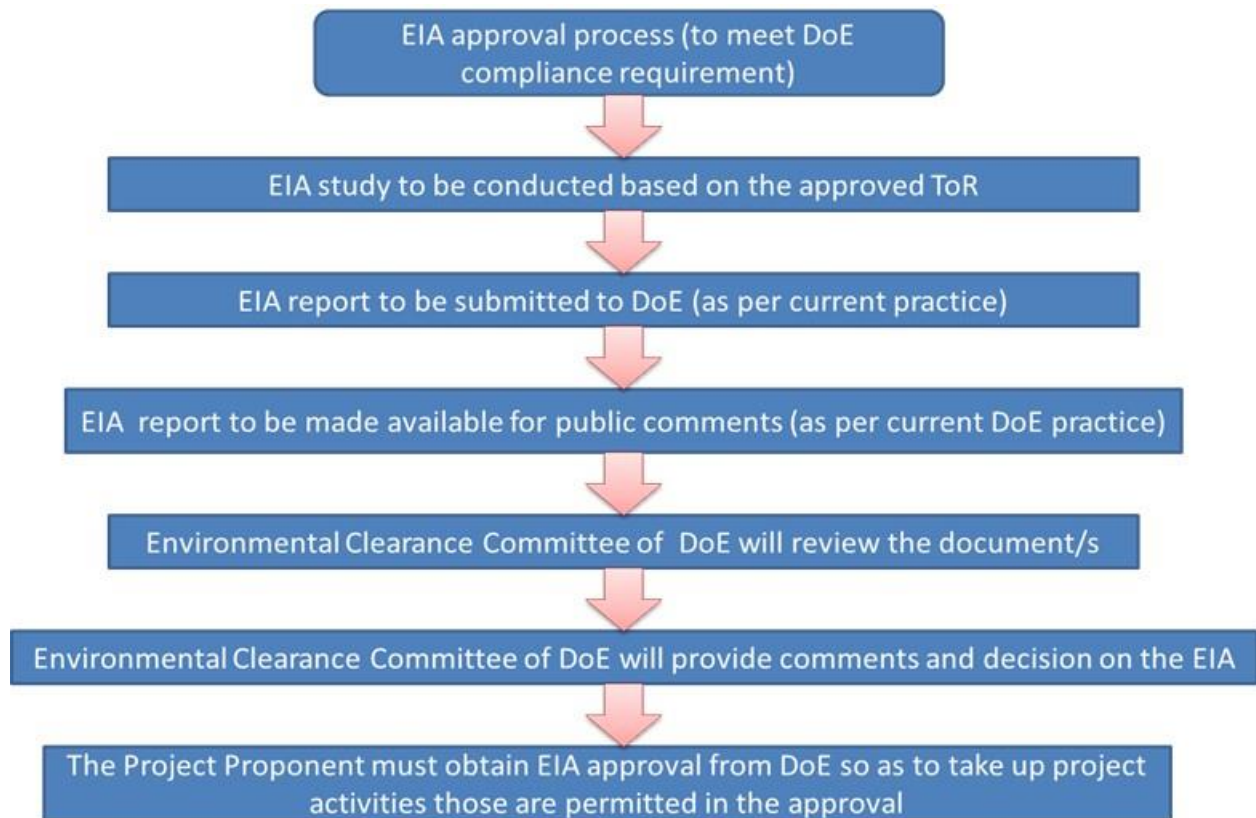


Figure 2-1: EIA approval process for the proposed Project

2.3 Conditions mentioned in the EIA approval letter for Rampal Power Plant Project

33. The Project will comply with all relevant conditions put forth in the EIA approval letter (**Annex 1-2**) issued for Rampal Power Plant Project from DoE, dated August 5, 2013. In this regard, according to requirements under Clause 53 of the EIA approval letter, the proposed EIA has been prepared on the basis of DoE approved ToR attached in the (**Annex 1-1**).

2.4 Relevant National Legal Requirements

34. All legal provisions relevant to environmental protection applicable to the planning stage and operational activities i.e. coal transportation activities were identified under the scope of the EIA study. **Table 2-1** presents the relevant national environmental regulations, and other laws and policies while **Annex 2-1** gives the relevant environmental quality standards of Bangladesh. This may be noted that where DoE standards are not present at the current stage, the World Bank Group (WBG) Guideline Values will be applicable as required.

Table 2-1: National Legal provisions applicable to the proposed project for ensuring environmental protection

Issue	Bangladeshi Legislation or Regulation	Remarks
Prevention of Pollution, Protection of Environment including the Sundarbans Ecologically Critical Area (ECA) and World Heritage	<ul style="list-style-type: none"> Ecologically Critical Area Management Rules, 2016 	Applicable- The major features of this rule is to consider in implementing any kind of activity or Project include “existing natural condition and biodiversity, reserved forest including wildlife habitat and protected area like fish sanctuary along with other animals and plants, swamp forest, mangrove a coastal area”. The proposed interventions including ROW of the coal transportation route of the project will overlap the ECA. Therefore, this rule is directly applicable for this project; hence any kind of violation of this legislation is essentially needed to be avoided.
	<ul style="list-style-type: none"> Biodiversity Act, 2017 	Applicable- The Project proposes to use coal transportation route through the Sundarbans ECA, SRF and WHS having rich biodiversity. As some aquatic species and terrestrial species are located at the river transportation route and also within the surrounding the Sundarbans ECA/Heritage area and are expected to be affected due to project activities. Therefore, this act is applicable.
	<ul style="list-style-type: none"> The Forests Act- 1927 (including all amendments) 	Applicable- The proposed interventions including ROW of the coal transportation route of the project will overlap ECA, the Sundarbans Reserve Forest and the World Heritage Site (WHS) site as well. Therefore, this regulation is directly applicable for this project; hence any kind of violation of this legislation is essentially needed to be avoided.
	<ul style="list-style-type: none"> Wildlife (Protection and Safety) Act- 2012 	Applicable- The project proposes to use coal transportation route through the Sundarbans ECA, SRF and WHS. As some aquatic species are located at the river transportation route and also within the surrounding the Sundarbans ECA/Heritage area and are expected to be affected due to project activities. Therefore, this act is applicable.
	<ul style="list-style-type: none"> Environment Conservation Act- 1995 (as amended in 2000, 2002 and 2010) 	Applicable- The project proposes coal transportation route through ECA and the Sundarbans heritage; hence all relevant bindings of the ECA and heritage shall be applied. The provisions of the act apply to all of the project interventions phases during project life cycle.
	<ul style="list-style-type: none"> Environment Conservation Rules- 1997 (including amendmentsof 2002, 2003, and 2005) Draft Environment Conservation Rules- 2017 	Applicable- as the subject project falls under “Red” category and requires clearance prior to commencement of any project activities. In addition, it is stipulated that environmental quality standards and other relevant requirements which shall be complied during project life cycle.
	<ul style="list-style-type: none"> The Environment Court Act- 2010 	Applicable for completing. The court has jurisdiction, in accordance with the act’s provisions, over trial for an offense or for compensation under an environmental

Issue	Bangladeshi Legislation or Regulation	Remarks
		law, imposing penalties for violation, etc.
	• Noise Pollution Control Rules- 2006	Applicable- The project will create noise within the surroundings, surface and under water environment particularly within the Sundarbans Reserve Forest and also UNESCO World Heritage Site, creating impact on endangered terrestrial and aquatic faunal species and therefore, requires to comply with these rules.
	• Bangladesh Water Act- 2013	Applicable- The project proposes to utilize waterways.
	• National River protection commission Act-2013	Applicable- as the proposed project has likeliness of pollution impact in the river.
	• National Conservation Strategy- 1992	Applicable- as related to conservation of environment.
	• NEMAP- 1995	Applicable- as related to the conservation of habitat and biodiversity including environmental management and quality of life.
	• Environmental Policy- 1992	Applicable- as the proposed project has likeliness of having impact on the surrounding environment.
	• National Forest policy-1994	Applicable- as the policy focuses on the management of reserved forest, increasing of forest areas, preparation of laws for necessary protection and development of forest areas.
	• National Water Policy- 1999	Applicable- The project proposes for transportation activities using water ways and has provision of pollution impact.
	• Wetland policy-1998	Applicable- as the proposed project has coal transportation route near the Sundarbans Ramsar and the policy provided guidelines for protection of wetland and related species.
	• National Fisheries policy-1998	Applicable- as the policy provided guidelines for protection of fish species and the subject project has likeliness of impact on the water ways and fish species as well.
Fisheries	• The Protection and Conservation of Fish Act- 1950 and The Protection and Conservation of Fish Rules- 1985	Applicable- The project requires compliance with any rules set out to protect fish in the inland waters of Bangladesh.
Land use	• National land use policy- 2001	Applicable– as designated land for disposal of dredging spoil will be required.
	• The Acquisition and Requisition of Immovable Property Ordinance- 1982	Applicable- as it is expected that the dredging spoil need to be disposed in an approved designated land and will subsequently require to comply this act for land possession.
	• Terrestrial Water and Maritime Zones Act- 1974 & Rules- 1977	Applicable- as the proposed project has provision of transportation through marine and adjacent inland waterways within Bangladesh territory and may have pollution impact in the surrounding water ways.

Issue	Bangladeshi Legislation or Regulation	Remarks
Coal Transportation, handling and storage	• Ports Act- 1908	Applicable -as the proposed project has likeliness of pollutant discharges (oil, grease, oily water, bilge and ballast water, rubbish etc.), creation of fires, creation of obstacles for navigation and spread of infectious diseases in the surrounding environment or damage of shore/bank.
	• Hazardous Wastes and Ship Breaking Waste Management Rules, 2011 (22 December, 2011; MoEF)	Applicable - Premised on Basel; barred import if ships not certified by authorized agents of exporting countries as not containing hazardous wastes; provided regulations of safe disposal of hazardous waste; emergency response plan; Implementation rests with a National Technical Committee under MoEF.
	• The removal of wrecks and obstructions in inland navigable water-ways Rules, 1973	Applicable -if wreck or obstruction is found in any inland navigable waterways, in that case the authority may cause the wreck or obstruction to be raised, removed or destroyed.
	• Bangladesh Merchant Shipping Ordinance- 1983	Applicable -as the proposed project has provision of engagement of seaman during project activities.
	• The inland shipping Ordinance-1976	Applicable -as project requires permit from the BIWTA.
	• Coast Guard Act-1994	Applicable -as the proposed project has likeliness of pollution discharges and requires compliance to this act.
	• Mongla Port Authority Ordinance- 1976	Applicable -as the proposed project activities will be within the jurisdiction of Mongla port authority.
Coal Sourcing, governance, power generation, energy and utilities	• Bangladesh Coal Policy (Draft)	Applicable -as coal will be utilized for coal power plant.
	• Power System Master Plan-2010	Applicable -as the proposed project utilizing coal as fuel for generation of power.
	• Bangladesh Energy Regulatory Commission Act-2003	Applicable -as the subject project is related to primary energy.
	• National Energy policy-(1995)	Applicable -as the subject project is related to primary energy.
	• Import and Export Control Act-1950	Applicable -as the coal will be imported and requires compliance with this act.
Procurement in Bangladesh	• The Public Procurement Regulations- 2003 (including all amendments)	Applicable -as coal and related shipment will be under procurement regulations.
Health and Safety and labor management	• Fatal Accidents Act- 1855	Applicable -as the proposed project has provision of unlikely and accidental event and may cause fatal accidents.
	• The Dock Labourers Act 1934 and the Dock Labourers Regulations 1948	Applicable - as the coal handling in jetty will utilize labor forces and workers require protection while loading and unloading ships against accidents.
	• Dangerous Cargoes Act- 1953	Applicable -as the proposed project has provision of carrying coal and may impact in the surrounding waterways that relate to the standard and acceptable quality of cargoes.

Issue	Bangladeshi Legislation or Regulation	Remarks
	<ul style="list-style-type: none"> The Explosives Act- 1884 	Applicable -as the proposed project has provision of carrying coal that are prone to fire and explosion situation and requires compliance to this act.
	<ul style="list-style-type: none"> The Penal Code- 1860 	Applicable -as the proposed project has provision of pollution impact on the surrounding environment.
	<ul style="list-style-type: none"> The Factories Act, 1965 and the Factories Rules 1979 	Applicable - as the proposed coal transportation involves person employed in cleaning any part of the machinery or premises used for any kind of work incidental to or connected with, the manufacturing process. Manufacturing process as defined by the act stands for any process fortreating any articles or substances with a view to its use, transport, delivery. This act prescribes the requirements of safety and health to be maintained in coal transportation and handling process.
	<ul style="list-style-type: none"> Fire prevention and Extinguish Act- 2003 	Applicable -as the proposed project has provision of unlikely accidental event and may create fire.
	<ul style="list-style-type: none"> Labor Law- 2006 and 2013 	Applicable —as provideshealth, safety and wellbeing of work force during project life cycle. In addition, it also stipulated that children under 18 years are not allowed to be employed during project life cycle and therefore, this law requires to be complied with.

2.5 Relevant Environmental and Natural Resources Sector (Brief outlines of some regulations)

The Environment Court Act, 2010

35. The Environment Court Act, 2010 provides for the establishment of environment courts and matters incidental thereto. This act also provides the jurisdictions of environment court, penalty for violating court's order, trial procedure in special magistrate's court, power of entry and search, procedure for investigation, procedure and power of environment court, authority of environment court to inspect, appeal procedure and formation of environment appeal court.

Environmental Conservation Act (1995, amended in 2010), and Environmental Conservation Rules (1997, amended in 2010)

36. The Environmental Conservation Act (ECA), 1995, is the primary legislative instrument regulating environmental protection and impact assessment in Bangladesh. This Act is promulgated for environmental conservation, environmental standards development and environment pollution control and abatement.

37. The main objectives of the ECA (1995) are:

- Conservation and improvement of the environment; and
- Control and mitigation of the pollution of the environment.

38. The main strategies of the Act can be summarized as:

- Providing appropriate organizational structure and regulatory powers to the Department of Environment to monitor environmental issues, and enforce control measures where appropriate;
- Declaration of ecologically critical areas and restriction on the operations and processes, which can or cannot be carried out / initiated within these;
- Promulgation of standards for quality of air, water, noise and soil for various applications;
- Regulation of allowable vehicle emissions;
- Regulatory responsibility for the environmental clearance process for new and existing project and developments;
- Regulation of discharge limits and discharge permits for industries and other developments;
- Promulgation of a standard limit for discharging and emitting waste; and
- Formulation and declaration of environmental guidelines for key issues.

39. The Department of Environment (DoE) executes the Act under the leadership of the Director General (DG). As stipulated under the ECA (1995), the Project proponent must obtain Environmental Clearance from the DG of DoE before any new project can be setup and operated. An appeal procedure exists for those proponents who fail to obtain clearance. The proposed project shall not be allowed to conduct any activities restricted in the Govt. notification related to Ecologically Critical Area (ECA), and the Sundarbans Reserve Forest (heritage).

The Environmental Conservation Act (Amendment 2000)

40. The Bangladesh Environment Conservation Act (Amendment 2000) focuses on ascertaining responsibility for compensation in cases of damage to ecosystems. It allows for increased provision of punitive measures both for fines and imprisonment, and the authority for nominated officials to record the details of alleged offences and to prosecute the offenders.

The Environmental Conservation Act (Amendment 2002)

41. The 2002 Amendment of the Environmental Conservation Act, elaborates on the following parts of the Act:

- Restrictions on automobile emissions;
- Restrictions on the sale and production of environmentally harmful items like polythene bags;
- Assistance from law enforcement agencies for environmental actions; and
- Authority to try environmental cases in court (also supported by the *Environmental Court Act, 2000*).

42. The proposed Project will be undertaken in line with the aims and objectives of the Act by managing potential impacts throughout all phases.

ECA-2010-Bangladesh Environmental Conservation Act (ECA), Amendments in 2010

43. The ECA 1995 was amended in 2010, which provided clarification of defining wetlands and Ecologically Critical Areas as well and included many important environmental concerns such as conservation wetlands, hill cutting, ship breaking, and hazardous waste disposal. This amendment empowered the government to enforce more penalties than before. Moreover, affected persons were given provision for putting objections or taking legal actions against the polluters or any entity creating nuisance for affected person.

Environmental Conservation Rules (ECR), 1997 and Amendments

44. The Environmental Conservation Rules (ECR) and related (amendments) is a set of rules, promulgated under the Environmental Conservation Act, which specifies environmental approvals processes for various project types and provides allowable limits for environmental disturbance or pollutive discharge / emissions. The Environment Conservation Rules (1997) and related (amendments) provides categorization of industries and projects and identifies types of environmental assessments required against respective categories of industries or projects. The rules set:

- The National Environmental Quality Standards for ambient air, various types of water, industrial effluent, emission, noise, vehicular exhaust etc.;
- The requirement for, and procedures to obtain, Environmental Clearance; and
- The requirement for IEE / EIAs according to categories of industrial and other development interventions.

45. The Rules covered to follow all ECC conditions throughout the project life cycle.

Draft Environmental Conservation Rules (ECR), 2017

46. The Environmental Conservation Rules (ECR), 2017 is in draft stage, which revises the categorization of Project Class and requirements for implementation and operation, modifies standards of different criteria pollutants, adds eligibility criteria and specification of individual expert, individual agency, etc.

Noise Pollution Control Rules (2006)

47. The act gives the authority to all the Union Councils, Paurasabhas, City Corporations, City Development Authority to mark off the areas under their jurisdiction as silent, residential, mixed, commercial or industrial. They should also put signs to mark those areas.

48. The act describes the approved standard limit of sound in the added schedule 1 and 2 (as described in **Annex 2-1**). In the Schedule 1, silent area means area up-to a radius of 100 meters around hospitals or educational institutions or special institutions/ establishments identified/to be identified by the government. In the silent area it is prohibited to use any kind of horns of vehicles, audio signals and loudspeakers. According to this act, daytime is counted from 6am to 9pm whereas night is considered from 9.00 pm to 6.00am.

49. According to noise pollution (control) amendment 2006, use of pneumatic horn/hydraulic horn/multi-tuned horn in any kind of vehicle is banned.

50. As the proposed project has provision of creating noise pollution in the surface and under water, hence this act is applicable.

Water Act-2013

51. The Act declares all form of water within the territory of Bangladesh as the property of the government. The Act requires permit/license for withdrawing large scale of surface or groundwater. Prevention of transboundary water pollution is also discoursed in the act. In this regard, combined survey, study and research on the international rivers and activities to prevent chemical and biological pollutant are suggested.

52. According to the Act, there will be a National Water Council to be chaired by the Honorable Prime Minister. This Committee will consist of 11 ministries, representatives from department in concerns and nominated national experts, who will formulate relevant policies and guidelines for integrated development, sustainable use, equitable distribution and conservation of water resources. An executive committee will work under the commission. According to this act, for regulating and controlling water pollution, the provisions of Bangladesh Environment Conservation Act, 1995 and ECR (1997) would be applicable. As the proposed project has provision of creating pollution in the water ways, hence this act is applicable.

The Forest Act, 1927 (and all amendments)

53. The proposed ROW of coal transportation route falls within the ECA of the Sundarbans Forest. Therefore, it is pertinent to review forest related laws and by-laws of the country to identify possible conflicts among the proposed project interventions and rule of law. The Forest Act, 1927 is the first and omnibus law of the land on forestry. It provides for reserving forests over which the Government has an acquired property right.

54. Under the Forest Act, the Sundarbans is declared as Reserve forest where many activities are prohibited which includes hunting, shooting, fishing, poisoning water or setting traps or snares; trespassing, etc.

55. In addition, the activities which cause damage/adversely impact on biodiversity, forest resources, wildlife, fisheries and other aquatic resources are also prohibited by the law.

56. Moreover, according to the Act, the Government (Forest Department) can also prohibit certain activities in the declared Reserved Forest Area such as any intervention kindles, keeps or carries any fire; causes any damage by negligence in felling any tree or cutting or dragging any timber; etc. The Forest Act also stipulated that any activity within the forest reserves is prohibited, unless permitted by the Forest Department.

57. Therefore, the proposed intervention shall not carry out any such activities that may cause damage or adversely impact on the natural resources including wildlife of the Sundarbans Reserve Forest as well.

58. The proposed interventions particularly ROW of the coal transportation route of the project will overlap ECA and World Heritage of the Sundarbans as well. Hence, any kind of violation of this legislation is essentially needed to be avoided.

Ecologically Critical Area Management Rules- 2016

59. The Ecologically Critical Area Management Rule, 2016 has enabled the government to form a “National Committee” headed by the Secretary, Ministry of Environment and Forest (MoEF). The Committee being convinced *Suo moto* or based on information from other source(s), if convinced an area is Environmentally Critical it can recommend Government to declare an area Environmentally Critical Area.

60. To implement the decision of the Directorate, District and Upazila committee may be formed. For conservation and development of the ecologically critical area one or more team may be formed. The responsibility of the team would be to implement the decision and planning of Government to improve the Environment for the Ecology.

61. The Rule also prohibited many activities and processes which are detrimental to the natural condition of habitat, tranquility, biodiversity, etc.

Biodiversity Act- 2017

62. The Biodiversity Act, 2017 has enabled the government to form a “National Committee on Biodiversity” headed by respective Minister/State Minister. The functions of the committee is to conserve biodiversity, genetical biodiversity, identification of biodiversity related important area, heritage, etc.

Wildlife Act- 2012

63. The Wildlife Act of 2012 has enabled the government to form a “Wildlife Advisory Board” comprising experts. The Board will assess present condition and give direction from time to time in relation to development and management of biodiversity, wildlife and forest. The Act has empowered the government to declare any area as sanctuary, community conservation area, Safari Park, Eco Park, Botanical Garden, Wildlife Reproduction Center, landscape zone, buffer zone, core zone in relation to wildlife and plant preservation, protection and their smooth growth.

64. The Act also prohibited many activities including establishing or undertaking of any industrial activities, disturbing or threatening any wildlife, or using chemicals, explosives or any other weapon or substances which may destroy wildlife habitat; and any activity that poses threat to the values of the property of the Sundarbans World Heritage.

The Protection and Conservation of Fish Act (1950) and Fish Rules (1985)

65. This Act aims to conserve and manage the country's fisheries resources in a sustainable and environmentally-responsible manner. The major issues which are regulated by this act and associated rules are:

- Ban on the use of certain fishing equipment and techniques (e.g. dynamite fishing), and regulation for others (e.g. mesh size restrictions for some types of nets);
 - Restriction on catch size for certain species;
 - Seasonal fishing closure in certain areas;
 - Regulation of certain activities which may cause pollution of water bodies;
 - Regulation of activities which may obstruct water courses; and
- Establishment of fish sanctuaries and provision of rules for managing these areas.

66. This Act will primarily have relevance to the proposed dredging activities. All dredging works will need to be carried out in a manner which limits potential impacts on fisheries resources, and provides fishermen a reasonable level of access to these areas. However, any of the activities including dredging activities for commercial purposes within ECA are prohibited by national regulations.

2.5.1 Pollution discharge management related legal framework

67. The proposed project has provision of pollution impact during routine coal transportation operations and also due to accidental events, hence applicable all legal instruments applicable in such case will be applied. Some of these legal instruments in connection to the anticipated pollutions are briefly described below (**Table-2-2**).

Table 2-2: Environmental pollution issues and related legal instruments

Environmental pollution issues	Legal instruments	Remarks
<p>i. Expected pollutions from the project are: gaseous emissions, noise, liquid and solid waste discharges.</p> <p>ii. Under water noise will have impact on the prey of aquatic threatened species.</p> <p>iii. Liquid and solid waste discharges to the surrounding environment may ultimately impact natural resources within the ECA</p> <p>iv. Accidental events or unplanned events (which are currently occurring during 2015-2016) may create catastrophic condition and cause damage/degradation of the ECA.</p>	<p>-ECA (1995) and ECR (1997) including related all amendments</p> <p>-Noise Pollution control Rules (2006)</p> <p>-Forest Act (1927) and all amendments</p> <p>-Wild life Act (2012)</p> <p>-Relevant WB guidelines in case of unavailability of GoB standards</p>	<p>-The schedules- 2 to 11 of the ECR (1997) have been established to regulate uncontrolled emissions and discharges</p> <p>-Schedule of Noise Pollution control Rules (2006) and details are shown in Annex 2-1.</p> <p>-However, in case of unavailability of GoB regulations, WB guidelines will be adhered to, and relevant WBG guideline values will be adhered.</p> <p>-In addition, in case of unavailability of any specific standards, applicable international stringent standards will be adopted.</p>

2.5.2 Legal bindings for protection of Ecologically Critical Areas and the Sundarbans World Heritage sites

68. Under this Section 5 (1) of the Environment Conservation Act 1995, the Ministry of Environment and Forest through an Official Gazette Notification on 30-08-1999 declared 10 km band of landward periphery area as an Ecological Critical Area. Upon declaring Ecologically Critical Area, all activities except those permitted by the law are prohibited in the specified area. In this regard, some of the activities or processes, which cannot be initiated or continued in an ECA, include any industrial establishment causing pollution of soil, water, air quality and noise level; felling or collecting trees; hunting, catching or killing wild animal; fishing and other activities those are harmful for aquatic life; polluting water by disposing waste; and any other activity that could destroy or change the natural characteristics of soil and water.

69. In addition, Wildlife Act-2012, under section-13 preserve the capacity for declaration of sanctuary as per Sub-section-1 and further under Sub-section-2 any declared sanctuary may be called as wildlife sanctuary, bird sanctuary, elephant sanctuary or wetland dependent animal sanctuary or, as the case may be, marine protected area.

70. And further to that, Section-14 of the same law has preserved the right for Prohibitions related to sanctuary and accordingly under Sub-section–(1) activities that are prohibited include many but some of these are: In a sanctuary, no person shall –

- establish or undertake any industrial operation;
- harvest, destroy or collect any plant;
- set any kind of fire;
- disturb or threat any wildlife, or use chemicals, explosives or any other weapon or substances which may destroy wildlife habitat;
- Introduce any exotic animal or plant;
- dump any materials detrimental to wildlife;
- fell any plant or part thereof except silvicultural operations required for natural regeneration of plants; (l) divert, stop or pollute watercourse; or introduce any alien and invasive plant species.

71. Subsection-(2) stated that notwithstanding anything contained in Sub-section (1), after the commencement of this Act, no person, institution or company shall establish or operate any industrial factory or brick-field within 2 (two) kilometers from the boundary of a sanctuary.

72. Further to that section-15 under sub-section-1 has stipulated that (1) No person shall enter or reside in a sanctuary, except permitted by the law.

73. The other conservation laws with provisions of protecting wildlife and fishes and their habitats include Forest Act, 1927 (and all amendments), The Protection and Conservation of Fish Act-1950 etc.

74. In circumstances where any proposed project is located within a legally protected and internationally recognized areas, the proponent shall demonstrate that the proposed development in such areas is legally permitted and in case of World Heritage, shall be internationally accepted as well.

75. The proposed coal transportation project proposes to utilize transportation route through ECA and also overlaps World Heritage sites having possibility of potential threat to the critical habitat/heritage, hence necessary to avoid such plan and use alternatives avoiding ECA/heritage and subsequently future legal obligations for noncompliance. As under the convention of World Heritage, Bangladesh is obligated not only to conserve the World Heritage Sites but also protect its national heritage as well. In regards with value assessment of the Property, Strategic Environmental Assessment (SEA) considering the Outstanding Universal Value (OUV) of the Property is being taken up by the MoEF, Government of Bangladesh. It is understood that the Govt. of Bangladesh will take appropriate actions in line with the findings of SEA study on OUV of WHS.

2.6 Environmental and Energy Policy Guidance (Brief outlines of some policies)

76. Under the study a number of sectoral national policies have been reviewed to identify the guiding principles which are relevant to the coal based thermal power plant installation, operation and maintenance activities. The sectoral policies will include energy, environment, water, forest, transport, import and fisheries.

2.6.1 National Environment Policy-1992

77. The National Environment Policy of 1992 sets out the basic framework for environmental action, together with a set of broad sectoral action guidelines. The Policy provides the broader framework of sustainable development in the country. It also stated all major undertakings, which will have a bearing on the environment; (including setting up of an industrial establishment) must undertake an IEE and EIA as required before they initiate the project.

78. The Policy delineates DoE, as the approving agency for all such IEE and EIA's to be undertaken in the country. The policy guidelines of fifteen sectors are stated in the Policy. Under the 'energy and fuel sector' (section 3.4), the use of environmentally sound and less harmful fuel has been encouraged in Section 3.4.1. Section 3.4.5 provides, 'Conservation of country's fossil fuel reserve and renewable sources of energy'. And section 3.4.6 provides that EIA should be conducted before implementation of projects for extraction of fuel and mineral resources.

79. Under the Environmental Action Plan Section of the Policy and sub-section 'Fuel and Energy' provides that:

- Section 4.2 "In the rural areas the use of gas, coal, kerosene and petrol as fuel will be expanded, so that fuel wood, agricultural residues and cow dung are conserved. This will help the use of agricultural residues, and cow dung etc. as manure"
- Section 4.7 "Appropriate measures will be taken to ensure that extraction, distribution and use of natural resources such as oil, gas, coal, peat etc. do not adversely affect air, water, land, the hydrological balance and the ecosystem".
- Section 3: 'Forest, wildlife and biodiversity' directs the followings:
 - Conserve wildlife and biodiversity, strengthen related research and help dissemination and exchange of knowledge in these areas; and
 - Conserve and develop wetlands and protection of migratory birds.

2.6.2 Power System Master Plan, 2010

80. The main objective of this study is to formulate a Master Plan for the attainment of stable power supply in the People's Republic of Bangladesh up to year 2030 in consideration of the diversification of fuel resources, including an optimum power development plan, power system plan, and identification of the potential power plant sites based on the fuel diversification study. Therefore, this study includes a comprehensive power development master plan where the study of the fundamental conditions of the development (demand forecast, procurement of primary energy resources, optimum power development plan, future optimum power supply structure including the positioning of gas-fired power plants, and so on) are added.

81. The power sector was heavily dependent on gas. Even two/three years back almost 90% of the electricity used to be generated from the natural gas of the country and rest by hydro electricity and coal. The power sector master plan 2010 has stressed on diversification of the fuel such as natural gas, coal, furnace oil, diesel etc as well as renewable energy sources. In this Master Plan, the target composition of power supply as of 2030 is set at 50% for domestic and imported coal, 25% for domestic and imported (in the form of LNG) natural gas and 25% for other sources such as oil, nuclear power and renewable energy.

2.6.3 National Environment Management Action Plan, 1995

82. The National Environment Management Action Plan (NEMAP) is a wide ranging and multi-faceted plan, which builds on and extends the statements set out in the National Environment Policy (NEP). NEMAP was developed to address issues and management requirements for a period between 1995 and 2005 and set out the framework within which the recommendations of the National Conservation Strategy (NCS) are to be implemented.

83. NEMAP has the following broad objectives:

- Identification of key environmental issues affecting Bangladesh;
- Identification of actions necessary to halt or reduce the rate of environmental degradation;
- Improvement of the natural and built environment;
- Conservation of habitats and biodiversity;
- Promotion of sustainable development; and
- Improvement in the quality of life of the people

84. One of the key issues in NEMAP regarding the energy sector is “energy conservation awareness is generally low throughout the country”. However, the policy focuses on the precaution for control of environmental degradation and conservation of the biodiversity.

The National Forest Policy, 1994

85. The National Forestry Policy of 1994 is the revised version of the National Forest Policy of 1977 in the light of the National Forestry Master Plan. The major targets of the Policy are to conserve the existing forest areas; manage protected areas, bring about 20% of the country's land area under the afforestation program, and increase the reserve forestland by 10% by the year 2015 through coordinated efforts of GO-NGOs and active participation of the people.

86. The priority protection areas are the habitats which encompass representative flora and fauna in the core area of national parks, wildlife sanctuaries, and game reserves. Multiple-use of forest, water and fish of the Sundarbans through sustained management will be ensured, keeping the bio-environment of the area intact.

87. The need of amendments of the existing forestry sector related laws and adoption of new laws for sectoral activities have been recognized as important conditions for achieving the policy goals and objectives. The Forest Policy also recognizes the importance of fulfilling the responsibilities and commitments under international multilateral environmental agreements.

The National Energy Policy, 1995

88. The National Energy Policy provides for utilization of energy for sustainable economic growth, supply to different zones of the country, development of the indigenous energy sources and environmentally sound sustainable energy development programs. The Policy highlights the importance of protecting the environment by requiring an EIA for any new energy development project, introduction of economically viable and environment friendly technology.

89. One (Section 1.2) of the seven objectives addresses the environment and states, "(vi) to ensure environmentally sound sustainable energy development programs causing minimum damage to the environment".

90. The seven specific policy recommendations are listed under Chapter 1.9. Of those, the following three are relevant to the present project:

- EIA should be made mandatory and should constitute an integral part of any new energy development project;
- Use of economically viable environment friendly technology is to be promoted; and
- Public awareness is to be promoted regarding environmental conservation.

The National Water Policy, 1999

91. The National Water Policy of 1999 was adopted to ensure efficient and equitable management of water resources, proper harnessing and development of surface and ground water, availability of water to all concerned and institutional capacity building for water resource management. It has also addressed issues like river basin management, water rights and allocation, public and private investment, water supply and sanitation and water needs for agriculture, industry, fisheries, wildlife, navigation, recreation, environment, preservation of wetlands, etc.

92. It provides the framework for the management of water resources of the country in a comprehensive, integrated and equitable manner. The policy recognizes that water is essential for human survival, socio-economic development of the country, and preservation of its natural environment. It is vital that the continued development and management of the nation's water resources should include the protection, restoration, and preservation of the environment and its bio-diversity.

93. The Policy states that excessive water salinity in the southwest region is a major deterrent to industrial growth. In addition, pollution of both surface and groundwater around various industrial centers of the country due to untreated effluent discharge into water bodies

is a critical water management issue. The Policy suggests that the following matters should be considered:

- a. Zoning regulations will be established for location of new industries in consideration of fresh and safe water availability and effluent discharge possibilities;
- b. Effluent disposal will be monitored by relevant Government agencies to prevent water pollution;
- c. Standards of effluent disposal into common watercourses will be set by WARPO in consultation with DoE;
- d. Industrial polluters will be required under law to pay for the cleanup of any water-body polluted by them.

National Fisheries Policy, 1998

94. The National Fisheries Policy provides the framework for the conservation and management of fisheries resources to ensure supply and enhance production. All the water bodies suitable for fisheries production and their fisheries resources conservation, development and management are addressed under this policy. These include rivers and canals, haor and baor, floodplains, open and coastal water systems.

Wetland Policy, 1998

95. The Policy is relevant to the Project because the proposed project has the provision of transportation of coal at the close vicinity of the Sundarbans Ramsar and may pose threat due to routine and unplanned event. In addition, the policy seeks to conserve wetlands to sustain their ecological and socio-economic functions and further sustainable development; establish key principles for wetland sustainability and unsustainable practices; maintain existing levels of biodiversity; maintain wetland functions and values; and actively promote integration of wetland functions in resources management and economic development decision taking.

2.7 Port and Water Ways Transportation Sector (Brief outlines of some laws)

Ports Act, 1908

96. The Ports Act 1908 was adopted to consolidate the enactments relating to Ports and port charges. The administering authority is the Ministry of Shipping. Subject to this Act, a Conservator is appointed to each port. Currently, the Mongla Port's Harbor Master is acting as Conservator of Mongla Port and administers the provisions of the Act for the Port.

97. Specific environmental management provisions of the Act are given under s.21 (1) which prohibits the discharge of ballast, rubbish and oil into any port or adjacent areas. Under s.31 of the Act, the movement of vessels of 200 tons or more cannot enter, leave or be moved within any port without having a pilot on board. In addition, no vessel of more than 100 tones is to enter, leave or be moved within any port without having a pilot, unless authority to do so has been given in writing. The lawful use of infrastructure such as piers and moorings, and ensuring navigable waters are not obstructed is detailed under s.10, whereas s.21 prohibits interference with buoys, beacons and moorings. Unless permission has been granted by the Conservator, any action that causes or may cause injury to the bank or shore is prohibited under s.30 (1). Therefore, the proposed project activities are to be conducted following the guidelines of this act.

Mongla Port Authority Ordinance, 1976

98. The Mongla Port Authority (MPA) Ordinance 1976, under the Ministry of Shipping, Government People's Republic of Bangladesh established the MPA. The Ordinance provides the MPA with the authority, function and jurisdiction over docks (wharves, warehouses, railways, piers, bridges, and other works) and vessels (including any ship, barge, boat, or raft designed or used for the transport by water of passengers or goods) within the port limits. The MPA also has authority to reclaim or excavate any part of the bank or bed of the river, to construct, maintain and operate dredgers and appliances for clearing, deepening and improving the bed of the river, and to construct, maintain and operate all means and appliances for berthing, loading and discharging vessels. The MPA's authority also extends to improvements made to the land and riverbank of its existing Port at Khulna (Roosevelt Jetty).

99. The MPA also has the authority to issue fines for the pollution of water or environment by throwing or allowing into the water, bank or land, any goods, ballast, ashes or any other material that leads to pollution.

The Dangerous Cargoes Act, 1953

100. The Dangerous Cargoes Act, 1953 was enacted to provide provisions related to the safety of ports in respect of the transit, working and storage of dangerous cargoes. Relevant provisions include s.3 (which deals with explosives and fires on vessels), s.6 (safety of vessels imports) and s.9 (enforcement). The concerned authority is the Deputy Conservator of the Port, Board of Trade or the Ministry of Communication and the Chief of Naval Staff. As the proposed coal transportation project involves in transportation of primary fuel and may pose threat due to unplanned event, therefore, this act is applicable.

2.8 Administrative and land acquisition sector (Brief outlines of some laws)

The Penal Code, 1860

101. The Penal Code of 1860 has some valid provisions related to pollution management, environment protection and protection of health and safety. Chapter XIV of the Penal Code provides offences affective public health, safety, convenience, decency and morals: Section 277: Falling Water or Public Spring or Reservoir; Section 278: Making Atmosphere Noxious to Health; Section 284: Negligent Conduct with Respect to Poisonous Substance; Section 285: Negligent Conduct with Respect to Fire or Combustible Matter; and Section 286: Negligent Conduct with Respect to Explosive Substance.

102. According to the Section 277, whoever voluntarily corrupts or fouls the water of any public spring or reservoir, to render it less fit for the purpose for which it is ordinarily used will be punished under the law.

103. According to the Section 278 whoever voluntarily vitiates the atmosphere in any place so as to make it noxious to the health of persons in general dwelling or carrying on business in the neighborhood or passing along a public way will get punishment.

104. The proposed transportation project is expected to have potential impact on the surrounding environment and life, hence this law is applicable.

The Acquisition and Requisition of Immovable Property Ordinance, 1982

105. The Ordinance has well-defined procedures regarding acquisition of the property and also payment of compensation for an acquired piece of land, provided that no property used

by the public for the purposes of religious workshop, graveyard and cremation site or crematory shall be acquired.

106. However, this regulation is applicable for this project due to requirement of acquiring of land for disposal of dredged materials in designated locations particularly during capital and maintenance dredging for carrying out transportation activities along the proposed ROW of transportation route.

2.9 Health and safety sector (Brief outlines of some laws)

The Fatal Accidents Act, 1855

107. An Act to provide compensation to families for loss occasioned by the death of a person caused by actionable wrong. It is mentioned in s.1, whenever the death of a person shall be caused by wrongful act, neglect or default, and the act, neglect or default is such as would (if death had not ensued) have entitled the party injured to maintain an action and recover damages in respect thereof, the party who would have been liable if death had not ensued shall be liable to an action or suit for damages, notwithstanding the death of the person injured, and although the death shall have been caused under such circumstances as amount in law to felony or other crime. The proposed project has possibilities of unplanned accidental event during project life cycle; hence this law is applicable.

Fire prevention and extinguish Act, 2003

108. The Act states to obtain license from Director General of Fire Services in case of any ware house. The proposed project activities expected to store large quantities of coal in a yard and may cause accidental fire; hence this regulation will be applicable.

The Explosives Act, 1884

109. Section-5 under Clause-1 states that the Government may for any part of Bangladesh, make rules consistent with this Act to regulate or prohibit, except under and in accordance with the conditions of a license granted as provided by those rules, the manufacture, possession, use, sale, transport and importation of explosives or any specified class of explosives.

110. Section-6 and Sub-section-3 stipulated that any person manufacturing, possessing, using, selling, transporting or importing an explosive in contravention of a notification issued shall be punishable with imprisonment for a term which may extend to ten years and shall not be less than two years and also with a fine which may extend to fifty thousand Taka, in default of which with a further imprisonment for a term which may extend to one year, and in the case of importation by water or land, the owner and master of the vessel or carriage in which the explosive is imported shall, in the absence of reasonable excuse, each be punishable with imprisonment for a term which may extend to ten years and shall not be less than two years and also with a fine with a further imprisonment for a term which may extend to one year. Since the proposed project activities involve in carrying coal, in that case this law appears to be applicable.

2.10 Relevant International Legal Obligation

111. It has been noted that Bangladesh has already accessed, ratified or signed a number of important multilateral environmental agreements (MEAs) related to environment protection and conservation of natural resources which shall have to be complied with during

implementation of the project. The pertinent ones of these are highlighted in **Table 2-3** below:

Table 2-3: Relevant Environment related International Convention and Treaties

Sector	International Convention and Treaties	Status and Remarks
Environment and biodiversity	<p>Convention on Wetlands of International Importance ("Ramsar 1971").</p> <p>Convention on the Conservation of Migratory species of wild Animals (Bonn 1979)</p> <p>Vienna Convention for the Protection of the Ozone Layer (Vienna, 1985) and Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal, 1997)</p> <p>United Nations framework convention on climate change-1992</p> <p>Convention on International Trade in Endangered Species of Wild Fauna and flora (Washington, 1973.) ("CITES Convention")</p> <p>Convention on Biological Diversity, (Rio De Janeiro, 1992.)</p> <p>Convention on persistent Organic Pollutants, Stockholm</p> <p>Basal Convention on the control of Transboundary Movements of Hazards wastes and their disposal (1989)</p>	<p>21-9-1992 (ratified)-Applicable as the subject project ROW has the likeliness of creating impact on the Sundarbans Ramsar</p> <p>1-12-2005 (ratified)-Applicable as the proposed project route passes through the Sundarbans ECA and overlaps WHS, hence it may have likeliness of potential impact on biodiversity within ECA and heritage as well</p> <p>02.08.90 (ratified). Not directly applicable. However, use of any ODS could have impact on ozone layer depletion which ultimately would affect plankton and food chain</p> <p>Applicable-as the proposed project has likeliness of fugitive emission of Green House Gas (GHG) and requires compliance of this convention.</p> <p>20-11-1981 (ratified)-Applicable as the subject project passes through ECA and overlaps WHS and likeliness to have impact on the wildlife, hence require to comply with this convention.</p> <p>23.5.2001 (signed) 3-5-1994 (ratified)-Applicable- as the proposed project has likeliness of potential impact on the biodiversity of the Sundarbans ECA and WHS.</p> <p>20 March, 1994 (ratified). Not directly applicable. However, the presence of any of listed materials/chemicals will be prohibited during project life cycle based on the guidelines.</p> <p>1-4-1993 (ratified). Applicable -as the proposed project has provision of carrying hazardous material. Hence, this convention is to be complied with.</p>
Marine/sea	United Nations Convention on the Law of the Sea (Montego Bay, 1982.)	10.12.82 (ratified). Applicable- as the guidelines related to the conservation of the marine environment and natural resource.
Cultural and natural Heritage	Convention Concerning the Protection of the World Cultural and Natural Heritage (1972)	03.08.83 (accepted). Applicable- as the proposed project ROW overlaps World Heritage Site and has the likeliness of potential impact due to routine and unlikely event during project activities causing degradation of Outstanding Universal Values (OUV) of the World Heritage.

Rio Declaration on Environment and Development, 1992

112. Rio declaration on Environment and Development adopted the global action program for sustainable development called 'Rio Declaration' and 'Agenda 21'.

113. Principle 4 of the Rio Declaration, 1992, to which Bangladesh is a signatory along with a total of 178 countries, states, "In order to achieve sustainable development, environmental protection should constitute an integral part of the development process and cannot be considered in isolation from it". The proposed coal transportation project route expected to pose threat to the surrounding ECA and heritage; hence Principal -4 of the Rio declaration is applicable for this project and therefore, alternative route shall be considered avoiding the Sundarbans ECA and heritage.

Convention on Biological Diversity, 1992

114. The Convention on Biological Diversity, Rio de Janeiro, 1992 was adopted on 5 June 1992 and came into force on 29 December, 1993. Bangladesh ratified the Convention on 20 March, 1994. The Contracting Parties of the Convention have committed to:

- Introducing appropriate procedures requiring environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biodiversity, with a view to avoiding or minimizing such effects, and where appropriate allow for public participation in such procedures; and
- Introducing appropriate arrangements to ensure that environmental consequences of its programs and policies, that are likely to have significant adverse impacts on biodiversity, are duly taken into account.

115. Obligation has been placed on State parties to provide for environmental impact assessments of projects that are likely to have significant adverse effects on biological diversity (Art. 14).

116. The proposed coal transportation route and related activities along the close proximity of ECA and also across ECA and also overlapping WHS content/property will pose threat to the IUCN Red Listed aquatic species and their prey including other terrestrial endangered species located within the Sundarbans ECA and heritage area. This is to be noted that a biodiversity offset of a large number of aquatic and terrestrial species, particularly some IUCN listed species currently existing in the complex naturally occurring ecosystem having OUV in the ECA/heritage area is not possible and therefore, this convention is applicable for this project. In addition, as per this convention, Bangladesh is obligated for avoidance of any such expected impact on the biodiversity within and around ECA including heritage area for protection of these valuable biodiversity.

Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar, 1971

117. This convention is also known as the Ramsar Convention. It was adopted 2 February, 1971 and came into force on 21 December, 1975. Bangladesh has ratified the Convention 20 April, 2002. This provides a framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. There are 127 Parties with 1085 wetland sites designated as Wetlands of International Importance'.

118. This is an intergovernmental treaty, which provides the framework for international co-operation for the conservation of wetlands habitats. Obligations for Contracting Parties

include the designation of wetlands to the “List of Wetlands of International Importance”, the provision of wetland considerations within their national land use planning, and the creation of Natural Reserves. Part of the Sundarbans Reserved Forest (Southwest of Bangladesh) is one of the Ramsar sites.

119. The Convention focuses on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) to stem the progressive encroachment on and loss of Wetlands now and in the future, recognizing the fundamental ecological functions of wetlands and their economic, cultural, scientific and recreational value.

120. The proposed coal transportation route and related activities will pose threat or potential environmental impact on the Sundarbans Ramsar due to routine activities and unplanned event hence, this convention is applicable for this project.

United Nations Convention on the Law of the Sea, Montego Bay, 1982

121. This Convention was adopted on 10 December 1982 at Montego Bay, Jamaica. Bangladesh has ratified this Convention. Main objectives of the convention are:

- To set up a comprehensive new legal regime for the sea and oceans, as far as environmental provisions are concerned, to establish material rules concerning environmental standards as well as enforcement provisions dealing with pollution of the marine environment; and
- To establish basic environmental protection principles and rules on global and regional cooperation, technical assistance, monitoring, and environmental assessment, and adoption and enforcement of international rules and standards and national legislation with respect to all sources of marine pollution.

122. The proposed coal transportation route and related activities will poses threat due to routine and unplanned accidental event and subsequently create marine pollution in the marine and adjacent riverine habitat and hence, this convention is applicable.

UNESCO World Heritage Convention, 1972

123. This convention has been ratified by 175 states including Bangladesh. This defines and conserves the world’s heritage by drawing up a list of natural and cultural sites whose outstanding values should be preserved for all humanity. The Convention sets out the duties of States Parties in identifying potential sites and their role in protecting and preserving them. By signing the Convention, each country pledges to conserve not only the World Heritage sites situated on its territory, but also to protect its national heritage. The States Parties are encouraged to integrate the protection of the cultural and natural heritage into regional planning programmes, set up staff and services at their sites, undertake scientific and technical conservation research and adopt measures which give this heritage a function in the day-to-day life of the community.

124. The purpose of the Convention Concerning the Protection of the World Cultural and Natural Heritage is to establish an effective system of collective protection of the cultural and natural heritage of outstanding universal value, organized on a permanent basis and in accordance with modern scientific methods. The Sundarbans is declared as the World Heritage Site. Therefore, the provisions of this convention regarding protection of World Heritage Site are very much relevant for the proposed intervention.

125. The proposed interventions particularly coal transportation route will follow the designated and established navigation route of the MPA, which passes through the protected area (SRF) and along side the World Heritage Site (WHS). The related activities of the coal transportation will also follow the defined anchorage points of the MPA on the same route by maintaining the rules and regulations of the MPA and IMO. Even though, unplanned or accidental events related to coal transportation may create high risk of catastrophic condition. It would be caused damage and degradation of the SRF including its integrity and also OUV of World Heritage resulting into noncompliance of both national and international legal obligations. Hence, proper precautions/contingency measures should be taken for any kind of accidental event which may cause violations of these legislations.

United Nations Framework Convention on Climate Change, 1992

126. The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. The Parties should protect the climate system for the benefit of present and future generations of humankind, on the basis of equity and in accordance with their common but differentiated responsibilities and respective capabilities.

127. Bangladesh is a signatory to the Protocol and thus the Project is being undertaken in line with the Bangladesh Government's strategies for greenhouse gas planning for the country. As the proposed coal transportation project has the provision of greenhouse gas emission (fugitive as well), hence this convention is applicable.

2.10.1 International Maritime Conventions, Protocols and Agreements applicable for coal transportation

128. The International Maritime Organization (IMO) came into existence in 1958 but before that, several important international conventions had already been developed including the International Convention for the Safety of Life at Sea of 1948, the International Convention for the Prevention of Pollution of the Sea by Oil of 1954 and treaties dealing with load lines and the prevention of collisions at sea. However, IMO was made responsible for ensuring that the majority of these conventions were kept up to date. It was also given the task of developing new conventions as and when required. Bangladesh is signatory of the IMO and therefore, all activities relating to shipment of coal through the Port shall have to be done strictly in compliance with the standards set by the IMO, particularly the conventions, protocols and agreements.

129. The Conventions/Protocols relevant for the proposed project and agreed by GOB are highlighted in **Table 2-4** below:

Table 2-4: International maritime conventions, protocols and agreements relevant to the project

Items/issues	Conventions, protocols and agreements	Remarks
Maritime safety	<ul style="list-style-type: none"> International Convention for the Safety of Life at Sea (SOLAS), 1960 and 1974 (and all other amendments which include IMSBC code to create an amendments to SOLAS chapter-VI and to make the code mandatory and adopted by maritime safety committee in 2008). 	Applicable-as safety and pollution issues are addressed. In addition, the IMSBC code categorizes coal carrying cargos as under both group "A and B" and accordingly shall follow all stipulated guidelines under this code.
	<ul style="list-style-type: none"> International Convention on Load Lines (LL), 1966 (and all amendments) 	Applicable-as limitation of draft and load issues are addressed for safety of the ship.
	<ul style="list-style-type: none"> Convention on the International Regulations for Preventing Collisions at Sea (COLREG), 1972 (including all amendments) 	Applicable-as the convention provided guidelines for avoidance of collisions and also vessels involved in dredging activities shall have specific guidelines as well.
	<ul style="list-style-type: none"> International Convention for Safe Containers (CSC), 1972 (and all amendments) 	Applicable-as it provided guidelines for high level safety of containers to avoid incidents.
	<ul style="list-style-type: none"> Convention on the International Maritime Satellite Organization (INMARSAT), 1976 (and all amendments) 	Applicable- as it is related to guidance of maritime communication and safety at sea.
	<ul style="list-style-type: none"> International Convention on Maritime Search and Rescue (SAR), 1979 	Applicable- as search and rescue plan (SARP) through cooperation with relevant government are addressed.
Solid Bulk Cargo Requirements	<ul style="list-style-type: none"> International Maritime Solid Bulk Cargoes Code (IMSBC) 	<p>All vessels carrying solid bulk cargoes are already required to comply with the IMSBC Code. The IMSBC Code classifies solid cargoes into three categories:</p> <ul style="list-style-type: none"> Group A – bulk materials that may liquefy Group B – bulk materials possessing chemical hazards Group C – bulk materials that are neither liable to liquefy nor possess chemical hazards <p>The cargo declaration form as required in section 4.2 of the Code should now contain a provisional declaration stating whether the cargo is HME or not. Coal and anthracite are already subject to a schedule under the IMSBC Code and are already shipped in Cargo B since they may create flammable atmospheres, may heat spontaneously, may deplete the oxygen concentration and may corrode metal structures.</p>
Marine pollution	<ul style="list-style-type: none"> International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL), 1954 (including all amendments) 	Applicable-as the convention controls deliberate discharge of oil and oil mixture from the sea going vessels causing environmental impacts.

Items/issues	Conventions, protocols and agreements	Remarks
	<ul style="list-style-type: none"> • Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LDC), 1972 (including all amendments) 	Applicable-as the convention represents international control and prevention of marine pollution due to dumping of wastes and other matter.
	<ul style="list-style-type: none"> • International Convention for the Prevention of Pollution from Ships (MARPOL), Adoption: 1973 (Convention), 1978 (1978 Protocol), 1997 (Protocol - Annex VI); Entry into force: 2 October 1983 (Annexes I and II). 	Applicable- The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes. Special Areas with strict controls on operational discharges are included in most Annexes.
	<ul style="list-style-type: none"> • MARPOL, Annex I Regulations for the Prevention of Pollution by Oil (entered into force 2 October 1983) 	Covers prevention of pollution by oil from operational measures as well as from accidental discharges; the 1992 amendments to Annex I made it mandatory for new oil tankers to have double hulls and brought in a phase-in schedule for existing tankers to fit double hulls, which was subsequently revised in 2001 and 2003.
	<ul style="list-style-type: none"> • MARPOL, Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk (entered into force 2 October 1983) 	Details the discharge criteria and measures for the control of pollution by noxious liquid substances carried in bulk; some 250 substances were evaluated and included in the list appended to the Convention; the discharge of their residues is allowed only to reception facilities until certain concentrations and conditions (which vary with the category of substances) are complied with. In any case, no discharge of residues containing noxious substances is permitted within 12 miles of the nearest land.
	<ul style="list-style-type: none"> • MARPOL, Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form (entered into force 1 July 1992) 	<p>Contains general requirements for the issuing of detailed standards on packing, marking, labelling, documentation, stowage, quantity limitations, exceptions and notifications.</p> <p>For the purpose of this Annex, “harmful substances” are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code) or which meet the criteria in the Appendix of Annex III.</p>
	<ul style="list-style-type: none"> • MARPOL, Annex IV Prevention of Pollution by Sewage from Ships (entered into force 27 September 2003) 	Contains requirements to control pollution of the sea by sewage; the discharge of sewage into the sea is prohibited, except when the ship has in operation an approved sewage treatment plant or when the ship is discharging comminuted and disinfected sewage using an approved system at a distance of more than three nautical miles from the nearest land; sewage which is not comminuted or disinfected has to be discharged at a distance of more than 12 nautical miles from the nearest land.
	<ul style="list-style-type: none"> • MARPOL, Annex V Prevention of Pollution by Garbage 	Deals with different types of garbage and specifies the distances from

Items/issues	Conventions, protocols and agreements	Remarks
	from Ships (entered into force 1 January 2013)	<p>land and the manner in which they may be disposed of; the most important feature of the Annex is the complete ban imposed on the disposal into the sea of all forms of plastics.</p> <p>Shippers have new responsibilities regarding cargoclassification which also affect the ability of the crew todischarge residues and wash water into the marine environment.</p> <p>From January 2013 shippers will need to consider whether or not thecargo and hence residues, including those contained in washwater are 'harmful to the marine environment' (HME).</p> <p>The discharge of wash water and any non-recoverable cargoresidues contained therein is primarily controlled throughMARPOL Annex V, where it is classed as garbage and thereforesubject to the controls specified within Regulations 4.1.3 and6.1.2 of the recent amendments to MARPOL. In essence thedischarge of cargo residues contained in wash water is governed by the following criteria:</p> <ul style="list-style-type: none"> • No discharge of cargo residues should occur less than 12 nautical miles from the nearest land, or the nearest ice shelf. • No discharge of any cargo residues specified as HME. Hold wash water should be discharged to a suitable receptionfacility. <p>Due to a reported lack of adequate reception facilities atpresent, MEPC Circular 8104 allows the discharge of HMEcargo residues contained in hold wash water until 31December 2015 outside Special Areas providing that:</p> <ul style="list-style-type: none"> • based on the information from the relevant port authorities, the master determines that there are no adequate RFs at the receiving terminal or at the next port of call, • the ship is en-route and as far as practicable (but at least 12 nautical miles) from the nearest land, • before washing solid bulk cargoes are removed (and bagged for discharge ashore) as far as practicable (and the holds swept) filters are used in the bilge wells to collect any remaining solid particles and that the discharge is recorded in the garbage record book with the flag state notified utilizing the revised consolidated format for reporting alleged inadequacies of port reception facilities stated in MEPC.1/Circ.469/Rev.2. <p>It is still a requirement for receiving terminals to provideadequate port</p>

Items/issues	Conventions, protocols and agreements	Remarks
		reception facilities for this waste stream, this circular only provides flexibility for ship owners and operator in the case when receiving terminals have failed to meet their obligations under the Annex. Under the timeframe stipulated under MARPOL Annex V by MEPC.1/Circ.7915 (i.e., from 1 January 2013 until December 2014) the shipper must take all reasonable measures to provisionally classify cargoes as HME or not. From 1 Jan 2015 the shipper should provide a complete classification for the cargo to be shipped. The shipper must also declare whether the cargo is HME or not to the port state authorities in the port of loading and unloading.
	<ul style="list-style-type: none"> MARPOL Annex VI Prevention of Air Pollution from Ships (entered into force 19 May 2005) 	Sets limits on sulfur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances; designated emission control areas set more stringent standards for SOx, NOx and particulate matter. A chapter adopted in 2011 covers mandatory technical and operational energy efficiency measures aimed at reducing greenhouse gas emissions from ships.
	<ul style="list-style-type: none"> International Convention Relating to Intervention on the High Seas in Cases of Oil Pollution Casualties (INTERVENTION), 1969 (and all amendments) 	Applicable- as this convention applied to casualties involving pollution by oil and other matter and impacts in the surrounding environment.
	<ul style="list-style-type: none"> International Convention on Oil Pollution Preparedness, Response and Cooperation (OPRC), 1990 	Applicable- as the convention provides guidelines for combating incidents of marine pollution and ensure Ships to carry a shipboard oil pollution emergency plan, the contents of which are to be developed by IMO.
Liability and Compensation	<ul style="list-style-type: none"> International Convention on Civil Liability for Oil Pollution Damage (CLC), 1969 (and all amendments) 	Applicable- as oil pollution related penalties are addressed
	<ul style="list-style-type: none"> International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (FUND), 1971 (including all amendments and related protocol) 	Applicable- as the convention and related protocol has provision for imposing greater compensation to be paid to victims of oil pollution incidents.
Others	<ul style="list-style-type: none"> International Convention on Tonnage Measurement of Ships (TONNAGE), 1969 	Not directly applicable- as providing guidelines for tonnage related issues.
	<ul style="list-style-type: none"> International Convention on Salvage (SALVAGE), 1989 	Applicable- as the convention has provision for special compensation to the salvors when there is a threat to the environment which may be salvors expense plus 30% or increased to 100% depending on the certain circumstances.

2.11 Development Agency's Health, Environment and Safety Guidelines

130. Current international financial institutions (IFIs), like the WB and ADB, have decades of experience in the development finance realm, allowing them to develop and shape their safeguard standards over the course of their respective histories. In addition to that, the new entrantssuch as Equator Principles Financial Institutions (EPFIs) also have developed their own policies, procedures with relative ease for financing projects. The health and safety guidelines of few development agencies have been reviewed and relevant portions for this project are outlined below.

World Bank's Environmental Safeguard Policies

131. The World Bank has developed a number of Safeguard Policies to ensure that all possible impacts are considered and mitigation measures are spelled out prior to the implementation of any proposed project. These policies ensure that the quality of operations is uniform across different settings worldwide. If the decision is taken that a Safeguard Policy should be applied, mitigation measures and plans must be developed and in place before the implementation of a proposed project.

132. The Bank requires environmental screening and classification for all investment projects (including ones financed by Trust Funds, Project Preparation Facilities and Guarantees) proposed for Bank financing, to help ensure that they are environmentally and socially sound and sustainable. Screening and classification take into account the natural environment (air, water, and land); human health and safety; social aspects (involuntary resettlement, Indigenous Peoples); cultural property; and trans-boundary and global environmental aspects.

133. The objectives of environmental screening and classification are: to evaluate the environmental risks associated with a proposed operation; to determine the depth and breadth of Environmental Assessment (EA); and to recommend an appropriate choice of EA instrument(s) suitable for a given project. The Bank recognizes that environmental screening and classification is not absolute and involves professional judgment on a case by case basis. When screening, careful consideration needs to be given to potential environmental impacts and risks associated with the proposed project. Judgment is exercised with reference to the policy expectations and guidance; real impacts on the ground; and established regional and Bank-wide precedence and good practice.

134. Each WB safeguard policy specifies circumstances that prompt its application. Policy-4.01 has provision for conducting of EA that evaluates a project's potential environmental risks and impacts in its area of influence. The Bank Policy also envisages that the borrower Government is responsible for carrying out the EA and the Bank advises the borrower on the Bank's EA requirements.

EA classification under WB-OP-4.01 policy

135. The World Bank classifies the proposed project into one of the four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. These categories are defined below.

Category A: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or

unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works.

Category B: A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas--including wetlands, forests, grasslands, and other natural habitats--are less adverse than those of Category A projects.

Category C: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.

Category FI: A proposed project is classified as Category FI if it involves investment of Bank funds through a financial intermediary (FI), in subprojects that may result in adverse environmental impacts.

136. The proposed project has been classified as Category A, since some of the potential impacts are likely to be significant and diverse.

137. With regards to the GoB compliance requirement of the proposed project, it may be noted that the proposed EIA of coal transportation project is triggered as a compliance requirement of clause - 53 of the ECC issued in favor of the proponent for construction of the coal power plant at Rampal (located at the close vicinity of Critical Area of the Sundarbans) and as such the planned EIA is outlined to meet GoB regulatory requirement. However, if there is any provision for accessing WB fund, in that case following WB policies (**Table 2-5**) will be applicable for this proposed project.

Table 2-5: World Bank Policies triggering for the proposed project

Directive	Policy	Triggered	Comments
Environmental Assessment	OP/BP 4.01	Yes	As the Project falls into Category A, the present full EIA has to be carried out.
Natural Habitats	OP/BP 4.04	Yes	Triggered. The proposed project activities are within the ECA, overlaps World Heritage, and also close to the Ramsar (the Sundarbans) and expected to have potential impacts within the area. However, following are the overall focus of the policy: The Bank does not finance projects that involve significant conversion of natural habitats. To all projects that have the potential to cause "significant conversion" (loss) or "degradation" of "natural habitats", directly (through project activities); or Indirectly, through human activities induced by the project. Impact, whether positive or negative, on "critical natural habitats." Compliance largely through use of covenants Legal documents which include supervision and corrective measures.
Involuntary Resettlement	OP/BP 4.12	Yes	Triggered, land acquisition is required for coal jetty construction and coal stackyard.
Forests	OP/BP 4.36	Yes	Triggered, since the project activities are within the Sundarban Reserve Forest and UNESCO World Heritage and Ramsar Site. The project activities are expected to impact on the forest areas. However, Banks focus under this policy: The Bank does not finance projects that would

Directive	Policy	Triggered	Comments
			involve “significant conversion” or degradation of critical forest areas or related critical natural habitats.
Access to Information		Yes	World Bank has developed a new approach to the disclosure of information, transparency and sharing of knowledge. The public will have access to a broad range of information about the project in preparation and implementation.

Safe Guard Policy of ADB

138. SPS 2009 provides for the environmental requirements and review procedures of ADB and applies to all projects and grants they finance. SPS 2009 comprises three key safeguard areas: environment, involuntary resettlement, and indigenous peoples; and aims to avoid adverse project impacts to both the environment and the affected people; minimize, mitigate and/or compensate for adverse project impacts; and help Borrowers to strengthen their safeguard systems and to develop their capacity in managing the environmental and social risks.

139. ADB's Policy states that all investments are subject to categorization to determine environmental assessment (EA) requirements. A project is therefore, categorized into one of the three environmental categories (A, B or C) to determine the level of environmental assessment. The process of determining a project's environment category is to prepare a Rapid Environmental Assessment (REA) screening checklist, taking into account the type, size, and location of the proposed project. A project is classified as one of the four environmental categories (A, B, C, or FI) as follows:

- (i) Category A (OM F1): Projects with potential for significant adverse environmental impacts. An environmental impact assessment and a summary EIA (SEIA) are required to address significant impacts.
- (ii) Category B (OMF1): Projects judged to have some adverse environmental impacts but of lesser degree and/or significance than those for category A projects. An initial environmental examination and a summary IEE are required to determine whether or not significant environmental impacts warranting an EIA are likely. If an EIA is not needed, the IEE is regarded as the final environmental assessment report.
- (iii) Category C (OMF1): Projects unlikely to have adverse environmental impacts. No EIA or IEE is required, although environmental implications are still reviewed.
- (iv) Category FI (OMF1): Projects are classified as category FI if they involve a credit line through a financial intermediary or an equity investment in a financial intermediary. The financial intermediary must apply an environmental management system unless all sub projects will result in insignificant impacts.

140. As per ADB screening process, this proposed project is categorized (Coal transportation Project due to its possible characteristics or/and activities impacts may impact ECA area) as Category “A” and subsequently an EIA will be required. However, if the project has plan to access fund for the proposed project, in that case all relevant operation policies such as (i) categorization of the project activities as per ADB (ii) environmental (iii) involuntary resettlement (in case of disposal of dredged spoil produced from dredging activities at the designated site), and iv) disclosures will have to be followed.

Equator Principles Financial Institutions

141. The Equator Principles (EP) are a framework to help financial institutions to address potential environmental and social risks when providing project finance loans or project finance advisory services. The principles apply to all new project financings globally with total project capital costs of US\$10 million or more, and across all industry and sectors. The objective of the EP policy is to ensure adequate implementation of the EP through internal guidelines and process related to project finance. By adhering to the EP, the member institution such as EXIM BANK may apply these principles to all project financings and also committed to ensure that the borrowers have to demonstrate that they meet the requirements of Environmental and Social Impact Assessment report referring the then applicable guidelines/standards of International Finance Corporation (IFC), WB safeguards and also local regulations where relevant.

142. This is to be noted that the IFC Performance Standards and the EP were borne out of an effort by the World Bank to ensure its private sector partners took the appropriate steps to meet best practice in sustainable development. However, if the proposed project has any plan for obtaining financial assistance from member of EPFI, in that case the following revised version of the EP agreement known as EP III will be adopted:

143. Principle 1: Review and categorization, Principle 2: Environmental and social assessment, Principle 3: Applicable environmental and social standards, Principle 4: Environmental and social management system and action plan, Principle 5: Stakeholder engagement, Principle 6: Grievance mechanisms, Principle 7: Independent reviews, Principle 8: Covenants, Principle 9: Independent monitoring and reporting, Principle 10: Reporting and transparency

IFC Safeguard Policies

144. The International Finance Corporation (IFC) developed its Sustainability Framework in 2006 and updated in 2012, which articulates its strategic commitment to sustainable development. The IFC's Environmental and Social Performance Standards, part of the overall Sustainability Framework, have been adopted by many as an international benchmark for identifying and managing environmental and social risks within the private sector. However for accessing fund under this institution for this project, the IFC safeguard policies shall be followed. Eight Performance Standards, which Clients must meet, cover the following: 1) Assessment and Management of Environmental and Social Risks and impacts 2) Labor and Working Conditions 3) Resource Efficiency and Pollution Prevention 4) Community Health, Safety, and Security 5) Land Acquisition and Involuntary Resettlement 6) Biodiversity Conservation and Sustainable Management of Living Natural Resources 7) Indigenous Peoples, and 8) Cultural Heritage.

3 Project Data Sheet

3.1 Project Proponent

145. The proponent of the Project is Bangladesh-India Friendship Power Company (Pvt.) Limited (BIFPCL), a joint venture company of Bangladesh Power Development Board and NTPC Ltd., India with the 50:50 share.

3.2 Project Location

146. BIFPCL has planned to set up a 1,320 MW coal fired power plant at Rampal, Bagherhat under Khulna division, Bangladesh. The coal fired power generation will be based on Ultra Super Critical (USC) technology. Coal required for the power plant will be imported from overseas. Depending on the weather and seasonal conditions, coal will be transported by mother vessel up to the transshipment points¹ Fairway Buoy, Akram Point and Mazhar Point in different seasons of the year. The transshipment Points are located under the jurisdiction of Mongla Port Authority. From these two points coal will be transported using smaller barges (with maximum capacity of 10,000 dwt) along the MPA designated route through the Passur River to the Project jetty. The jetty is located about 14 km upstream of the Mongla Port.

3.3 Study/ Project Influenced Area

147. The project components are located in both Bagerhat and Khulna districts and spread over in Mongla and Rampal Upazila of Bagerhat and Dacope and Batiaghata Upazila of Khulna district in the south-western part of Bangladesh. In addition, a major portion of the transportation route will pass through the Sundarbans. In general, the Project influence area will include the areas which will benefit from the Project, or which may be directly affected in a negative way, by various components of the Project (**Figure 3-1**). Specifically, the project influence area will include the following:

- The distance from Fairway Buoy to Project jetty on the Passur Channel, the designated route of the Mongla Port Authority, is 144 km, which may have impacts on fish, biodiversity of the Sundarbans, wetlands, riparian habitats, water quality, and other aquatic animals. For biodiversity, socio-economic and hydrological point of view the study area is considered 5 km buffer area from the proposed coal transportation route along the Passur Channel. It is thought that pollutants in water if released from the coal transportation vessel may spread over the adjoining areas up to 5 km laterally through the creeks in the Sundarbans. A total of 140 km length (extending 25 km radius from the stack of the plant) and with a width of 50 km along the Passur River for the air quality assessment. The considerations of 140kmX50km for airshed analysis are given in Para: 762 in detail;
- The land resources affected by construction activities related to the plant jetty and coal stackyard at Saphmari Katakhal Mouza. Four and half acres of land will be required for the plant jetty and 75 acres of land for coal stackyard; and
- Potential risk of affecting the Sundarbans along the Passur River due to accidental events.

¹ Three transshipment points were recommended by the coal logistic study. During the EIA study it was decided that two transshipment points are sufficient for the project, to minimize activities within the Sundarbans.

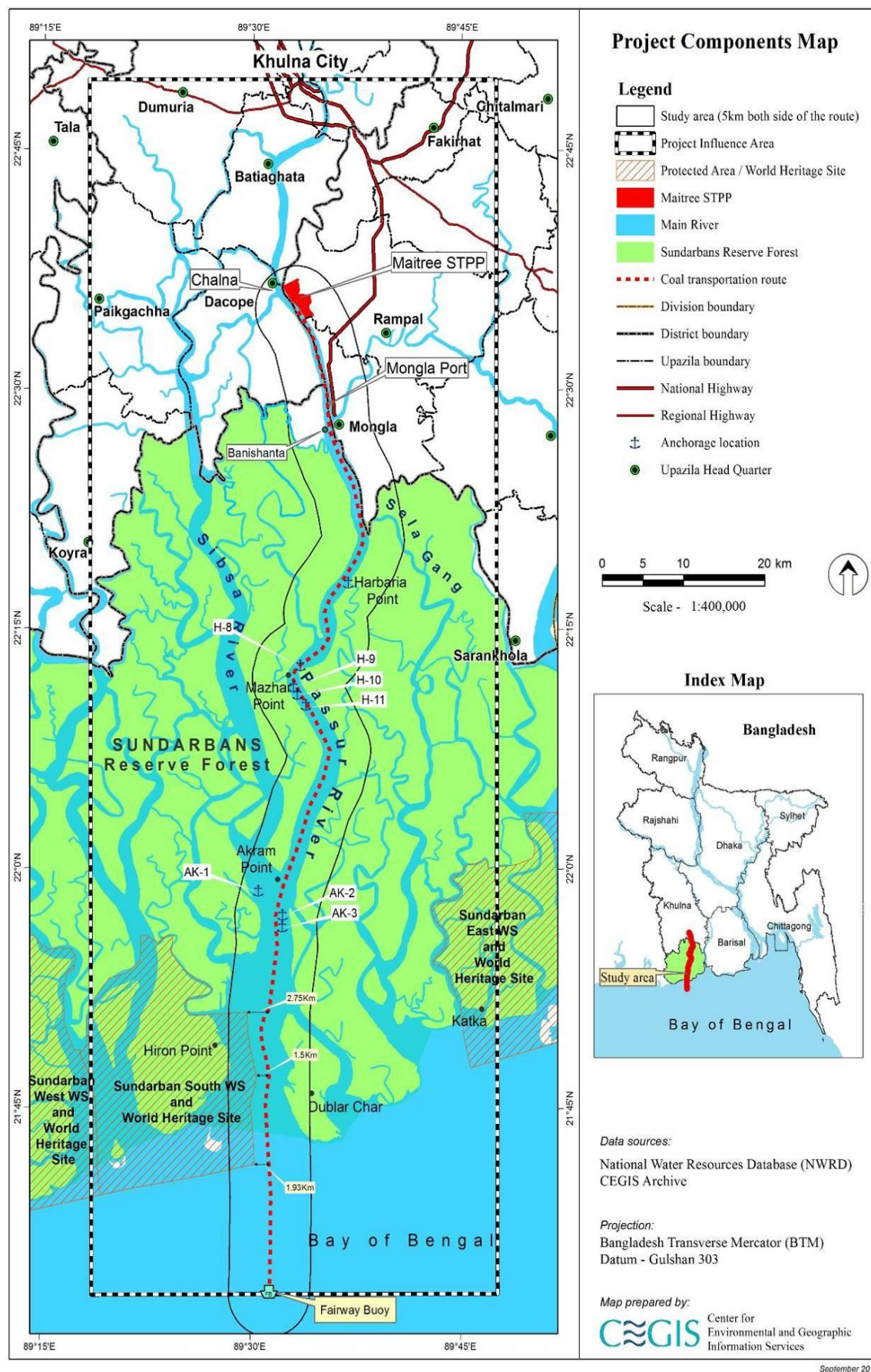


Figure 3-1: Study/Project influence area

3.4 Nature of the Project

148. The Project involves transportation of maximum 4.7 million metric tons per annum of coal from overseas via Fairway Buoy to the project site. The transportation also involves coal unloading and loading at transshipment points using transshipper to lighterage vessels and transporting of coal to plant jetty and eventually unloading using conveyors and storing coal at coal stackyard. MPA's designated route along the Passur River will be used during transportation. Three transshipment anchorage points are considered in the technical design of the Project depending on the weather and seasonal conditions, and they are: (a) Mongla Port's Fairway Buoy Anchorage which is a deep sea anchorage located at a distance of about 130 km (70 NM) from Mongla Port and about 144 km (78 NM). It allows large size vessel like Capesize vessels of capacity upto 100,000 DWT and unload coal safely from November to March for 4-5 months and (b) Akram Point Anchorage is located at a distance of about 57 km (31 NM) from Power plant jetty. It has a draft of around 8m allowing vessels loaded upto 42,000 DWT. The weather conditions at Akram Point can only allow the Anchorage to be operational for 5-6 month in a year. (c) Mazhar Point Anchorage at Harbaria is located at a distance of about 34 km (18 NM) from Power plant jetty. It has a draft of around 8m allowing vessels loaded upto 30,000-32,000 DWT. The weather conditions at Mazhar Point are calm throughout the year allowing the Anchorage to be operational round the year.

149. Transshipment will be carried out using an environment friendly transshipper/floating transfer station (FTS). A typical Transfer Station is supported by 2 cranes of grab, 2 hoppers, 2 barge loaders with a loading capacity of 1,000 t/h each. An unloading rate of 16,000 - 20,000 t/d or 5.00 million t/year can be achieved from mother vessel by using an FTS.

150. The coal will be shipped in mother vessel and will be brought to the power plant jetty in smaller barges of size upto 10,000 DWT. The design for coal jetty has considered a width of 30 m and a length of 540 m to accommodate all functional facilities such as rail mounted grab type unloaders, carriage way and clearance between berth line and crane rail at the edge of the of structure, hopper/hoppers, mooring facilities and other facilities. The dimensions of coal berth is also sufficient for handling fly ash and lime stone of various sizes of ship/ barges to be loaded/ unloaded from the berth.

3.5 Project Component

151. There are five major components of the Coal Transportation Project. These are: (i) Mother Vessel; (ii) Transshipper; (iii) Covered Lighterage/Smaller Barge; (iv) Unloading at Plant Site Jetty, and (v) Coal and Limestone Transfer to Coal and Limestone Stack Yards. Another associated important component of the Project is navigability of the channel for waterway transportation. Details of the project components are given in Chapter 4.

3.5.1 Mother Vessel

152. The Project design has considered Capesize mother vessel with capacity of more or less 100,000 DWT. Capesize vessels will be anchored at the Mongla Port's Fairway Buoy for five (5) months from November to March and transship coal using a Floating Transfer Station (FTS) to lighterage vessels. It is expected that each Capesize vessel will carry about 80,000 tons of coal in each trip. Handysize dry bulk carrier with a capacity between 15,000 and 40,000 DWT. Similarly, it is expected that each Handysize vessel will carry about 25,000-30,000 tons of coal in each trip up to the Mazhar Point. This type of vessel requires

shallow draft (8.1-10.4 m), which allows them to operate in most of the ports and terminals across the world. Due to their small dimensions, Handysize ships can serve ports and terminals of all sizes, even ports with length and draft restrictions. As they are fitted with on-deck cranes, they can also serve ports lacking transshipment infrastructure. The Handysize vessels will sail across the Bangladesh Water Territory from the Fairway Buoy up to the Mazhar Anchorage Points. The vessel will follow the applicable IMO convention to avoid generating undesired wave, collisions with other inland water transport, discharge of bilge (oil and grease mixed water) and ballast water to the river. The mother vessel will be covered to avoid dispersion of coal dust to the surrounding environment.

3.5.2 Transshipper

153. Due to lack of adequate river draft, mother vessels will not be able to sail up to the project site jetty. Transshipment of Coal from the mother vessel to smaller vessels (max.10,000 tons) may require a transshipper. Transshipment will be carried out by an efficient and environment friendly transshipper (Floating Transfer Station- FTS) or by direct unloading preventing coal overflow into water and dust dispersion in the surrounding environment. A common transshipper has been recommended in the coal logistics study for all anchorage points with capacity of 25,000-30,000 DWT. An FTS will have two cranes, which work in conjunction with a material handling system comprising of hoppers, conveyors, and material delivery boom. The cranes has grab with 35-50 cbm/grab, 2 hoppers (50-60 t each), 2 barge loaders with a loading capacity of 1,200 t/h each. An unloading rate of 30,000 tpd can be achieved from mother vessel by using an FTS. FTS will have buffer storage of 8,000 – 10,000 tons allowing smooth and continuous unloading of mother vessel for higher efficiency on one side and loading of barges on other side. Light-beam of the trans-shipper can create light hazard to the wildlife of the surrounding area. The transshipper will be attached with the house boat or self-accommodation for the workers. Waste of the trans-shipper will be disposed of at the port facilities maintaining IMO and Environmental Rules and Regulations.

3.5.3 Lighterage/Smaller Vessel

154. Coal will be transported by covered applicable class vessel to the plant jetty to contain coal dust. Cargo barges are ideal for handling unloading / discharge of coal from mother vessel and safely transporting the cargo to nearest jetty or berth. Most of the cargo handling agency (CHA) or cargo forwarding agencies engaged in handling coal and unloading the cargo for ship will use self propelled barges, if required tug boat may also be used. These barges along side the ship will be loaded with the coal by the transshipper from mother vessel.

3.5.4 Coal Terminal/ Plant Site Jetty

155. Unloading of coal will take place in power plant jetty, specifically design to handle multiple vessels of coal at given time and have additional space available for handling of smaller barges for fly ash, limestone and gypsum, supply of fuel and water. The infrastructure required for handling of coal at jetty will include conveyor, hopper, grab type unloader, and other mobile equipment's. Jetty construction along with others (Coal Stack-Yard etc.) was considered in the EIA study of the 2x660 MW Maitree Super Thermal Power Project, which was approved by DoE. The Construction of Jetty already been awarded to EPC contractor under EPC contract for Main Plant. According to the condition of the EIA

approval (condition no. 53) the present EIA study of Coal Transportation is being carried out. One of the specific objective of the Study (Section 6: Terms of Reference, Annex 1-1) is: "3.0 Objective of the assignment: v) Assessing all the potential environmental and socio-economic impact of the proposed coal transportation and associated transshipment." On the above background considering due diligence, some details of the impact of jetty construction on the bio-diversity of construction site of the Passur River and corresponding mitigation measures have been elaborated in the current EIA study. It may be noted that construction of jetty does not fall under the purview of Environmental Conservation Rules, 1997 and subsequent amendments.

3.5.5 Coal and Limestone Transfer to Coal Stackyard

156. Coal and limestone from lighterage/smaller vessel will be unloaded at jetty site on berth with the help of grab type unloaders and then stored at covered coal stackyard using mobile equipment, fully enclosed conveyor belt and accessories, stacker/reclaimers, etc. Details of coal and limestone handling system from plant jetty to the coal stackyard are described in **Section 4.6.5**.

3.6 Project Activity

157. The anticipated activities of the project are as follows:

- i. Construction of the power plant jetty with necessary infrastructures and equipment;
[The plant jetty is a long term asset of the power plant which will be the permanent infrastructure and cannot be altered frequently. For meeting up the construction water requirement and potable water requirement for the officials and laborers water will be fetched from nearby the Passur River and will be used after Reverse Osmosis (RO) process or by desalinization of water of the Passur River.]
- ii. Preparation of coal stackyard complying with design requirements;
- iii. Negotiations with coal exporter, shipping companies, and transshippers. During negotiations, care will be taken to ensure that all coal exporters and shipping companies are complying with the applicable revised Convention for the Prevention of Pollution from Ships (MARPOL) and the International Maritime Solid Bulk Cargoes Code (IMSBC).;
- iv. Transporting coal by mother vessel from load port to the anchorage points;
- v. Transshipment of coal from mother vessel to lighterage;
- vi. Transportation of coal by lighter vessel to plant jetty through designated route complying with Mongla Port and applicable IMO requirements; and
- vii. Unloading coal from smaller vessel to coal stackyard.

3.7 Associated Components (Navigability of the Passur Channel)

158. Mongla Port Authority (MPA) will be responsible for maintaining the channel at required depth for navigation. For such, if required, they will carry out maintenance and capital dredging. Navigation aids including signalling on both sides of channel and marking

on the channel bents, etc. is also the responsibility of the Mongla Port Authority for smooth navigation.

3.8 Project Schedule

159. Construction of the jetty facility is expected to take approximately 6-8 months, followed by installation of equipment and commissioning period of approximately four (4) months. Construction is expected to start shortly after the financial closure. It is expected that the Project Site jetty would be able to handle more than 4.7 million tons of coal, limestone etc. per annum. The coal terminal jetty with complete unloading equipment would be ready before coal transportation starts, however, part of the jetty or whole may become functional during construction period to handle the construction materials and plant equipment. The tentative construction timeline is as follows:

Feasibility and Design Phase - Design of coal terminal/jetty and approval:

- Finalize detailed design: 3 months; and
- Finalization of Agency including Consultant's review: 4 months.

Months 6 to 35 – Equipment procurement:

- Order and procure necessary equipment, including rail mounted grab or continuous ship unloader at berths, mobile hopper, cranebelt conveyor for transport of coal from the berths, rail mounted stackers/ reclaimers in the stackyard, etc.

Months 5 to 11 Implementation (Jetty Construction):

- The EPC Contractor will make initial Jetty, for transportation of project construction material / equipment within first 7 months from NTP (Notice to Proceed). However, the construction of complete jetty will be done before the coal transportation starts.
- Following receipt of building permits, construct foundations/footings for berth line, revert structure/ RCC retaining wall, conveyors;
- Construct wastewater treatment ponds; and
- Construct access roads.

Months 7 to 39 – Equipment Installation:

- Install rail mounted grab or continuous ship unloader at berths, cranebelt conveyor for transport of coal from the berths, rail mounted stackers/ reclaimers in the stackyard., etc.; and
- Install new pilings.

Months 35 to 39 – Install water sprayer and environmental monitoring systems:

- Install water sprayer at coal stackyard, automation and controls and environmental monitoring system.

Months 7 to 39 – Commissioning:

- Testing and commissioning of individual components.

Months 8 to 38 – Safety and Environmental Training:

- Training for operators regarding best practices, safety and environmental mitigation measures, as and when required before start of each operation.

Sl. No.	Activities	Months																																					
		1	2	3	4	5	6	7	8	9	10	11	35	36	37	38	39																			
Feasibility and Design Phase																																							
1	Design of Coal Terminal/Jetty & Approval																																						
1.1	Finalizing Detailed Design																																						
1.2	Finalization of Agency including Consultant's review																																						
2	Equipment Procurement																																						
Implementation Phase																																							
3	Jetty Construction																																						
4	Equipment Installation																																						
5	Installation of water sprayer and environmental monitoring systems																																						
Commissioning																																							
6	Safety and Environmental Training																																						

Figure 3-2: Tentative schedule of jetty construction

4 Project Description

4.1 Project Objective

160. The main objective of the Project is to transport maximum 4.7 million metric tons of coal per annum from overseas via Fairway Buoy to the Maitree STPP jetty, located at Rampal, Bagerhat. The Project also involves coal unloading and loading at transshipment points using Transshipper to lighterage vessels and transporting coal to plant jetty and eventually unloading using conveyors and storing coal at the coal stackyard.

161. According to the Power System Master Plan (2010), electricity demand forecast of Bangladesh in the year 2021 will be 19,000 MW and in 2030 will be 34,000 MW (TEPSCO, 2010). To meet this demand the generation capacity should be increased to 39,000 MW in 2030. To help mitigate potential electricity demand in the Country, Bangladesh-India Friendship Power Company (Pvt.) Limited (BIFPCL) has proposed the development of a 2 x 660 MW supercritical coal fired power project. The development objective of the Project is to support the power station with coal imported from overseas.

4.2 Project Significance to Country's Power Sector

162. Bangladesh is a power starving country. The installed generating capacity is low compared to many other similar countries with less than 70% of the population having access to electricity. The major rivers have divided Bangladesh into two regions. The eastern region and the western region. Most of the power generating plants are in the eastern region and are mainly gas based. In the Western Zone, coal and imported liquid fuel are used for generation of electricity. Power shortage in western region is very high. Load shedding and under voltage are common phenomenon. Natural gas reserve in Bangladesh is depleting with an availability of limited coal. Government has prioritized the power sector and has taken the initiative to install imported coal based new power plants primarily in the coastal region. "Maitree Power Station" is one of such power plant now under construction in Khulna region. The imported coal for this Power station needs to be transported using inland river transport to the project jetty. Since the river route passes through the Sundarbans, it is quite challenging to finalize a route that has limited environmental impacts. The project proponent entrusted CEGIS to conduct an EIA study for the coal transportation to explore a safe, environment friendly and economically viable navigation route for transshipment of coal from Fair way buoy to plant jetty. So the significance of the project is very high. A successful finding of the project will ensure the enhancement of western power grid by 1,320 MW of electricity. This will enrich the national economy in many ways, through industrialization and urbanization of western region and will also improve the lifestyle of the local people. On the other hand, a failure in finalizing a sustainable route may lead to major disasters for the proposed Maitree coal based power Project.

4.3 Brief of Coal Transportation

163. Considering the safety of the Sundarbans and surrounding ecosystem and public health and safety, the specification of the coal has been selected. The specification defined Gross Calorific Value 5400-6300 kcal/kg, moisture content max. 15% and average sulfur content 0.6%. Specification of the coal considered for the selected source countries is shown below: (Ref. Table 5.4a of Volume –I: EIA Report of Rampal Power Plant).

Table 4-1: Quality of the coal available in selected source country

GCV (Kcal/kg)	TM (%) Max)	IM (%) Max)	Ash (%) Max)	VM (%)	FC (%)	TS (% Max)	HGI	Sizing (mm)	AFT Deg. C (Max)
ADB	AR	ADB	ADB	ADB		ADB			
For Indonesian Sources									
5500 - 5800	26-42	15-20	5-10	38-44	By Diff.	0.5 - <1	42- 60	50	1100- 1250
For Australian Sources									
6100 - 7250	6.0 - 18.5	1.0- 13.5	8.7 - 21.0	19-50	by diff.	0.2 - 1.0	37 - 82	50	1300 - 1600
For South African Sources									
6100- 6500	8 -12	3-5	15	20 – 22	By diff.	0-1.0	45- 70	50	1200- 1300

Note: AR- As Received; ADB- Air Dry Basis; TM- Total Moisture; IM- Inherent Moisture; VM- Volatile Matter; FC- Fixed Carbon; TS- Total Sulphur; HGI- Hardgrove Grindability Index; AFT- Ash Fusion Temperature.

164. However, considering suggested coal specification, availability, cost of coal and transportation and reliability of supplying coal judiciously, it has been planned to import coal from Indonesia, Australia, South Africa and any other suitable source country under long term/short term agreement with coal producers and suppliers. In such case, good quality, Sub-bituminous coal might be imported from Indonesia (GCV 5200 – 5800 kcal/kg AR basis) and Bituminous (GCV 5800 – 6300 kcal/kg AR basis) coal might be imported from Indonesia, Australia and South Africa. Maximum sulphur content and ash content of such imported coal will be less than 0.9% (as per approved EIA average sulfur content is 0.6%) and 18% (avg. 10%) respectively. Accordingly Boiler of the power plant has been designed to cater coal of GCV 5200 kcal/kg to 6300 kcal/kg AR basis.

165. In addition to above, in the far future, any time during the operation stage of the plant, in case of unavailability of required quantity of coal of quality mentioned above, the Plant will have to use different quality of coal. To take care of this contingent situation, provision for blending of different quality coal (to meet the above quality of blended coal) as per design of boiler (with above mentioned max. sulphur content), has been envisaged in the design of Plant. Such variety of coal will be imported and transported by the same route. This will ensure uninterrupted generation of power from the project at optimum cost which will benefit Bangladesh Power sector in particular and its economy in general.

166. The Imported coal will be transported through the sea and maritime/inland transportation through the Passur Channel. The coal logistics study recommended three anchorage points for mother vessel for lightering during various seasons of the year depending on the stability and suitability of loading-unloading against wave condition. These are (i) Fairway Buoy for two to three months with higher capacity mother vessel (>100,000 DWT); (ii) Akram Point for four to five months for 42,000 - 45,000 DWT vessel; (subject to availability of permissible draft in future) and (iii) Harbaria for round the year for 26,000 – 32,000 DWT vessel. Mother vessel will carry the coal for transportation from the source countries to the anchorage points and then by lighterage vessel of capacity about 8,000 to 10,000 DWT (but not less than 5,000 DWT initially till power plant stabilization) for further transportation up to the power plant jetty. Two anchorage points have been considered for transshipment of coal; one at the fairway Buoy, which is outside the Sundarbans and

another at Harbaria, which is inside the Sundarbans, so that the activities involved exert less impact on the Sundarbans.

4.4 Project Details

167. The coal transportation will be carried out through the waterway from Fairway Buoy to the power plant jetty which is the Mongla Port's designated and established route along the Passur River (**Figure 4-1**). This route has been selected based on the multi-criteria analysis of alternative routes, which is described in detail in the following Chapter 5: Analysis of Alternatives.

168. The most preferred option for coal transportation from load port to destination (power plant jetty) has been considered as follows:

- a) Mother vessel from load port (coal exporting country) to any designated anchorage area of the MPA like Fairway Buoy or Harbaria¹.
- b) Transshipment of coal from mother vessel to lighter vessels.
- c) Coal transportation through lighterage to the berth/jetty at power plant site.
- d) Unloading of coal at the jetty and storage at coal stackyard.

169. Under above circumstances berthing facilities has been developed for lighterage vessels at power plant jetty, which are shown in the layout plan of the power plant (**Figure 4-2**). Construction of the jetty or coal terminal at the project site is considered more effective in saving time and cost for coal transportation than berthing at the Mongla Port Terminal.

170. Suitable mooring arrangements and fenders shall be provided on the jetty. Unloading system considers two rail mounted grab unloader with average capacity of 900 t/h each. For the stability of the jetty shore line facilities and revetment will be created.

171. Covered lighterage vessel of about 10,000 DWT with the draft of 5 - 5.5 m (16.4 - 18 feet) will be engaged for transporting coal from mother vessel to the plant jetty. The BIFPCL will engage flat bottom shallow draft type covered applicable class vessels for coal transportation through Passur River following MPA's designated route to the plant jetty from the anchorage of mother vessel. To ensure uninterrupted operations of power plant, the jetty will be operational and fully capable of handling vessels/ barges of different sizes at a time. Various bulk materials like coal, lime stone, fly ash, bottom ash and gypsum will be handled from this berth.

172. The infrastructure required for handling of coal at jetty will include conveyor, mobilehopper, crane, and other mobile equipment. Thus, dimensions of the berth/jetty are critical inputs that will depend upon:

- Maximum size of vessels to be handled;
- Various types of Bulk Materials to be loaded/unloaded at a time from the berth;
- Provision of adequate flat deck areas for carrying out routine maintenance of the crane unloaders and other accessories; and

¹ Three transshipment points were recommended by the coal logistic study. During the EIA study, it was decided that two transshipment points are sufficient for the project, to minimize activities within the Sundarbans.

- Parking of ship loaders/unloaders, space for mooring of ships/barges, conveyors, mobile hopper/hoppers, space for movement of trucks and other mobile equipment.

173. List of Berthing Facilities on Jetty:

- Bunkering facilities;
- Fresh water supply;
- Facility for collection, storage and transfer/ treatment/ disposal of waste/ waste water/oily water/ sewerage from ships/ barges in the MPA designated area;
- Mooring bollards;
- Fenders;
- Bits and rings for securing cables; and
- Firefighting system.

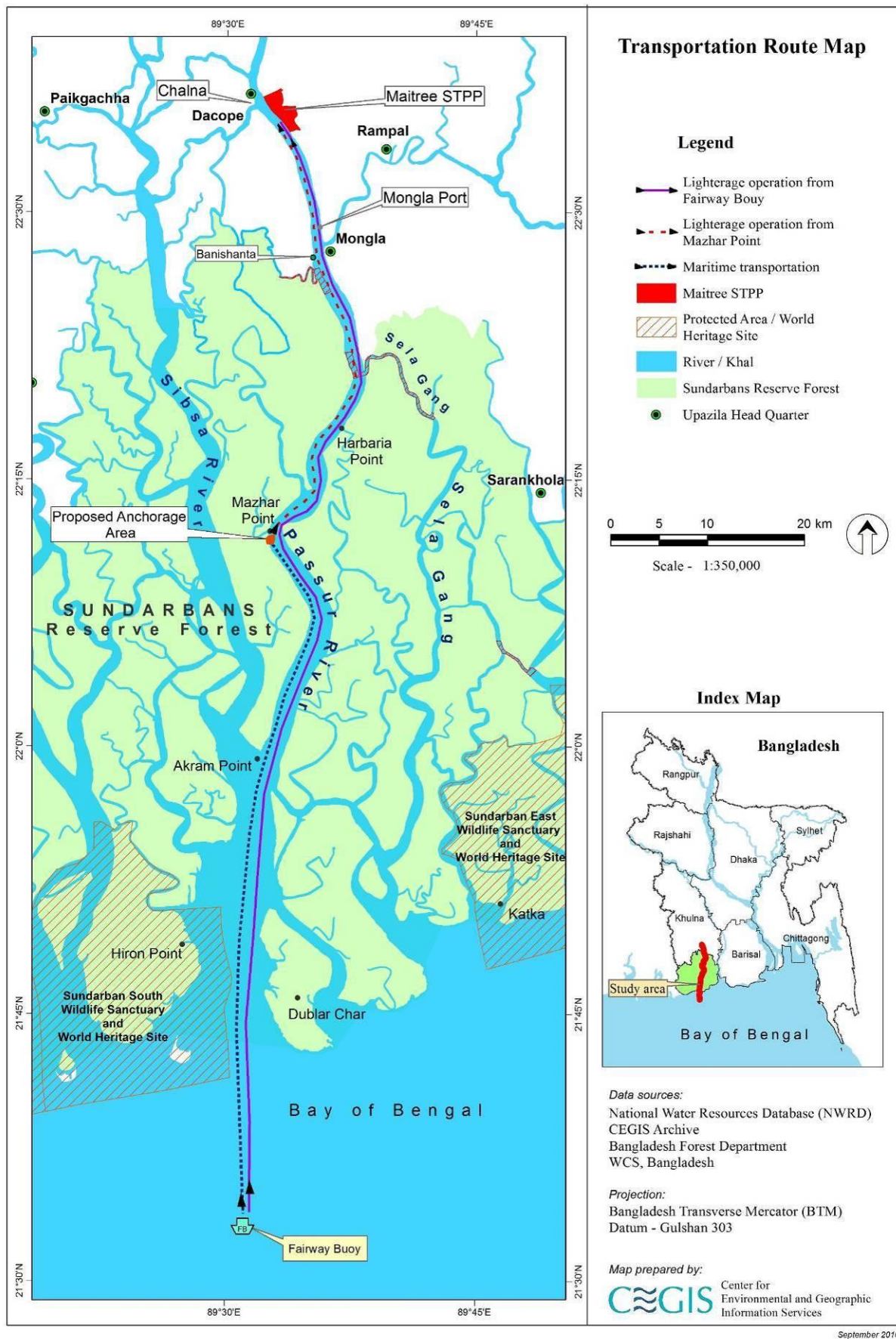


Figure 4-1: Coal transportation route

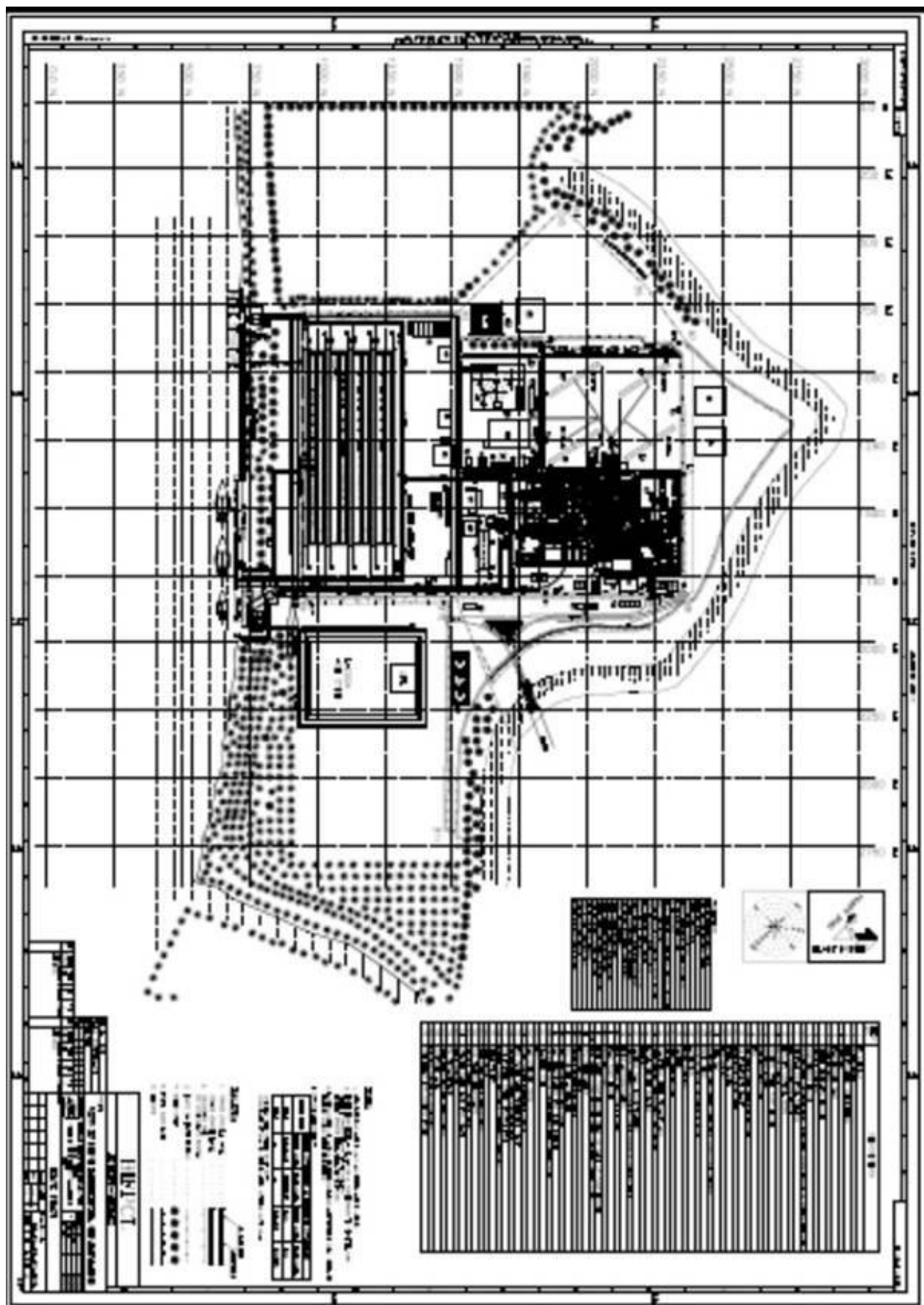


Figure 4-2: Layout boundary

4.5 Land Requirement

174. Land Requirement Land requirement for the construction of coal terminal/jetty facilities with the dimension of 540 m x 30 m is about 4.1 acres plus 2-3 acres for associated infrastructure and for coal stackyards, it is about 75.0 acres. This land has already been acquired and properly compensated through DC office and the proponent has already raised the land along with the coal power plant and other facilities.

4.6 Project Components

175. There are five major components of the Coal Transportation. These are: (i) Mother Vessel; (ii) Transhipper; (iii) Covered lighterage/smaller barge; (iv) Unloading at Plant Jetty, and (v) Coal and Limestone Transfer to Coal Stack Yard. The flow diagram of activities of the coal transportation Project is presented in Figure 4-2. In addition, both capital and maintenance dredging in the alignment of the Passur River from Power Plant Jetty to Fairway Buoy is an associated component of the project for maintaining suitable draft for sailing the vessel of required capacity. MPA is responsible for maintaining the navigability of the route from Fairway Buoy to Plant jetty. Details of the project components are given below:

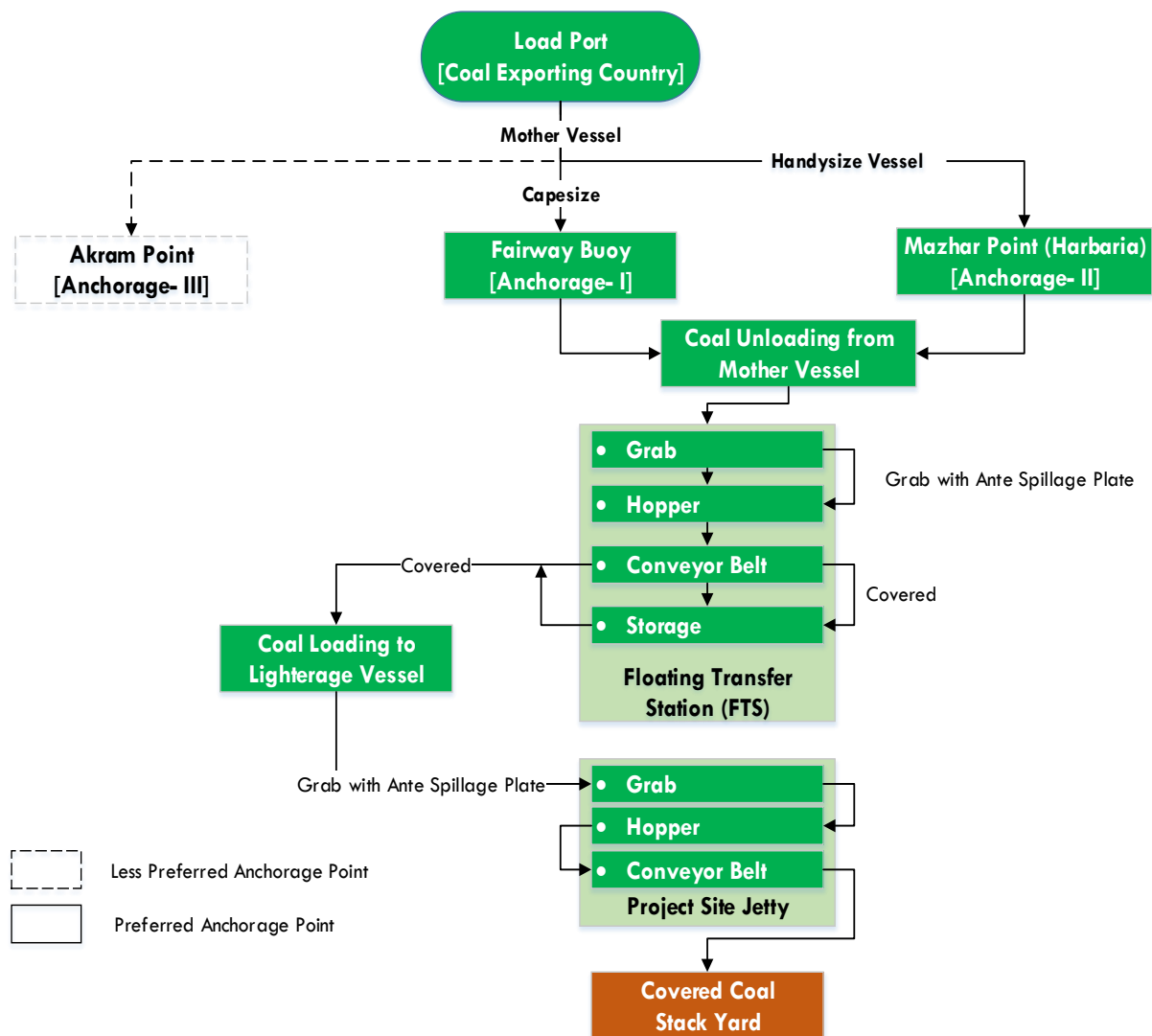


Figure 4-3: Flow diagram of the coal transportation Project activities

4.6.1 Mother Vessel or Bulk Carriers

176. The project has considered two types of mother vessels, Capesize and Handysize. Capesize for transporting coal with a load of 80,000 tons from load port to Mongla Port Fairway Buoy and Handysize with a load of 25,000-30,000 tons from load port to Mazhar Point. This tonnage of coal will more after clearing the obstruction at Outer bar by the MPA. For transporting maximum 4.7 million tons of coal annually from load port to the selected anchorages, it is expected that about 26 Capesize vessels (less than 6 vessels in a month or 1 vessel in every 6 days) will be anchored in Fairway Buoy during November to March and 117 Handysize (less than 17 in each month or 1 vessel every alternative day) in Mazhar Point during April-October every year.

177. According to estimates, 93% cargo of Capesize bulkers comprises of iron ore and coal. The salient features of this Capesize bulk carriers (**Figure 4-4**) are as follows:

- Vessels of size >100,000 DWT;
- Dimensions: Length 235-320 m; Draft 13.6-18.9 m; Beam 41.7-52 m;
- Cargo: Vessels with 7-8 cargo holds (depending on the construction of vessels).
- These ships serve deep water terminals handling bulk raw materials, such as iron ore and coal. Terminals with required infrastructure to handle capesize vessels are limited when compared with total number of ports around the world.
- The fleet size for Capesize grew at a compound annual growth rate (CAGR) of 18% over last 5 years;
- The crew on a Capesize typically consists of 20 to 25 people (as per the requirements of SOLAS and STCW); and
- The carriers are non-geared vessels for cargo work. Port facilities or transhipper is used for unloading activities.



Capesize vessel



Handysize bulk carrier

Figure 4-4: Different types of mother vessels

178. The Project will require Handysize vessels without cargo gear, as the unloading operation will be conducted by a transhipper. Salient features of Handysize vessels are:

- Dimensions: Length 134-186 m; Draft 8.1-10.4 m; Beam 21.9-28.7 m;
- This type of vessels operate in a large number of geographically dispersed global trades, mainly carrying grains, coal and minor bulks including steel products, forest products and fertilizers;
- These vessels are suited for small ports with length and draft restrictions;
- The fleet size for Handysize grew at a CAGR of 4.1% over last 5 years; and
- The crew on a bulk carrier typically consists of 20 to 30 people (as per the requirements of SOLAS and STCW).

4.6.2 Transhipper

179. A common transhipper may be used at both Fairway Buoy and Mazhar Point transshipment locations. Coal may be unloaded directly from Mother Vessel to smaller barge. Considering all the short listed options, Mazhar Point Anchorage has the lowest draft of 8m. Thus, considering present draft restriction at Mazhar Point Anchorage, a Transshipper of 25,000-30,000 DWT is recommended for use. This transhipper can be shifted from one place to another as per requirements of power plant.

180. Design of the transshipper has not yet been finalised by BIFPCL. However, this study has considered the Transshipper/FTS having environment friendly features with following description: the floating transfer station (FTS) is a vessel with two heavy duty cranes and two swiveling ship-loaders, along with a combination of hoppers and conveyors. An FTS will be able to transship an average of 1,200 t/h net in standard conditions (with a peak of 1,500 t/h) from barges to Ocean Going Vessel (OGV), up to Capesize vessels with a maximum beam of 45m and maximum DWT of 180,000.

181. Two heavy-duty cranes of 30 tons Safe Working Load (SWL) are installed on the vessel starboard side towards a midship, in order to guarantee the optimization of the barge/ Floating Transfer Station (FTS) cycle. The system is furnished with grabs for coal of between 19.7m³ and 22m³, as well as:

- Two duly designed hoppers with belt-feeders
- A belt conveyor system, designed to handle 2,000t/h of coal
- Two ship-loaders with swiveling trimming spouts.

182. The FTS is environmentally friendly and designed to meet the requirements of applicable international classification societies such as IMO, MARPOL (SOPEP), IOPP, ISPP, IAPP; as well as local regulations.

183. The main advantages of the Floating Transfer Station over standard floating cranes are given below:

- On a floating crane there is no additional stockpile, therefore, transshipment operations cannot be carried out during mooring/ unmooring and waiting for the feeder barge. A Floating Transfer Station instead avails itself of buffer storage and can therefore continue to work during such periods, resulting in cost improvement for barging and shipping.

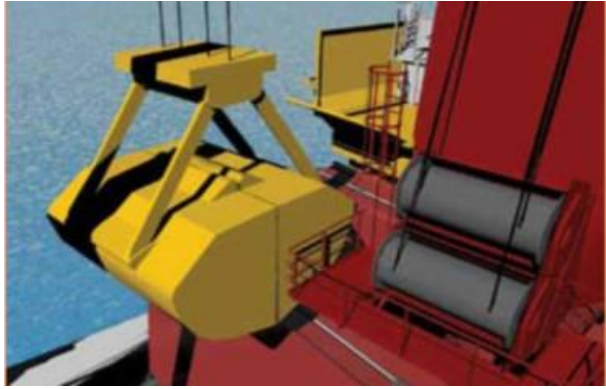
- The buffer storage requires the construction of a larger pontoon which guarantees greater platform stability, a better berthing place for coal barges, and the optimization of crane operations, and as a result, the Floating Transfer Station is less sensitive to the adverse weather conditions compared to floating cranes.



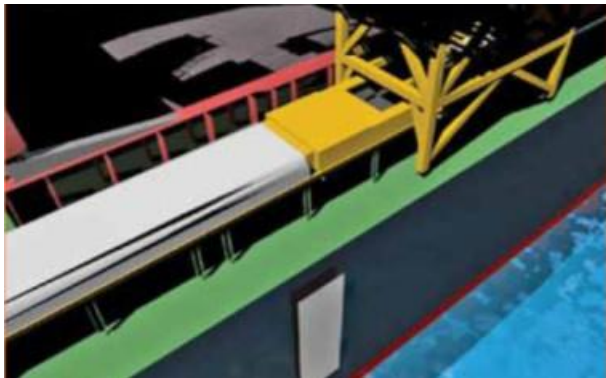
Figure 4-5: Floating transfer station

184. Coal spillage and pollution are prevented by the following devices in a floating transfer station:

1. Duly designed hoppers: larger hoppers facilitate the operation of the crane driver. Hoppers are provided with ante-spillage plates so that the cargo spillage, if any, is collected inside the hoppers instead of falling into the sea.
2. Grabs equipped with dust cover plates.
3. Closed conveyor belts: all belts and the loading boom are covered to avoid wind borne dust and are kept clean by means of scrapers.
4. Storage: an emergency storage of coal for facilitating early leaving of the mother vessel.
5. High-efficiency diesel generators: the internal combustion engines of the auxiliary generators are of high fuel efficiency type, thus minimizing emissions.
6. Sewage system: the sewage treatment unit is in accordance with applicable Class Rules.



The grabs are equipped with dust cover plates.



All conveyors and the loading boom are covered to shield coal from the wind.



Hoppers designed with anti-spillage plates prevent coal falling into the sea.

Figure 4-6: Environmental management in Transhipper

4.6.3 Lighterage/Smaller Barge

185. Lighter vessels with shallower draft of 5 – 5.5 m will be used for transporting coal from transhipment point to power plant jetty. The covered class lighterage barge/smaller vessel of about 10,000 DWT with self-contained ballast and bilge water will be used in coal transportation. It is estimated that annually about 500 lighterage (42 per month about 1.4 or less than two per day) will be used for transporting coal to the plant jetty. The barges shall follow applicable IMO Convention and MPA rules. The specifications of the barges shall be as below:

- Draft: 5-5.5 m
- Length: 95-105 m
- Breadth: 22-28 m
- About 3 cargo holds
- Approx. maximum speed: 9.0 knots
- Accommodation for about 12-15 persons.

186. All vessels including both mother and lighterage will comply with the applicable revised Convention for the Prevention of Pollution from Ships (MARPOL) and the International Maritime Solid Bulk Cargoes Code (IMSBC). Under MARPOL Annex V on the Prevention of Pollution by Garbage from Ships, the International Maritime Organization

(IMO) introduced new classification criteria to enable identification of substances harmful to the marine environment (HME). Since January 1, 2013, shippers are responsible for assessing and declaring whether cargoes are harmful to the marine environment using specific environmental classification criteria. In addition, specific health criteria must be assessed since January 1, 2015. As a result of the above changes, the discharge of residues of certain cargoes into the sea will no longer be allowed when the cargo is classified as a substance harmful to the marine environment. For such cargoes the dry residues and/or the wash water that contains residues from an HME must be discharged at adequate port reception facilities. Under the IMSBC Code, the IMO also introduced new classification criteria to identify materials hazardous only in bulk (MHB). The new criteria used to define HME under MARPOL Annex V and MHB under the IMSBC Code are taken from the UN Globally Harmonized System of Classification and Labelling (GHS). Further to requirements impacting on the shipping of bulk cargoes, the UNGHS is progressively being adopted by countries where it is replacing existing classification systems.

4.6.4 Coal Terminal/Plant Site Jetty

187. Proposed power plant will be dependent on imported coal from Indonesia or South Africa or Australia or other countries having the coal of desired specifications. The coal will be shipped in mother vessel and will be brought to the power plant jetty in smaller barges of size up to about 10,000 DWT. To ensure uninterrupted operations of power plant, the jetty should be operational and fully capable of handling vessels/ barges of different sizes for unloading coal, lime stone and other materials.

188. The infrastructure required for handling of coal at jetty will include conveyor, mobile hopper, crane, and other mobile equipment's. Thus, dimensions of the berth/jetty are critical inputs that will depend upon:

- Maximum allowable size of vessels to be handled
- Various types of Bulk Materials to be loaded/unloaded at a time from the berth
- Provision of adequate flat deck areas for carrying out routine maintenance of the crane unloaders and other accessories
- Berthing of ship loaders/unloaders, space for mooring of ships/barges, conveyors, hoppers, space for movement of trucks and other mobile equipment

189. Considering all the above factors, the proposed power plant will have a coal berth of length 540 m and width 30 m, accommodating all functional facilities such as rail mounted crane unloaders, carriage way and clearance between berth line and crane rail at the edge of the structure, hoppers, right of the way for conveyors on berth, mooring facilities and other facilities. The deck level at + 6.0 m channel depth (CD) is considered. The proposed length will be sufficient for handling coal, fly ash and lime stone, etc. of various sizes of ship/ barges to be loaded/ unloaded from the berth. **Figure 4-7** highlights the dimension of jetty capable of handling vessels/ barges of different sizes.

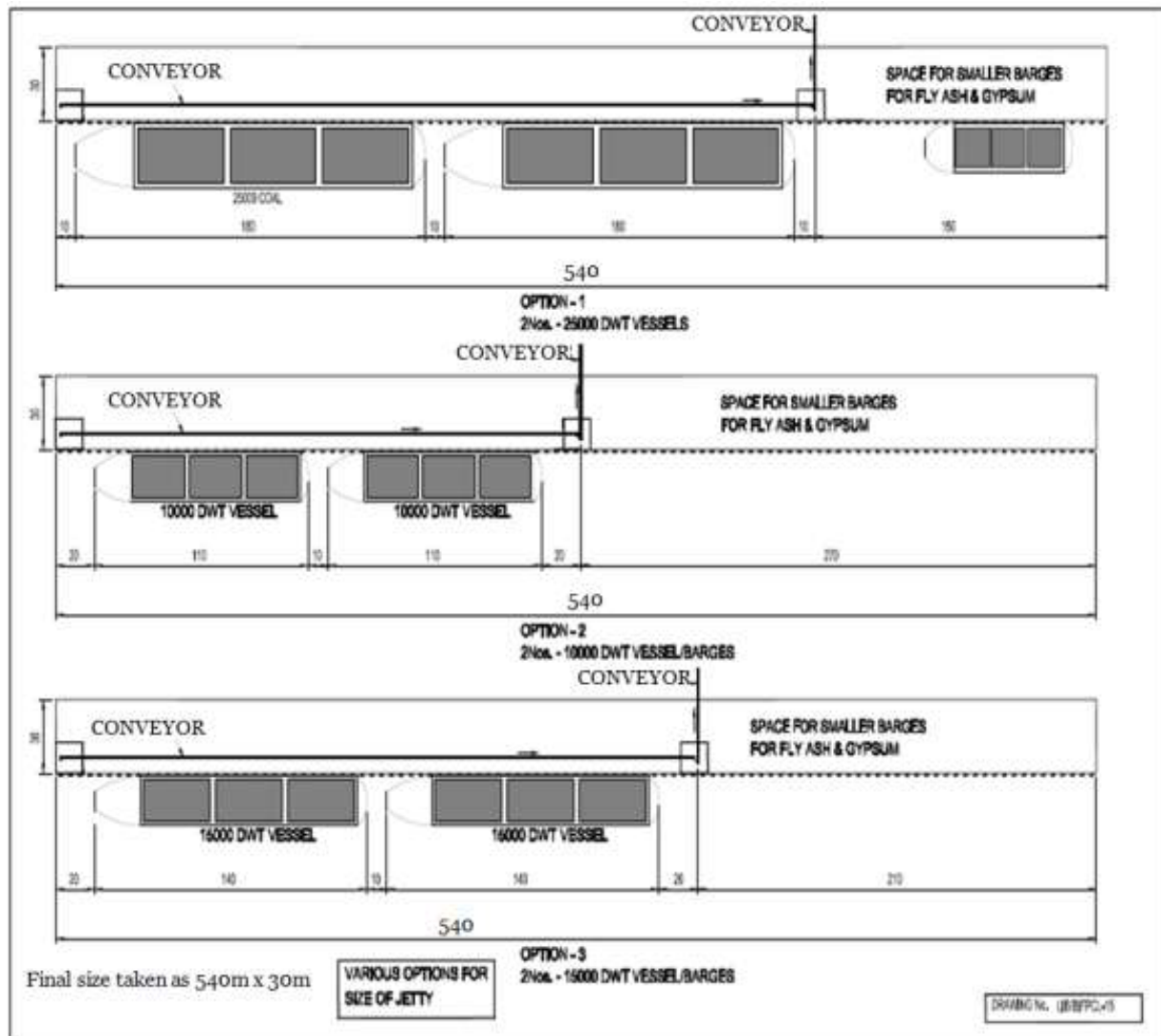


Figure 4-7: Various options for Jetty of 540 m x 30 m

4.6.5 Coal and Limestone Handling System

190. Mainly coal, limestone and gypsum will be handled at the plant jetty. Details of the coal and limestone handling systems are as follows:

Coal Handling System (CHS)

191. The coal handling system including a coal control building shall have following aspect. The control and regulation of the CHS should be based on the Distributed Control System (DCS):

- three (3) grab-type ship unloaders to unload the coal supplied from bulk-cargo vessels/barges berthed at the jetty constructed under this Contract;
- mobile equipment: three (3) light wheel loaders of approx. 10tons weight with a bucket of 1.0 to 1.5 m³ for cleaning-up operation in the holds of the coal vessels to perform the ship unloading trimming works;
- all fully enclosed redundant belt conveyors, conveyor bridges and transferring towers needed to supply the coal to the coal yard and to the station coal bunkers of the unit;

- four (4) travelling type, slewing and luffing stackers for longitudinal coal storages for storing and blending the coal (see section B4.3.2), fully equipped with water spray for dust suppression;
- four (4) portal reclaimers for longitudinal coal storages for reclaiming and blending the coal, fully equipped with water spray for dust suppression;
- mobile equipment: two (2) heavy duty front end loaders for coal supply on the stock yards;
- coal stock yard, consisting of 4 longitudinal coal storages, with a minimum capacity of ninety (90) days of total supply (BMCR operation with worst coal), including dewatering system and coal runoff pond. At maximum of 5% of the coal yard may be passive (accessible only via bulldozers);
- water spray system for the coal stock yard for dust suppression;
- full roof coverage of the coal stock yard to prevent dust emissions and to protect against rain; Provision of direct feeding of coal from conveyor from jetty to bunkering path conveyor bypassing stock yard shall be provided;
- four (4) magnetic iron separator stations, one (1) for each coal receiving conveyor at the jetty and one (1) for each of the two coal conveyors to the station coal bunkers;
- four (4) metal detectors, one (1) for each coal receiving conveyor at the jetty and one (1) for each of the two coal conveyors to the station coal bunkers;
- at least four (4) coal weighing stations, two (2) for the coal received at the jetty, two (2) for the coal transported to the coal bunkers at the units;
- four (4) fully automatic coal sampling stations, two (2) for the coal received at the jetty and two (2) for the coal fed to the station coal bunkers;
- four (4) online coal analyzers, one for each belt conveyor line from the coal yard to the boiler bunkers and for each belt conveyor to blending silo;
- one (1) screening station, including two (2) vibrating screens/sizers for debris removal upstream of the coal yard;
- one (1) crusher building including two (2) crushers of an adequate type, including vibrating screens;
- four (4) Bunker conveyors with motor driven, rail mounted three way chute discharge Travelling tripper. Coal shall be fed to bunker by travelling tripper through bunker conveyor. However, coal to last bunker of each bunker bay shall be fed through discharge chute of bunker conveyor;
- one (1) Coal Handling Control Building;
- mobile equipment: Two (2) heavy-duty bulldozers for moving and compacting coal on the coal yard;
- all auxiliary devices for the trouble-free and safe operation of the coal handling system such as: spray water system (complete for all areas), fire fighting system (complete for all areas), access systems in accordance with valid fire protection rules, water washing system, mobile vacuum cleaning system (refer to Part B12), dust collection system for crusher building, transfer towers and bunker area;

- ventilation systems for all underground tunnels/installations, if any;
- sump pumps for dewatering all underground tunnels/installations, if any;
- the complete power supply, electrical distribution boards, earthing, etc.;
- lightning protection for each of the equipment and towers;
- communication system: wireless, fiber-optic as back-up;
- two (2) coal blending silos, each 1000 m³, with frequency controlled rotor extractor for accurate addition of coal between 0 to 1000 t/h;
- Dust extraction system for crusher house; and
- Hoists and monorails shall be supplied as per general practice where necessary for handling heavy weights e.g crusher, pulleys, gearboxes, motors, etc. Hoist shall be used to lift belt drum during maintenance.

Limestone Handling System

192. As per the approval given by DoE, FGD will be used for controlling SO_x in the flue gas to improve the air quality. This necessitates use of lime stone in FGD for aforesaid purpose. The project proponent has considered the import of lime stone of about 0.1 million tons per annum of 95% purity during the commissioning as well as O&M period of this power project. The limestone handling system shall have following aspects:

- limestone transportation from jetty unloading to pipe conveyors
- limestone transportation from the pipe conveyors to the limestone stock yard with corner towers
- one (1) slewing and luffing stacker, for longitudinal limestone storages for storing coarse limestone, fully equipped with water spray for dust suppression
- one (1) covered limestone stock yard, consisting of 1 longitudinal limestone storage, with a minimum capacity of ninety (90) days of total supply (BMCR operation with high sulphur coal), including roof coverage to prevent dust emissions and to protect against rain and also including dewatering system and limestone runoff pond
- water spray system for the limestone stock yard for dust suppression
- mobile equipment: two (2) front end loaders for limestone supply to the two (2) limestone hoppers
- all belt conveyors and transferring towers needed to supply the limestone to the limestone yard
- all auxiliary devices for the trouble-free and safe operation of the limestone handling system such as: spray water system (complete for all areas), fire fighting system (complete for all areas), access systems in accordance with valid fire protection rules
- sump pumps for dewatering all underground tunnels/installations, if any
- the complete power supply, electrical distribution boards, earthing, etc.
- lightning protection for each of the equipment and towers.
- hoists and monorails.

Coal Unloaders/ Ship Unloader at Plant Jetty

193. Coal and limestone arrive via bulk-cargo vessels/barges with capacities between 3,000 DWT and 25,000 DWT at the facility's unloading jetty. Coal shall be unloaded from the ships by three (3) grab-types rail mounted grab bucket type unloader. The conveyors downstream of the unloaders shall be of the maximum unloading capacity of both unloaders working simultaneously. The unloaders shall be operated dust-free and be suitable to operate during rough weather conditions:

- At least one of the unloaders shall be connected to unload limestone from bulk cargo vessels to dedicated limestone conveyor belt system.
- The unloaders deposit coal via hoppers onto the coal jetty conveyor belts. From the coal jetty, the coal is moved via the receiving conveyor belts to the coal storage yard. Four (4) travelling stackers in the coal yard stack the incoming coal in a series of piles.
- The coal is reclaimed with portal scraper reclaimers onto the reclaiming coal conveyor belts, which transfer the coal to the boiler bunkers.
- Blending shall be either achieved on the coal yard itself, if vessels from different location will arrive in a staggered mode. The stacking equipment shall be able to use following stacking methods: Chevron, Strata (preferred), Windrow, cone shell.
- In addition blending shall also be achieved by parallel operation of two portal scraper reclaimers via coal blending silos. The blended coal is transported via belt conveyors to the crusher building and from there to the coal bunkers. If seen advantageous, the crusher station may also be implemented upstream of the coal yard.

194. An automatic sampling system for both the coal received from the vessels as well as of the coal being fed to the coal bunkers shall be foreseen. A fully covered coal yard shall be provided. The operational requirements are as follows:

- The coal handling system shall be designed with sufficient redundancy that the failure of any individual component shall not disrupt delivery from the jetty to the stackyard or feeding of coal to the station coal bunkers.
- The conveying and crushing system shall have 100% redundancy. The system shall be capable of offloading ships, feeding coal to the station coal bunkers and stocking out to the stockpile simultaneously. The unloading station shall also be used for unloading of limestone.

Care for Environment:

195. Run-off water from the coal yard shall be directed to the coal settling pond through drainage system and decanted water from settling pond shall be pumped to tank of dust suppression pump house. Sump pump with sump shall be provided for all under ground tunnel, building. The capacity of each sump pump shall not be less than 50 m³/hr. Minimum 10% margin on capacity and 20% margin on computed head shall be considered for selection of pumps.

196. The system shall be designed to handle the whole range and condition of coal that may be delivered to the site in a safe, reliable, economic and environmentally acceptable manner. Considering the fact that the coal delivered to the site may:

- be raw coal from open cast mines or beneficiated coal
- have a high clay content, contain fines, have a high moisture content, be sticky and difficult to handle
- contain rock, tramp metals, plastic sheets and other contaminants
- may be very dry, free flowing and dusty

197. The system shall be designed to handle oversize material and any metal contaminants must be safely detected and removed automatically from the coal handling system.

198. The complete coal handling system shall be possible to be operable for 24 hours/day. The design of the coal handling system therefore take care the nightly noise limitations into account.

Weather conditions

199. The coal handling system shall be designed to be able to convey in any weather conditions. With the expected rain conditions at site, the coal handling system shall be designed to deliver the required loading with the worst coal in terms of moisture content and mill primary air flow.

Design quality and standards

200. The coal handling system and auxiliaries shall be of standard proven design. The coal handling system shall be designed, manufactured and tested based on the ISO standards and CEMA Belt Book where applicable or equivalent codes, in particular:

ISO	5048	Continuous mechanical handling equipment Belt conveyors with carrying idlers
ISO	5049	Mobile equipment for continuous handling of bulk materials CEMA Belt conveyors for bulk materials.

201. The system shall be designed for ease of operation, maintenance, inspection and cleaning, as well as to prevent the undesirable effects of dust and water.

Technical Specification of Coal unloaders

202. The three (3) coal unloaders located on the jetty shall be of rail mounted grab bucket (screw (option)) type and shall be of proven design, with extensive track record and experience, applying all modern practices for easy and safe operation and rapid unloading with additional emphasis on accessibility for ease of maintenance.

203. The coal unloading system shall be capable of unloading all typical bulk-vessels/barges with capacities between 3,000 and 25,000 DWT.

204. The unloaders shall be able to simultaneously and independently discharge coal via their own hopper and via vibro feeders onto jetty conveyors. Anti-collision control devices shall be installed for the unloaders.

205. The unloading equipment shall be designed such, that the unloading (excluding berthing and unberthing) of the coal supply ships can be achieved in the following maximum time with one unloader in operation:

3,000 DWT ships:	3.5 hours
10,000 DWT ships:	11 hours
25,000 DWT ships:	27 hours

206. The unloaders shall be operable under the following operation mode:

- manual operation from the operator's cabin
- auto/semi-auto operational mode.

207. Three (3) wheel loaders shall be available for cleaning-up operation in the holds of the coal vessels.

208. Appropriate fittings shall also be included to facilitate lifting of the equipment by the unloaders from the jetty into the holds and vice versa.

209. Sufficient and adequate lighting shall be provided to ensure safe and efficient bulk unloading operations in all weather conditions at all times of day, including highly efficient floodlights along boom girder and the hopper area.

210. To ensure safe operations and travel on the unloading jetty, the unloader shall be equipped with amber strobe warning lights as well as audio warning units at the corners of the gantry bogies.

211. Power back up shall be provided to cater the event that during storm and a power failure the unloader shall be parked in save position. Arrangement for preventing Spilling of coal into the river has or any other unsafe operating condition shall be provided.

212. A storm anchorage system shall be provided for the crane. A passenger hoist to boom level shall be provided.

213. The machinery house and electrical room shall be located on top of the main girder as a single unit. It shall provide a weatherproof casing to the hoist travel bases as well as the electrical power distribution equipment. In the machinery house, an overhead travelling service crane shall be provided, capable of lifting the largest as well as the heaviest equipment included in the machinery house. The crane shall be able to service all parts and lower them to jetty level for servicing.

214. The electric drive control panels and PLC are to be located in an air-conditioned electrical room inside the machinery house. Visual observation of the mechanical equipment from the electrical room shall be possible via suitably large safety glass windows for ease of maintenance and operations. Walkways shall be provided for maintenance access to all points requiring attention.

215. Anemometers shall be provided on the top of coal unloader to indicate the wind velocity at the coal handling control room and operator's cabins. When the anemometer indicates winds above allowed maximum value, the grabber shall be parked in a safe condition.

216. All control functions of the unloader operation shall be carried out in the operator's cabin. Each cabin of the unloaders shall be designed as follows:

217. The cabin shall be totally enclosed with glazed design giving all round vision to the operator and shall be air-conditioned. The seat for the operator shall be adjustable to enable him to suit different operations. Hinged windows shall be provided where necessary to allow the windows to be cleaned. Electrically operated wind screen washers and wipers shall be provided where essential.

218. The whole operator's cabin shall be securely fixed to the unloader structure and able to withstand the maximum storm wind condition. Access to the cabin shall be convenient and safe.

219. The operator cabin shall be of rigid construction and be thermally and acoustically insulated. It shall be designed to facilitate the operator's safety, comfort and performance. Special attention shall be paid to the isolation of the operator from shocks and vibrations associated with the operation of the equipment as well as other ergonomic considerations.

220. Intercommunication system between the cabin and the foreman and cable between the cabin and the Coal Handling Control Room shall be provided. Loudspeaker to talk to the ground level or the hold bottom shall be provided. A clock and a manual chemical extinguisher shall be provided. A TV monitor, which shows the digging place, shall be provided.

221. A computerized system shall be included to provide continuous data monitoring and diagnostics for operation and maintenance purposes with the necessary sensors and transducers. The systems data shall be presented in an ergonomical way through a HMI (Human Machine Interface) in the operator cabin. The HMI shall allow the operator to control all machine functions in manual mode as well as operate the unloading automatically or semi-automatically (only start and end movements of the trajectory are manually controlled). The system shall include among others: bucket trajectory control, automatic grab closing, grab fill control, grab load monitor and adjusting system, vessel height monitoring.

222. Water spraying system shall be equipped on all coal transfer points from the digging device to the jetty conveyors so that dust emission can be reduced to a practicably minimum level. Dust suppression devices shall be provided for the receiver hoppers.

Technical Specification of Grab-type Unloaders

223. The gantry crane travel system shall consist of an arrangement of bogies with a driven and a non-driven wheel. The drive systems shall each be protected by rigid, heavy duty crash guards. Suitable overload and slack cable protection devices shall be provided. The construction shall make sure that the gantry corner weight is equally distributed to all wheels. Jacking support points shall be provided under the gantry frame to allow replacement of any wheels and pins. Shock absorbers and bumpers shall be installed on the ends of each bogie.

224. The winding drum mechanisms of the main hoist shall include hoisting, grab opening/closing, trolley towing and shall be mechanically independent and electronically synchronized in such a manner that operations are safe in every possible operation mode.

225. The trolley holds the load on the grab transmitted by the hoists and grab opening/closing ropes. The trolley is towed by the winding drum mechanisms on the rail mounted on top of the main and boom girders.

226. The trolley shall be easily accessible from the machinery-house while in parking position. This implies that shall be possible to lift or lower to ground every piece of the trolley, including wheel assemblies and sheaves assemblies, without difficulty by using the maintenance crane of machinery house.

227. The grab shall be suitably designed for the above mentioned vessel sizes as well as time efficient unloading. Furthermore, it shall accommodate lifting lugs to handle bulldozers and other mobile equipment.

Coal Conveying System

Belt conveyors

228. The coal conveyors from the coal unloaders to the coal yard shall cope at minimum with the maximum unloading capacity of the grab unloaders considering two unloader unloaded. It shall be ensured that two unloaders can discharge simultaneously onto one single belt conveyors.

229. The complete coal handling system from the coal yard shall be designed to meet the one day coal requirements of two units. The minimum conveying capacity for the coal handling system from the coal yard to the boiler bunkers shall be at least 2 x 1,200 t/h nominal capacity.

- The maximum incline of conveyors shall not exceed 14 degrees.
- The maximum speed of the conveyor belt shall not exceed 3.5 m/s.
- All belts must be capable to start fully loaded.

230. All conveyors shall be provided with an emergency trip wire system and shall be provided with misalignment switches to offer protection from belt damage.

231. All conveyors shall be provided with a belt speed detector on the return belt, to detect belt slip or severance to stop the drive before further damage to the belt system occurs.

232. The belt type shall be either synthetic fabric such as nylon-nylon/polyester-polyamide or steel cord belt (preferred for conveyors of more than 800m length). Belt types shall be with rubber covers of adequate flexibility for the troughing angle. Steel cord belt shall be provided with rip-protection.

233. Heat resistant conveyor belts according EN 12882 class 4 or fire retardant according to ISO 340 shall be provided for all conveyors. All splices are to be hot vulcanized.

234. Drum friction and electrical surface resistance shall be tested and conform to Canadian standard CAN / CSA M-422-M87.

235. All outdoor belt conveyors shall be fully enclosed. All over ground and overhead conveyors shall be located in suitably enclosed bridge structure. Structural steel bridges of adequate width and depth (2700 mm clear head room) shall be provided complete with conveyor bottom deck plates, seal plates, walkways of chequered plates with anti-skid arrangement(s), hand rails on both sides of each conveyor belt.

236. If full enclosure is technically not possible (e.g. for the jetty conveyor) a dust- and weather proof conveyor cover shall be applied. All outdoor conveyor covers shall be of galvanized steel and shall comply with BS 1449. The sheets shall be 0.7 mm thick. Both sides shall be coated to a minimum thickness of 200 microns on each side. Inspection doors including door support shall be provided in the conveyors.

237. All conveyors shall be fitted with internal and external belt cleaners. The belt cleaner shall be fitted with hard, durable materials for the blade to prevent damages to the belt.

238. Dual side-by-side conveyors shall be supplied with a 1.100 mm clear central main walkway and 800 mm clear side auxiliary walkways.

239. Checkered plate shall be installed across the full width of all walkways and minimum 3mm thick seal plate shall be installed for the remaining width of the structure. The checkered plate and seal plate shall prevent equipment from falling and allow safe access to

the far side of the conveyor for maintenance. The minimum height of the conveyor crossing over any road shall be 8 meters and in case of the main access road 8 meters.

240. All transfer points shall be located in an enclosed transfer house or tower, where the enclosure shall be done up to last operating floor and where the enclosure shall offer protection to the drive assembly of the conveyor and associated plant. Each junction tower shall be equipped with an access area, a minimum of 1.5 meter wide around the drive and pulley locations, to facilitate the routine maintenance of the equipment.

241. All conveyors and transfer towers shall be designed to permit easy access for 'bob cat' type equipment to clean up spillages that might occur beneath the conveyor structure. The shell and diaphragm sizing of pulley shall be according MEHA.

Chutes

242. The design of the chutes shall be suitable for the trajectory of the coal as it leaves the conveyor, so that minimum wear takes place and no spillage occurs. The size and shape of the chutes shall ensure free flow of coal at the transfer point, without plugging even under extreme moisture.

243. Chutes shall be fabricated from wear resistant steel plates, Hardox 400, 400HBN or higher quality. The material selection shall assist the free flow of coal. The thickness of the chutes shall be 20mm for the three sides where coal slides/impacts the chute and 10mm for the chute wall that is not subject to abrasion. The chutes shall include external integral stiffeners and shall be provided with support brackets to attach chutes to adjoining structures. Chutes and supports shall be designed to withstand the load imposed by a totally plugged condition and also designed so that the load is shared by the floor(s) the chute passes through.

244. Chutes shall be provided with permanent lifting lugs and shall be designed to allow removal of parts or the entire chute without removing other equipment such as conveyor pulleys, crushers, etc.

245. Suitable access doors to allow ease of maintenance to items such as detectors, bearings, liners and belt cleaners shall be provided for all chutes.

246. Chutes shall be provided with 12 mm thick abrasion resistant wear plates at impact points and bolted with countersunk screws.

247. Chutes, which feed onto conveyors, shall be supplied with skirt boards. A suitable soft rubber dust curtain shall be provided on all entries into conveyor head chutes and also at the end of each covered skirt plate area.

248. A suitable arrangement, i.e. tilt-switch or better, shall be provided to indicate a blocked chute.

Belt conveyor drives

249. The drive system for the various conveyor systems shall consist of drive motors, fluid couplings, gear reduction, low speed flexible couplings and pulleys. Hydraulic drives or controlled start transmission (CST) drives may also be considered.

250. Rating of all drive motors shall not be less than 120% of the power required at drive motor output shaft at specified design capacity. The motor rating shall be at 50°C ambient temperature.

251. For replacement of spare parts all components must be easily accessible. Near the drive unit a local control cubicle (on/off) with key-operated-switch shall be foreseen.

Gearbox

252. The gearbox shall be designed for continuous operating and at least 80.000 operating hours. All gearboxes shall be of bevel-helical gearbox type and equipped with splash lubrication. The gearbox must be equipped with outside oil level indicator.

253. For replacement of oil the gearbox shall be located such that full size oil containment can be placed below the gearbox. The oil screw cap shall be easy accessible.

Clutch

254. Between motor and gearbox a fluid coupling/fluid clutch shall be installed. The clutch shall be connected directly to the motor and allow easy inspection of the oil level without the need for tools.

255. It shall be possible to repair the clutch without disassembly of the motor or gearbox.

256. Adjustment of the start-up delay time shall be possible. The construction of the bearings shall allow long lifetime.

257. The replacement of the clutch shall be possible without prior emptying of the oil and without disassembly of the clutch. The clutch design shall ensure that after re-assembly the system motor – clutch – gearbox is not necessary to re-adjust.

258. The maximum start-up torque shall be limited to 1.5 times the nominal torque. Contact free thermal limit switch for surface temperature of the fluid clutch shall be provided.

Brakes

259. Belt conveyors shall be equipped with wheel-disc brakes which shall be installed between clutch and gearbox, the brakes shall be designed for the full capacity.

Pulleys

260. All pulleys shall be welded construction and balanced after machining. Pulley diameters shall follow DIN 22 101. The drive and tensioning pulleys shall be equipped with rough surface. Adequate support and / or lifting hoists shall be foreseen, also for taking the load of the belt. For interchangeability reasons, the belt pulleys for the different conveyors shall be preferably identical, as far as practical. The pulley shafts sizing shall be according CEMA.

Pulley bearings

261. Bearing with permanent lubrication (grease box) shall be installed. The bearing house shall be of split type with removable cover. The design lifetime of the bearing shall not be less than 80.000 operating hours.

Belt cleaning

262. Downstream of the discharge belt cleaning by scrapers shall be installed. For reversible conveyors two belt cleaners shall be installed suitable for reversible operation. Limit switches for each belt cleaner are required. The coal attrition shall be directed to the downstream chute. Belt cleaners shall be easy accessible and easy replaceable. An inspection opening shall be installed for checking of each belt cleaner.

Rollers/Idlers

263. Only rollers/idlers that follow DIN 15 207 part 1 shall be used. They shall be of low-noise type. The calculated life time of the bearings shall be minimum 80.000 operating hours. The roller arrangement and the trough shape of the conveyors shall follow DIN 22 107. For the upper belt 3 identical rollers shall be used. The distance between rollers shall be selected such to ensure deflection of maximum 2%, preferably less than 1%.

Belt tensioning/take-up

264. For short conveyors length (up to approx. 50m length) an adjustable spindle-type belt tensioning system shall be provided. For long belt conveyors a weight tensioning system shall be provided, complete with all necessary take-up equipment as: bend pulleys, take-up pulley, supporting/sliding assembly, wire ropes with turn-buckle arrangement for suspending the take-up weight sliding assembly close to the ground, counter weights and other accessories.

Belt weighers

265. Four (4) automatic belt weighing stations consisting each of two (2) belt weighers of load cell type shall be provided on the belts from the jetty to the coal yard and two (2) belt weighers of load cell type shall be provided on the bunker feeding conveyors. Each weigher shall be provided with indicating and continuous integrating mechanism arranged for easy observation. The accuracy of the weighing system shall be within $\pm 0.25\%$ at 20 to 120% of total belt conveyor capacity. The coal flow rate shall be transmitted to the Coal Handling Control Room and/or the integrating figures to the coal sampling systems for their operation. Integrating data per bunker shall also be transmitted to the Coal Handling Control Room. Belt weighers to comply with relevant ISO standards or comparable, including but not limited to DIN EN 61326, IEC 1000-4 (3/4/5/6), DIN VDE 0843.

Online coal analyzers

266. Four (4) nos. online coal analyzers, one for each belt conveyor line shall be installed on the coal conveyors from the coal yard to the boiler bunkers before and after coal blending silos. The online analyzer shall be of cross-belt type and shall give real-time information about total moisture, ash, sulphur and determine the heating value. The analyzer shall be fully contained in a heavily shielded enclosure that contains the radioactive source and all electronics. Interfaces with the DCS and with the PLC display system shall be provided. The complete system shall not cause any radioactive pollution or unacceptable radiation to operating and maintenance staff. The analyzer system shall not contain any wear parts.

Travelling tripper cars/mobile shuttle conveyors

267. Two (2) travelling tripper cars/mobile shuttle conveyors per unit shall be provided. The tripper cars/mobile shuttle conveyors shall be arranged such that the feeding of each unit can be performed simultaneously. During switchover from one bunker to the next bunker it must be possible to feed the bunker without interrupting the feeding procedure.

Coal sampling equipment

268. Four (4) automatic coal sampling systems shall be provided on the receiving conveyors to sample the coal from the vessels and on the bunker feeding conveyors.

269. Sampling shall be in accordance with ISO standards or equivalent. The coal sampling units shall be suitable to provide samples that follow ASTM-D-2234. The automatic sampling equipment shall be complete with all necessary samplers, belt conveyors, belt

feeders, chutes, crushers, dividers and turntables. The different equipment selected for the coal sampling units shall be such that there shall be no loss of fines and moisture from the samples.

270. The first sampling equipment acts as primary sampler, which determines the quality of the coal received from the coal vessels. The primary sampler shall be operated automatically by interlocking with the conveyor scale. The primary sampler has to sample from entire width of the conveyor. Four (4), one for each line, spoon type sampler shall be provided.

271. The equipment shall have a maximum sampling capacity to cater to a consignment at once. The final sample shall be automatically filled in a can of 15 kg capacity on the turntable and the rejected portion of the sampled coal shall be returned to the main conveyor lines respectively.

272. The second system, the secondary sampling system, samples the coal stream, which is supplied to the bunkers. This automatic sampling equipment shall be complete with all necessary samplers, belt conveyors, scales, crushers and turntables. The equipment shall have the maximum sampling capacity of the maximum coal consumption for the unit and have the function for managing the samples.

273. The equipment shall be completed with a bucket elevator, belt conveyors, a scale, dividers, a drying tumbler, an auto packer, feeders, crushers and a turntable. The samples shall be treated to a size under 0.25 mm for the analysis. Stainless steel shall be used in the fabrication of all moving parts.

274. Sample crushers (make subject to Employer's approval) shall be provided for reducing the main input feed coal to 95% minus 8 mesh size and 100% minus 4 mesh size. Single stage crushing shall be provided. There should be no re-circulation of fines in the crushers.

Screening and Crushing Equipment

275. The screening and crushing of the received coal shall occur in the Crusher House.

276. Two (2) vibrating screens shall be provided on the coal belt conveyors from the jetty to the coal yard. The vibrating screens shall remove rock and contamination in excess of 100 mm from the coal stream. The vibrating screen bars shall be manufactured from a cast manganese alloy. Alternatively perforated deck may be provided.

277. Four (4) magnetic separators shall separate ferrous materials, such as tramp iron, bolts, nuts etc. The system shall be capable of separating tramp iron pieces, starting from 0.05 kg up to 50 kg of individual mass. Two (2) separators shall be installed in the coal receiving system, one in each line, and two (2) shall be installed one in the bunker feeding system, upstream of the coal crushers. The magnetic separators shall be fixed type.

278. For the arrangement of the metal detectors, care shall be taken that due to the use of metallic and/or magnetic material near the metal detectors no negative effect will occur on the function of the detectors. The sensitivity of the metal detector shall allow detection of any metal part of approx. 10 mm diameter or 40 mm length. The sensitivity of the metal detector shall be adjustable.

279. Two (2) vibrating screens shall be provided on the coal belt conveyors from the coal yard to the boiler bunkers. The vibrating screens shall separate coal particles larger than 50mm size and feed this oversize material to the coal crusher. The fine fraction shall bypass

the coal crusher. The vibrating screen bars shall be manufactured from a cast manganese alloy.

280. Two (2) crushers, preferably of ring granulator type, shall be supplied, which each shall be designed to crush the oversize fraction of the coal that is screened off. The coal crushers shall be sized to provide the desired coal size for the coal mills.

281. Provision shall be made to seal the inlet and outlet opening of the crushers to prevent the emission of dust during operation. The crusher shall be constructed to allow disassembly inspection and replacement of worn out parts. The construction of the crushing equipment shall be rugged and extra heavy-duty casings shall be provided. Shafts shall be generously designed in cross sectional area and fitted between heavy-duty roller bearings.

282. Since the screens and crushers cause large noise and vibration, special care shall be considered for sound insulation to limit the noise levels below permissible limit.

Dust Extraction System

283. Dust extraction system shall be either wet type dust extraction system for Vibrating Grizzly Screen and Belt Feeder in crusher house. The dust extraction system shall be of Venturi scrubber system. One independent dust extraction system for each stream shall be provided (Total 2 nos. system to be provided). Dust extraction system may have multiple Units in each of the independent dust extraction system.

OR

284. A dust collecting system using bag filters shall be provided in the crusher house for belt conveyors, screens, samplers, sample preparation equipment and crushers. Collected dust shall be returned to a suitable point on the coal stream. Filtrated air through the bag filter shall be exhausted outside of the house. Suitable measure shall be taken into consideration during design to avoid firing at bag filter.

Covered Coal Yard

285. The Coal yard system shall be suitable to cover the complete coal yard. The cover shall be suitable to protect the environment from dust pollution from the coal yard during dry season and to protect the coal from heavy rainfalls during monsoon, such that the moisture of the coal reclaimed from the coal yard differs by less than 1 % (relatively) from the moisture of the same coal stacked as it was stacked onto the coal yard. The coal yard coverage may in no way inhibit the normal operation of the coal yard, and the coal stored in the covered portion may be both stacked and reclaimed at will at any time.

Coal Yard Equipment

286. The coal yard equipment and mainly the conveyor belts and the stacking and reclaiming machines have to be designed considering the following operation philosophy:

- The coal yard shall have sufficient storage capacity for ninety (90) days of operation (total storage) at full load (i.e. 100% BMCR with the worst coal), of which up to a maximum of 5% may be passive (i.e. only accessible via bulldozer).
- The coal yard equipment shall have the capacity to stack coal at the same rate that the ship unloaders and conveyor system can supply it, sufficient capacity to reclaim at the same rate that the conveyor system can supply it to the station coal bunkers for all bunkers at 100% BMCR with worst coal.

- Stacking shall be performed at the maximum capacity of the unloading devices. Redundancy of the same capacity shall be considered for the stacking purpose and in function of the proposed number of stockpiles.
- The reclaiming operation shall be performed at the minimum capacity of the station coal bunkers supply system (min 2 x 1,200 t/h each). Redundancy of the same capacity shall be considered for the reclaiming purpose.
- The discharging conveyors shall be redundant. Each line shall have a capacity of 2 x 100 % BMCR capacity plus 10% with worst coal (min. 1,200 t/h each).
- Two (2) heavy-duty bulldozers (Caterpillar D9 or equivalent) operated with HSD shall also be provided to allow further moving of coal on the coal yard.
- Sufficient redundancy is to be incorporated into the design to ensure that no failure in any part of the system shall cause the loss of coal supply to the station coal bunkers.

287. In the reclaiming operation, coal on the stockpile shall be reclaimed by the portal scraper reclaimers (option: travelling, slewable, luffablebucket wheels), and then transferred to the yard conveyors through hoppers.

288. The reclaimer shall have in-machine coal hoppers and constant feeders to adjust the discharging coal flow for the coal blending operation. The stacking and reclaiming equipment shall be operable under the following operation modes:

- manual operation from the operator's cab
- semi-automatic operation from the Coal Control Room.

289. Anemometers shall be provided on the roofs of operator's cabins to indicate the wind velocity at the control panels. Access to and on the machines shall be by means of walkways, stairways and ladders. However, ladders will only be used if it is difficult to install stairs.

290. Anti-friction bearings shall be used in such parts that continuously rotate at high speed as pulleys, gear reducers for belt conveyors and travelling units and high speed rotating parts of other gear reducers. The conveyor pulley shall be, in principle, of shaft rotating type.

291. The driving pulley shall be herringbone grooved rubber lined, and the driven pulley of the boom top shall be crowned to avoid misalignment of conveyor belt.

292. The coal yard machines shall have mainframe substructures supported on rail-mounted bogies. The substructures shall also support the boom gantries and counterweights on roller paths or large diameter slew bearings.

293. The stacking and reclaiming equipment shall be operable semi-automatically from the Coal Handling Control Room. Semi-automatic meaning, that the task to be provided (stacking or reclaiming at a certain rate at a certain site with a certain feed rate) shall be established from the Coal Handling Control Room, and then be performed without human interference. Nevertheless, a manual operation shall also be possible, from a local operator's cabin. These cabins shall be suitably equipped and shall provide an uninterrupted bird's eye view of the stacking and/or reclaiming operations. The cabins shall be arranged in the center of the machine and be equipped with a camera (controllable angle, tilt, zoom) at the boom end. The cabins shall be resiliently mounted, sound- and dustproof and air-conditioned.

294. The coal yard machines shall be capable of travelling in either direction between the coal stockpiles running on heavy-duty rail track, which must be permanently secured on foundations. Integrally mounted rail clamps designed to operate on the rail track, shall be provided on the stacker and reclaimer bogies. Both, manual and hydraulically operated rail clamps shall be provided on both sides of the rail. These clamps shall be capable of retaining the structure in a wind velocity of 35 m/s, which is defined as the instantaneous gust velocity at the anemometer.

295. The coal yard machines shall be capable of operating in wind speeds up to 16 m/s at which speed the rail clamp shall be automatically applied.

296. Rail cleaners shall be provided on the both ends of the machines for protection of the travelling wheels.

297. All coal yard machines shall be designed to operate in conjunction with the coal yard conveyors and travel the full length of the coal storage yard. Three (3) meters distance shall be provided between the coal piles and foundations of coal yard machines to be provided for the use of bulldozers.

298. Each coal yard machine shall comprise of a travelling portal frame straddled over the yard conveyor, a slewing and luffing belt conveyor with a stacking chute attached on its end, and a trailed tripper for stacking and shall be of counter-balanced type utilizing link mechanism.

299. All necessary facilities including foundations and track rails shall be provided and installed. Necessary interlocks shall be provided to prevent collision between the yard machines and any adjacent coal plant structures especially the adjacent yard machine.

300. Rotation of the superstructure supporting the gantry and boom or conveyor boom shall be achieved by a minimum of two slew drive assemblies consisting of an electric motor driving through torque limiting coupling, brake and gear reducer.

301. The coal yard machine boom limit shall be 0.3 meters above the ground level of the coal stockpiles. The boom lengths shall be designed to be capable of stacking the coal to the stockpiles. Indicating equipment shall be provided in the operator's cabins.

302. The discharge chutes shall rotate with the boom and direct material from the boom conveyors into the in-machine hoppers when reclaiming. Impact table skirt-board sections shall be located at the bottom of the discharge chutes to receive reclaimed material into the in-machine hoppers. Plugged chute devices shall be located at the transfer points to shut down conveyors loading into the blockage.

Portal Scraper Reclaimer

303. Each reclaimer shall consist of a portal structure mounted on end carriage beams and bogies running on rails on either side of the stockpile.

304. A scraper conveyor consisting of chain driven scraper bars is mounted from the portal frame and covers the width of the stockpile.

305. The chain conveyor shall include a mechanism for raising and lowering the scraper conveyor. The raising and lowering mechanism shall include appropriate safety devices and interlocks.

306. The reclaimer shall be capable of remote automatic operation without an operator on board and also manual operation from a cab mounted on the reclaimer. The reclaimer local control cab shall be air conditioned.

307. The reclaimer shall send basic data such as position, mode of operation and fault alarms to the coal plant control room. The following modes of operation shall be provided:

- automatic reclaiming,
- automatic relocation to the parking position,
- manual movement to any position,
- manual reclaiming.

308. The reclaimers shall be designed to operate in a dusty environment and shall be capable of handling wet coal and dry dusty coal with a high fines fraction. Each reclaimer shall be capable of reclaiming minimum 1200 tonnes per hour. The portal structure shall be designed to a recognized international structural steel design code. The reclaimer shall be fitted with rail clamps to prevent movement under the highest wind loading.

309. The reclaimer shall have a variable speed long travel, with higher speeds used for reclaimer relocation. The reclaimer frame shall be fitted with dropping stops to limit the drop of a bogie to 20mm in the event of a wheel failure.

310. The reclaimers shall be designed for ease of operation, inspection and maintenance and for access for adjustment and component replacement. The reclaimers shall be designed to accommodate rail installation tolerances. The reclaimers shall use standard components to the greatest degree possible including (wherever possible) with stacker components.

311. The reclaimers shall be designed so that all routine maintenance can take place between reclaiming operations. All platforms ladders and walkways required for maintenance of scraper, raising/lowering mechanism, all movement systems, cable reel and electrical equipment shall be included in the scope of supply.

312. Bearings shall be protected from dust, spillage and wash water. Hydraulic cylinder seals shall be suitable for the operating environment.

313. The reclaimer shall be fitted with energy absorbing impact buffers. The reclaimer shall have an anti-collision system installed.

314. An automatic fire detection and fire extinguishing system shall be provided for the electrical equipment enclosure. The fire extinguishing system shall comply with the relevant local legislation and NFPA codes for such systems.

315. The scraper blades shall be carried by two drive chains which shall be supported by guides. The roller shall be designed to accept side thrust due to scraper movement. The chains shall be heavy duty chains. The chain drive shall be an electric motor with a fluid coupling. All surfaces in contact with coal during the reclaiming process shall be lined with erosion resistant material.

316. Transfer chutes shall be designed to transfer reclaimed coal from the scraper onto the conveying belt without spillage.

Dust suppression systems

317. A water spray system shall be supplied to suppress the coal dust. The dust suppression system shall be provided wherever dust formation may occur, including at minimum but not limited to the ship unloading discharge hoppers, the coal belts, the transfer towers, the stacker conveyor discharge points, the reclaimer, along the complete length of the coal yard and for the coal bunker feed points.

318. Spray nozzles shall be installed along the length of the both sides of stockpiles. The spray nozzles shall cover all the area of the coal stockpiles, including the stockpile faces.

319. The water spray system shall be piped and divided into groups in order to facilitate sequential or progressive step spraying from the coal handling control room.

320. The sprays shall form a mist suitable to settle fine dust particles, which become airborne during strong winds. The mist spray shall be able to cover the whole area and reach the maximum height of the coal piles.

321. The system shall be complete with all the necessary components including vessels, pumps, piping, valves, anemometers and all control and instrumentation.

322. At all transfer points dust suppression shall be installed, e.g. as dry fog dust suppression systems.

323. It has to be ensured that water spray does not add any salt/chlorine to the coal on the coal yard. Water spray shall be preferably rainwater/drainage water that is collected. If rainwater is not available service water has to be used.

On-Machine Water Spray System

324. The entire yard machines shall be supplied with self contained dust suppression systems of the atomized water sprays type at all transfer points and the bottoms of booms for coal piles.

325. The spray nozzles shall be supplied with water from tanks located on the yard machines, and filled with water by a snap-on hose connection from points located on the pipe work of domestic water lines installed along the rails.

326. The sprays for the atomized mist shall consume a minimal amount of water, while offering a width of spray suitable to settle the airborne dust particles.

327. Connections from the above water supply system shall be provided and fitted with purge jets to clean chutes and hoppers.

328. The systems shall be complete with all the necessary components and shall include but not be limited to storage tanks, pipe work, valves, pumps, controls and instrumentation.

Coal Handling Control System

329. A comprehensive and efficient system of control and instrumentation(DCS based control system) for all of the equipment included in this specification shall be provided to give:

- remote sequential and remote individual start and stop control and necessary monitoring system for the coal handling conveyor system under VDU operation system. VDU controller shall have hot stand-by redundancy
- local control for conveyor system

- automatic/manual control for the reclaimers
- coal yard management computer system with uninterruptible power supply (UPS).

330. The main functions of the coal yard management computer to be installed in the coal handling center shall be:

- data acquisition related to coal movements, coal handling equipment and ambient conditions
- stock inventory control of the coals in the yard
- anti-collision calculations for stackers, reclaimers and other machinery, with initiation of alarm and stop commands to the machines.

331. The system shall be operable with the following operation modes, as selected by the operator in the coal handling control room:

- remote sequential operation mode
- remote individual operation mode
- local operation mode.

Coal handling control room

332. The coal handling control room shall be located in one ancillary building. The rooms shall be air-conditioned. In the coal handling control room the following systems, desks and panels shall be installed:

- four (4) interchangeable VDU operation systems each with redundant controllers. Each controller shall support all four VDUs.
- two (2) Large Video Screen with size 65" - 70"
- two (2) yard management computers with CRT's, interchangeable.
- back-up panel (Large screen display, TV's, alarms, switches etc.)
- control desk
- printers, hard copier with console
- fire alarm monitoring panel.

333. These electronic devices shall be of the same technical characteristics than the one installed in the Central Control Room (CCR) of the unit. A minimum amount of important alarms and information about the status of the coal system shall be sent to the CCR.

Coal Blending Silos

334. Two (2) blending silos, located between the coal sock yard and the boiler day bunkers, shall be provided, including at least:

- steel silo with minimum 1000 Te/hr effective storage capacity
- level monitoring equipment incl. minimum level indicators, maximum level indicators and continuous level monitoring
- dedusting system

- frequency controlled or hydraulically controlled discharge/dosing equipment for controlled between 0 t/h to 1000 t/h for any coal from the coal range as defined in Part C Annex M-01
- all required chutes
- all required structural steel, platforms, weather protection and dust suppression.
- Required coal conveyors.

335. The coal extraction system (rotor extractor, scraper arm reclaimer) of the silos shall be of robust design and allow for a controlled coal flow in a wide range.

Limestone System

336. Generally the same special technical requirements shall apply for the limestone system as for the coal handling system.

Limestone Yard Equipment

337. The limestone yard equipment and mainly the conveyor belts and the stacking-reclaiming machines have to be designed considering the following operation philosophy:

- The limestone yard shall have sufficient storage capacity for ninety (90) days of operation (total storage) at full load (i.e. 100% BMCR with high sulphur coal).
- The limestone yard equipment shall have the capacity to stack limestone at the same rate that the ship unloaders and pipe conveyor system can supply it. If the capacity is lower than the nominated capacity of the ship unloaders, adequately sized buffer hoppers shall be provided.
- The reclaiming operation shall be performed by mobile front end loaders into the limestone unloading hopper of the limestone milling system. N+1 redundancy shall be considered for reclaiming.
- Two (2) front end loaders for limestone supply to the two (2) limestone hoppers shall be provided.

Pipe Conveyor System

338. The gypsum pipe conveyor shall also be used to transport limestone from the jetty to the limestone storage. The pipe conveyor system shall consist of:

- two (2) x 100% limestone/gypsum pipe conveyors of, each, including
- transport and dosing systems with chutes from intermediate gypsum silo to pipe conveyor loading station
- chutes and transport system from pipe conveyor unloading station to gypsum storage silo at jetty
- pipe conveyor with drive stations
- structural steel for conveyor support with walkways and stairs/ladders are required distances
- belt cleaning
- belt tensioning
- safety devices (emergency trip wire, etc.)

- dust suppression, wherever required
- weather coverage and ventilation at loading and discharge area.

339. The design of the pipe conveyors and equipment shall be in such a way that all regulations will be safely fulfilled for all operating conditions. All obligations of the system shall be fulfilled by the design of the systems.

340. The equipment of the pipe conveyor system shall enable fully automatic operation, including startup and shut-down remote-controlled processes. It shall be operated via DCS from the Central Control Room. Control shall be possible from respective LCC also. It must be possible to restart the conveyor fully loaded.

341. The belt conveyors must be adequate for the climatic site conditions. It must be safely avoided that any rain water can enter into the conveyor. The allowable capacity of a pipe conveyor shall be based on maximum 70% of the cross-sectional area of the actual inner diameter. Overfilling of the pipe conveyor must be safely prevented in all operating conditions. At each end of the belt conveyor belt cleaning must be provided. The cleaning system must be suitable for all different bulk materials that shall be transported. Belt cleaners must be easy accessible and easy replaceable.

342. In addition to the belt cleaning a belt washing and drying station shall be installed, if the remaining moisture film after gypsum transportation could cause hard deposits on the belt. An inspection opening shall be installed for checking of each belt cleaner. The calculated life time of the bearings shall be at minimum 80,000 operating hours. All chutes must be fully tight, non-clogging type and equipped with inspection and cleaning openings. The pipe conveyor must be designed and manufactured based on internationally recognized standards.

4.6.6 *Employment Generation*

343. Employment of a moderately big number of local and migrant workforces of about 150-200 people in different levels, i.e., unskilled, semi-skilled, skilled, technicians, etc. temporarily and permanently during construction of plant jetty will be encouraged by the EPC Contractor. Also, employment of local people will be provisioned during engineering surveys. In addition to this, for such a huge workforce a new market facility will be developed which will promote economic activity of the local producers, buyers, sellers, etc. This issue will also generate more employment opportunity in the area.

4.6.7 *Construction Philosophy of Coal/ Lime Stack Yard and Plant Jetty*

344. Coal yard and lime stone storage shall be constructed on already filled land. The land was raised/ filled up using river dredged materials. The construction of the labour camp is planned along with the general labour camp. As no filling works are required, no new area for quarry and borrowing activity is necessary. Excavated soil will be used as borrow material. Excavation work will be limited to already developed land. Presently there are no trees existing on the developed land inside the plant boundary. For accommodating about 150-200 workers, about 0.31 acres of land is required in the Project premise for labour camp.

345. Jetty construction area has very little vegetation and trees. The Jetty will be constructed with a retention wall at the water side. The base plate of the jetty will be supported by this retention wall and deep foundation/piling.

346. The majority of construction materials and plant equipment will be transported using water ways. Movement of heavy vehicle shall be mostly confined to project area which is away from the local community and wildlife area. A six (06) lane access road to site will be constructed (2 lane already constructed) which is passing through mainly non habitat area.

347. Wherever possible the contractor shall use electrically operated equipment.

348. Construction activity mostly shall be limited to day time. Jetty will be constructed in first phase for unloading of construction materials and equipment, which will require short period of about six months. In second phase, a full fledged jetty will be constructed for unloading and loading of coal and coal ash and lime respectively, which will require another 2.5 years.

4.6.8 Care for Environment during Jetty Construction

349. Solid waste generated during construction will be segregated in following category:

- i) Compostable
- ii) Re-cycleable
- iii) Landfill.

350. Accordingly, three facilities will be developed for above categories, i.e., composting facility, re-cycle facility and landfill facility.

351. The Project provisioned Reverse Osmosis (RO) Plant for meeting up the requirement of drinking and other consumptive water. For 150-200 workers, the consumptive and non-consumptive water requirement is about 8-10 metric tons per day. In addition to this, water will also be required for the officials involved in the Project work. Altogether the requirement of water will be about 11-13 metric tons per day.

352. Sewage from the labour camp and official residence will be collected in septic tank(s) having capacity of about 41-55 metric tons of organic solid waste would be generated in three years which would require sound management. Kitchen waste is about 54-68 kg/day to be generated from the official dorms and labour camp.

353. No untreated liquid waste will be discharge to any water body. Fuel oil and other hazardous materials will be kept in safe and isolated place away from water body. Various dust suppression measures are to be undertaken.

354. Silt curtains along river training works and/or other industry good practice management controls will be used to restrict the spread of sediment released during construction of Jetty/Materials Offloading Facility.

4.6.9 Role of EPC Contractor

355. The EPC contractor shall prepare the dust suppression and control measures. It will develop a Hazardous materials management plan along with fire fighting plan in line with international practise.

356. Hazardous waste will be disposed of following environment friendly disposal system by designated contractors.

357. Good housekeeping shall be adopted to reduce generation of construction wastes and the potential water pollution. The EPC contractor is also responsible implementing the EMP in totality and the same has been included the EPC contract document.

358. The EPC contractor shall follow the waste management plan included in the EPC contract document. It will continuously monitor the ambient air quality and shall take appropriate measures accordingly.

4.7 Associated Components (Navigability of the Passur Channel)

359. For improving the navigability for the coal transportation would require dredging from Mongla Port to Project Site Jetty. As such a separate EIA study was conducted by the MPA for dredging and duly approved by the DoE, where details on impact and mitigation measures for dredging have been suggested in the EIA. There are some other dredging activities, which will not directly related to BIFPCL, however, the Consultant would like to provide some brief description of such activities like navigability in this section. For maintaining the navigability of the Passur Channel, the MPA as responsible agency has conducted dredging program for removing the shoals/humps at different reaches of the Channel, which are considered as obstacle for smooth operation of the vessels. Accordingly, the MPA has conducted separate EIA studies to assess the impacts of the dredging operations at different reaches time to time as a routine activity to maintain the navigability and the study will provide full reference of those studies for the readers to consult with them. The dredging reaches are, (a) Dredging at outer bar, and (b) Base Creek to Mongla Port.

360. Recently in December 2014, the MPA has accomplished dredging in the harbor area of the Passur channel and has ensured safe movement of 7.5 m draft vessels along the Passur River from Outer Bar up to the Mongla Port. It is evident from the Navigable chart that a 7.5 m draft vessel require a depth of 5.5m CD (with 2.5 m tidal effects), which is available from Mongla port to the immediate downstream of Sabour Beacon. However, dredging is only required from Sabour Beacon to proposed Maitree power plant jetty based on bathymetry data of July 2015 where shoals are appeared.

361. The Mongla Port Authority maintains a demarcated navigation channel in Passur River for safe entrance and manoeuvring of ships. The channel is around 140 km long from Port's jetty to South end of the Port's limit at outer bar area. It is difficult to maintain a constant depth in the entire channel.

362. **Figure 7-22** shows long profile of navigation channel of Passur River with available draft. Currently, there is a draft restriction of 7 m at outer bar in between Jefford Light House Tower and Mongla Port Fairway Buoy (at south end of port limit) restricting vessel size upto 20,000 dwt to pass. While moving upward, the channel has sufficient draft of around 8 m upto Harbaria. From upstream Harbaria, the channel draft decreases below 5 m upto Power plant Jetty.

363. However, Mongla Port Authority plans to dredge the channel and increase the navigational draft to 8.5m at outer bar and 5.5 m from Power Plant Site to Base Creek as shown in **Figure 4-8**.

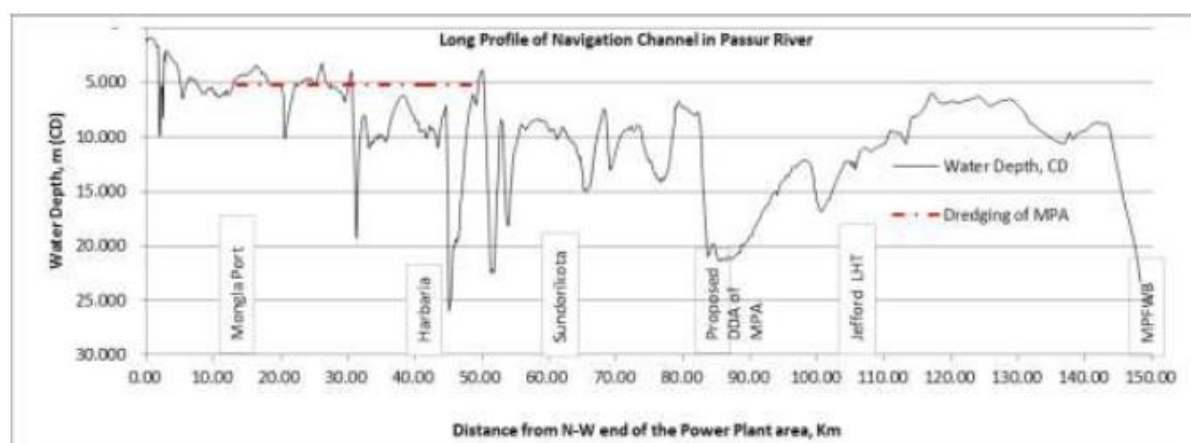


Figure 4-8: Long profile of the proposed navigational draft

4.7.1 Navigability of Passur Channel from Mongla Port to Plant Jetty

364. There is a requirement of dredging for ensuring navigability from Mongla Port LPG jetty of Kleen Heat Gas (Sabour Beacon) and power plant jetty. The total length of this dredging alignment is about 8 km. A feasibility study and EIA was conducted for the dredging of this section by the Government through the MPA for ensuring safe movement of coal vessels between Mongla Port to the Maitree STPP and the study reports are available. The EIA study report has been approved by the DoE on 16 November, 2015. Considering a draft of 5.5m CD and a channel width of 200m for safe movement and maneuvering of ships, it is estimated that the dredging volume will be 3.88 million m³. **Figure 4-9** and **Table 4-2** provide the location, length, width, volume of dredging required from Mongla Port to plant jetty and dredged spoil disposal sites. According to study report, maintenance dredging will be required about 40% to 60% of Capital Dredging. But practically, the required maintenance dredging is about 20% to 30% of Capital Dredging (MPA, 2017).

Table 4-2: Summary of length and volume of dredging¹

Alignment Reach (m)	Dredging Length (m)	Dredging width (m)	Design depth (m, CD)	Tolerance limit of Dredging (m)	Volume of dredged spoil (m ³)
Power Plant TG	500	300	5.5	0.30	6,50,480
Jetty front	500	200	8.0	0.30	6,06,076
Maidara-Jetty front	2,400	200	5.5	0.30	14,37,224
Digraj-Maidara	2,900	200	5.5	0.30	4,20,936
Sabur Beacon TG to Holcim C. factory Jetty	1,650	200	5.5	0.30	7,66,071
Total	7,950				3,880,787

¹ IWM (2015); Feasibility Study for Dredging of the Passur River from Mongla Port to Rampal Power Plant.

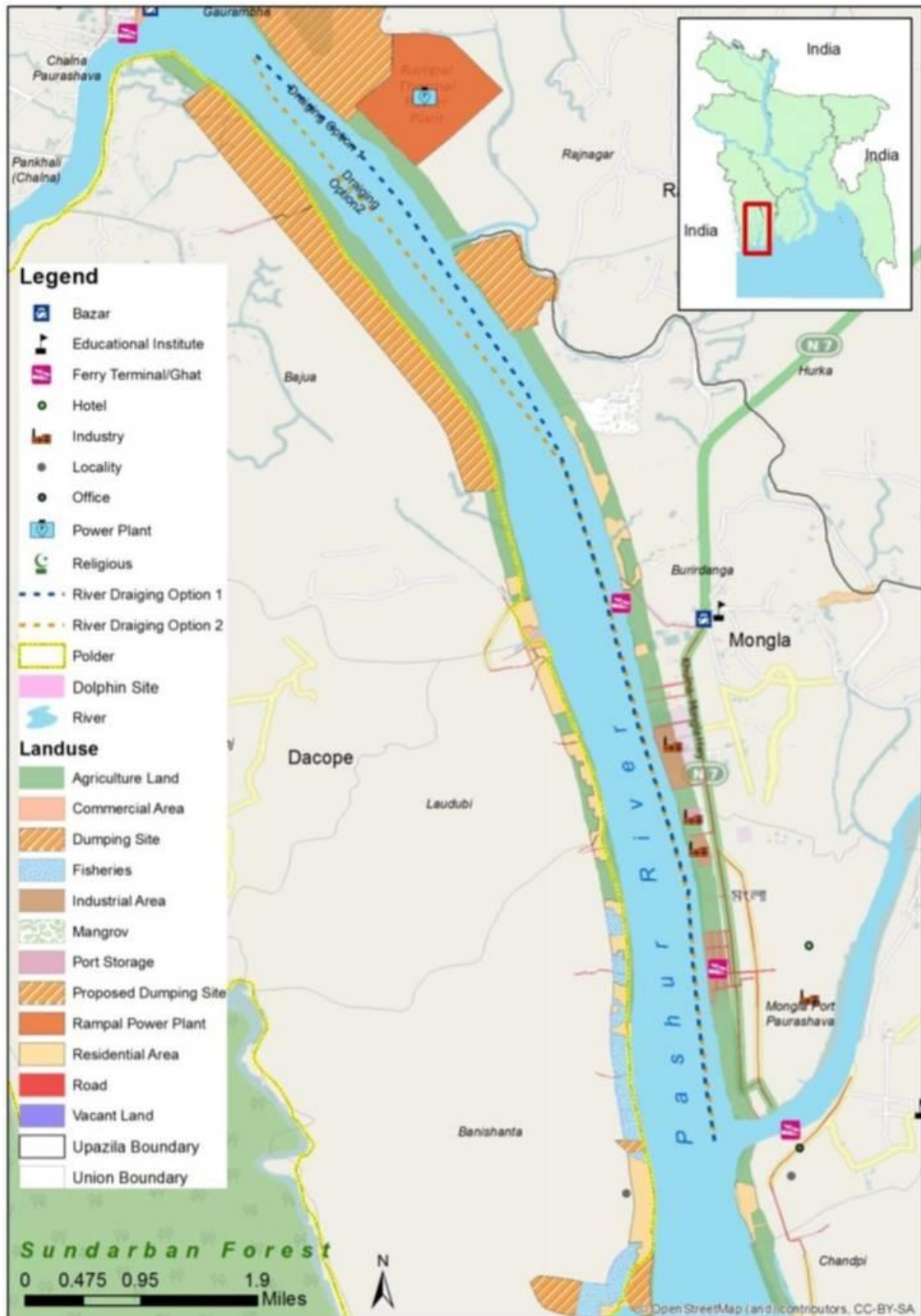


Figure 4-9: Proposed dredging alignment from plant jetty to Mongla and disposal sites

365. The IWM study findings indicate few suitable spoil disposal sites which were proposed by the local people around the Project area. All of these locations are primarily government acquired land and or private lands interested to fill their property. These potential areas are near dredging site along both banks of the Passur River. The survey result shows that more than 85 million cubic meter of dredged spoil can be accommodated in the undeveloped areas of Maitree STPP and surrounding areas which is more than sufficient for the expected dredged volume generated (3.41 million m³).

4.7.2 Navigability at Outer Bar

366. The length of Outer Bar area is about 16.5 km in which only about 11 km has draft restriction of more than 8.5 m draft vessel. Mongla Port Authority is planning to dredge this area, i.e., about 11 km at a width of 600-900 m. All dredged materials will be disposed at deep sea which is outside of Swatch of No Ground. The dredging requirement has been assessed on the basis of the recent hydrographic charts/maps of Mongla Port Authority (surveyed in 2013) taking the design draft of the ongoing dredging program under consideration. **Figure 4-10** presents alignment and location of the dredging. An EIA study was conducted by the MPA for the stretch along the Outer Bar, which is approved by the DoE on 25 August, 2013.

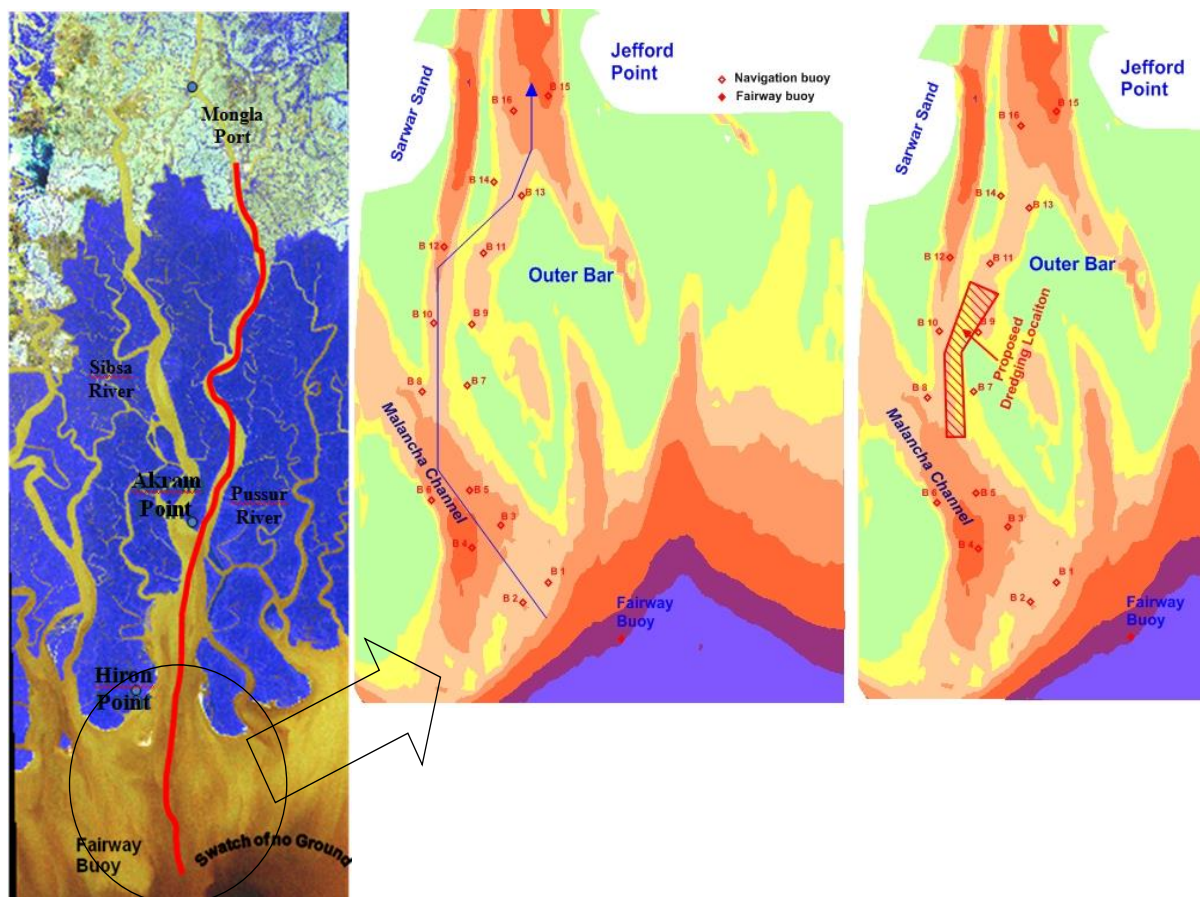


Figure 4-10: Proposed dredging alignment at Outer Bar

4.7.3 Navigability from Base Creek to Mongla Port

367. For maintaining navigability from Base Creek to Mongla Port, approximately 10 km of dredging will be required in a reach of around 10.8 km in between Base Creek to LPG Jetty of Kleenheat Gas (2 km upstream of Port's Jetty - 9 end). Mongla Port Authority has an ongoing dredging program by which the channel draft has already increased to 5.2 m CD for a channel width of 200m. Assuming design draft of 5.5m CD, the estimated initial dredging volume come to 0.6 million m³. The estimation of maintenance dredging has been made considering the pre-dredging condition of the River having a draft of 4.5 m. According to study report, maintenance dredging will be required about 40% to 60% of capital dredging. But practically, the required maintenance dredging is about 20% to 30% of capital dredging (MPA, 2017). The yearly maintenance dredged material volume will be 1.9 million m³.

5 Analysis of Alternatives

5.1 Alternative Means of Carrying out the Project

368. The Project has considered a number of components and activities in its design which were dealt in Section 4.6 of Chapter 4. One of the major objectives of the study is to ensure the environment friendly coal transportation and associated activities. Several alternatives to the currently proposed Project design have been considered, including for the following elements:

- Route selection for carrying coal from anchorage points to plant jetty;
- Type of bulk carriers to transport coal from load port to transshipment point;
- Transshipment/anchorage points for unloading and loading coal from bulk carrier to lighter vessels;
- Transshipment Process and Transshipper alternatives;
- Vehicle impacts, including barge traffic configuration and equipment specifications;
- Dust and air quality management systems, including fugitive dust mitigation strategies;
- Noise reduction and control methods;
- Coal unloading at plant jetty; and
- Marine traffic safety.

369. Industry best practices have been employed, where practical, throughout the Project design and operational plans. After a detailed review of the alternative options, BIFPCL concluded that other designs did not offer the level of risk mitigation that the current design allows for. Examples of alternative design components that were reviewed are presented below.

5.1.1 Route Selection

370. Three routes were studied to assess the geometric overview, socio-economic profile, and environmental settings of the routes. All three routes are shown in **Figure 5-1**. They are (1) Passur Chennel: Fairway Buoy to Maitree STPP Jetty via Hiron Point - Akram Point - Harbaria and Mongla Port (Option 1) and (2) Sibsa Channel: Fairway Buoy to Maitree STPP Jetty via Hiron Point - Akram Point - Chalna and through Sibsa – Dhaki - Chunkuri (Option 2), and (3) Mongla - Ghasiakhali Canal (MG Canal): Fairway Buoy to Maitree STPP Jetty via Mongla Port through Baleswar – Ghasiakhali - Mongla Nulla - Passur – Mongla Port (Option-3).

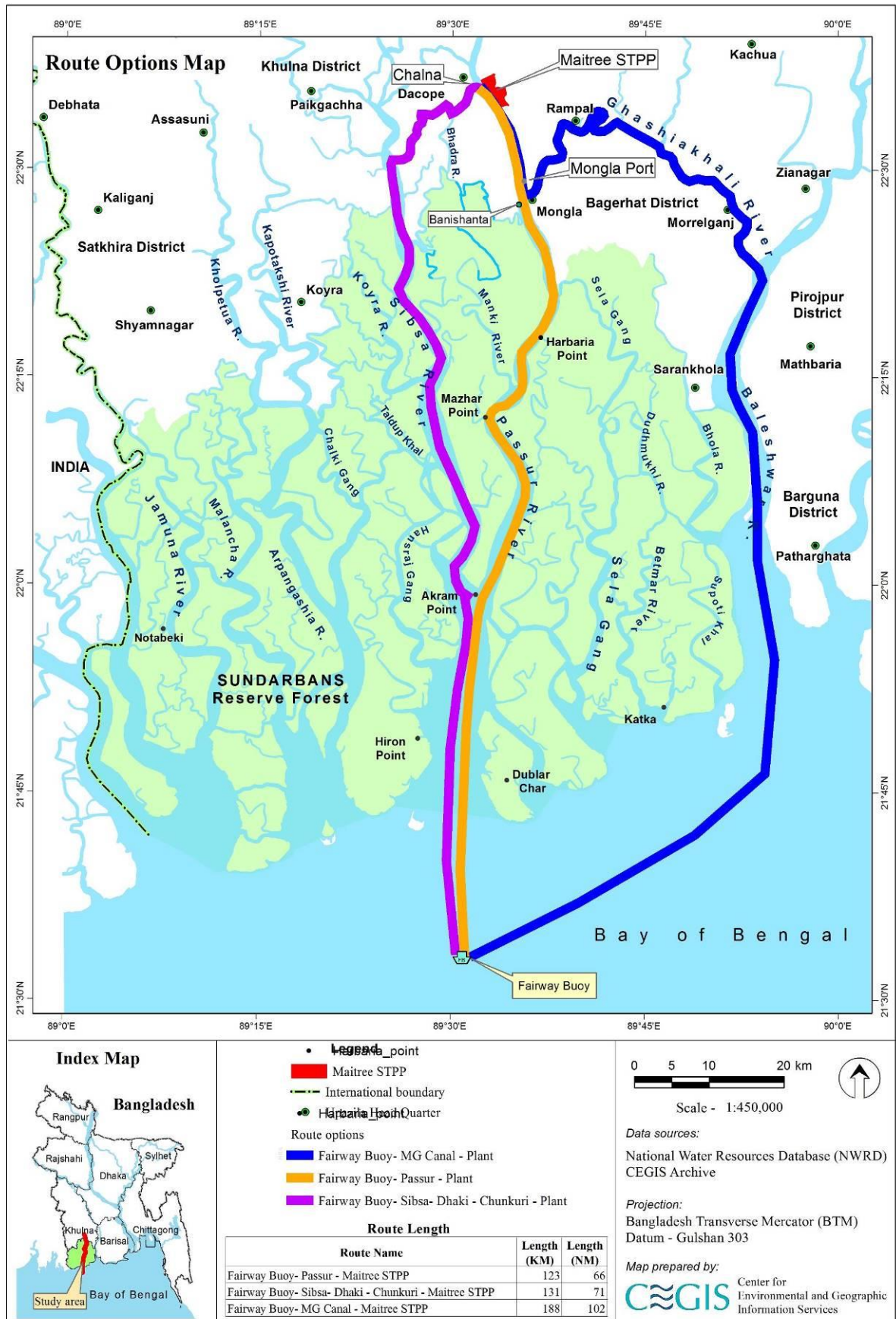


Figure 5-1: Alternative coal transportation routes

Option 1: Passur Channel

371. The route along the Passur is the designated maritime route of the Mongla Port Authority (MPA) and it has been maintaining the draft of the river to keep the port operational through maintenance dredging. It is the shortest route from the Fairway Bouy to the Maitree Power Project jetty about 66 NM. Mongla Port Authority keeps the route operational due to its mandate which will be positive for the coal transportation. As there will be a minor additional investment needed for maintenance dredging from Fairway Bouy to Mongla Port compared to other alternative routes. A comparison is made among the route options and presented in **Table 5-1**.

Option 2: Sibsa Channel

372. The distance of the route along the Sibsa Channel under Option-2 is 71 NM which is longer than Option 1: Passur Channel. Section of the route falls in connecting Chunkuri River / Khal, is more meandered river than others having sharp bents (**Figure 5-2** and **Figure 5-3**), which will pose potential threat for lighterage vessel movement with capacity of 10,000 dwt. Sporadic erosion along the Chunkuri Khal banks (**Figure 5-4**) has also been observed. It may aggravate due to the increase number of coal vessel movement. This Route Option will have more travel length within the Sundarbans than travelling through the Option 1: Passur Channel to the Plant site jetty. More information with other details are compared in **Table 5-1** and many of which are disfavour of using this route for coal transportation. As such this route was not recommended for coal transportation to Maitree STPP Jetty.

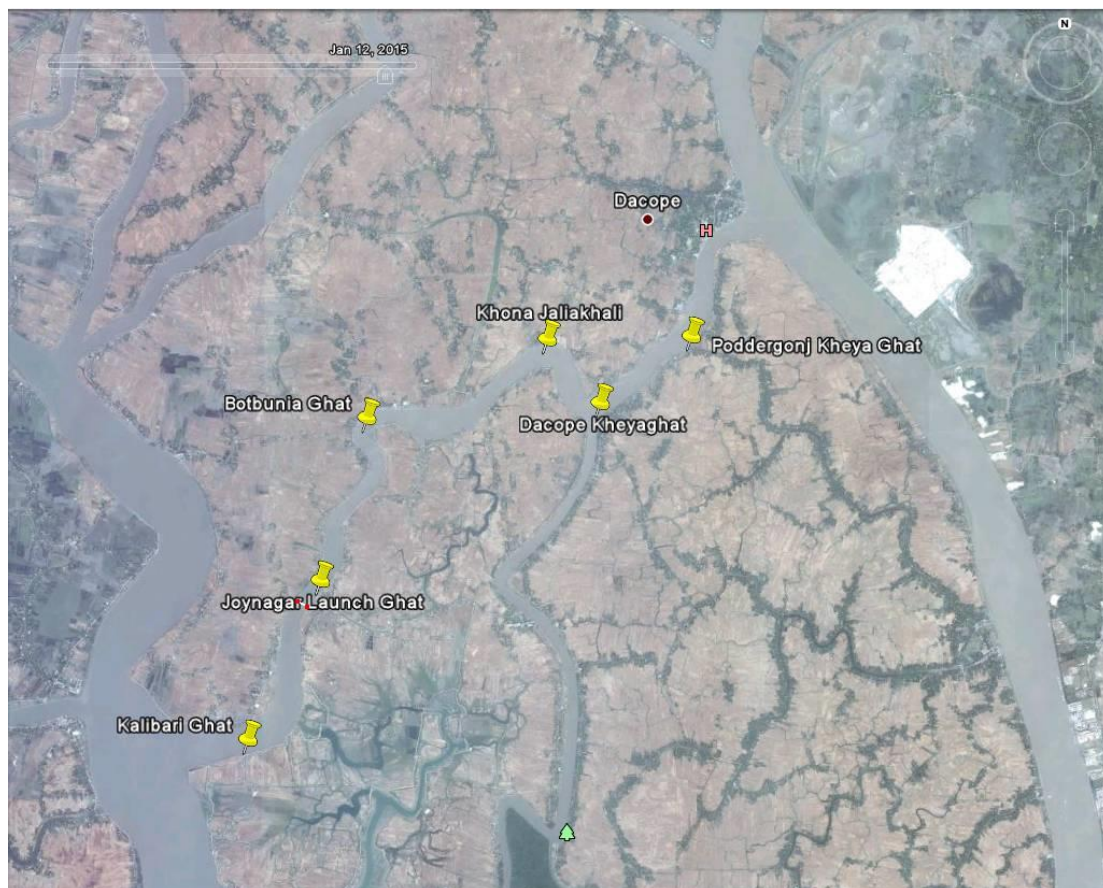
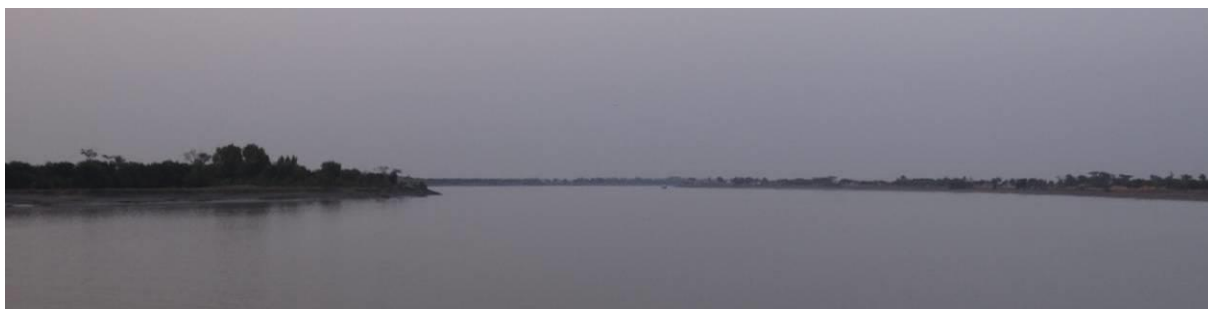


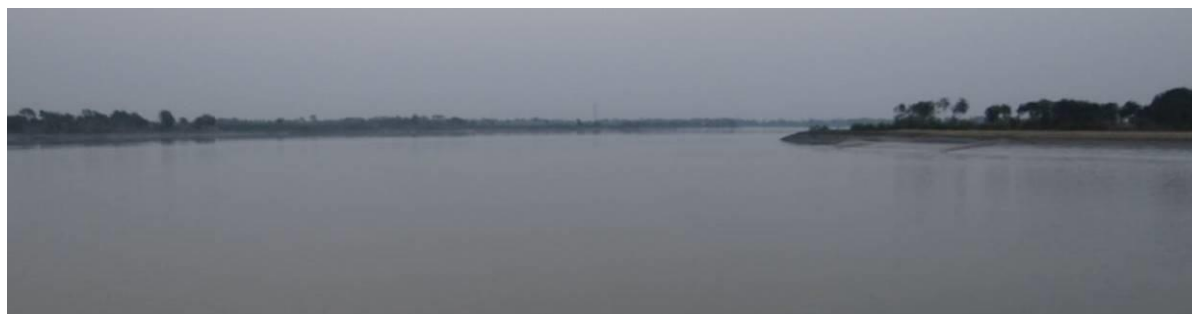
Figure 5-2: Bent points of Dhaki and Chunkuri rivers in the Sibsa route



Bent at Dhaki River near Kalibari Ghat



Sharp Bent at Dhaki River at Botbunia Ghat



Sharp Bending Point of Dhaki River at Jaliakhali



Sharp Bending Point of Dhaki River near Dakope Kheya Ghat



Confluence point of the Chunkuri-Passur River

Figure 5-3: Bents along the Sibsa route



Erosion at Akram Point Forest Ridge



Erosion along the Sibsa River



Erosion along the Sibsa River

Figure 5-4: Erosion along the Sibsa route

Option 3: Mongla-Ghasiakhali Channel

373. There is no independent anchorage point for Mother Vessel in this route. The nearest anchorage point would be around Fairway Buoy. This can be used only for 4-5 months a year.

374. Alternately, the Mother Vessel may be anchored at Chittagong Anchorage point, transshipping to smaller vessel and sailing to Maitree Power Project Jetty via Baleswar - Ghasiakhali route. As such cost of transportation will be increased substantially. Lighterage vessel having maximum draft of 3.8 m would be able to sail through Ghasiakhali Channel, which will allow sailing only 1,200- 2,000 dwt vessel through this route. It will increase significant traffic movement in the route causing pollution. The route is designed for inland water traffic movement. Considering the above, this route has not been recommended for Coal transportation for the Project. All three options are compared against various indicators and the outcome is presented in **Table 5-1**.

375. The routes along the Sibsa and MG channels have a number of physical constraints with sharp bends, low draft, and sign of sporadic erosions, which may make the routes difficult for the designed lighterage vessels (10,000 dwt) to manoeuvre and operate. Additional traffic may aggravate ongoing erosions on the left bank of the Sibsa River. Settlements were observed along the Shibsa compared to the Passur route. The Passur route has added advantage of being the designated maritime route of the Mongla Port. There will be a minor investment required to keep the route operational. The Option 1: Passur Channel secures highest weighted score, 7.3 out of 10 and thus recommended as the most suitable route for coal transportation.

Table 5-1: Alternative route selection

Indicators	Option 1: Passur Channel: Fairway Buoy to Maitree STPP Jetty via Hiron Point-Akram Point-Harbaria-Mongla Port	Option 2: Sibsa Channel: Fairway Buoy to Maitree STPP Jetty via Hiron Point-Akram Point-Chalna and through Sibsa-Dhaki-Chunkuri	Option 3: MG Canal: Fairway Buoy to Maitree STPP Jetty through Baleswar -Ghasiakhali-Mongla Nulla-Passur via Mongla Port	Weightage out of 1	Score out of 10			Weighted Score out of 10		
					Option-1	Option-2	Option-3	Option-1	Option-2	Option-3
Physical Aspects										
Route type	Maritime Route, MPA's designated Route	Maritime route: Fairway Buoy to Akram P. Inland route: Akram Point to Plant Jetty	Inland Route	0.10	10	8	5	1.0	0.8	0.5
Travel length	145 km/78 NM	153 km/83 NM	196 km/106 NM	0.08	8	6	4	0.6	0.5	0.3
Bents	Negligible. MPA designated route.	Negligible at Sibsa but many at Dhaki-Chunkuri Canal. Hindrance to 8-10 thousand dwt vessel movement.	Many. No vessel above 3.7m draft able to sail.	0.08	8	5	4	0.6	0.4	0.3
River bank erosion	Less	More	Less	0.04	4	2	3	0.2	0.1	0.1
Availability of bathymetry data	Available. Periodic surveys carried out.	Available from outer bar to Akram Point. Bathymetry survey data at upstream of Akram Point is not available.	Available	0.08	8	5	8	0.6	0.4	0.6
Independent Anchorage	Fairway Buoy, Akram Point (Passur) and Harbaria	Fairway Buoy and Akram Point (Passur)	N/A. Either Fairway Buoy of MPA or Chittagong Anchorage Point	0.10	10	8	5	1.0	0.8	0.5
Draft/ Tonnage	Mother Vessel: 8.5m+	Mother Vessel: 8.5m+	Mother Vessel: 8.5 m+	0.08	8	6	2	0.6	0.5	0.2
	Lighterages: draft 5.5m capacity- 10,000 dwt	Lighterages: 4.5m/5,000dwt	Lighterage: 3.7m /1200 dwt	0.05	5	3	2	0.3	0.2	0.1
Biological Aspects										
Forest	About 80% of route passes through the Sundarbans	About 75% of route passes through the Sundarbans	One side of the route is forest	0.10	5	8	10	0.5	0.8	1.0

Indicators	Option 1: Passur Channel: Fairway Buoy to Maitree STPP Jetty via Hiron Point-Akram Point-Harbaria-Mongla Port	Option 2: Sibsa Channel: Fairway Buoy to Maitree STPP Jetty via Hiron Point-Akram Point-Chalna and through Sibsa-Dhaki-Chunkuri	Option 3: MG Canal: Fairway Buoy to Maitree STPP Jetty through Baleswar -Ghasiakhali-Mongla Nulla-Passur via Mongla Port	Weightage out of 1	Score out of 10			Weighted Score out of 10		
					Option-1	Option-2	Option-3	Option-1	Option-2	Option-3
Habitat Disturbance	Aquatic organisms are habituated with regular vessel movement because this route has been operating for last 50-60 years.	Aquatic organisms are partially habituated with vessel movement; Effort will need to adapt with the changed condition.	Aquatic organisms are habituated with regular vessel movement	0.05	5	3	5	0.3	0.2	0.3
Naval Traffic	Least movement of lighterage vessel may lead to less degradation to aquatic habitat and environment as well.	Increased movement of lighterage vessel may lead to more degradation to aquatic habitat and environment as well.	Significant increase in lighterage vessel traffic may lead to much degradation to aquatic habitat and environment as well.	0.05	5	4	3	0.3	0.2	0.2
Pollution due to naval traffic	Least amount of pollution	More pollution than Passur channel	Significant increase in emission	0.08	8	6	4	0.6	0.5	0.3
Socio-Economic Aspects										
Investment	Need of little additional investment for dredging activities	Need much investment for dredging activities	Even spending huge investment it is not possible to bring navigability at the level of the Passur Channel.	0.03	3	2	1	0.1	0.1	0.0
Cost of lighterage transportation	Least cost	Moderate	Significant increase in cost	0.08	8	6	4	0.6	0.5	0.3
Total Weightage=				1.0				7.3	5.8	4.7

Note: Total weightage has been considered 1; Based on importance of the items weightage has been distributed through brainstorming of the team members and relevant experts; Scores are given based on the possible **physical and environmental** consequences due to vessel movement through the routes and **socio-economical** perspective.

5.1.2 Bulk Carrier Alternatives

376. Thermal Coal is primarily transported in Bulk Carriers. Bulk carriers are specially designed to maximize capacity, safety, and efficiency. These bulk carriers are further classified on the basis of their size and they are Capesize, Panamax, Handymax/Supramax and Handysize.

Capesize

377. Capesize vessels are large-sized bulk carriers and tankers typically above 100,000 dead weight tonnage (dwt). They are much bigger than Panamax and Supramax vessels both in terms of draft size and dwt, and so they are categorized under VLCC, ULCC and bulk carriers. Now-a-days, Capesize vessels with a dwt of up to 400,000 dwt are being built to meet the demands for ultra-large bulk carriers.

378. Due to their large dimensions and deep drafts, Capesize ships are suitable to serve only large ports with deep water terminals in the world. As a result, they can serve a comparatively small number of ports in the World.

Handymax and Supramax

379. Handymax and Supramax are bulk carriers with a capacity less than 60,000 dwt. A Handymax vessel typically has a capacity between 35,000 and 50,000 dwt, while Supramax vessels are relatively bigger in size with 50,000 to 60,000 dwt. Modern Handymax designs are typically 52,000-58,000 dwt in size. These bulkers are well suited for small ports with length and draft restrictions, or ports lacking transshipment infrastructure. As a result, Handymax and Supramax bulkers represent the majority of bulk carriers over 10,000 dwt. Though these bulkers are primarily used for carrying dry cargo such as iron ore, coal, cement, finished steel, fertilizer, and grains, sometimes the category is also used to define small-sized oil tankers. The salient features of this Supramax/Handymax bulk carrier are as follows:

- Vessels of size between 40,000 – 65,000 DWT;
- Dimensions: Length 150-200 m; Draft 10.8-12.9 m; Beam 30.6-32.4 m;
- Cargo: Vessels with 5 cargo holds and 4 cranes of 30 metric ton lifting capacity. As they are equipped with on-deck cranes, they provide best options for carrying cargo to less sophisticated ports.
- This type of vessels operate in a large number of geographically dispersed global trades, mainly carrying grains, coal and minor bulks including steel products, forest products and fertilizers;
- These vessels are suited for small ports with length and draft restrictions and also lacking bulk handling infrastructure;
- The fleet size for Handymax grew at a CAGR of 18.3% over last 5 years;
- The crew on a bulker typically consists of 20 to 30 people;
- The carriers are normally geared vessels with cranes or conveyors which allow them to load or discharge cargo in ports without shore based equipment's.

Handysize

380. Handysize refers to a dry bulk carrier with a capacity upto 40,000 DWT. Sometimes they are used to refer vessels with dwt of up to 60,000, thus including Handymax and Supramax vessels under its category. These vessels also have shallower draft in comparison to larger Supramax, Panamax and Chinamax ships, which allows them to operate in most of ports and terminals across the world. Due to their small dimensions, Handysize ships can serve ports and terminals of all sizes, even ports with length and draft restrictions. As they are fitted with on-deck cranes, they can also serve ports lacking transshipment infrastructure. As a result, Handysize vessels make up the majority of bulk carriers over 10,000 DWT. The salient features of this Handysize bulk carrier are as follows:

- Dimensions: Length 134-186 m;
- Beam 21.9-28.7 m;
- Draft 8.1-10.4 m;
- This type of vessels operate in a large number of geographically dispersed global trades, mainly carrying grains, coal and minor bulks including steel products, forest products and fertilizers;
- These vessels are suited for small ports with length and draft restrictions;
- The fleet size for Handysize grew at a CAGR of 4.1% over last 5 years; and
- The crew on a bulker typically consists of 20 to 30 people (as per the requirements of SOLAS and STCW).



Handy Size Nord Hakata



Handysize IVS Hunter

Figure 5-5: Handysize vessels

381. The project has considered two types of mother vessels, Capsize and Handysize. Capsize vessel is considered for transporting coal with a load of 80,000 ton from load port to Mongla Port Fairway Buoy and Handysize with a load of about 25,000-30,000 tons from load port to Mazhar Point based on present draft of the channel.

5.1.3 Anchorage Points

Mongla Port Fairway Buoy Anchorage

382. Mongla Port Fairway Buoy Anchorage is a deep sea anchorage located at a distance of 70 NM from Mongla Port (**Figure 5-6**). It has a draft of 24+ m allowing Capesize vessels (more than 100,000 DWT) to arrive and discharge cargo safely. At anchorage, coal can be transhipped from mother vessel into barges of size upto 10,000 DWT using a transshipper (a floating transfer station). Currently, Basundhara group is using Mongla Port Fairway Buoy Anchorage for their lighterage operations. At Mongla Port Fairway Buoy Anchorage, lighterage operation of cargo may be carried out safely from November to March for 4-5 months. For rest of the year (April-October), the wind and waves come from Southward direction resulting in rough sea conditions at the Fairway Buoy Anchorage area. Mongla Port limit has started from Fairway Buoy. Mother vessels, which anchor a Fairway Buoy will be imposed charges as per tariff of Mongla Port. Pilotage and tugging is only given for vessels/ barges using the channel from the Hiron Point.

383. Lighterage at Mongla Port Fairway Buoy Anchorage is a suitable option for transportation of coal from load port to proposed Power Plant. The various merits and demerits of Fairway Buoy Anchorage are presented below:

Merits:

- a) Large quantities of coal can be brought at a time;
- b) Cheaper Maritime transportation cost due to cost economies as a result of bigger vessel; and
- c) Avoid impacts on the biodiversity of the Sundarbans.

Demerits:

- 1) Unloading of coal is possible/suitable only for five months. Rest of the months of the year, unloading is not possible/suitable due to rough weather and sea condition.
- 2) Distance from project site is long.
- 3) Chartering of a Capesize vessel for only 5 months (November to March) in a year is not be very cost effective.

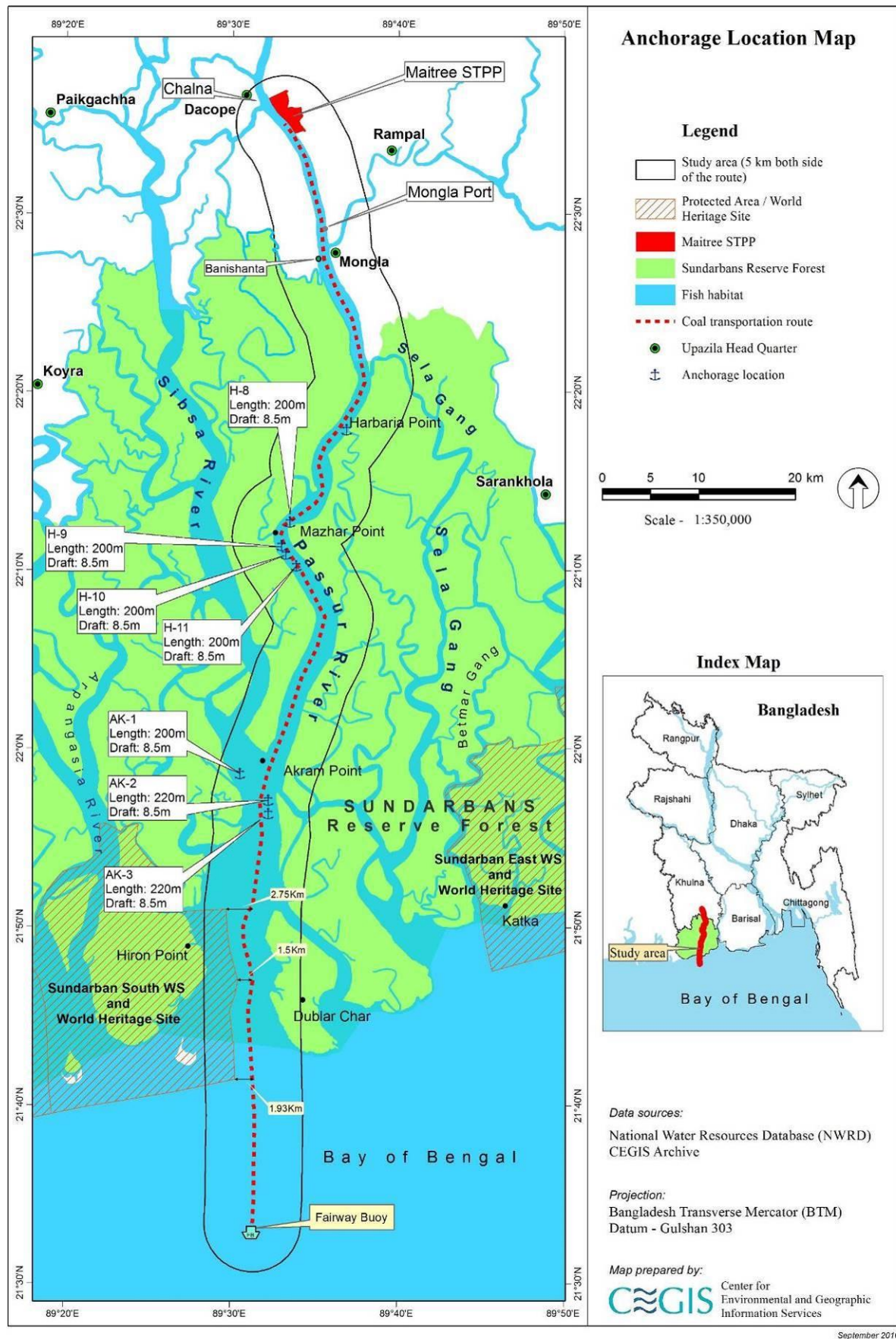


Figure 5-6: Anchorage points

Akram Point Anchorage⁹

384. Akram Point is an area on the confluence of Sibsa and Passur River located around 36 nautical miles (NM) from Mongla Port (**Figure 5-6**). It is located at a distance of around 42.0 NM from Power Plant jetty. It has sufficient draft of around 13-15 m allowing vessels of size upto 50,000-55,000 DWT to anchor. Currently, there is a draft limitation/restriction at outer bar restricting vessel size upto 30,000 DWT to pass. Mongla Port Authority plans to commence capital dredging activities at outer bar to increase current draft level in the range of 7 m to 8.5 m. This will facilitate berthing of 10.5-11.0 m draft vessels loaded upto 42,000-45,000 DWT considering average tidal draft. After discharging/shipment from mother vessel, coal will be transported to project site through Passur River with barges of size upto 10,000 DWT.

385. Akram Point as anchorage may be used during 6–7 months during fair weather. MPA has designated three anchorage points in the Passur River in and around the Akram Point area. In these points, transshipment of coal is not possible from April to September due to rough weather and wave. The merits and demerits of Akram Point Anchorage are presented below:

Merits:

- 1) Distances of Anchorages at Akram Point are roughly 35 NM, which is less than Mongla Port's Fairway Buoy Anchorage to the Plant site jetty.
- 2) Enough area for smooth operations.
- 3) Width of Passur River is sufficient for manoeuvring and anchoring of vessels up to 80,000 tons.

Demerits:

- a) Lighterage only possible for 6-7 months during fair weather.
- b) Location is within the Sundarbans Reserve Forest.
- c) Wind action is dominant in this location during Monsoon.
- d) Akram point can accommodate smaller size of vessels compared to Fairway Buoy with present day draft of the Outer Bar.
- e) Akram Point is closer to World Heritage Site (SSWS) compared to Harbaria.

Trans-shipment at Mazhar Point Anchorage (Harbaria)

386. Harbaria/ Mazhar Point Anchorage is the outer anchorage of Mongla port located at a distance of around 16 NM from Power Plant jetty (Figure 5-6). Harbaria anchorage allows to anchor the vessels of 7.5-11 m draft. But Mazhar Point anchorage allows more than 11 m draft vessels. Due to draft restriction of Outer Bar, presently maximum 8.5 m draft vessel can berth. Thus considering average tidal draft of 2.6 m, vessel loaded upto 30,000-32,000 DWT

⁹Three anchorage/transshipment points were recommended by the coal logistics study. During the EIA study, it was found that Akram Point is less suitable than Mazhar Point as an anchorage/transshipment point. The EIA study has concluded that two transshipment points are sufficient for the project at this stage, to minimize activities within the Sundarbans.

can enter into the channel and transhipped coal at Harbaria anchorage. After transshipment/discharging from mother vessel, coal will be transported to project site through Passur River with barges of size upto 10,000 DWT. Harbaria Anchorage is located about 62 NM inside the channel resulting in very different weather conditions as compared to the Coast (at Fairway Buoy). The weather conditions at Harbaria are calm almost throughout the year allowing the Anchorage to be operational for the whole period of the year. Thus, coal can be transhipped from mother vessel into barges at Harbaria throughout the year.

387. Lighterage at Harbaria Anchorage is a suitable option for transportation of coal from load port to proposed Power Plant. The various merits and demerits of Harbaria Anchorage are summarized below:

Merits:

- a) Uninterrupted operations throughout the year.
- b) Better wave conditions compared to Akram point favouring smoother lighterage during rough weather.
- c) Location is much closer to Plant site jetty and within MPA designated anchorage area.

Demerits:

- a) Significant increase in traffic volume within the SRF area.
- b) Higher logistic cost compared to Fairway Bouy.
- c) Located within the Sundarbans Reserve Forest.

388. A comparative analysis of anchorage points has been drawn on six (06) indicators. The following **Table 5-2** has presented the results of analysis.

Table 5-2: Compative analysis of Anchorage Points

Indicator	Anchorage Point		
	Fiarway Buoy	Akram Point	Mazhar Point
Distance from Plant Jetty	115 km (62 NM)	67 km (36 NM)	44 km (24 NM)
Distance from WHS (SSWS)	29 km (16 NM)	19 km (10 NM)	43 km (23 NM)
Draft	24+ m	13-15 m	8 m
Capacity of Vessel	100,000+ DWT	50,000-55,000 DWT	30,000-32,000 DWT
Duration of operability	Four (04) months	6-7 months	12 months
Round trip time of Lighterage vessel	20 hrs	12 hrs	8 hrs
Preference	Selected for coal transhipment	Less preferred for coal transhipment	Selected for coal transhipment

5.1.4 Transshipment Process and Transshipper

389. Due to the draft restriction of the channel, coal will be trans-shipped from mother vessel into smaller barges with lower draft and taken to the Power Plant jetty. Thus, the process of trans-shipment becomes critical for operations of Power Plant.

390. There are various options for coal transshipment from mother vessel into smaller barges:

- Direct unloading from geared vessel into barges using ship gears: Geared bulk carriers are typically in handysize to handymax size range having grab cranes mounted on them. Transshipment of coal using geared vessels is not viable for this project because of the following reasons.
- Unloading rate is very slow due to smaller size of grabs mounted on the vessel. Thus, high time consumption during mooring and unmooring of barges during operations.
- The maximum unloading rates from one geared vessel can be 10,000-12,000 tpd.
- High vessel turnaround time.
- Self-geared vessels will not be able to meet the annual requirement of about 5.00 million t/yr of coal for this Project.
- Possibility of spillage of coal and spreading of coal dust is more.

Floating Cranes

391. A typical floating crane with 25-30 cbm/grab has an unloading rate of 7,000 - 8,000 t/d with utilization availability/factor of 45-50% only. Thus, trans-shipment of coal using floating crane will not be viable for this project because of the following reasons:

- Low unloading rate of 7,000 - 8,000 t/d and low utilization of 45-50%. Thus, to meet annual coal requirement of about 5.00 million t/yr, approximately 3 cranes will be required.
- No additional stockpile/buffer storage; therefore, transshipment operation cannot be carried out during mooring/unmooring of barges.
- Cannot operate during rough weather.

Floating Transfer Stations

392. A floating transfer station is a vessel with two cranes mounted on it, which work in conjunction with a material handling system comprising of hoppers, conveyors and material delivery boom. A floating transfer station with two (2) cranes of between 19.7 m³ and 22m³ per grab, two (2) hoppers, two (2) barge loaders with loading capacity of 1,200 t/h each. An unloading rate of 30,000 t/d can be achieved from mother vessel by using this type of facility. A floating transfer station is the most viable option due to the following reasons:

- Buffer storage of 8,000 – 10,000 tons allowing smooth and continuous unloading, thus increasing efficiency
- Reduced turnaround time of mother vessel
- Possibility of direct unloading of coal from mother vessel in to barge
- Same Transshipper can be used across different locations
- High unloading rate of 30,000 t/d required to meet the annual coal requirement of five (5) million t/yr.
- Two duly designed hoppers with belt-feeders
- A belt conveyor system, designed to handle 2,000t/h of coal
- Two ship-loaders with swiveling trimming spouts.

393. The main advantages of the Floating Transfer Station over standard floating cranes:

- On a floating crane there is no additional stockpile, therefore, transshipment operations cannot be carried out during mooring/ unmooring and waiting for the feeder barge. A Floating Transfer Station instead avails itself of buffer storage and can therefore continue to work during such periods, resulting in cost improvement for barging and shipping.
- The buffer storage requires the construction of a larger pontoon which guarantees greater platform stability, a better berthing place for coal barges, and the optimization of crane operations, and as a result, the Floating Transfer Station is less sensitive to the adverse weather conditions compared to floating cranes.
- The FTS is environmentally friendly and designed to meet the requirements of applicable international classification societies such as IMO, MARPOL (SOPEP), IOPP, ISPP, IAPP; as well as local regulations.

5.1.5 Alternate Coal and Limestone Handling System

394. Coal and limestone will be transported by lighterage vessel up to the Mongla Port Jetty and unloaded at a specialized Jetty. From there coal and lime stone will be carried by covered conveyor belt up to the Coal Stack Yard of the MSTPP. During field investigation, it was observed that there is no specialized coal jetty in the Mongla Port. Based on the discussion with the officials of the MPA it is found out that one such Jetty could be built on the northern side of the present Mongla Port Jetty. In that case, the distance between the Coal and limestone stack yard of the Mongla Port Jetty and the Maitree STPP will be about 14 km. Under such scenario, the construction and operation cost for Jetty and conveyor belt and associated risk would have been more. Transportation of coal and limestone and equipment and construction materials for the Power Plant would have been costlier and hazardous. As such this option of coal/limestone handling in the Mongla Port Jetty has not been considered.

5.1.6 Dust Control

395. There will be a number of dust control measures utilized during operations including water, dust suppressing agents, and/or incorporating physical barriers into the Project design (i.e., covered vessel and covered conveyor system, fencing, enclosures, barriers, walls, etc.). One or more of the following dust control methods will be used at various stages of the coal transportation process, from load port to transshipment point, unloading using the Transshipper, coal transportation using the lighterage vessels, unloading at plant jetty, through to the final storage site at coal stackyard. Dust control methods are listed below.

Drop Height

396. Rotary dumper operations, although often considered more efficient from an operational perspective, were considered to produce higher level of dust emissions than a bottom dump. The drop height of the coal was substantially reduced and better controlled in a bottom dump operation. Drop heights were also reviewed in conjunction with the configuration of the system at transfer points and barge loader. The system has been designed in such a way as to minimize drop heights wherever possible.

Covered Conveyors

397. Uncovered conveyors were considered as an option to transport coal within the plant jetty. However, increased challenges in dealing with wastewater treatment, and dust emissions control were identified with this option that are not expected to occur with covered conveyors.

Wetting

398. Wetting keeps coal moist and prevents dust generation, while fogging/misting removes airborne dust particles. Water will be delivered to the coal handling area through a combination of misting sprays, large nozzle sprays, large volume sprays, and/or sprinkler piping. BIFPCL will use recycled coal drainage wastewater or clean freshwater for dust suppression on site to wet down as required in coal conveyor transfer points and in the receiving coal stackyard. A wastewater management system will be implemented to manage all waste water.

Covered Barges

399. Covered barges present best alternatives in terms of efficiency, practicality and effectiveness. For this reason, covered barges were considered as only option for carrying coal from the transshipment point to the Plant site jetty.

Dust Limiting Design

400. All exposed conveyors will be covered on three sides and conveyor transfer points will be completely enclosed. Points of transfer will incorporate chutes, baffles, belts skirting, shrouds and/or drop height limiting designs (i.e., lufting) to limit dust.

401. Coal spillage and dust are prevented in the floating transfer station (Transshipper) by (a) making changes in hoppers design with anti-spillage plates so that the cargo spillage, if any, is collected inside the hoppers instead of falling into the sea, (b) grabs equipped with dust cover plates, (c) closed conveyor belts and the loading boom are covered to avoid windborne dust and are kept clean by means of scrapers, (d) equipping the Transshipper with high-efficiency diesel generators, thus minimizing emissions, and (e) design the sewage treatment unit in accordance with Class Rules. The barge loader and snorkel arrangement will be used to profile the coal as best as possible onto the barge in a slightly rounded (not peaked) shape, to reduce the chance of wind catching the coal and creating airborne fugitive dust particulate while en route to plant jetty.

402. Wind fencing can be installed in areas that are subject to regular high winds or to protect adjoining property from fugitive dust if it is found to be required. To provide real-time air quality readings, several air quality monitoring stations will be positioned on and around the Project based on the dispersion modeling outcome.

403. Based on multi-criteria analysis considering 13 pertinent parameters of physical, biological and socio-economical aspects, it is found that Option- 1, i.e., the Passur Channel has scored highest (Table 5-1), which have been used for last 60 years as maritime route and second largest port of Bangladesh (Mongla Port) operates. With the concurrence of Mongla Port Authority, there were three anchorage points identified for transshipping coal. These were: (i) Fairway Buoy at the Bay (Transshipment possible for 4-5 months from November to March); (ii) Akram Point at the Passur Channel (Transshipment possible for 6–7 months during fair weather); and (iii) Mazhar Point (Harbaria) at the Passur Channel (Transshipment possible for round the year). All of the anchorage points possess merits and

demerits in terms of data availability, natural calamity, tonnage, proximity to WHS, etc. Considering all pros and cons of mentioned factors (not inclusive) the study has suggested two transshipment points, i.e., Fairway Buoy and Mazhar Point for transshipment of coal for MSTPP. The points were selected considering less disturbances to the Sundarbans Reserve Forest. Harbaria is a regular anchorage of MPA. The anchorage at Mazhar Point, which is allowed by MPA for transshipment of coal of MSTPP is close to Harbaria and study suggested that there may be negligible impact on the Sundarbans ecosystem. So transshipment can be done for four months of a year at Fairway Buoy and rest of the time at Mazhar Point, Harbaria. The Akram Point was found less preferred as anchorage point for transshipment of coal since it is nearer to the World Heritage Site compared to the Mazhar Point and it becomes wavy and turbulent in the wet season. On the other hand, it is estimated that about 500 lighterage vessels need to be travelled all through the Sundarbans if Fairway Buoy is alone considered as an Anchorage Point. In that case, more emission is expected as smaller vessel emits more than that of larger vessel; more travel more susceptibility to accidental event; more release of bilge water and other contaminants. Mother vessel coming at Mazhar Point may erase all such problems at larger extent because only about (Mother Vessel: 117 + Lighterage Vessel: 292 = 409 vessels) vessels need to be sailed from Mazhar Point to the MSTPP.

404. Moreover, the protocol vessel coming from India (about 400 vessels) carrying ash sail through a part of the Passur Channel. Ash generated from the MSTPP may outweigh the ash demand of the cement factories at Mongla area mostly. In such case, vessel sailing through the Passur Channel will be reduced and in all practical purposes the reduction of protocol vessel with ash from India will compensate the additional voyage required for coal transportation. Thus net increase of vessels in the Passur Channel will be nil. This will be beneficial for the Outstanding Universal Value of the Sundarbans and its adjoining area.

6 Detail Description of the Study Area

6.1 Introduction

405. Remote sensing and GIS technology both are mutually used for prepare land use and land cover mapping of the study area (5 km radial area from the proposed coal transportation route), which occupies 320,500 acres of land and water area of Bagerhat District. The land use and land cover of study area have been derived from multispectral RapidEye and Landsat 7 satellite images. Those images were collected on 2015 and 2010 respectively. The major classes that were extracted from images are agricultural land, permanent fallow land, forest, industrial area, inter tidal area, road, rural settlement with homestead vegetation, built-up area and water body.

6.2 Description of Satellite Image

406. The multispectral RapidEye satellite image is suitable for identification of general land uses and land covers of an area. RapidEye satellite image provides 5 meters spatial resolution data with 5 spectral bands. On the contrary, Landsat image provides 30 meters spatial resolution data with 7 spectral bands. Moreover, they revisit the globe in a single day and 16 days repeatedly. However, the RapidEye images of 11th February, 6th and 20th March, 2015 were used for land use and land cover map preparation for major part of the study area. In addition to these, Landsat image of 30th January, 2010 was used for land use and land cover map preparation for the remaining portion of the area. **Figure 6-1** shows the area of satellite images used for land use and land cover analysis for the study area. The name and wavelength of each band is given in the **Table 6-1**.

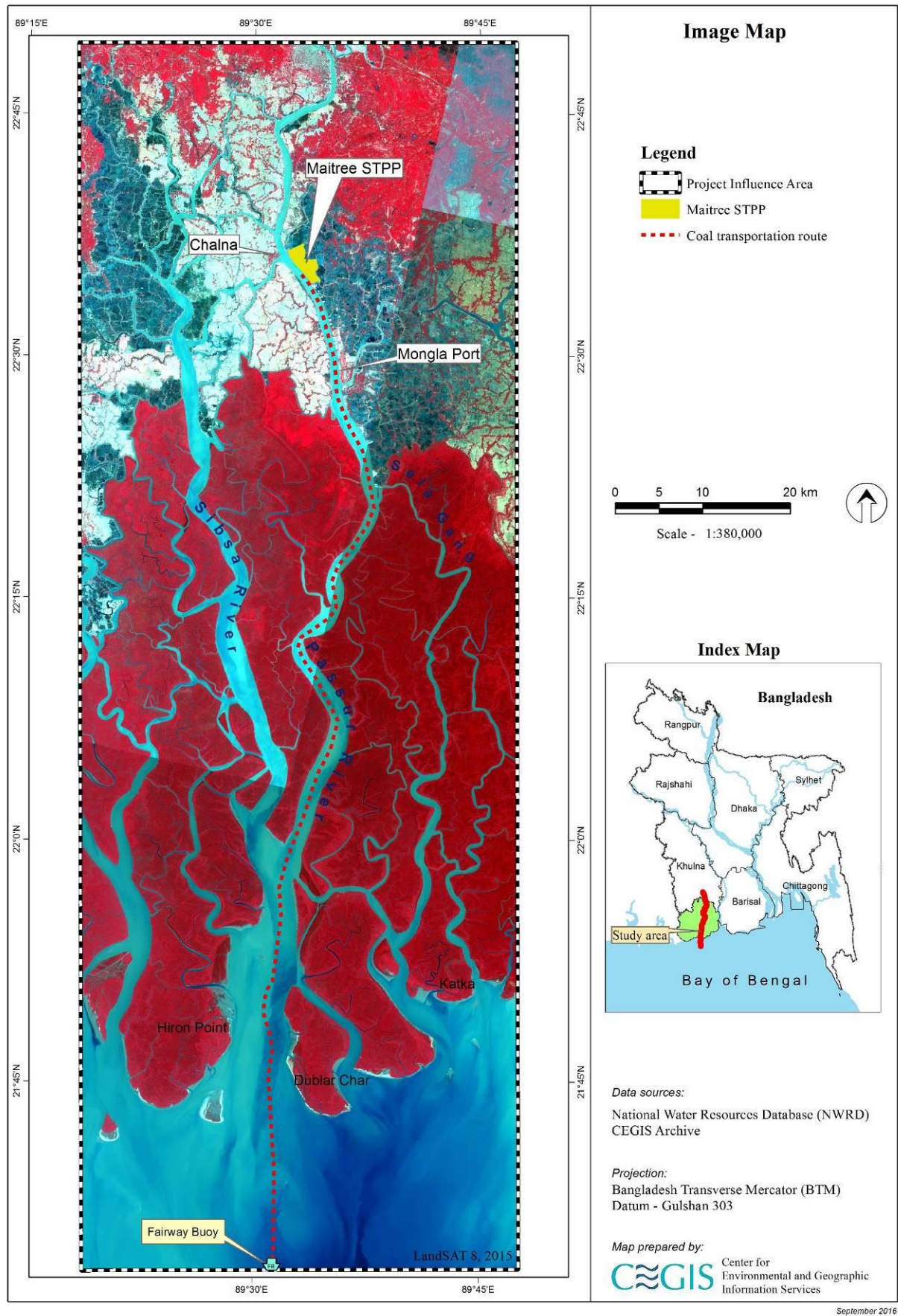


Figure 6-1: Satellite image data of the study area

Table 6-1: Band name and wavelength of each band

RapidEye Band Name and Wavelength		
Band ID	Band Name	Wave length (nm)
1	Blue (B)	440-510
2	Green (G)	520-590
3	Red (R)	630-685
4	Red Edge (RE)	690-730
5	Near Infra Red (NIR)	760-850

Landsat 7 Band Name and Wavelength		
Band ID	Band Name	Wave length (nm)
1	Blue (B)	441-514
2	Green (G)	519-601
3	Red (R)	631-692
4	Near Infra Red (NIR)	772-898
5	Mid Infra Red (MIR)	1547-1749
6	Thermal Infra Red (TIR)	10310-12360
7	Mid Infra Red ()	2064-2345

6.3 Methodology of Image Analysis

407. The image analysis was carried out using image processing software ERADAS IMAGINE. All images of the study area were geo-referenced to Bangladesh Transverse Mercator coordinate system (BTM). After geo-referencing, a field survey was carried out to collect referenced data and those data was used for image classification. The following major classes: *Agricultural Land, Permanente Fallow Land, Forest, Industrial Area, Inter Tidal Area, Road, Rural Settlement with Homestead Vegetation, Built-up Area and Water Bodies* were extracted from satellite images using visual interpretation and on screen digitization technique:

6.4 Description of Land use Items

6.4.1 Agriculture Land

408. Three types of agricultural land have been identified from satellite images:

1. Current fallow and agricultural land area
2. Seasonal shrimp Gher and
3. Shrimp aquaculture pond/Gher

409. The image signature signified that most of the area was *Shrimp Aquaculture Pond/Gher* at the dates of image acquisition and was classified as *Agricultural Land*. *Seasonal Shrimp Gher* means those areas where shrimp aquaculture (Bagda) is practiced in the dry season and crop is practiced in the monsoon season. Shrimp aquaculture practiced throughout the year is classified as *Permanent Shrimp Gher* areas.

6.4.2 Permanent Fallow Land

410. The land area which remains year round fallow was classified as Permanent fallow land.

6.4.3 Rural settlement with homestead vegetation

411. The spatial distribution of Rural Settlements with Homestead Vegetation in the study area is linear. The texture and tone of the settlements are more distinct than other land uses and land covers. The class Rural Settlements with Homestead Vegetation includes rural house structures, yards, small vegetable gardens and trees, and other vegetation surrounding rural settlements.

6.4.4 Forest

412. The forest area within the study area has been derived from satellite image analysis. The mangroves within the Sundarbans are classified as Mangroves Reserved Forest, which grow naturally near saline water in the active delta along the coast of the Bay of Bengal. Some river side mangrove areas outside the Sundarbans are classified as River Side Mangrove Vegetation.

6.4.5 Road and Embankment

413. Road class was sub classified as National road, Local road and Embankment. The National and Local road includes all types of metal and non-metal roads visible in the satellite images. The existing road network data available in CEGIS archive was also used during identification, interpretation and digitization of roads and embankments from satellite images.

6.4.6 Industrial Area

414. The sub classes of Industrial Area include Mongla Port and Area under development.

6.4.7 Water bodies

415. The Water Bodies class was further subdivided into River, Canals, Creeks, Pond and Seasonal Water Bodies. Most of the water bodies and rivers were digitized by visual interpretation. Branches of the rivers are considered as canal.

6.4.8 Results

416. The **Figure 6-2** shows the Land use and Land Cover Map of the Study Area derived from analysis of satellite images. It was found from image analysis that the study area is mostly surrounded by Mangrove Reserve Forest (115,471 acres) 36.0% of the total area. Agricultural land occupies only (37,930 acres) 11.8% including Permanent and Seasonal Shrimp Gher. The rural Settlement with Homestead Vegetation is 2.3% and Water Bodies are 48.3%. The detail area coverage of each class and sub-class is given in the **Table 6-2**.

Table 6-2: Land covers classification of the study area

Major Class	Sub Class	Area (Acres)	%
Agricultural Land	Current fallow and Agricultural Land Area	18,107	5.65
	Seasonal Gher	4,135	1.29
	Shrimp Aquaculture Pond/Gher	15,688	4.89
Forest	Mangrove Reserve Forest	115,471	36.02
	River Side Mangrove Vegetation	163	0.05
Industrial Area	Area under development	1,402	0.44

Major Class	Sub Class	Area (Acres)	%
	Mongla Port Area	1,377	0.43
Other Landuse	Inter tidal area	570	0.18
	Permanent Fallow Land	86	0.03
Road	Embankment	229	0.07
	Local Road	309	0.10
	National Road	21	0.01
Rural Settlement with homestead Vegetation	Rural Settlement with homestead Vegetation	7,461	2.33
Urban Built Area	Urban Built Area	672	0.21
Water Bodies	Canal	8,580	2.68
	Creek	3,207	1.00
	Pond	577	0.18
	River	76,110	23.74
	Sea	66,322	20.69
	Seasonal Water Bodies	10	0.00
Total		320,499	100.00

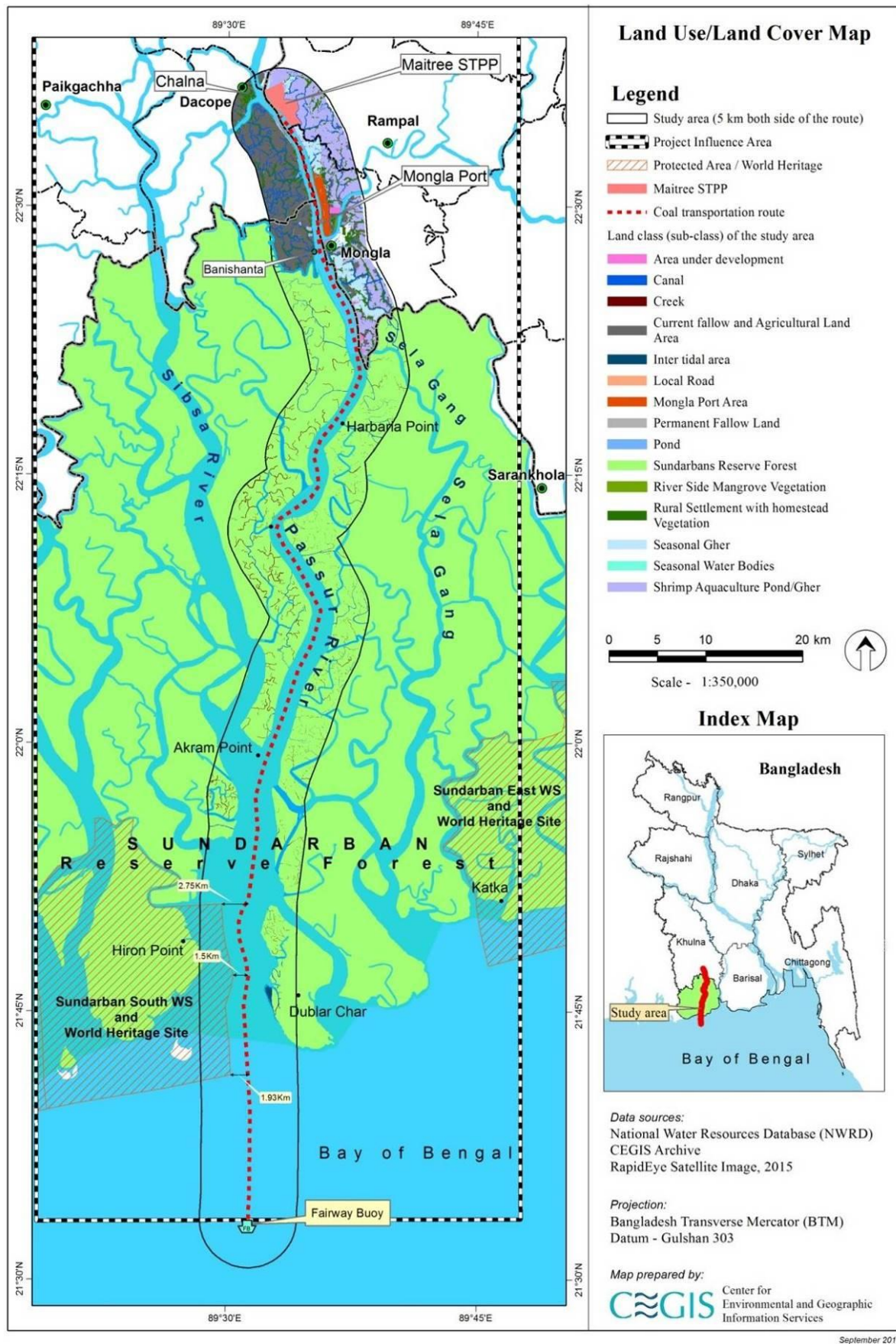


Figure 6-2: Land use and land cover map of the study area

7 Environmental and Social Baseline

7.1 Introduction

417. The environmental and social baseline description in this chapter has been prepared using both primary and secondary data collected for the selected coal transportation route from the Fairway Buoy to the Power Plant Jetty and defined study area. The baseline condition has been delineated in respect of physical environment (e.g., including meteorological, hydrological, morphological components and processes), land resources (e.g., including land use pattern and soil quality), biological environment (e.g., including flora, fauna, fisheries resources and other ecosystems goods and services), socio-economic condition (e.g., including livelihood patterns, historical, cultural and archaeological sites, economic status, etc.) and probable hazard events of the study area.

7.2 Climate and Meteorology

418. The selected coal transportation route along the Passur River from the Fairway Buoy to the Power Plant Jetty lies in two climatic sub-regions of the country, which are (i) South-central climatic zone, shown in the map with alphabet 'G' (top part of the route) and (ii) South-eastern climatic zone, shown in the map with alphabet 'A' (bottom part of the route) (**Figure 7-1**). Bangladesh has a tropical monsoon climate characterized by wide seasonal variations in rainfall, high temperatures, and high humidity. Regional climatic differences in this relatively flat country are minor.

419. The South-central zone (G) is characterized by an abundance of rainfall above 1,900 mm. The range of temperature is, much less than the west, but somewhat more than that in the South-eastern zone. This is a transitory zone between the South-eastern, North-western and South-western zones and most of the severe hailstorms, nor'westers and cyclones are recorded in this area.

420. The South-eastern zone (A) comprises the Chittagong sub-region and a strip of land extending from southwest Sundarbans to the south of Comilla. The hills over 300m in height have north-eastern zone climate. The rest of the area has a small range of temperature, rarely goes over a mean of 32°C and below a mean of 13°C. Rainfall is high; usually over 2,540 mm per year and in the winter dew fall is heavy.

421. Under the Köppen climate classification system, the area has a tropical wet and dry climate with the three prominent seasons - Summer/Pre-monsoon - March to May; Rainy season/monsoon - June to October; and winter season - November to February.

422. Seasonal variation of rainfall, temperature, and humidity is the noteworthy aspect of the climate. The summer is hot and dry, interrupted by occasional heavy rainfall. The winter is predominantly cool and dry. The rainy season is hot and humid, and characterized by heavy rainfall, tropical depressions and cyclones. It has a distinct monsoonal season, with an annual average temperature of 26.1°C (78.98 °F) and monthly means varying between 19-20°C in January and 28-29°C in April. The annual average rainfall of 2,000 (78.7 inch) occurs during the monsoon period (**Figure 7-1**).

423. Gentle north/north-westerly winds with occasional violent thunderstorms called northwesterners during summer and southerly wind with occasional cyclonic storm during monsoon are prominent wind characteristics of the region.

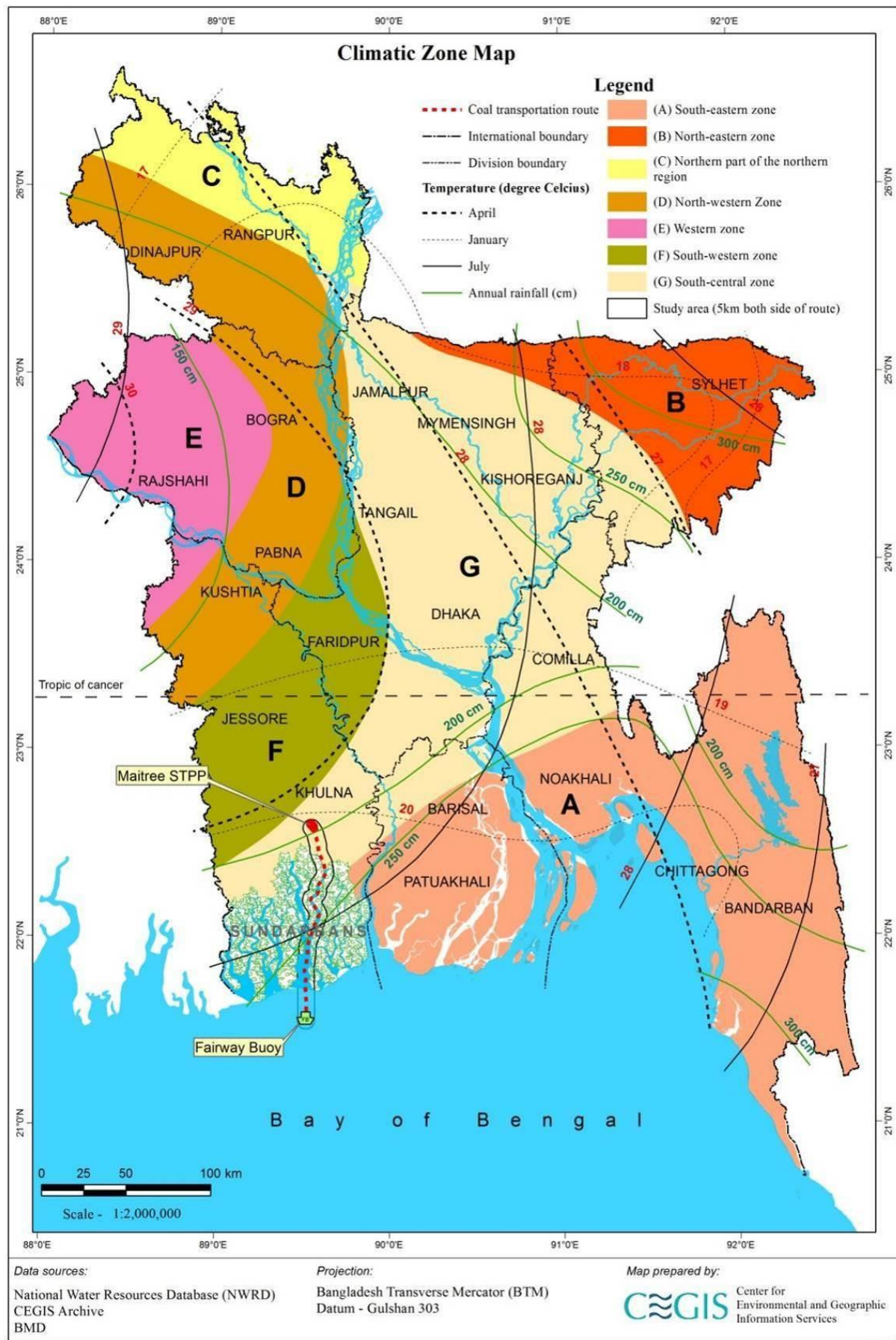


Figure 7-1: Climatic Zone of Bangladesh

424. Meteorological time series data from 1983 to 2013 have been collected from the nearest BMD stations in Mongla (BMD Station ID: 41958) which is analyzed to get the overall micro-climatic conditions of the study area. Summary of the analysis of meteorological parameters is given in the following sections:

7.2.1 Temperature

425. Analysis of time series temperature data of Mongla Station for the last 22 years (1991-2013) show that monthly maximum temperature varies from 30.4°C to 40.4°C, and April and May are the warmest months in the pre-monsoon period. The monthly minimum temperature varies within a range of 8°C to 23.7°C, and January is the coldest month. The highest recorded maximum temperature during the last 22 years is 40.4°C that occurred in April, 2010. Moreover, almost the same case has happened in April, 1995, where the temperature was 40°C and again in May, 2009. The lowest ever recorded minimum temperature was 8°C that occurred in January, 2013. The graphical representation of monthly maximum, minimum and average temperature of the last 22 years (1991-2013) is shown in **Figure 7-2**. **Figure 7-3** shows the trend of annual maximum and minimum temperature of Mongla BMD station, which reveals that the annual average temperature of the winter season, is increasing and that of summer season, in contrast, is decreasing.

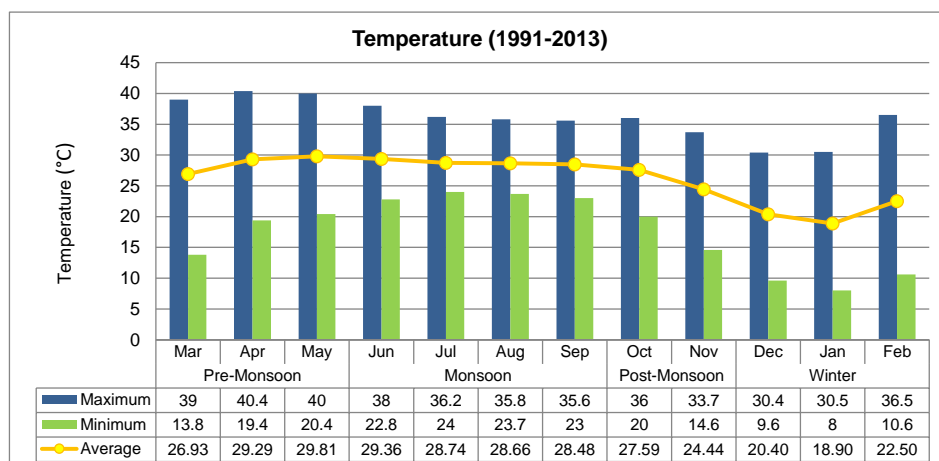


Figure 7-2: Monthly maximum, minimum and average temperature (1991-2013)

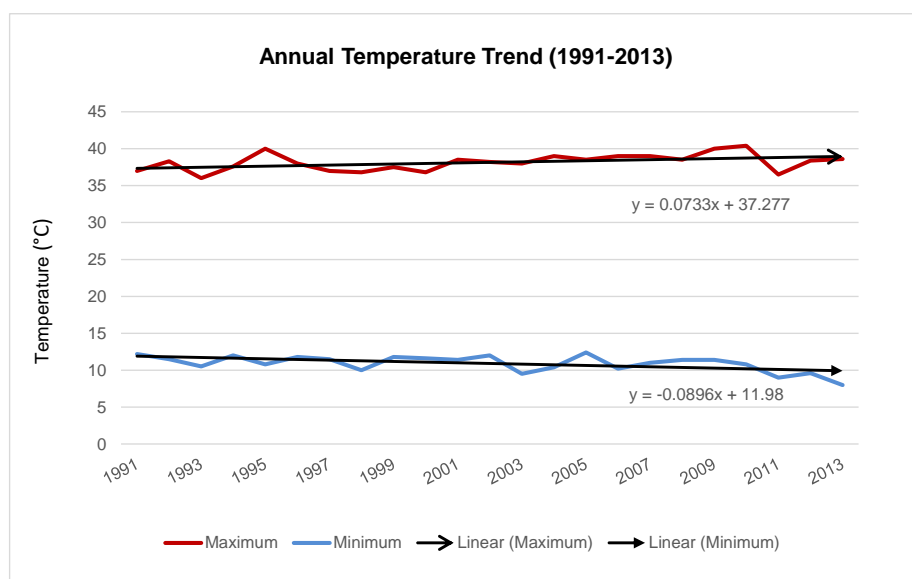


Figure 7-3: Trend of annual maximum and minimum temperature (1991-2013)

7.2.2 Rainfall

426. The last 30 years data from the Mongla BMD station shows that the annual average rainfall has been recorded as 357 mm/yr during the dry period and 1563 mm/yr during the wet period. According to the data analysis, monthly maximum rainfall occurs in June (983 mm/month) and monthly minimum rainfall is recorded during the winter season. This indicates that the rainy season is very prominent in this region. The highest ever maximum annual rainfall was recorded as 2786 mm in 2002. It is also observed that, the annual rainfall in this area is gradually increasing at a rate of 2.74 mm/year. Average monthly rainfall of available twenty (20) years is presented by graphical presentation in **Figure 7-4** and **Figure 7-5**, both showing that the Monsoon period (June to October) having the maximum rainfall record of a year. On the contrary, the period from November to March shows a negligible amount of rainfall.

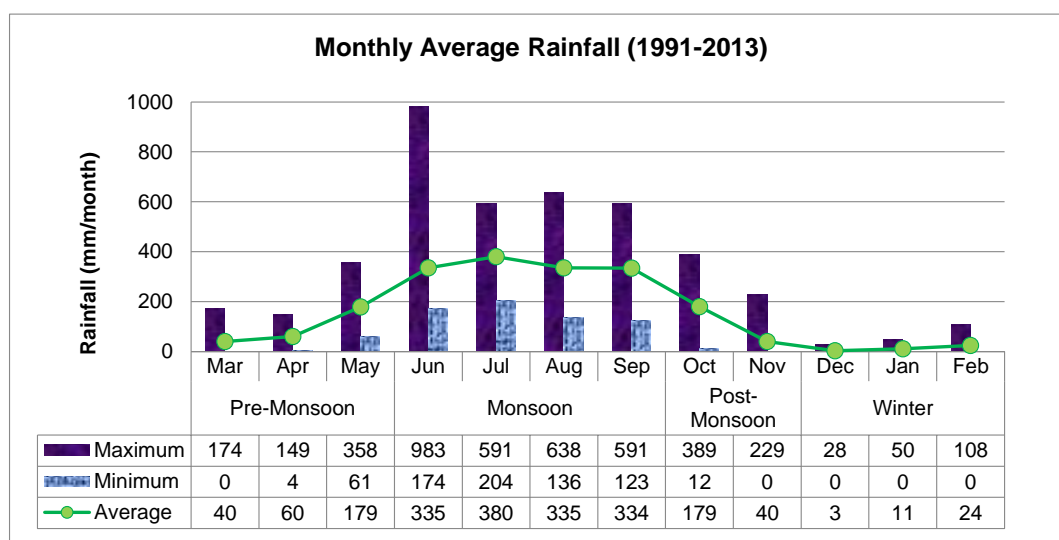


Figure 7-4: Monthly maximum, minimum and average rainfall

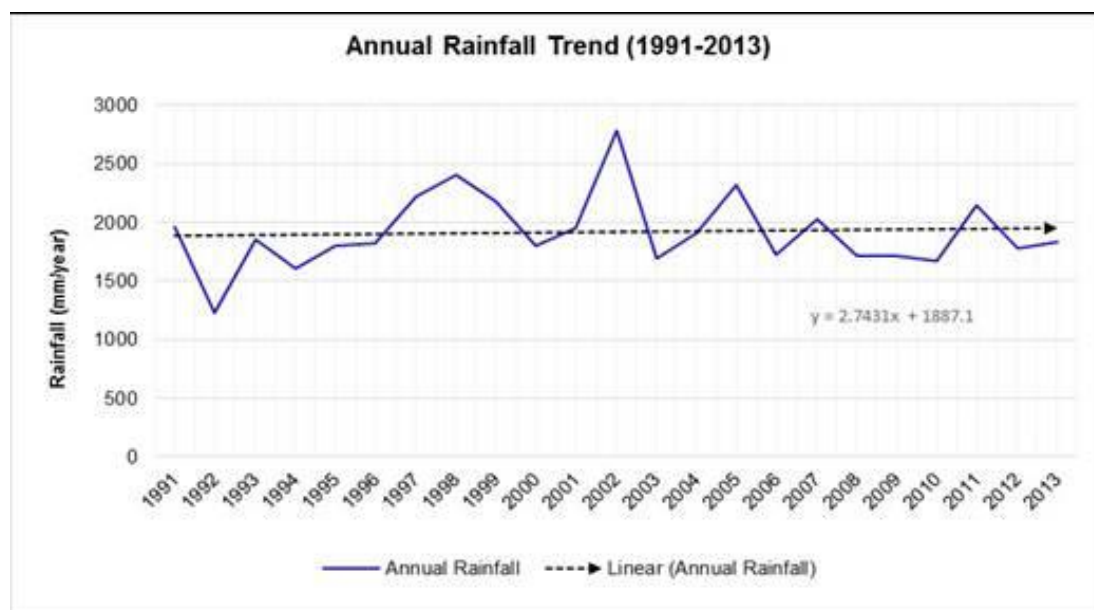


Figure 7-5: Trend of annual rainfall (1991-2013)

7.2.3 Sunshine Hours

427. Sunshine hour is a climatological indicator, measuring the duration of sunshine for a given location and period which indicates the total energy delivered by sunlight. In order to investigate the sunshine hour over the study area, available sunshine hour records (2001-2013) of Mongla BMD station have been analyzed. The monthly average sunshine hour in Mongla varies from 4:22 to 8:68 hour/day in a year. The monthly maximum of average sunshine hour occurs in February i.e. 9:97 hour/day. Length of the sunshine hour reduces during the monsoon period. **Figure 7-6** shows the daily sunshine hour condition of the nearest station of the study area in different months.

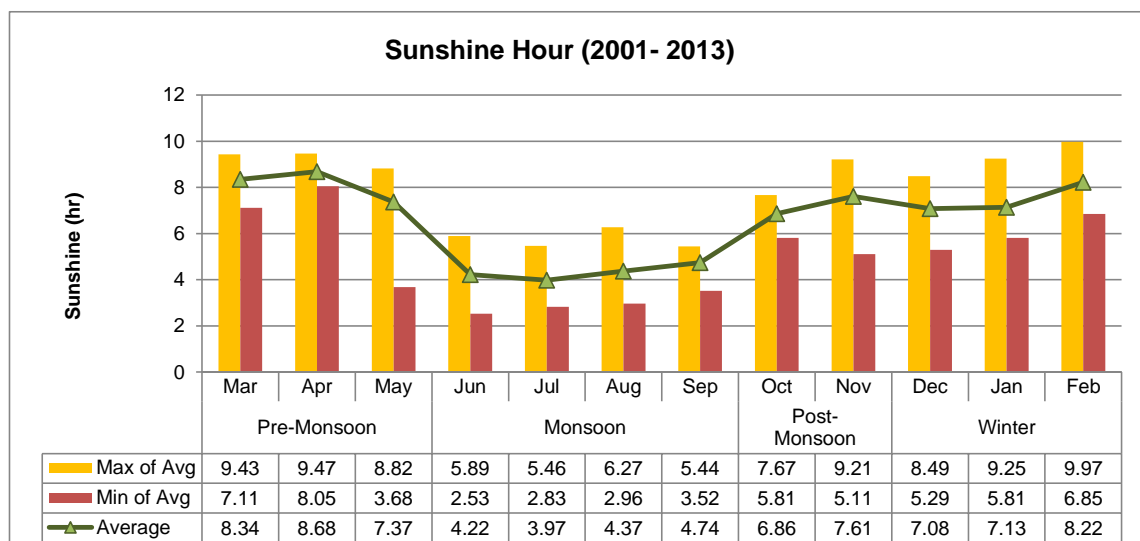


Figure 7-6: Monthly maximum, minimum and average sunshine hour (2001-2013)

7.2.4 Evaporation

428. Evaporation is the process by which a substance in a liquid state changes to a gaseous state due to an increase in temperature and/ or pressure. It is a fundamental part of the water cycle and is constantly occurring through out the nature. To investigate the rate of evaporation over the study area, evaporation records (1993-2013) of the nearest BMD station, Khulna (BMD station ID: 42) have been analyzed. **Figure 7-7** shows the daily evaporation of the nearest station of the study area in different months. The monthly average evaporation rate in Khulna varies from 1.88 to 3.92 mm/day in a year. The monthly maximum of average evaporation occurred in April i.e. 6.38 mm/day and the minimum of average evaporation occurred in January i.e. 0.97 mm/day.

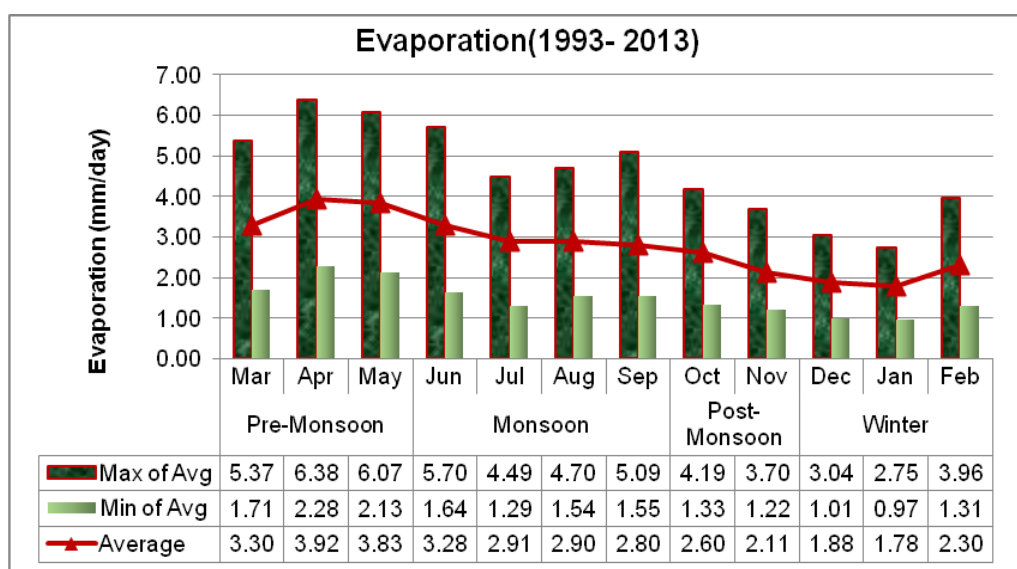


Figure 7-7: Monthly maximum, minimum and average Evaporation (1993-2013)

7.2.5 Humidity

429. Humidity is directly related to temperature fluctuations of a region. Mongla BMD Station (station ID: 41958) has been selected in order to delineate the situation of humidity of the study area. The monthly average relative humidity of the study area varies seasonally from 73.29% to 89.10%. Monsoon (June to September) is the most humid period, whereas from winter season to pre-monsoon i.e. December to May, the weather remains relatively dry. **Figure 7-8** shows the data for monthly maximum, minimum and average humidity of the available last twenty four (24) years (1989 to 2013) for Mongla station.

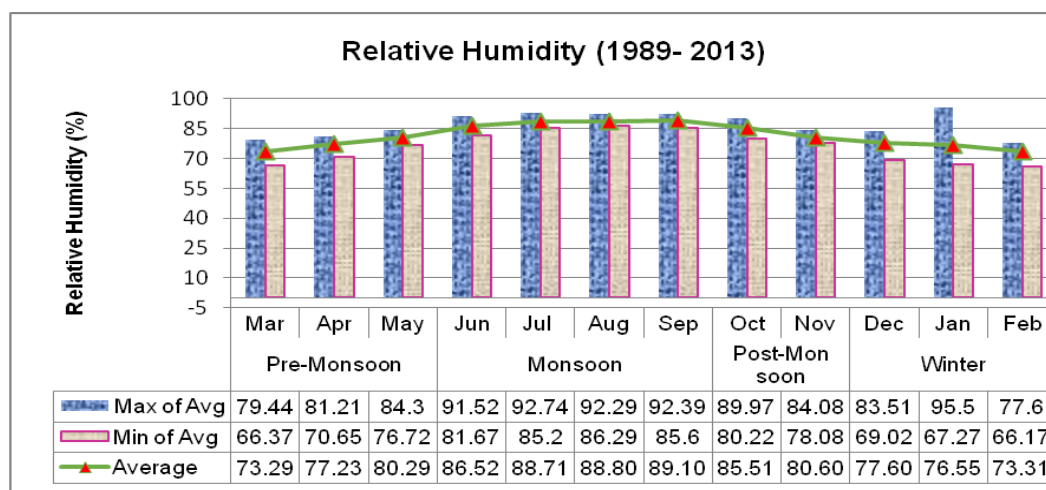
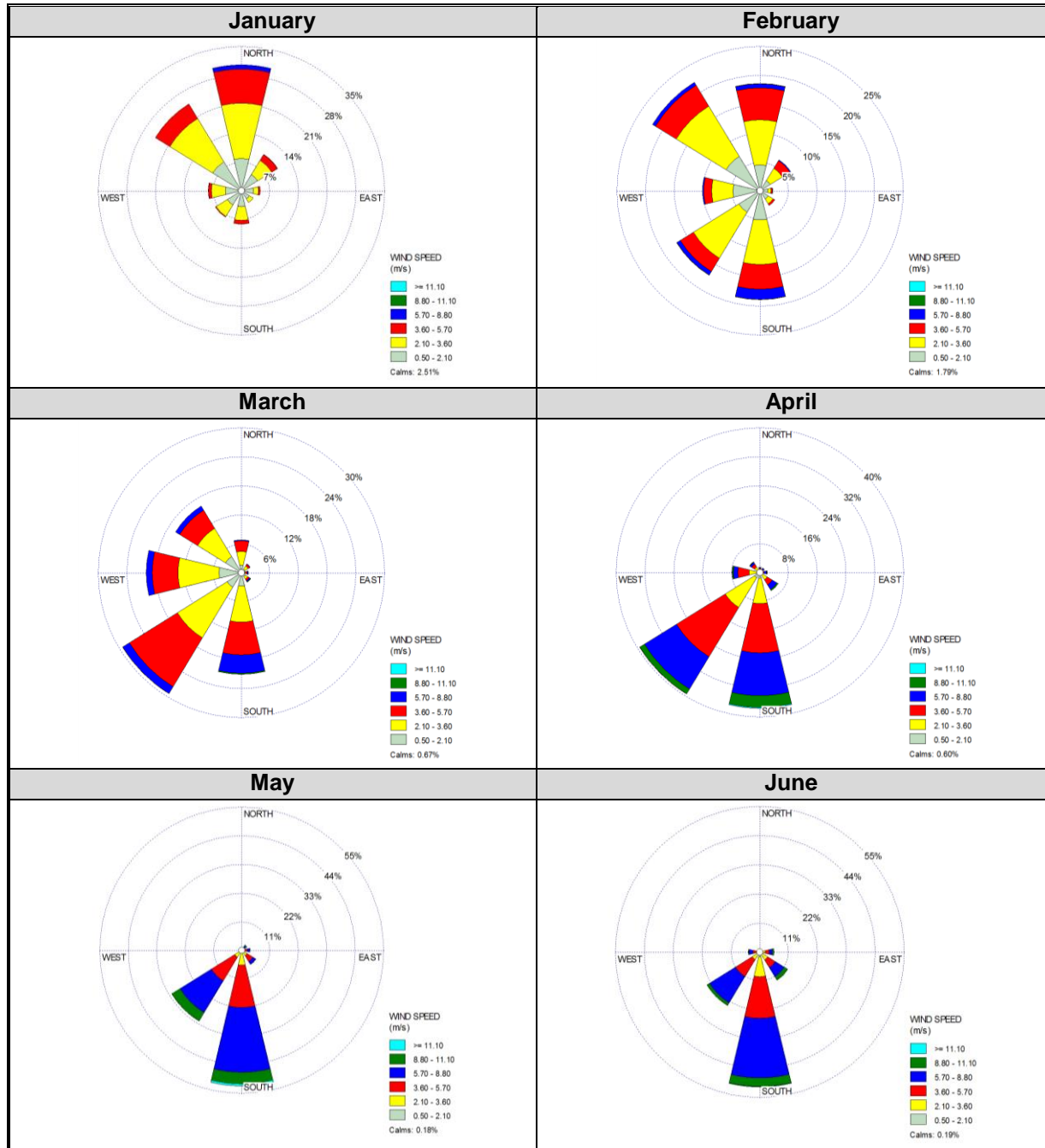


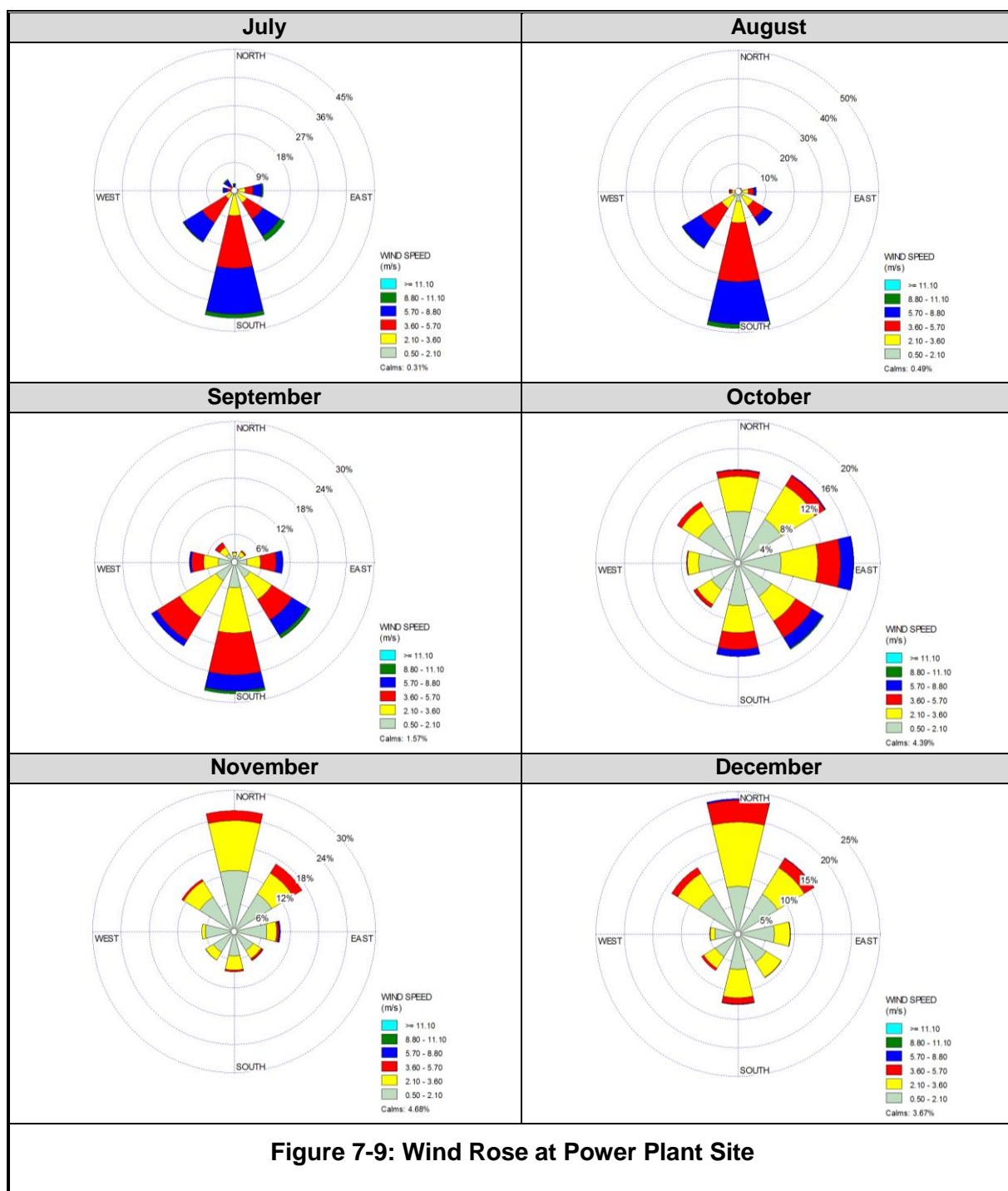
Figure 7-8: Monthly maximum, minimum and average of relative humidity (1989-2013)

7.2.6 Wind Speed and Direction

430. The directions of winds and their speeds vary depending on the seasons and even on the months. Considering the importance of the Sundarbans and the UNESCO World Heritage Site, wind directions and speeds have been shown by months below in the **Figure 7-9**. Wind speed data and direction have been obtained from the analysis of upper atmospheric data collected for last three years (Yr 2014-16) from Lakes Environmental Consultants Inc., Canada. The monthly wind rose diagrams show predominant wind

directions broadly towards north (narrowly northeast, north and northwest directions) from the south for eight (8) months and for the rest four (4) months towards south (southeast and south directions) from the north (**Table 9-9 in Chapter 9**). The October month shows very clumsy wind directions. **Figure 7-9** presents wind speed and direction graphically round the year.





7.3 Ambient Air Quality

431. The objective of the ambient air quality monitoring program was to establish the baseline ambient air quality in the study area. The profile of the study area is mainly rural on the both sides of the Passur River except Mongla Port part which is an industrial belt. The major sources of air pollution noted within the study area include industries along the left bank of the Passur and vessel movement through the same river and domestic emissions. A major industrial activity is reported in the study area. The air quality monitoring locations were selected based on the locations of forest, settlements and other sensitive receptors within the study area. Logistic factors such as consent of foresters and villagers, mainly the

house owners, power connection, accessibility, security, etc. were also taken into account in selecting the monitoring stations.

Methodology of Air Quality Monitoring

432. The existing ambient air quality of the study area was monitored at eleven (11) locations during the monitoring period (April, 2014 – January, 2016). The monitoring parameters included Particulate Matter [Suspended Particulate Matter (SPM), PM₁₀ and PM_{2.5}], Sulphur Dioxide (SO₂), Oxides of Nitrogen (NO_x) and Carbon Monoxide (CO). USEPA, NAAQS guidelines along with other guidelines were used to determine the data and find ambient concentrations for 8-hr averaging periods.

Selection of Sampling Locations

433. The baseline status of ambient air quality has been established through a scientifically designed ambient air quality monitoring network. The ambient air quality monitoring locations were based on the following aspects covered in field survey plan developed prior to the field work:

- Meteorological conditions of the area based on information of BMD observatory at Khulna;
- Topography of the study area;
- Location of sensitive receptors such as forest, major settlements, etc.
- Other criteria e.g. the sensitivity of the receptors, project activities like coal-carrying vessel movement, transshipment point etc.; wind direction and atmospheric stability class.

434. Moreover, the potential location of air pollution has been projected on the basis of model generated pollutant dispersion scenario. U.S. EPA approved regulatory air quality modeling software CALPUFF has been used to select the location of potential pollutants which may be dispersed from the Power Plant. The geographical locations and setting of the ambient air quality monitoring locations has been presented in **Table 7-1** and the methodologies of air quality monitoring has been given in **Table 7-2** while the photographs of monitoring are presented in **Figure 7-10**. Air quality monitoring locations are presented in **Figure 7-11**.

Table 7-1: Ambient Air Quality Sampling Locations

Sl. No.	Sampling Station	Station Code	Distance From Project Boundary	Direction From Project Site	Geographical Location	Location Setting
1	Project Site	AQ 1	0	SW corner of Project Site	22°34'36.05"N 89°33'35.30"E	Part of the proposed Power Plant
2	Proposed Township Area	AQ 2	0	NE corner of Project Site	22°36'1.06"N 89°33'51.8"E	Do
3	Kaigar Daskati	AQ3	3.2 km	NW side of Project Site	22°36'32.5"N 89°32'3.8"E	Rive (vessel traffic) and rural setting
4	Barni at Gaurambha union	AQ4	6.2 km	NE side of Project Site	22°38'51.8"N 89°34'37.7"E	Village and rural setting
5	Chunkuri-2, Bajua Union	AQ5	6.5 km	SW side of Project Site	22°32'3.3"N 89°34'01.1"E	Village and rural setting

Sl. No.	Sampling Station	Station Code	Distance From Project Boundary	Direction From Project Site	Geographical Location	Location Setting
6	Pankhali, Dacope	AQ 6	4.0 km	NW side of Project Site	22°36'6.7"N 89°31'24.2"E	Rive (vessel traffic) and rural setting
7	Mongla Port Area	AQ 7	14.3 km	SE side of Project Site	22°28'24.8"N 89°35'50.4"E	Industrial and commercial (vessel traffic) setting
8	Harbaria, the Sundarbans	AQ 8	33.3 km	SW side of Project Site	22°17'43.1"N 89°35'34.2"E	SRF (vessel traffic)
9	Akram Point, the Sundarbans	AQ 9	67.8 km	SW side of Project Site	22°1'16.0"N 89°30'45.52"E	SRF (vessel traffic)
10	Hiron Point, the Sundarbans	AQ 10	91.6 km	SW side of Project Site	21°46'27.60"N 89°27'53.2"E	WHS (vessel traffic)
11	Khan Jahan Ali Bridge (Khulna)	AQ 11	19.8	NE side of Project Site	22°46'36.8"N 89°35'35.5"E	Urban (road and vessel traffic)

Table 7-2: Analysis procedure for Air quality monitoring parameters

Sl. No.	Parameters	Analysis Procedure
1	SPM	Gravimetric method
2	PM10	Gravimetric method
3	PM2.5	Gravimetric method
4	SO2	Colorimetric method at 560 nm using spectrophotometer (West-Gaeke method)
5	NOx	Colorimetric method at 540 nm using spectrophotometer (Jacob and Hochheiser method)
6	CO	Digital CO meter (Model GCO-2008)



Ambient Air quality monitoring in Harbaria



Ambient Air quality monitoring in Akram point

Figure 7-10: Site Photographs- Ambient Air Quality Monitoring

Ambient Air Quality in the Study Area

435. The monitored ambient air quality is summarized in **Table 7-3** by broad head by season and one time data for January, 2016 is shown by the sampling location in **Table 7-4** and results are annexed in **Annex 7-1**.

436. It is evident from the above comparison of ambient air quality results with the applicable standards that the ambient air quality of the project study area is good with respect to the gaseous pollutants and fine particulate matter (PM_{2.5}). The monitoring results

show values of criteria pollutants (for 2014 and 2015) are mostly well below the Bangladesh Standard and Interim Target (IT-1) as well as Guidelines of IFC Standard except the Suspended Particulate Matter (SPM). The SPM values of the Project area during pre-monsoon and winter seasons and of the Khan Jahan Ali (KJA) Bridge during pre-monsoon, monsoon and winter seasons exceed the Bangladesh Standard (for SPM, IFC Standard is absent). Exceedances of SPM during the mentioned seasons in the Project site occurred due to land development activities, leveller and earth carrying vehicles whereas in the KJA Bridge due to movement of significant quantity of vehicles (Highway N7), water way vessels Bangladesh-India IWT Protocol Route, Akram to Nalian Route), industrial activities like operation of cement factories, oil refinery, brick fields, Rupsha Tank Terminal, etc. All the monitoring results clearly indicate that the study area is not a degraded airshed.

Table 7-3: Average ambient air quality of different monitoring locations

Monitoring Area	Monitoring Period				IFC Standard	Bangladesh Standard		Parameter/ Unit
	Pre-Monsoon	Monsoon	Post-Monsoon	Winter		ECR,1997	Draft ECR, 2017	
Project Area	24.3	19.7	22.7	26.6	75 ^{24hr} (IT-1)	65 ^{24hr}	35 ^{24hr}	PM _{2.5} (µg/m ³)
The Sundarbans	15.6	12.4	18.5	15.6	75 ^{24hr} (IT-1)	65 ^{24hr}	35 ^{24hr}	
KJA Bridge	29.4	24.7	26.1	28.3	75 ^{24hr} (IT-1)	65 ^{24hr}	35 ^{24hr}	
Project Area	57.7	51.0	43.8	65.9	150 ^{24hr} (IT-1)	150 ^{24hr}	150 ^{24hr}	PM ₁₀ (µg/m ³)
The Sundarbans	34.6	24.3	30.9	33.3	150 ^{24hr} (IT-1)	150 ^{24hr}	150 ^{24hr}	
KJA Bridge	78.7	67.1	51.5	72.0	150 ^{24hr} (IT-1)	150 ^{24hr}	150 ^{24hr}	
Project Area	216.4	136.2	146.4	210.9	-	200 ^{8hr}	-	SPM (µg/m ³)
The Sundarbans	101.8	109.7	90.8	108.0	-	200 ^{8hr}	-	
KJA Bridge	261.5	234.0	170.0	219.0	-	200 ^{8hr}	-	
Project Area	13.7	19.7	20.2	14.2	125 ^{24hr} (IT-1)	365 ^{24hr}	85 ^{24hr}	SO ₂ (µg/m ³)
The Sundarbans	9.1	10.7	15.7	10.0	125 ^{24hr} (IT-1)	365 ^{24hr}	85 ^{24hr}	
KJA Bridge	18.4	24.0	22.4	16.2	125 ^{24hr} (IT-1)	365 ^{24hr}	85 ^{24hr}	
Project Area	44.5	42.1	46.9	39.5	200 ^{1hr} (G)	-	-	NO _x (µg/m ³)
	3.5	3.3	3.7	3.1	40 ^{Annual} (G)	100 ^{Annual}	100 ^{Annual}	
The Sundarbans	33.4	31.6	39.4	30.8	200 ^{1hr} (G)	-	-	
	2.6	2.5	3.1	2.4	40 ^{Annual} (G)	100 ^{Annual}	100 ^{Annual}	
KJA Bridge	57.9	56.1	58.2	46.5	200 ^{1hr} (G)	-	-	
	4.6	4.4	4.6	3.7	40 ^{Annual} (G)	100 ^{Annual}	100 ^{Annual}	
Project Area	111.65	124.12	139.07	131	-	10000 ^{8hr}	10000 ^{8hr}	CO µg /m ³
The Sundarbans	61.44	60.16	75.16	59.2	-	10000 ^{8hr}	10000 ^{8hr}	
KJA Bridge	166.33	165	212	197	-	10000 ^{8hr}	10000 ^{8hr}	
Project Area	19.85	15.125	15	13.71	100 ^{8hr} (G)	157 ^{8hr}	157 ^{8hr}	O ₃ µg/m ³
The Sundarbans	17	12.75	7.83	10	100 ^{8hr} (G)	157 ^{8hr}	157 ^{8hr}	
KJA Bridge	27	24.66	30.5	20.5	100 ^{8hr} (G)	157 ^{8hr}	157 ^{8hr}	

Note: IT- Interim Target; G- Guidelines

* CO concentrations and standards are 8-hourly only.

** The Bangladesh National Ambient Air Quality Standards have been taken from the Environmental Conservation Rules, 1997 which was amended on 19th July 2005 vide S.R.O. No. 220-Law/2005.

*** WHO Ambient Air Quality Guideline Values (2005 and 2000), which are also being referred in the World Bank and IFC's General EHS Guidelines (2007).

**** Shaded values indicate exceedances of the Standard.

437. The monitoring results of January, 2016 do not show any exceedance of criteria pollutants at any place against the Bangladesh and IFC Standards applicable for Bangladesh.

Table 7-4: Ambient air quality measured in January, 2016 in the study area

Sl. No	Monitoring Locations	PM2.5 (µg/m ³)	PM10 (µg/m ³)	SPM (µg/m ³)	SO ₂ (µg/m ³)	NOx (µg/m ³)	CO (µg/m ³)	O ₃ (µg/m ³)
	BD Standards	65 (24hr)/15 Annual	150 (24hr)/50 Annual	200 (8hr)	365 (24hr)/80 Annual	100 (Annual)	40000 (1 hr)/10000 (8hr)	157 (8hr)
	IFC/WBG Standards	G: 25 (24hr) IT-1: 75 (24 hr) IT-1: 35 (Annual)	G: 50 24hr IT-1:150 (24 hr) IT-1: 70 (Annual)	- - -	G: 20 (24hr) IT-1: 150 (24 hr) -	G: 200 (1hr) G: 40 (Annual)	- -	G: 100 (8 hr) -
1	SW Corner of Project Site	25.0/5.0	99.3/19.9	175.0	10.3	32.2/2.65	132.1/74.0	2.9
2	Proposed Township Area of the PP	25.7/5.1	85.3/17.0	192.0	9.6	28.6/2.36	137.5/77.0	0.7
3	NW Corner of the Project	17.6/3.5	91.9/18.4	187.0	9.6	32.2/2.65	137.5/77.0	1.5
4	Barni, Gaurambha	21.3/4.3	71.3/14.3	176.0	11.8	37.6/3.09	144.6/81.0	2.9
5	Chunkuri-2, Bajua	22.8/4.5	72.0/14.4	167.0	15.4	28.6/2.36	125/70.0	0.7
6	Mongla Port Area	25.0/5.0	97.0/19.4	189.0	11.8	23.3/1.91	126.8/71.0	2.2
7	Pankhali, Dacope	34.6/6.9	94.1/18.8	198.0	13.2	26.8/2.21	180.3/101.0	1.5
8	Hiron Point (WHS)	12.5/2.4	30.1/5.7	97.0	10.5	39.3/3.10	107.1/60.0	9.0
9	Akram Point, the Sundarbans	13.2/2.6	56.6/11.3	128.0	10.3	26.8/2.21	114.3/64.0	0.7
10	Harbaria, the Sundarbans	19.1/3.8	60.3/12.1	159.0	11.0	25.0/2.06	110.7/62.0	1.5
11	Khulna City, near Khan Jahan Ali Bridge	25.7/5.1	82.3/16.5	181.0	11.8	28.6/2.36	175/98.0	1.5

Note: IT- Interim Target; G- Guidelines

Source: Measured data

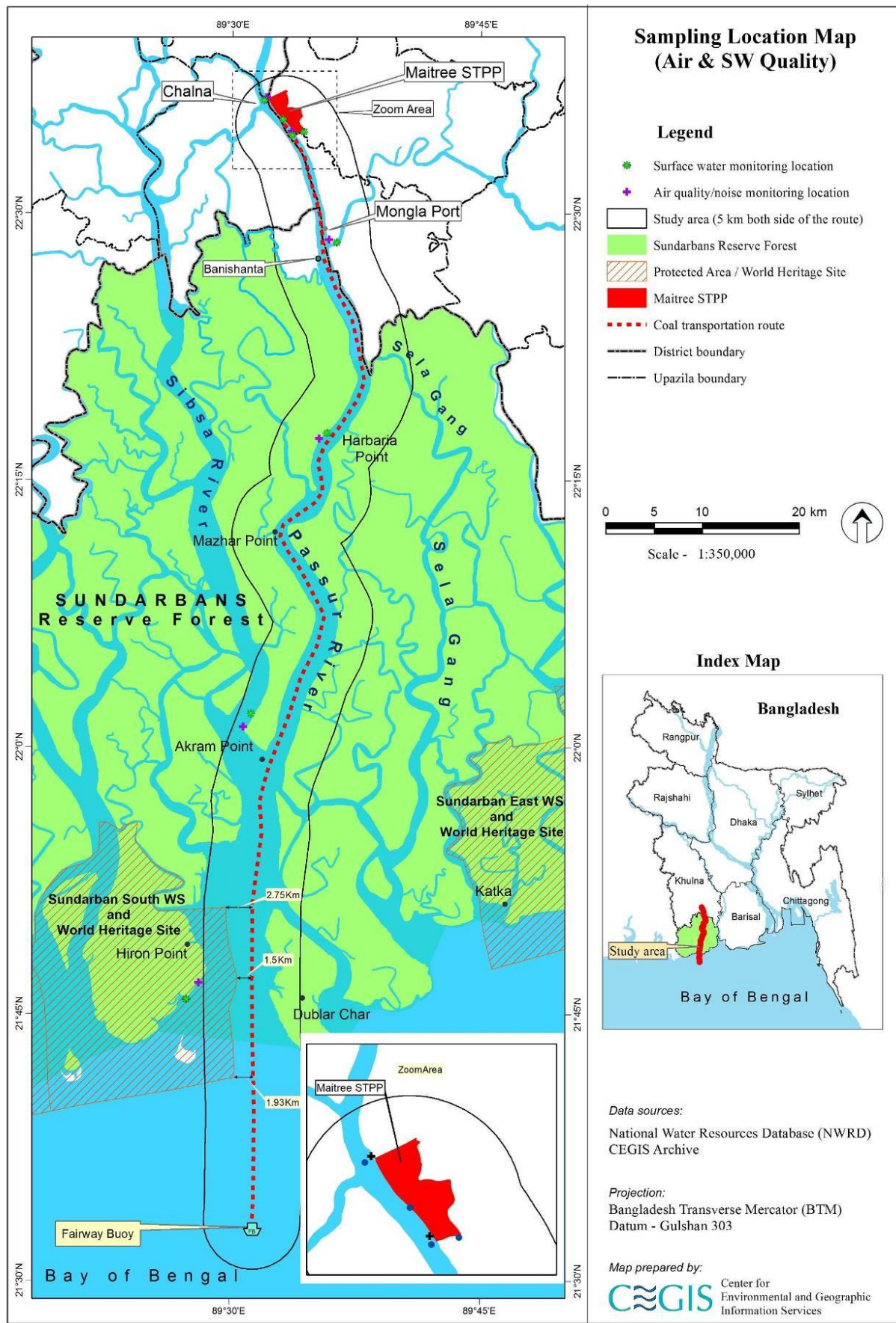


Figure 7-11: Sampling locations of physical parameters

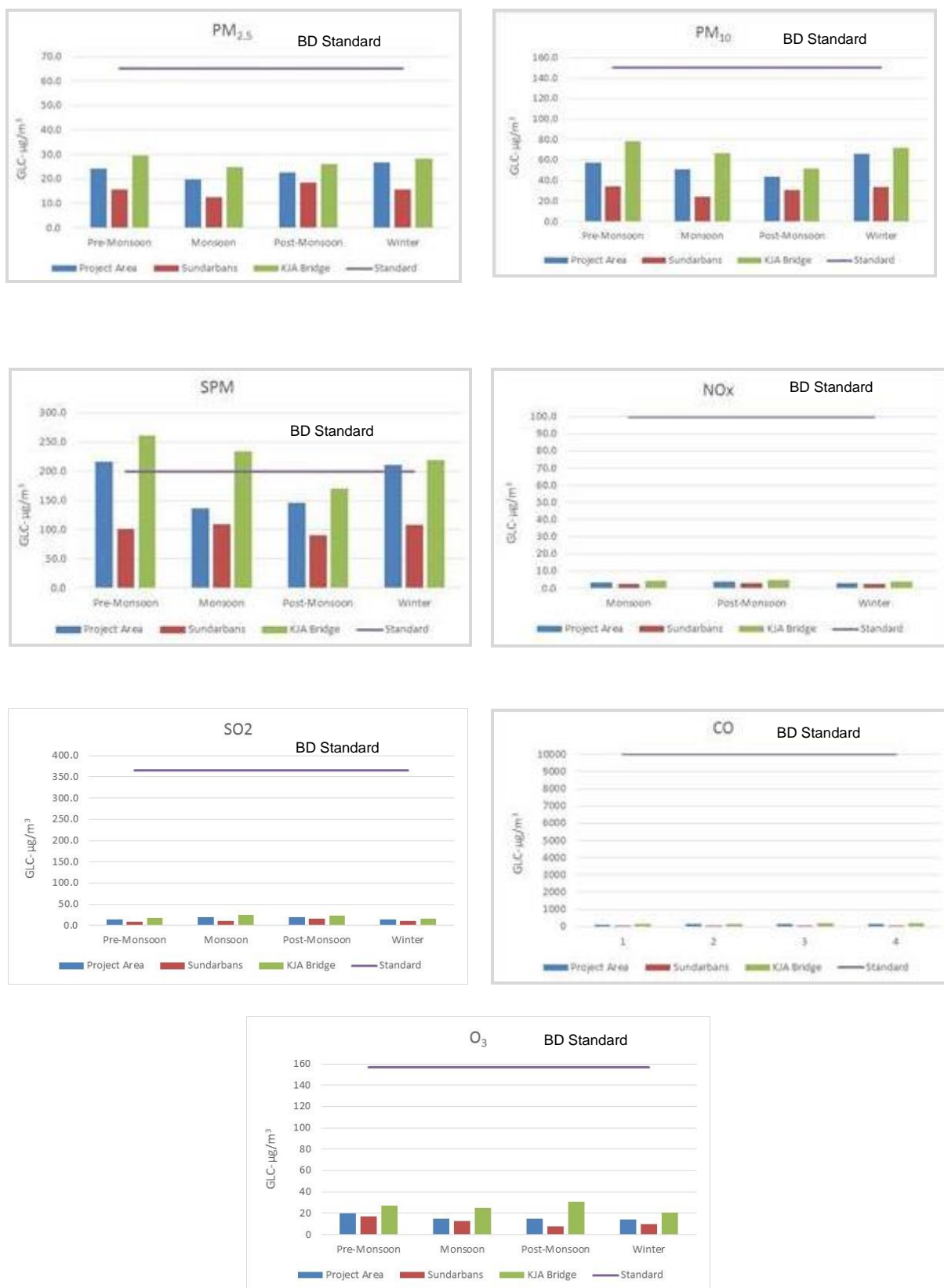


Figure 7-12: Seasonal variation of criteria pollutants against standard

438. During the monitoring period, the values of $PM_{2.5}$ and PM_{10} have been found within the standard limit at each of the locations. The maximum concentration of $PM_{2.5}$ ($47 \mu\text{g}/\text{m}^3$) is found in Pankhali, Dacope and that of PM_{10} ($135 \mu\text{g}/\text{m}^3$) is near the SW corner of the Project area, the SPM is also noted the highest ($182 \mu\text{g}/\text{m}^3$) at Pankhali, Dacope. A large number of two-stroke human haulers, small engine boats and the anthropogenic activities are the possible sources of SPM. Cement industries, road traffic and ongoing dredging operation of Mongla Port Authority in the Passur River might also be the sources of SPM. In addition, concentration of Sulphur Dioxide in the ambient air is found within the Bangladesh Standard of $455 \mu\text{g}/\text{m}^3$ for 8 hours (calculated). The SO_2 values in and around the Sundarbans area ranges from $13 - 21 \mu\text{g}/\text{m}^3$. Besides, NO_x concentration in the ambient air of the Sundarbans ranges from $13 - 18 \mu\text{g}/\text{m}^3$. The values are within the Bangladesh Standard of $405 \mu\text{g}/\text{m}^3$ for 8 hours (calculated). Besides, CO concentration found to be varied from $62 - 101 \mu\text{g}/\text{m}^3$ in and around the Project site. The possible sources of CO concentration are activities, such as the anchorages of large vessels beside the sampling point and for the loading-unloading activity; whereas in the Sundarbans, the concentration ranges $62 - 64 \mu\text{g}/\text{m}^3$. The values are found very insignificant in the context of Bangladesh Standard ($10,000 \mu\text{g}/\text{m}^3$ for 8 hours). Similarly, results of O_3 in the Sundarbans are found lower ($1 - 4 \mu\text{g}/\text{m}^3$) than the Bangladesh Standard of $157 \mu\text{g}/\text{m}^3$ for 8 hours (calculated). As Ground-level or "bad" ozone is not emitted directly into the air, and hence is considered to be created by chemical reactions between oxides of nitrogen (NO_x) and volatile organic compounds (VOC) in the presence of sunlight. The seasonal variations of various criteria pollutants against their standards are shown in **Figure 7-12**.

7.4 Ambient Noise Level

439. The purpose of ambient noise level measurement was to determine sound intensity at the monitoring locations. These locations are chosen in such a way that representative data could be recorded all over the study area. The study area consists of some highly sensitive areas like the Sundarbans Reserve Forest (SRF), World Heritage Site (WHS), etc. The SRF and WHS fall under the silent zone according to the Noise Pollution Rule, 2006 of DoE. The major sources of noise inside the forest are mainly natural phenomena or anthropogenic sometimes. This study focus on around 5 km both sides of the Passur River as the vessels move regularly through this river.

7.4.1 Methodology of Noise Level Monitoring

440. The noise levels were recorded at 11 locations in the study area during the monitoring period of April, 2014 to January, 2016. The locations of noise monitoring have been selected based on the impact potentiality of the power plant and coal transportation as well as the spatial sensitivity (**Figure 7-11**). Noise levels were recorded in the form of sound pressure levels using a portable ANSI II digital sound level meter. Every location is justified based on the location sensitivity as well as the potentiality of the impact of coal transportation and transshipment process. Each time noise level is recorded for fifteen minutes time span with 1 second interval. The noise monitoring locations are described in **Table 7-5**.

441. Depending on the site condition and acoustic environment, the noise meter is set up and calibrated each time following the manual. The sound level is recorded in the form of a-weighted equivalent continuous sound pressure level (Leq) values. The quarterly noise monitoring data are presented in **Table 7-6**.

Table 7-5: Details of ambient noise monitoring locations

Sl. No.	Sampling Station	Station Code	Distance From Project Boundary	Direction From Project Site	Geographical Location	Location Setting
1	Project Site	NL 1	0	SW corner of Project Site	22°34'36.05"N 89°33'35.30"E	Part of the proposed Power Plant
2	Proposed Township Area	NL 2	0	NE corner of Project Site	22°36'1.06"N 89°33'51.8"E	Do
3	Kaigar Daskati	NL3	3.2 km	NW side of Project Site	22°36'32.5"N 89°32'3.8"E	Rive (vessel traffic) and rural setting
4	Barni at Gaurambha union	NL4	6.2 km	NE side of Project Site	22°38'51.8"N 89°34'37.7"E	Village and rural setting
5	Chunkuri-2, Bajua Union	NL5	6.5 km	SW side of Project Site	22°32'3.3"N 89°34'01.1"E	Village and rural setting
6	Pankhali, Dacope	NL 6	4.0 km	NW side of Project Site	22°36'6.7"N 89°31'24.2"E	Rive (vessel traffic) and rural setting
7	Mongla Port Area	NL 7	14.3 km	SE side of Project Site	22°28'24.8"N 89°35'50.4"E	Industrial and commercial (vessel traffic) setting
8	Harbaria, the Sundarbans	NL 8	33.3 km	SW side of Project Site	22°17'43.1"N 89°35'34.2"E	SRF (vessel traffic)
9	Akram Point, the Sundarbans	NL 9	67.8 km	SW side of Project Site	22°1'16.0"N 89°30'45.52"E	SRF (vessel traffic)
10	Hiron Point, the Sundarbans	NL 10	91.6 km	SW side of Project Site	21°46'27.60"N 89°27'53.2"E	WHS (vessel traffic)
11	Khan Jahan Ali Bridge (Khulna)	NL 11	19.8	NE side of Project Site	22°46'36.8"N 89°35'35.5"E	Urban (road and vessel traffic)

7.4.2 Results of Noise Monitoring

442. Results of noise monitoring at the hot spots are described as below:

Chalna, Dacope

443. Noise levels were measured at the right bank of the Passur River located at the Chalna Port. This location falls under commercial zone class where the ambient day-time noise level standard is 70 dB(A) (ECR, 2006). The major noise sources of the area are loading and unloading activities of smaller barges, mechanized boats, road vehicles, mobs, etc. No exceedances of noise level were observed in this location at any of the quarters.

North West Corner of the Project Area

444. The north-west corner of the Project area is under Kaigar Daskati Mauza of Gaurambha union. The measurement location is nearby a Gucchha-Gram (a cluster village built by the Government for the landless and homeless people). This is a residential area and the day-time standard is 55 dB(A) (ECR, 2006). The major sources of noise are mechanized boats, barges; ships, etc. ply through the Passur River, wave breaking, etc. No exceedances of noise level were observed in this location at any of the quarters.

Chunkuri-2, Bajua

445. This area is a residential area and the day-time standard is 55 dB(A). Noise levels in two consecutive years were measured at roughly three (3) months interval and found fluctuations. The levels are within the permissible limit except the level 57.76 dB(A) found in 1st quarter in March, 2014 at the time of measurement probably due to road traffic and mobs. The major noise sources of the area are rural road traffic and mobs. The road traffic consists mostly of locally made engine van (called Nosimon), motorcycle, bicycle, van, etc.

South-West Corner of the Project Site

446. The south-west corner of the project site is at Sapmari, Katakhal Mauza of Rajnagar union. This is a residential area and the day-time standard is 55 dB(A). The noise levels measured at different quarters are found within the standard except levels found in 8th quarter (60.44 dBA) in January, 2016 and 10th quarter (65.37 dBA) in July, 2016 probably due to frequent movement of water vessels.

Proposed Township Area of the Power Plant

447. The proposed township area of the Power Plant is located at the middle of the eastern part of the Project area. This is a residential area and the day-time standard is 55 dB(A). The noise levels measured at different quarters are found within the permissible limit except noise level found in 10th quarter, 55.79 dB(A) in July, 2016 probably due to frequent movement of water vessels. The major sources of noise of this location are water vessels, power plant's land development activities, mobs, etc.

Barni, Gourambha

448. Noise levels were measured at Barni area of Gourambha, which falls under the mixed zone (residential and commercial area) and the day-time standard is 60 dB(A) (ECR, 2006). The major sources of noise of this area are road vehicle, commercial activities, mobs, etc. No exceedances of noise level were observed in this location.

Khan Jahan Ali Bridge, Khulna

449. Noise levels were measured on the Khan Jahan Ali Bridge at Khulna, which falls under the commercial zone and the day-time standard is 70 dB(A). The major sources of noise of this area are road vehicle, river traffic, commercial activities, mobs, etc. Noise levels measured in this location were observed within the permissible limit except for the 1st quarter in March, 2014 and 5th quarter in April, 2015 probably due to sudden horn of the vehicles.

Mongla Port Area

450. Noise levels have been recorded at 200 m northward from the main entrance of the Mongla Port on the Khulna-Mongla Highway. The area is designated as an industrial area and ambient day time noise level standard for this location is 75 dB(A) (ECR, 2006). No exceedances of noise level are observed in any of the quarters. The major sources of noise are road traffic (heavy vehicles, light vehicles, etc.) and noise from Mongla Port's loading, unloading and repairing activities.

Harbaria Point, the Sundarbans

451. Harbaria Point inside the Sundarbans is very important due to richness of biodiversity. This area is an effective anchorage point of mother vessels those are calling at the Mongla Port. Most of the Ocean Going Vessels (OGV) uses this anchorage for lighterage operation. The area falls under silent zone class where the ambient day-time noise level standard is 50 dB(A) (ECR, 2006). The noise levels are recorded at 100 m inside the forest on the right bank of the Passur River to avoid the disturbance of noise from wave breaking against the shore. No exceedances of noise level are observed in any of the quarters. The major noise sources of this location are ship movement, running engines of anchored ships, wind, chirping of birds, wave breaking and wind action on tree leaves.

Akram Point, the Sundarbans

452. Akram Point inside the Sundarbans is another biodiversity hot spot in the Sundarbans. This area falls under the silent zone class where the ambient day-time noise level standard is 50 dB(A). The noise measurement location is at the left bank of the Sibsa River. Noise is recorded at about 100 m inside the forest from the river bank to avoid noise from wave breaking. The noise levels measured at different quarters are found within the permissible limit except for the 5th quarter, 54.86 dB(A) in April, 2015. The major sources of noise are chirping of birds, stormy wind, wave and wind action on tree leaves.

Hiron Point/World Heritage Site

453. Noise levels were measured at the right bank of the Passur River mouth located at the Sundarbans South Sanctuary also known as World Heritage Site. This location falls under silent zone class where the ambient day time noise level standard is 50 dB(A). This location is very important as the Mother vessel enters into the Passur River. However, the river is roughly 5-6 km wide between two banks at the confluence point. No exceedances of noise level are observed in this location except 2nd quarter, 51.29 dB(A) in July, 2014. The major sources of noise are sea shore wave breaking, wind blowing, chirping of birds and mechanized sea going boats. The **Figure 7-13** shows the seasonal variation of noise at different monitoring locations.

Table 7-6: Summary of the ambient noise recorded in consecutive 10 Quarter monitoring sessions in 2014, 2015 & 2016

Sl. No.	Location	QM1 Mar-14	QM2 Jul-14	QM3 Oct-14	QM4 Jan-15	QM5 Apr-15	QM6 Jul-15	QM7 Oct-15	QM8 Jan-16	QM9 Apr-16	QM10 July-16	Day-Time Std*
1	Chalna, Dacope	68.13	52.87	54.63	53.28	57.08	49.77	65.12	66.07	65.08	52.42	70
2	North West Corner of the Project Area	51.89	NM	41.92	35.25	44.67	41.56	41.94	50.96	50.79	52.65	55
3	Chunkuri-2, Bajua	57.76	52.55	51.39	49.29	47.05	40.66	47.43	53.62	44.49	53.4	55
4	SW Corner of the Project Site	49.2	47.6	45.95	36.03	43.58	43.75	42.7	60.44	54.50	65.37	55
5	Proposed Township Area at Project Site	48.75	46.68	41.92	41.47	41.47	46.75	50.52	53.77	53.37	55.79	55
6	Barni, Gaurambha	58.84	49.95	49.78	43.6	54.17	46.18	55.16	59.16	53.97	56.75	60
7	Khan Jahan Ali Bridge, Khulna	71.7	60.8	66.28	61.72	73.45	52.82	64.25	68.45	65.85	63.77	70
8	Mongla Port area	61.24	53.84	60.5	38.69	48.15	39.61	47.01	52.7	49.88	52.86	75
9	Harbaria Point, the Sundarbans	40.88	56.13	55.3	34.38	65.37	35.03	50.75	45.2	44.55	52.9	50
10	Akram Point, the Sundarbans	40.94	47.9	43.98	34.32	54.86	NM	49.6	42.95	42.95	47.96	50
11	Hiron Point, the Sundarbans	38.63	51.29	47.98	37.37	47.84	NM	46.06	NM	43.11	NM	50

Note: All values are in decibels (dBA), QM- Quarter Monitoring, NM – Not Monitored, *Std- Standard as defined in National Noise Control Rules 2006; Shaded values are showing the exceedances of noise level from the Bangladesh Standard

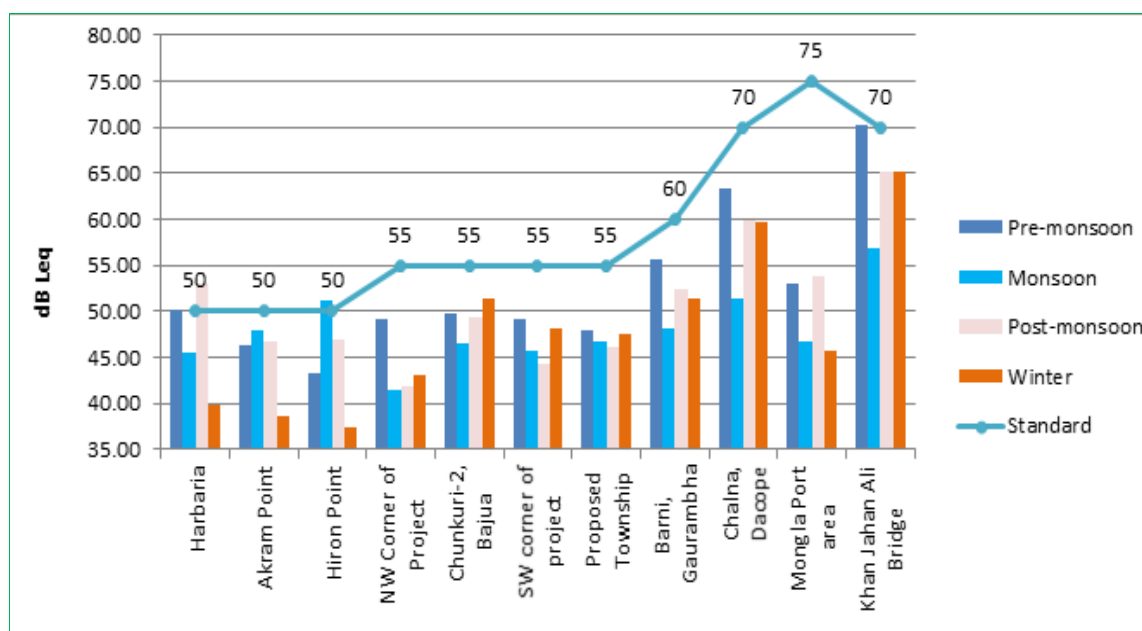


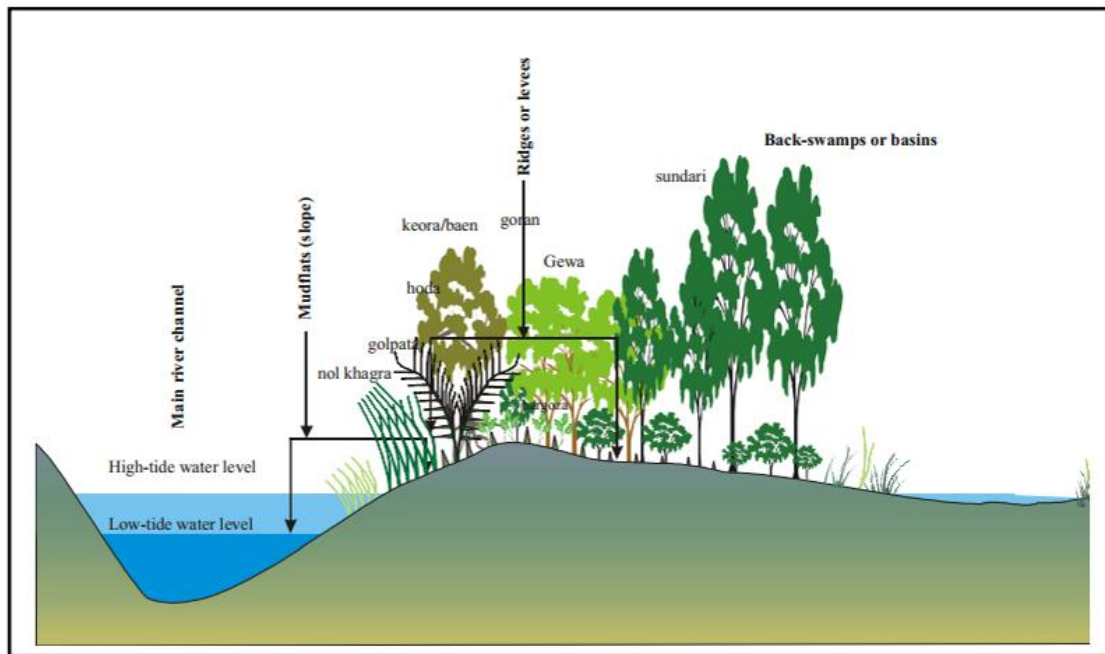
Figure 7-13: Seasonal variation of Noise level at different locations

454. During the monsoon or post monsoon, the level of noise crosses the standard limit (e.g. 50 dBA at day) at Harbaria and Hiron Point due to the rain drops, wave of river water, breeze inside the forest, birds chirping or vessels movement.

7.5 Water Resources

7.5.1 Geomorphology

455. The coal transportation route i, e, the Passur river crosses the Sundarbans which transforms into a series of low elevated isolated (like islands) landmasses under strong tidal influences. Geological and tectonic activities, along with past and present drainage patterns, have been instrumental in defining the present geomorphology of the Sundarbans. At least four morphometric categories can be discerned here (CEGIS, 2012), i.e., river or stream creeks, mudflats, ridges and back swamps, one grading into the other and responding to the changes in the fluvial process. While the geomorphic process largely determines the development of the mangroves in a region, they are mainly important in producing certain substrate or soil conditions and regulating the inundation time and frequency. Analysis of vegetation along the gradient landform reveals that species assemblage patterns change with the shifting pattern of landform and its position in relation to the elevation from sea level. Thus, hydrological factors (sedimentation, drainage density, tidal asymmetry, tidal prism, etc.) that change the morphometric pattern of the landscape have bearings on the vegetation development in the Sundarbans. **Figure 7-14** illustrates a profile of vegetation along the geomorphologic gradient.



(Source: CEGIS, 2012)

Figure 7-14: Profile of vegetation along the geomorphic gradient

7.5.2 River System

456. There are three rivers connecting to the coal transportation route, the Passur River, the Sibsa River and the Maidara- Ichamati River. The Maidara-Ichamati river system serves as a tidal creek on the left bank of the Passur River, supporting the parcels of mangrove vegetation along the banks.

457. The Passur River originates/starts from the downstream of the Kazibacha River at Bajuya Union of the Khulna Sadar Upazila, and finally the Bay of Bengal. After passing through the Mongla Port, the Passur River flows through the Sundarbans keeping the Trikona and Dubla chars at its left bank (east side). From the upstream maximum flow of the Gorai-Madhumati river passes into this river through the Nabaganga River. The Mongla canal joins the river near the Mongla Port which is about 14 km south of the proposed Power Project site. Flowing further south, the river meets with the Sibsa at about 67 km from the Mongla Port and finally keeping Hiron Point on the right bank debouches into the sea with its original name Passur. It is more than three times wider at its outfall mouth. Water flow overtops its banks during the monsoon.

458. The river is about 500 m wide at Batiaghata area just below the Kazibacha-Rupsa River confluence and about 2.44 km wide at the confluence of the Passur-Sibsa. The total length of the river is about 104 km. The Passur and all its distributaries are tidal channels and is the main river to control drainage system of the surrounding area. The name of connected drainages or tidal channels of Passur River are the Maidara, the Ichamati and the Chunkuri, Soalmari and Atharobaki rivers. All these channels act as creeks through which tidal water enters into the project site during high tide and drains out during the ebb tide. General features of the Passur River are given in **Table 7-7**. The river system of the study area is shown in **Figure 7-15**.

Table 7-7: General Features of the Passur River

Features	Bay of Bengal
Geographical location	South Western Region
River originates	It continues from the downstream of the Kazibachha at Bajuya union of the Sadar Upazilla, Khulna, up to the Bay of Bengal
River flow path	Freshwater from the Ganges flows through the Gorai-Madhumati, the Nabaganga, the Atai, the Rupsa and the Kazibachha into this channel
Route type	Class-I Route of the BIWTA
Length	104 km
Width (avg.)	1164 m
Depth	6-8 m at Mongla
Catchment area	425 sq. km
Seasonal/Perennial	Perennial
Minimum of monthly minimum discharge (February)	6000 cumec
Minimum depth in dry season	6-6.5 m at Mongla
Maximum of monthly maximum discharge (August)	22500 cumec
Tidal	Yes
Flooding pattern during normal flood	Tidal flood (tidal inundation, storm surge)

Source: Rivers of Bangladesh (BWDB, 2005 and 2012)

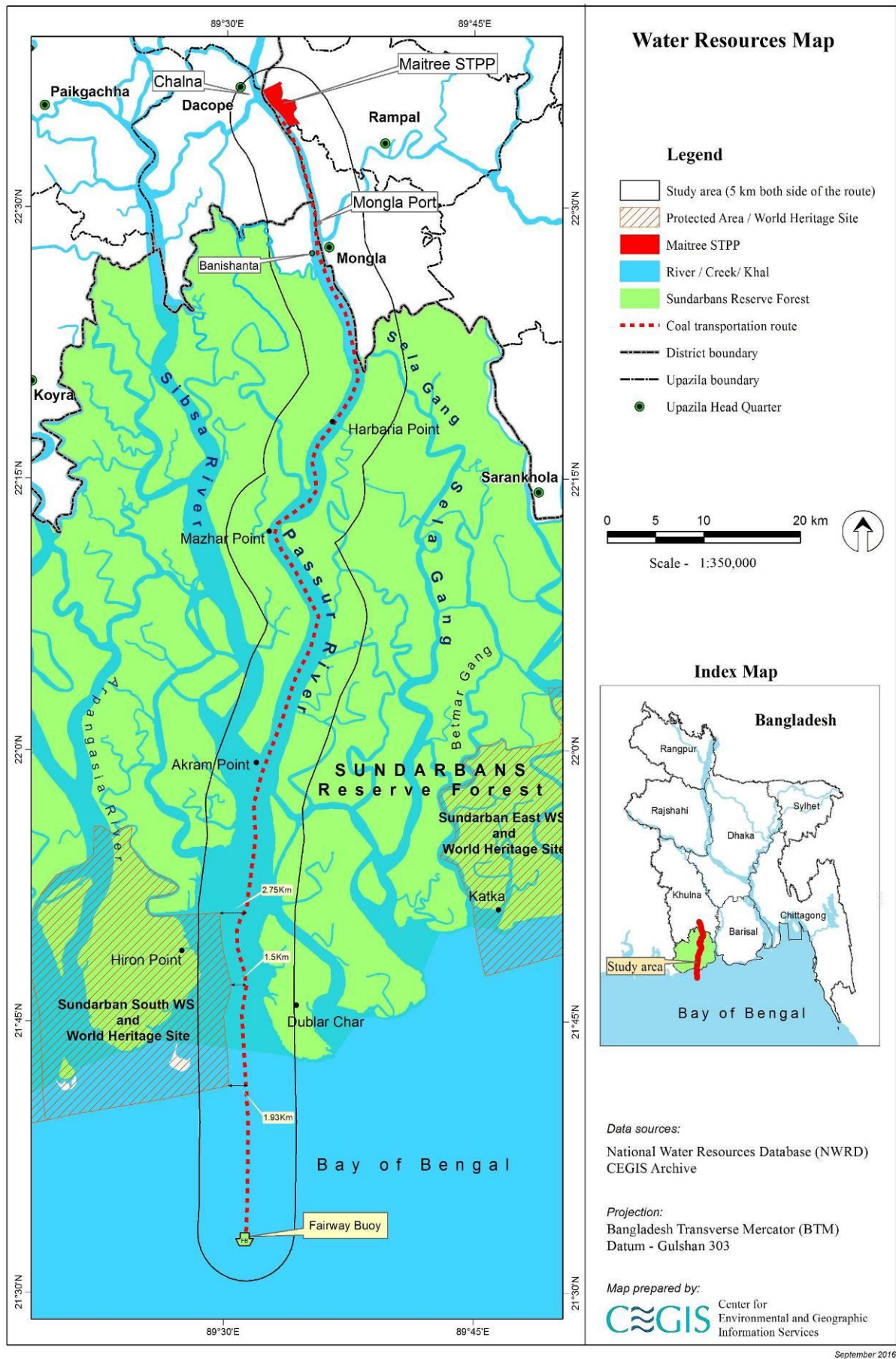


Figure 7-15: River system of the Sundarbans

7.5.3 Estuary System

459. The principal rivers of Bangladesh in the south-west region are the Gorai, the Passur-Sibsa, the Chitra, the Bhola, the Sonatola, the Bishkhali and the Baleswar rivers. These rivers connect with the Bay of Bengal through a specific land formation, known as estuary. The downstream of the confluence of Sibsa and Passur River has formed one of the most important estuaries in Bangladesh due to its geographic location and ecological setting. The second largest sea port of Bangladesh, Mongla located in Bagerhat District is approximately 132 km upstream of the Bay of Bengal. For proper functioning of the Mongla port, adequate navigability throughout the Passur River is a prerequisite. Discharges, salinity, sediment flow of the Passur River have a profound impact on the livelihood of the people of the Passur dependent area.

7.5.4 Riverine and Estuarine Morphology

460. The Passur River is mainly a tidal river, which is receiving fresh water mainly during the monsoon through the Gorai-Madhumati system. The river is flowing on the moribund delta and has a wide eroding estuary.

461. The minimum width of the river is about 690 m which is near the project location and maximum is about 8.0 km which is near Akram point. Maximum discharge of this river is observed during July–September and minimum during February–April. This river from Fairway Buoy to the Port Jetty is a designated maritime route of the Mongla Port and it is maintained by the Mongla Port Authority (MPA). The Port and the proposed Maitree Coal based Power Plant is situated on the left bank of the river. From the Mongla Port to Chalna, the river reach is maintained by the BIWTA as a class 1 inland route having a draft of 4 m.

462. The erosion and accretion is a big concern for river morphology. The erosion and accretion of the river has been analyzed with the help of Arc-GIS tool using banklines of 1973, 1984, 1997 and 2010 (**Figure 7-16**). The upper portion from Mongla experienced erosion at left bank whereas accretion at right bank at the time of 1973 to 1984. From 1984 to 2010 erosion observed at right bank and accretion at left bank.

463. The lower portion of the Passur River from Mongla port experienced significant erosion and accretion. From 1973 to 1984 both the bank of the river inside the Sundarbans eroded and accreted at a higher rate. The erosion rate of any bank of the Passur River is approximately equal to the rate of accretion on the other bank. The downstream portion of the river from Hiron point became narrower in 2010 than 1984 and 1997 due to accretion. The extent of right bank-line reduces approximately 700 m to 1.4 km compared to the bank-lines of 1984 while the change is about 800 m to 1.5 km at the left bank.

464. During the ebb tides, the receding water level causes scouring of top soil and creates innumerable number of small creeks, which normally originate from the centre of the islands. The eroding actions of the ebb tides is stronger in some islands, and the receding water carries large volumes of silt, which is deposited along the banks of rivers and creeks during high tides, resulting in an increase in the heights of the banks as compared to the interiors of the islands (FD, 2010).

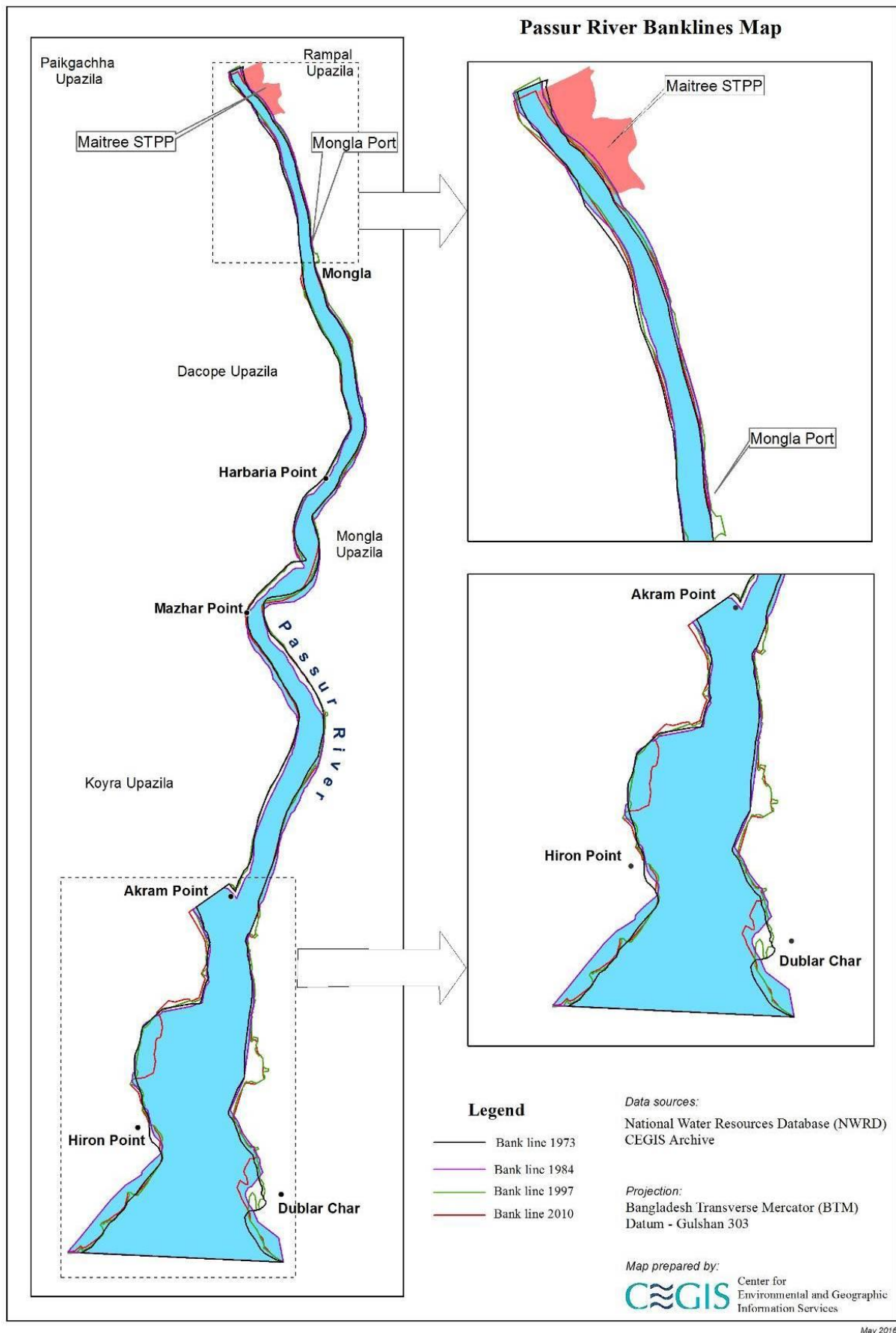


Figure 7-16: Erosion and accretion map of the Passur River

a. Tidal Fluctuations

465. Water level data of two stations, e.g., Mongla and Hiron Point have been analyzed for understanding the tidal fluctuations of the Passur River from Fairway Buoy to the Plant Jetty. In this regard, five years water level data (2008-2012) of BIWTA at Hiron Point has been collected and analyzed to find out the tidal fluctuation at that location. A hydrograph of the Passur River based on water level data is given in **Figure 7-17**, shows the variation of daily maximum and minimum water level. The water level of the Passur River rises from April to August and then recedes up to January. The highest water level observed at Hiron Point was 4.58 m in the year 2009 (**Figure 7-18**) and the lowest was -0.12 m in 2010. On average, the tidal variation of Hiron point is about 2 m. Daily minimum water level increases by 0.5 m during the monsoon.

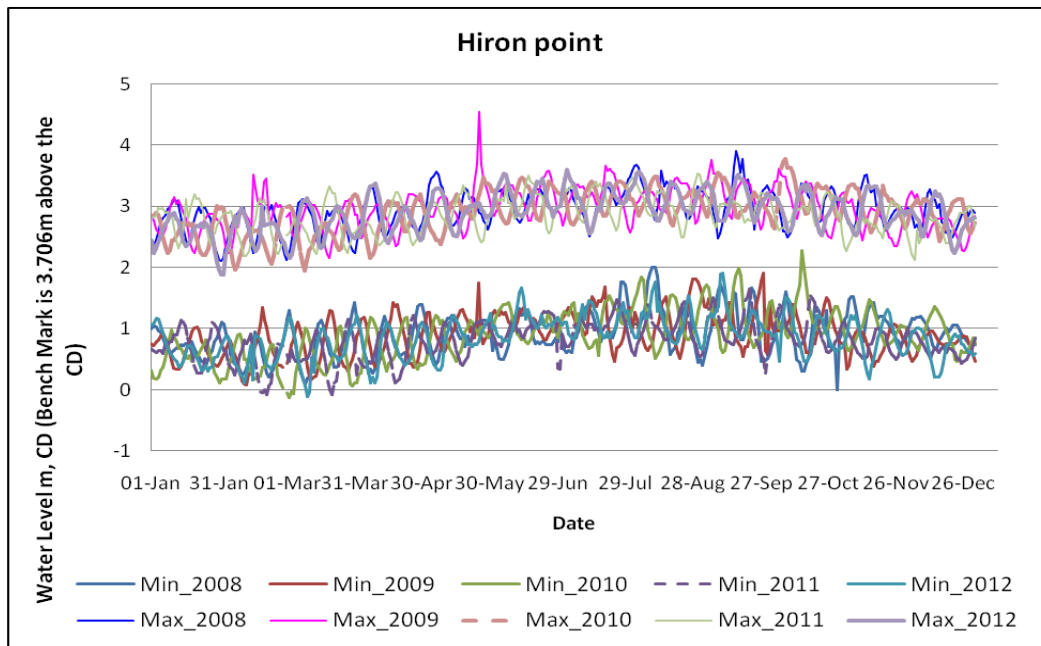


Figure 7-17: Tidal water level fluctuation at Hiron point over time

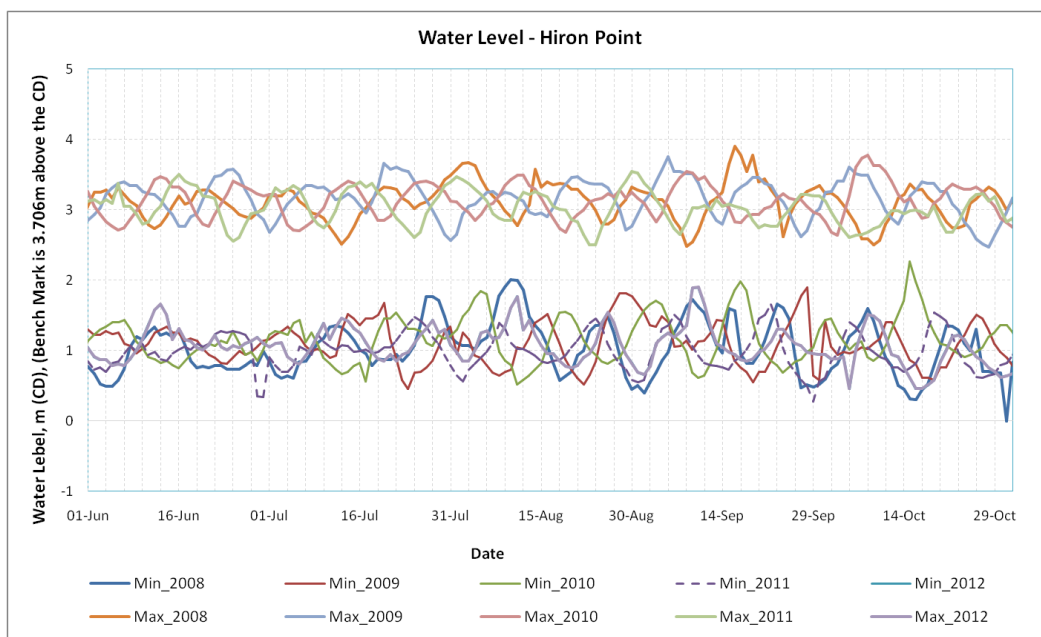


Figure 7-18: Tidal water level fluctuation during monsoon period

466. Water level data of Mongla BIWTA station for six years from 2005-2010 has been collected for analyzing tidal fluctuation. **Figure 7-19** shows the daily variation of water level of the Passur River at Mongla Port which is about 2.5 m. It also indicates that both the maximum and minimum water level rises from the month of April to July and the recession period is from August to October. From December to February, the maximum and minimum water level is fairly uniform.

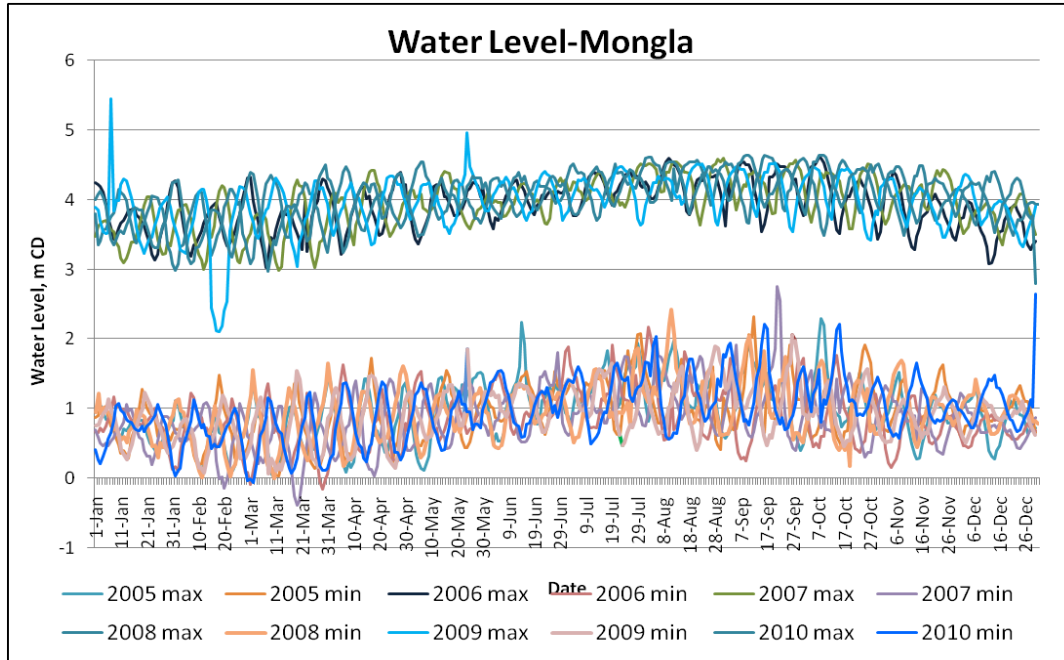


Figure 7-19: Water Level variation at Mongla

467. Water level fluctuation from April to October during the period of 2005-2010 at Mongla Port is shown in **Figure 7-20**. The observed highest water level was 4.96 m in 2009 and minimum water level was 0.03 m in 2007.

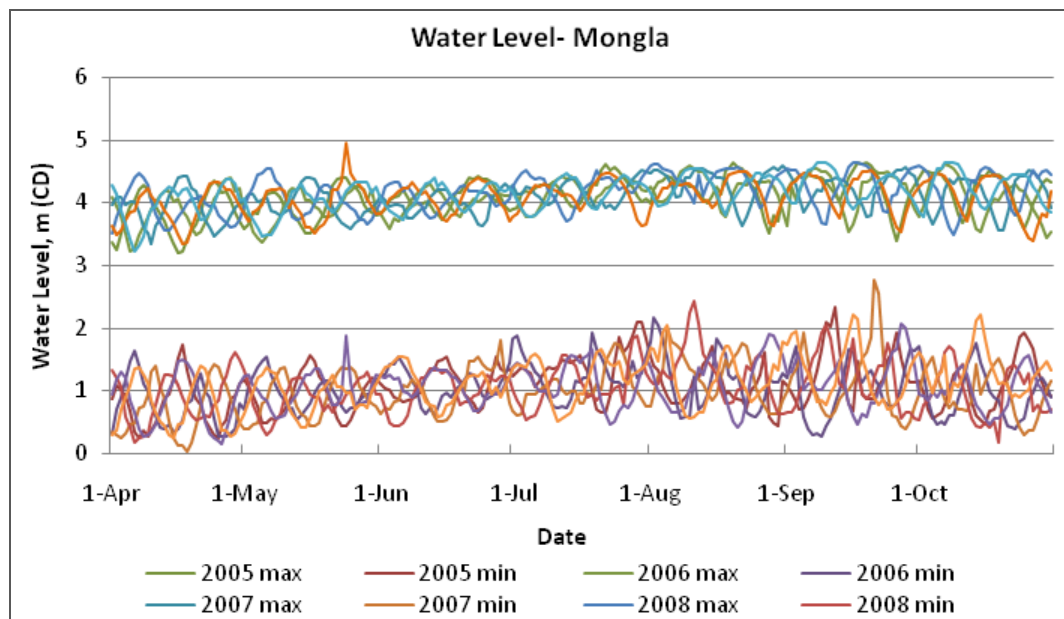


Figure 7-20: Water level variation at Mongla (April- October)

Tidal Inundation

468. Tidal flooding is a regular phenomenon in the study area. Tidal water intrudes during the high tied period which is accentuated especially at full moon or new moon period. The coverage area of Passur river tidal inundation varies with seasonal change. Therefore, tidal water generally does not extend much to the bank of Passur river. However, the back swamp areas of the Passur River are susceptible to water logging, seasonal flooding through breaching or over topping the Polder. The highest flood level was recorded as 4.2mPWD in the year of 1996 after analysis the data from 1979 to 2009 at Mongla Port Station of BWDB (ID 244). The peak water level has been distributed through the use of Gumbel Distribution methods for extreme value analysis. **Table 7-8** shows the return period of 100 years, 50 years, 25 years and 10 years.

Table 7-8: Estimated height water level in future at Mongla Port Station

Content	100 Year RP	50 Year RP	25 Year RP	10 Year RP
Highest water level	4.79	4.43	4.08	3.59

469. In Bangladesh, sea level rise has been considered as the main risk of climate change. According to IPCC (2007), the global sea level rise situation has been given in **Table 7-9** where the Sea Level Rise (SLR) has been predicted with respect to Special Report on Emissions Scenarios (SRES). The calculated SLR is based on AOGCMs for different SRES of IPCC.

Table 7-9: Sea level rise for SRES of AR4

	Scenarios					
	B1	A1T	B2	A1B	A2	A1F1
Temperature (°C)	1.1-2.9	1.4-3.8	1.4-3.8	1.7-4.4	2.0-5.4	2.4-6.4
SLR (m)	0.18-0.38	0.20-0.45	0.20-0.43	0.21-0.48	0.23-0.51	0.26-0.59

Source: IPCC (2007)

470. In case of Bangladesh's coast, different organizations have estimated sea level rise on the basis of 3rd IPPCC report. The estimated SLR at the coast of Bangladesh is shown in **Table 7-10**.

Table 7-10: Projected SLR at the coast of Bangladesh

Year	Sea level rise (cm)		
	TAR, IPCC(2001)	SMRC	NAPA scenario
2030	14	18	14
2050	32	30	32
2100	88	60	88

Source: IPCC, (2001); SMRC, (2000); and NAPA, (2005)

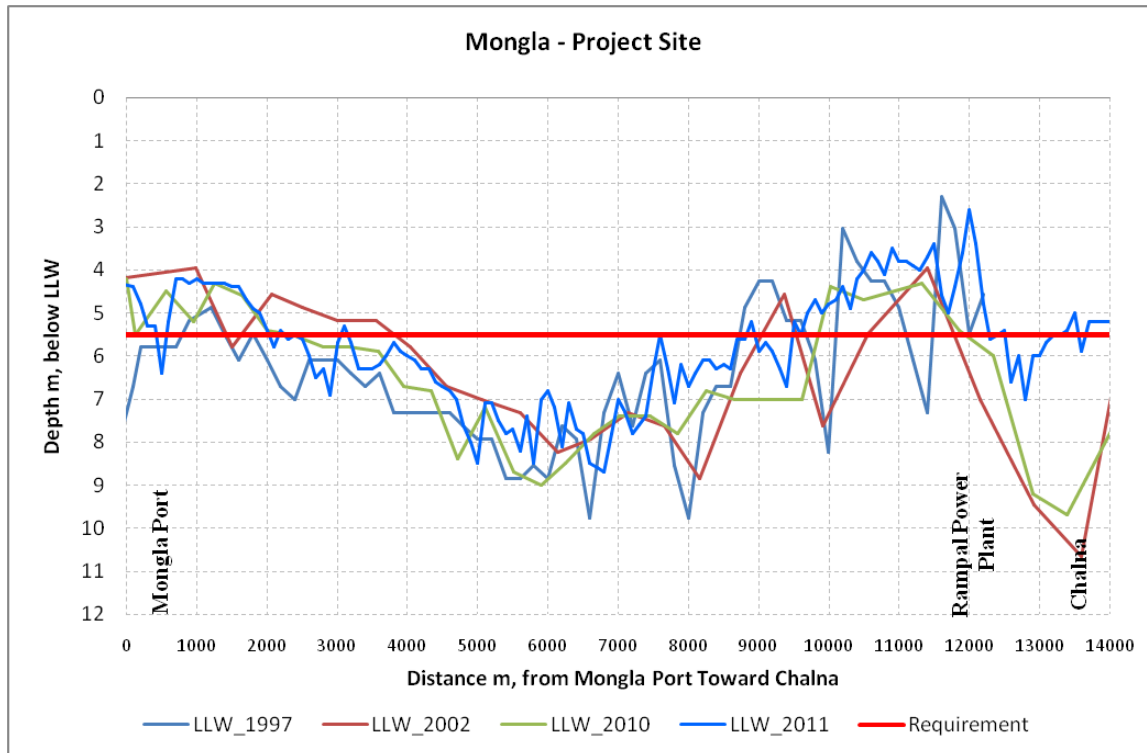
471. The water level inside the coastal river will also increase through a number of causes due to intrusion of sea water, backwater effects and increasing the upstream flow. In case of the Passur River, climate change may significantly increase the water level.

b. River Draft

472. The navigation route from the Anchorage Point of mother vessel to the Plant jetty is divided in two categories based on the jurisdiction of management, e.g., (i) Maritime route (Anchorage Point-Mongla Port) which is maintained by the MPA and (ii) The channel (Inland Waterway) between Mongla Port to Chalna also falls within the jurisdiction of Mongla Port, which is maintained by the MPA. Hydrographic charts were analyzed for understanding the

condition of river drafts at different locations along the coal transportation route from the anchorage point to the project site.

473. For the section of inland waterways, time series Hydrographic charts were analyzed to observe the draft condition (**Figure 7-21**). It has been observed that there is no drastic change in the draft but it is significant that the draft is very low in different reaches from Mongla Port to the Project site. The analysis indicates that from Mongla Port to the project site, 0-4 km and 8.7 – 12.3 km stretches have less draft compared to the required draft (minimum 5.5m) for the navigability of the lighterage of 10,000 dwt.



Note: LLW means Lower Low Water, which defines a vertical reference line for a specific area. It is fixed on the basis of astronomical cycles (19.6 years). Some where the datum is fixed from the lowest water level of the last three consecutive year's average data.

Figure 7-21: Long profile of Passur River from Mongla Port to Chalna

474. For the maritime portion (Fairway Buoy to Mongla Port) bathymetric map, cross and long sections have been generated based on the latest hydrographic charts of the Mongla Port Authority. A surface is generated with the help of GIS tool to observe the bed profile and to find out the suitable paths for navigation of coal carrying vessel up to the project site.

475. In the Passur Channel, survey was conducted from 2012 to 2016 by the Mongla Port Authority. For better understanding of the bathymetry of the river long profile from Mongla to Fairway Buoy (**Figure 7-22**) and cross-sections of different locations are given in the following map (**Figure 7-23**) as section 1-1, 2-2, 3-3, 4-4, 5-5 and 6-6.

476. In existing condition, Akram point shows depth of 15 m to 20 m but there are some shoals in outer bar that limit approaching of vessel having Draft over 8m. The same vessel can proceed up to Mazhar Point just downstream of Harbaria (17 nautical miles downstream of Mongla Port Jetty). Currently, vessel of maximum 5 m – 6 m Draft can proceed up to Mongla without taking tidal advantage. But the cross sections indicate that there were some reaches (section 3-3 to Section 6-6) where the width is low. It is necessary to increase the

channel width (vessel movement path) by dredging considering the accelerated movement of vessel during the functional period of Maitree Coal based Power Plant.

477. To facilitate the transportation of coal for the Maitree Power Plant Jetty, it is required to dredge the river in different reaches (mentioned in EIA of Dredging from Mongla Port to Power Plant Jetty conducted by IWM for MPA and approved by DoE in 2015) from Mongla Port Jetty to the project jetty. The experience of Mongla Port Authority suggested that it is possible to maintain the route through the capital dredging. But it is also suggested that 55-60% maintenance dredging may require in each year.

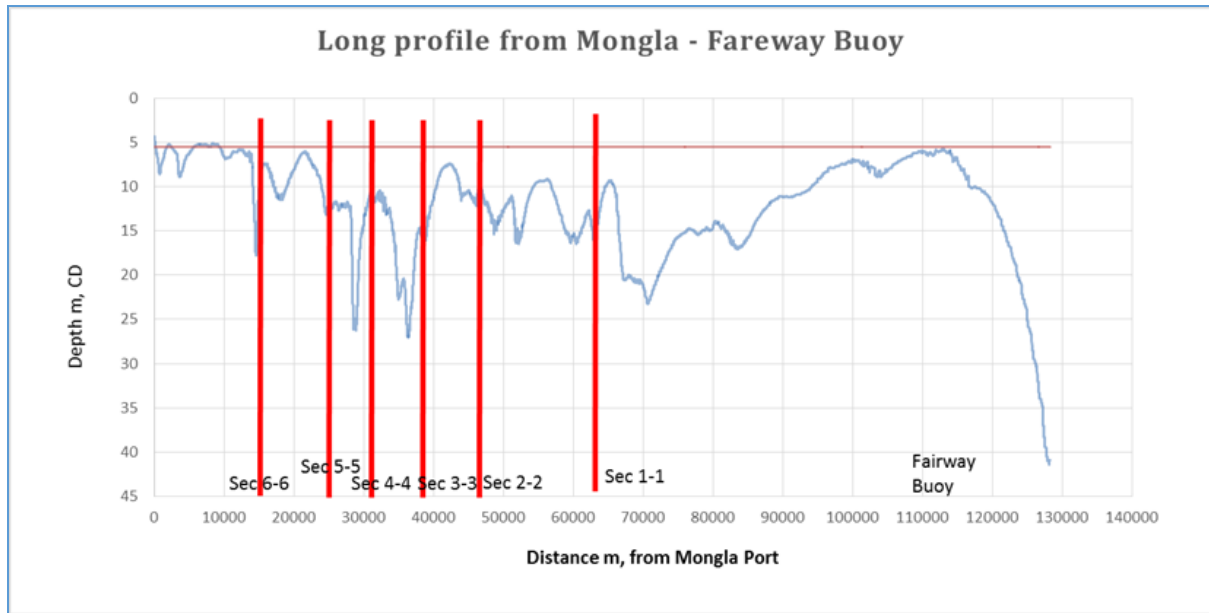


Figure 7-22: Longitudinal section of Passur River from Mongla to Fairway Buoy

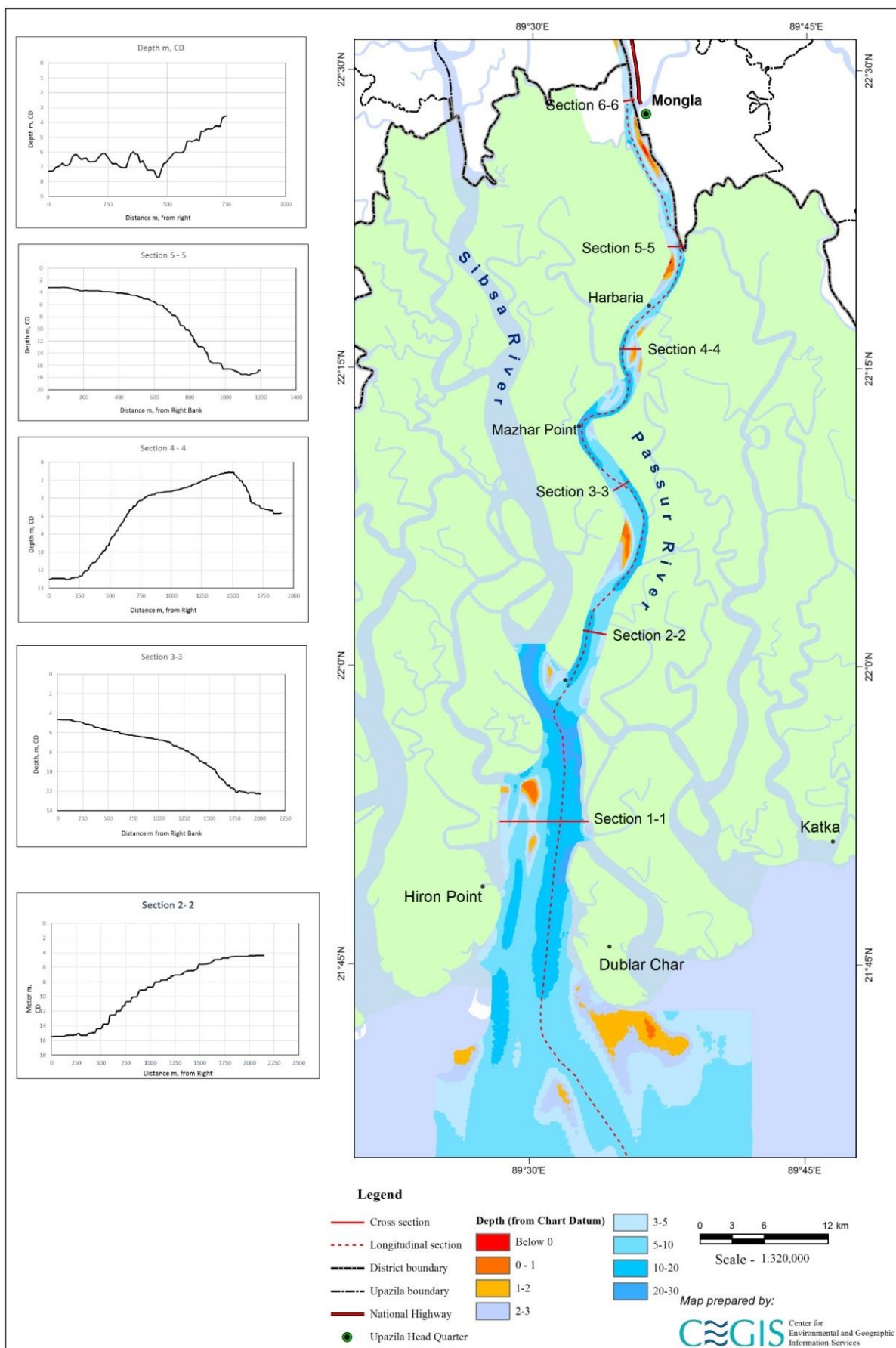


Figure 7-23: Bathymetric map and Cross sections of the Passur River

478. In the Passur River, a survey was conducted from 2007 to 2009 by Mongla Port Authority. BIWTA conducted Hydrographic survey up to 1 km downstream of Nalian Hat (village market) in Sibsa River in 2010.

479. In the existing condition, Akram point shows the drafts of 15 m to 20 m but there are some shoals in the outer bar that restrict vessels having a draft of over 8 m. The same vessel can proceed up to near Harbaria (30 NM from the Plant Jetty). Presently, the vessels of maximum 5 m – 6 m draft can proceed up to the port jetty taking a tidal advantage. Up to the south end of the project area draft varies from 4m to 7m. But in some places, shoals restrict the sailing of vessels. Towards the upstream of the south end of the project, the draft decreases due to shoals and submergible sandbars. Dredging the river reach is required for improving its navigability for various vessels including the vessels for coal transportation.

480. To find out the favorable travel time one (1) tidal cycle of spring tide and one (1) of neap tide cycle data of Hiron point has been analyzed and compared with the Mongla data for the same cycle. Hiron Point analysis indicates that the tidal fluctuation is sharper for the spring than that of neap tide (**Figure 7-24**). The tidal difference between spring and neap is around 0.75m during flooding and ebbing is 1.0m. At Hiron point flooding and time is nearly same for spring and neap tide.

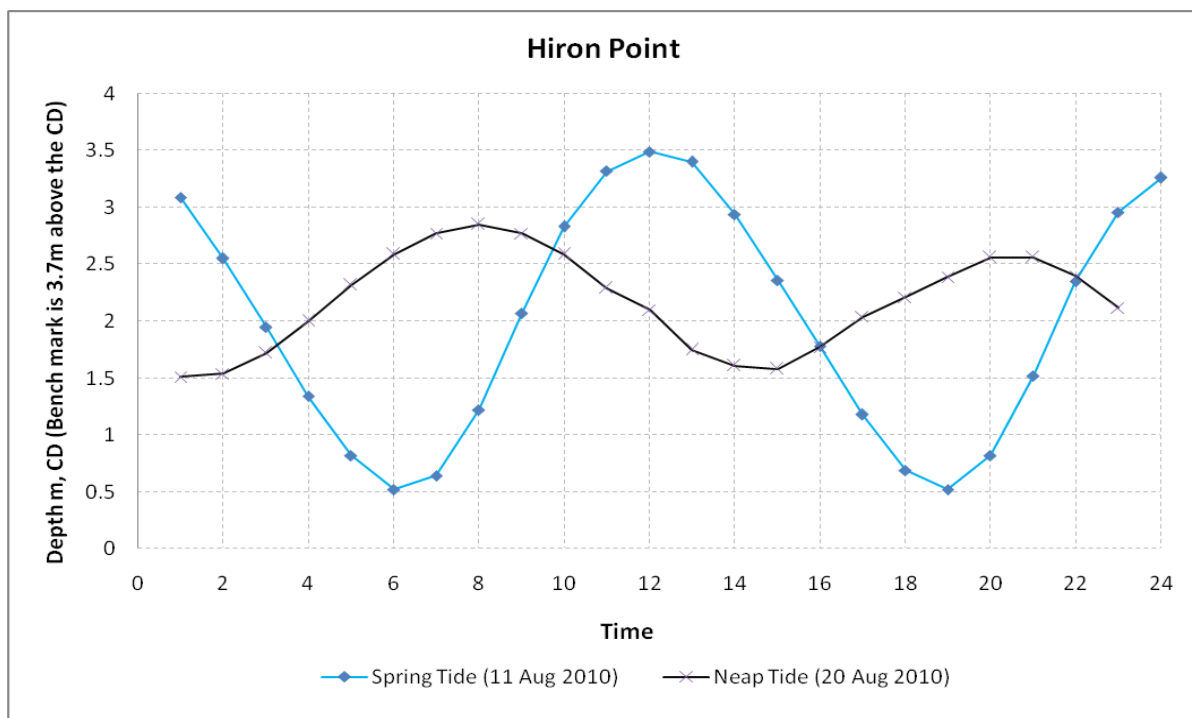


Figure 7-24: Tidal cycle at Hiron Point

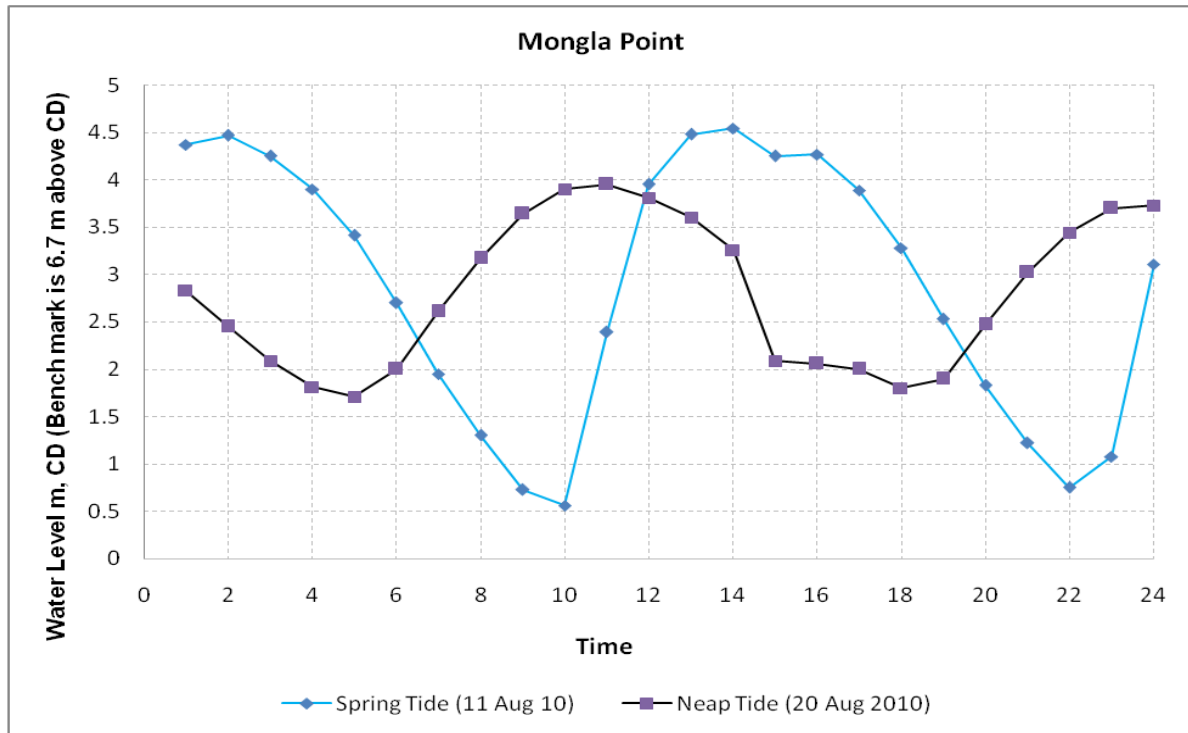


Figure 7-25: Tidal Cycle at Mongla

481. Mongla data analysis (**Figure 7-25**) indicates that the flooding time during spring tide is 5 hours and during neap tide it is 6 hours, Ebbing time for the both is nearly 7.5 hours. Due to tidal asymmetry Mongla is very much a sedimentation prone compared to that of Hiron Point vicinity. Flooding difference between the neap and spring tides is around 0.5m and during ebbing it is around 1.0m. Flooding starts 2 hours later from the Hiron Point for both cases. So, the vessel movement can take advantage of this situation. The hydrographic map is shown in **Figure 7-26**.

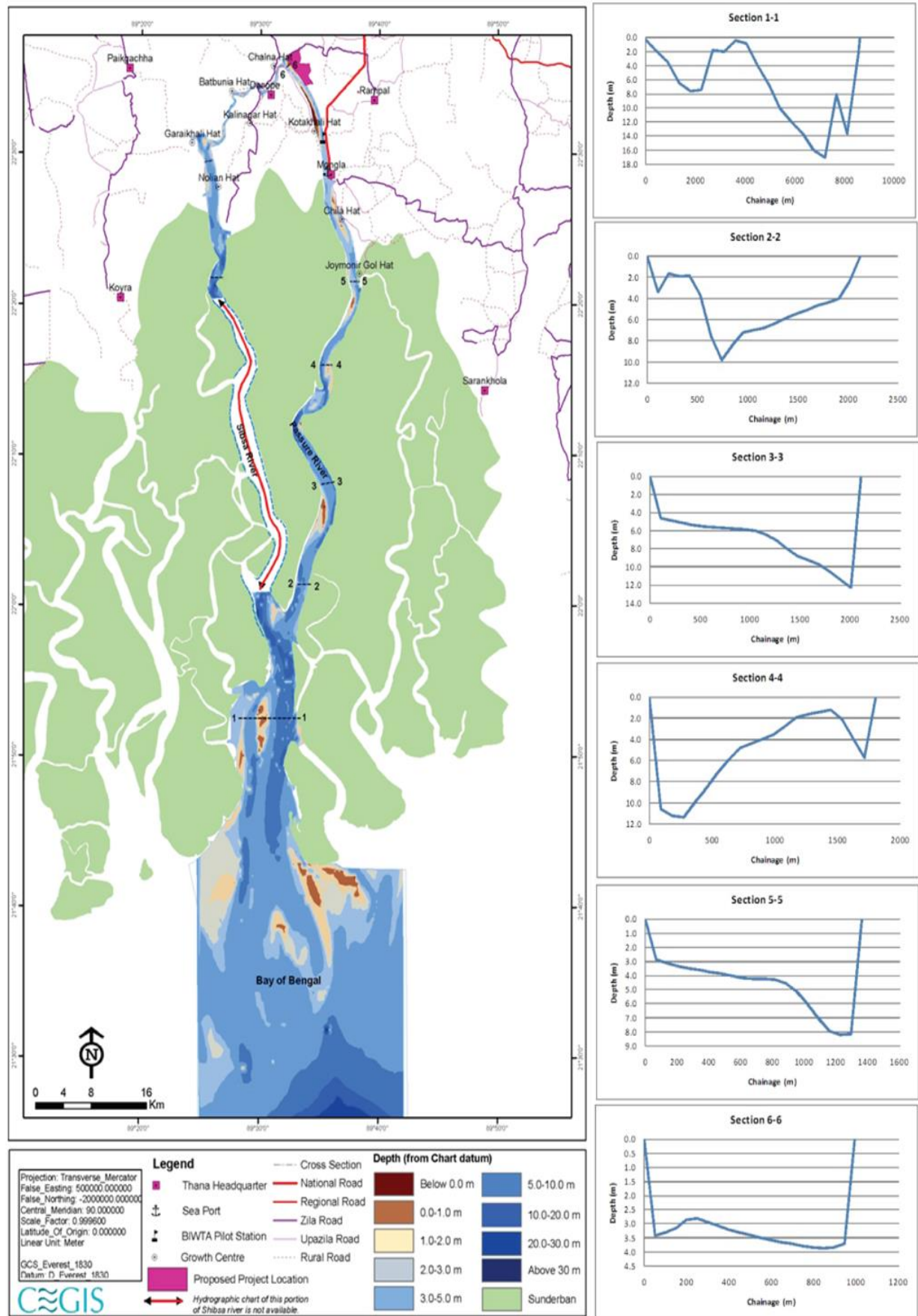
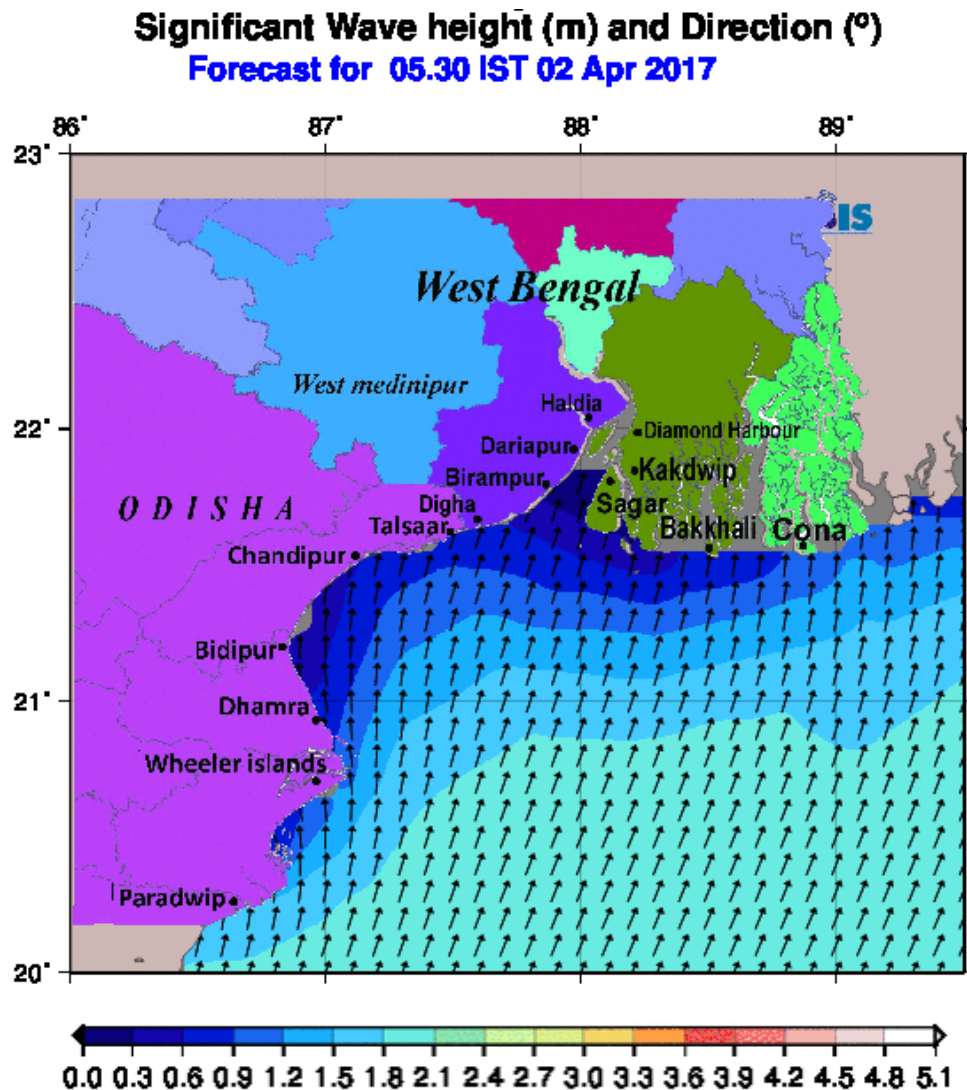


Figure 7-26: Hydrographic Map of the Passur River System

c. Wave Height/Action

482. The outer Bar is at the edge of the Bay of Bengal and is under the direct influence of long ocean waves and storm generated local waves coming from the south. A study undertaken by IWM (2005) showed that the waves at the Bay of Bengal have a significant wave height (H_s), equal to three (03) meters, a wave period of 8.8 seconds and a wave length of 125 m. Waves propagate over the Outer bar and slowly reduce in height when progressing over the outer Bar towards the Passur River. Approximately 23 km from the entrance to the Bay of Bengal, the wave height is reduced to less than one meter (SMEC, 2006a). High wave in the mouth of the Passur River only occurs during monsoon. During this period, sea level is up to one (01) meter higher than the dry season level due to the wave set up towards the coast. The wave height in the Passur River is 0.5 m. The recent wave data and wave direction of 2nd April 2017, it is observed from the following **Figure 7-26a** that the wave height of the Passur is in the range of 0.3-0.6 m and in the Bay of Bengal is in the range of 0.9-2.1 m (INCOIS, 2017).



Note: Arrows indicate direction of wave in degree from North and color scale indicate wave height (m)

Figure 7-26a: Wave height and direction of the Passur and the Bay of Bengal

7.6 Water Quality

483. Water sampling and analysis was undertaken to understand the overall baseline water quality characteristics of the surface. The surface water sampling was based on the identification of the major surface water body and its interaction with the project e.g. the Passur River. Major sources of water pollution of the area include industries, residential and commercial sources, agricultural and some of the natural sources (Field Data, 2016).

484. Fifteen (15) water samples were collected as grab water samples in pre-washed 5-litre plastic jerry cans and 250 ml sterilized clean PET bottles prepared by DPHE for completing physiochemical and bacteriological tests respectively. The samples were analysed as per standard procedure/method given in Standard Method for Examination of Water and Wastewater Edition 20, published by the American Public Health Association (APHA).

485. The quality of surface water was compared with the standards for Inland Surface Water, Environment Conservation Rules (ECR), 1997-Schedule 3 (A). Few additional parameters were also analysed, apart from those given in Schedule-3 (A), for determining the ambient water quality of the Passur River. The standards have been presented along with the monitoring results of surface water for comparison. Some of the water analysis parameters are discussed below in detail:

a. Salinity

486. Salinity in the Sundarbans is highly dependent on the salinities at the coast and the volumes of freshwater flowing from the upstream. Salinity increases almost linearly from the beginning of October, and this rise generally continues until the start of the monsoon (JOEC, 2002). From January to August, the salinity at Hiron Point varies from 4.5 ppt to 25 ppt (2014 and 2015 data, maximum in April). The salinity rate tends to reduce from September and no salinity exists during the month of October (Source: Wetland Monitoring Report, 2007 and CEGIS field survey). Salinity in the Passur River varies from 9.5 to 25.0 ppt during April, (2014 and 2015) and 0.0 to 19.5 ppt during June, (2014 and 2015) due to high upstream freshwater flow during monsoon. Measured data of salinity is shown in Table 7-11 in different quarters of the years 2014 and 2015.

Table 7-11: Salinity level at different points along the route

Sampling Location	2014				2015			
	1QM (April- 2014)	2QM (July- 2014)	3QM (Oct- 2014)	4QM (Jan- 2014)	1QM (April- 2015)	2QM (July- 2015)	3QM (OCT- 2015)	4QM (Jan- 2016)
Project site and adjacent area	10.73	1.59	0	4.8	12.5	0	0	4.5
Confluence of Passur River and Mongla Nulla	10	9.5	0	5	14	0	0	4.8
Passur River at Harbaria	12	10	0	6	15	0	0	5.3
Sibsa River at Akram Point	19	15	1	16	20	-	5	11.3
Passur River at Hiron Point	23	19.5	2	23	25	-	6.2	-

Source: Field measurement, CEGIS

487. An analysis of the variation in salinity for three years 2011, 2012 and 2013 based on field data is shown in the **Figure 7-27**. The salinity level had decreased at Mongla in 2012 as a result of an increased flow of freshwater from the Ganges through the Gorai River, which was dredged at its offtake near Kushtia area (IWM, 2013).

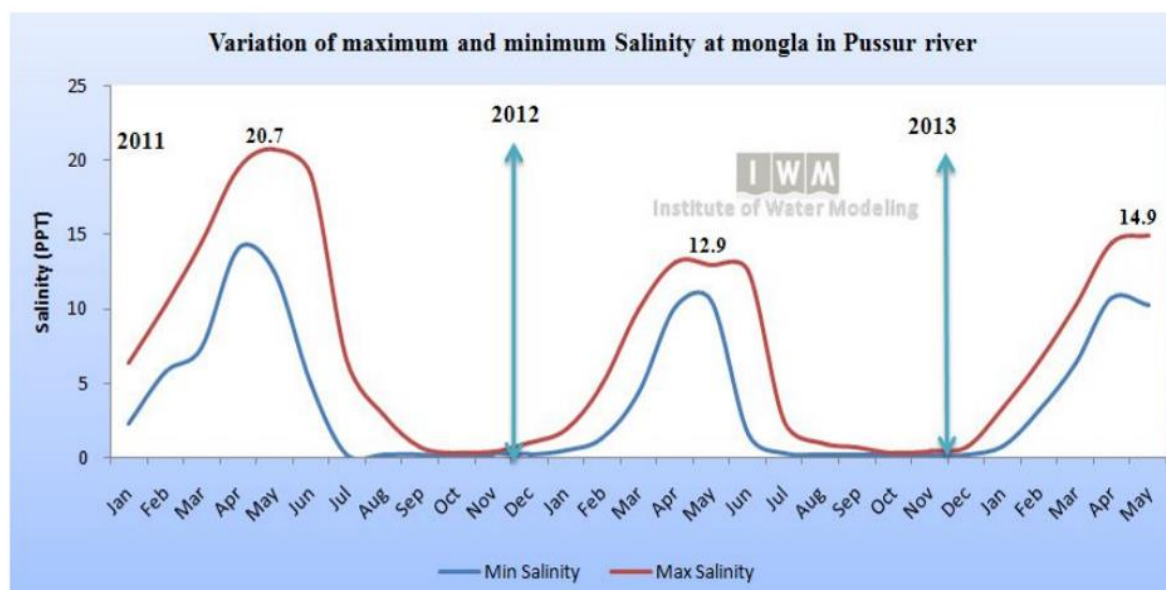


Figure 7-27: Variation of Salinity in Passur River at Mongla, Bagerhat

Total Carbon (TC)

488. Total Carbon (TC) consists of Inorganic Carbons (ICs) like carbonate, bicarbonate, and dissolved CO) and Total Organic Carbon (TOC), Dissolved Organic Carbon (DOC), Particulate Organic Carbon (POC). The concentration of total carbon varied from 25.9 mg/L to 32.0 mg/L among the five monitoring sites. The Passur-Sibsa river system gets runoff from agricultural lands, industrial wastewater discharges, and storm water from the upstream, which may contribute to this amount of total carbon in the river water. In addition, washed litter and woody debris from the Sundarbans forest may also add organic carbon to the river water. Concentrations of TC in river water at different locations are illustrated in **Table 7-12**.

Table 7-12: Concentrations of TC in river water

Locations	Concn. of TC (mg/L)	Locations	Concn. of TC (mg/L)
Hiron Point (Passur R.)	25.9	Harbaria (Passur R.)	31.7
Akram Point (Sibsa R.)	27.1	Project Site (Passur R.)	27.1
Mongla Port Site (Passur R.)	32.0	-	-

Source: Laboratory analysis done by BCSIR for CEGIS, February 2016

b. Total Organic Carbon (TOC)

489. An estimation of organic content of water has been used for sometimes as an indicator of water quality. During the study, the TOC concentration varies from 2.25 to 20.22 mg/L among the monitoring locations. Maximum concentration was found in Dublar Char, the Sundarbans (20.22 mg/L) while the minimum value (2.25 mg/L) was recorded in the Project site (**Table 7-13**). Higher concentration of TOC usually represents organic pollution in the water. Moreover, organic pollutants originate from domestic sewage (raw or treated), urban run-off, industrial (trade) effluents and farm wastes. Sewage effluents are the major sources of organic matters discharged to waters. However, the higher concentration of TOC in the estuary may be due to the surface and industrial runoff from the upstream and huge amount of organic components splashed from the Sundarbans.

Table 7-13: Concentrations of Total Organic Carbon

Sl. No.	Location	Concentration (mg/L)	Sl. No.	Location	Concentration (mg/L)
1	Dublar char	20.22	4	Akram Point	2.95
2	Mongla-Passur confluence	3.42	5	Hiron Point	2.61
3	Harbaria	3.65	6	Project site	2.25

Source: Laboratory analysis done by BCSIR for CEGIS, 2016

c. Oil and Grease

490. The concentration of oil and grease has been analyzed since April, 2014 and the results are generally found to be within the standard limit set by ECR' 1997. During or after the capsizing of oil tanker, it is observed that the availability of oil and grease exceeded the standard 10 mg/L (waste discharge standard from the Project or Industry) at the mentioned measurement locations (Table 7-14). The Passur and the Sibsa rivers contain high concentration of oil and grease in winter, 2014, which may be due to the accidental oil spill which occurred on 9th December, 2014. Approximately, 350,000 liters (Philips, 2014) of furnace oil was spilled in the river which spread over a 350 km² area (Welle, 2014). The concentrations of oil and grease were also shown exceedances in the month of January, 2016. The quarterly analysis results of oil and grease observed during 2014 and 2015 are presented in **Table 7-14**.

Table 7-14: Analysis result of oil and grease in river water

Sampling Locations	Oil and Grease (mg/L)							
	2014				2015-16			
	1QM (April-2014)	2QM (July-2014)	3QM (Oct-2014)	4QM (Jan-2014)	1QM (April-2015)	2QM (July-2015)	3QM (Oct-2015)	4QM (Jan-2016)
Left Bank of Passur River at Southwest corner of Project site	<5	<5	<5	>15	16.9	9	<5	39
Mongla-Passur Confluence	<5	<5	<5	>15	13	7.63	9.87	21
Passur River at Harbaria	<5	6.3	<5	>20	39.1	10.1	<5	14
Passur River at Hiron Point	<5	<5	<5	>20	<5	ND	10.8	ND
Akram Point of the Sundarbans (in Sibsa)	<5	<5	<5	>20	<5	<5	9.73	36

Source: Laboratory analysis done by BCSIR for CEGIS, 2016; Shaded values are exceeded the limit of Bangladesh and IFC Standard for Inland Surface Water (10 mg/L).

d. PAHs (Polycyclic Aromatic Hydrocarbons)

491. Coal is a mixture of a variety of chemicals, especially hydrocarbons, which is considered to be a major source of PAHs. Besides, these organic contaminants are primarily derived from the incomplete combustion of organic matter, such as fossil fuel, wood, and coal. PAH contamination is a major hazard that is a concern for aquatic life in marine environments, particularly in areas close to anthropogenic sources. Many PAHs are persistent and at the same time, bio-accumulative, and toxic for humans and aquatic organisms. The concentrations of PAHs are found to be very insignificant in the locations mentioned in **Table 7-15**.

Table 7-15: The concentrations of PAH in river water

PAHs (Polycyclic Aromatic Hydrocarbons)	Concentrations in ng/m ³				
	Hiron Point	Sibsa River	Mongla Port Area	Harbaria	Project Site
Acenaphthalene	ND	ND	ND	ND	ND
Flourene	ND	ND	ND	ND	ND
Phenenthrene	ND	ND	ND	ND	ND
Anthracene	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND
Benz [a]anthracene	ND	ND	ND	ND	ND
Chresene	ND	ND	ND	ND	ND
Benzo [a] pyrene	ND	ND	ND	ND	ND
Benzo [K] flueranthene	ND	ND	ND	ND	ND
Indeno [1, 2 cd] pyrene	ND	ND	ND	ND	ND
Diabenz [a, h] anthracene	ND	ND	ND	ND	ND
Bezo [g, h i] pyrelene	ND	ND	ND	ND	ND
Benzo [b] floranthene	ND	ND	ND	ND	ND

Source: Laboratory analysis done by BCSIR for CEGIS, 2016;

Note: ND means Not Detected

e. Other Water Quality Parameters

492. The following water quality parameters of surface water have been analyzed in the last two years data of environmental monitoring study of 1320 MW Maitree Power Project and are presented in the **Table 7-16** and **Table 7-17**. The data have been collected from 15 locations of the study area.

Table 7-16: Analysis results of the selected surface water quality parameters

Sl. No.	Locations	pH		Temp. (°C)		DO (mg/l)		BOD ₅ (mg/l)		TDS (mg/l)		TSS (mg/l)	
		2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
1	Passur R. Left Bank at 100m u/s of North West corner from the Plant Site	7.6	7.5	28.5	28.7	5.8	5.9	2.3	2.6	4462	5266	284	69
2	Middle of Passur River at 100m u/s of North West corner from the Project boundary	7.6	7.6	28.8	28.3	6.5	5.7	3.7	2.4	4247	5430	135	71
3	Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	7.6	7.6	28.5	28.1	6.6	6.1	2.8	2.8	4441	5167	142	94
4	Left Bank of Passur River at Project site-Jetty	7.8	7.5	28.5	28.8	6.5	6.4	2.8	2.9	4638	5166	207	75
5	Middle of Passur River at Project site-Jetty	7.5	7.7	28.0	28.5	6.5	6.4	2.6	3.5	4689	5161	160	74
6	Right Bank of Passur River at Project site-Jetty	7.5	7.7	28.0	28.1	6.8	6.4	3.7	2.9	4701	4999	136	78
7	Left Bank of Passur River at South West corner from the Project boundary	7.5	7.9	28.3	28.7	6.4	6.6	2.6	3.0	4759	5169	156	76
8	Middle of Passur River at South West corner from the Project boundary	7.5	7.7	27.5	28.3	6.5	6.5	3.1	3.3	4795	5165	301	71
9	Right Bank of Passur River at South West corner from the Project boundary	7.5	7.7	27.5	28.4	6.5	6.5	3.8	3.5	4860	5056	253	75
10	Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	7.5	7.6	27.0	28.6	6.6	5.9	3.4	3.5	4529	5488	287	73
11	Maidara river near proposed Township area	7.4	7.3	27.3	29.0	6.9	6.3	3.5	2.8	4531	4712	157	72
12	Passur river at Passur-Mongla confluence	7.4	7.5	27.5	27.8	6.3	6.3	2.1	3.1	6137	4858	210	83
13	Passur river at Harbaria of the Sundarbans	7.7	7.9	27.3	27.9	6.2	6.4	2.3	3.1	6676	4932	356	75
14	Passur river at Akram point of the Sundarbans	7.5	7.8	27.3	27.1	7.2	6.5	3.5	2.8	13302	10383	86	92
15	Passur river at Hiron point of the Sundarbans	7.3	7.5	27.3	30.2	7.1	6.4	3.3	2.5	14792	15565	157	162
ECR, 1997 (Surface Water Standard for Fisheries)		6.5 – 8.5		-		5 or more		6 or less		-		-	
ECR, 1997 (Industrial Effluent Discharge Standard)										2100			

Source: Water quality analysis done by DPHE for CEGIS Note: DO- Dissolved Oxygen; BOD Biological Oxygen Demand; TDS- Total Dissolved Solid; TSS- Total Suspended Solid

493. For determining surface water condition, water quality standard meant for fisheries in ECR, 1997 was used in all respects. As it is seen from Table 7-16 and Table 7-17 that only pH, DO and BOD remains relatively within ECR standard values for surface water used for fisheries. However, no standard values for surface water used for fisheries are available for Total Hardness (TH), temperature, COD, TDS, TSS, nitrate, phosphate, arsenic and mercury. As the Passur River is a tidal river, the TDS is always remains high throughout the year. It may be noted that industrial effluent discharge standard for TDS is 2100 mg/L. Except for spatial and seasonal variations is still present for the analyzed parameters, results of all parameters were found to be minimal or similar in concentrations compared to the results of previous years.

Table 7-17: Analysis results of the selected surface water quality parameters

Locations	TH (mg/l)		COD (mg/l)		Nitrate (mg/l)		Sulphate (mg/l)		Phosphate (mg/l)		Arsenic (mg/l)		Mercury (mg/l)	
	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015	2014	2015
Passur R. Left Bank at 100m u/s of North West corner from the Plant Site	1074	1191	116	71	1.8	13.1	616.5	501	0.9	3.1	0.003	0.0015	0.00015	0.00015
Middle of Passur River at 100m u/s of North West corner from the Project boundary	942	1218	100	59	1.5	8.0	455.3	467.3	1.1	0.7	0.003	0.0015	0.00015	0.00015
Right Bank of Passur River at 100m u/s of North West corner from the Project boundary	1006	1239	122	68	2.4	13.5	457.5	455	1.3	0.9	0.0028	0.0018	0.00015	0.00015
Left Bank of Passur River at Project site-Jetty	1014	1288	126	66	1.7	15.9	497	456.5	1.0	0.9	0.0035	0.0018	0.00015	0.00015
Middle of Passur River at Project site-Jetty	1051	1252	147	69	1.9	20.9	405.5	428.5	1.5	0.8	0.0033	0.0015	0.00015	0.00015
Right Bank of Passur River at Project site-Jetty	1075	1229	246	58	3.5	5.8	476.8	350.5	1.5	0.6	0.0028	0.0015	0.00015	0.00015
Left Bank of Passur River at South West corner from the Project boundary	1063	1367	146	67	1.9	27.8	592.5	385.3	0.9	0.6	0.004	0.0018	0.00015	0.00015
Middle of Passur River at South West corner from the Project boundary	1155	1376	119	43	1.9	15.5	538.8	441.8	1.2	0.6	0.0037	0.0015	0.00015	0.00015
Right Bank of Passur River at South West corner from the Project boundary	1069	1355	159	76	1.8	35.4	511	367	1.0	0.7	0.0035	0.0018	0.00015	0.00015
Maidara river of the South East corner of the Project at Ichamoti-Maidara confluence	1070	1216	108	70	2.7	19.9	443.3	349.8	1.1	0.7	0.0043	0.002	0.00015	0.00015
Maidara river near proposed Township area	1106	1184	122	70	1.8	14.5	513.3	339	0.8	0.6	0.0025	0.0018	0.00015	0.00015
Passur river at Passur-Mongla confluence	1482	1252	172	56	2.1	13.3	663.5	344	0.7	0.8	0.003	0.0023	0.00015	0.00015
Passur river at Harbaria of the Sundarbans	1523	1203	174	66	1.9	7.98	769.8	364.5	0.9	0.5	0.0038	0.0023	0.00015	0.00015
Passur river at Akram point of the Sundarbans	2871	2453	356	161	2.0	11	1560	794.7	0.7	0.5	0.0028	0.0017	0.00015	0.00015
Passur river at Hiron point of the Sundarbans	3008	2550	387	283	1.5	19.8	1775	1009	2.3	0.5	0.0025	0.0015	0.00015	0.00015

Source: Water quality analysis done by DPHE for CEGIS

Note: TH- Total Hardness; COD- Chemical Oxygen Demand

7.7 Vessel Traffic in Mongla Port and Channels

494. The Mongla Port was developed in 1970s and is situated within the following coordinates: NW corner Lat 22°29'39.48"N and Lon 89°35'24.19"E; NE corner Lat 22°29'40.26"N and Lon 89°35'34.36"E; SE corner Lat 22°29'8.51"N and Lon 89°35'38.06"E, and SW corner Lat 22°29'7.95"N and Lon 89°35'27.62"E on the left bank of the River Passur in the Bagerhat District under Khulna Division. The Port is located just outside the Sundarbans to the north but the designated waterway from the Fairway Buoy to the Port is the Passur River and goes across the Sundarbans. Prior to the development of port facilities at the existing site, cargo was generally unloaded from ships anchored in the river to lighter and delivered to Chalna.

7.7.1 Condition of Fairway

495. Available draft in the Fairway Buoy ranges from above 20 m to 25 m. There are 21 lighted buoys and one beacon, permissible length of ships in the Passur is 200-220 m. For the purpose of navigation, the fairway can be divided into three following groups:

- a) **Outer Bar:** The outer bar started from the Fairway Buoy in the Bay of Bengal and ended at the distance of about 22 NM (40 km) towards the Port up to the Hiron Point. Sedimentation and development of shoal along the outer bar is a major constraint for the sailing of higher draft vessel. The water depths range from 5.5 to 6.5m along the bar. Ships with more draft have to wait for the high tide. Ships with draft up to 7.50 m may go beyond this point in all seasons and up to 8.50 m during the monsoon only.
- b) **Hiron Point to Mongla:** The length of the reach between Hiron Point and the Mongla Port is about 49 NM (90 km), sailing is possible during second tide cycle which requires about six hours due to several shallow patches along the reach.
- c) **Port Basin:** The upper segment includes the turning basin and jetties of the Port. This area is dredged to create a berthing pocket alongside the jetties. Another area which is about 5 km south of the Port is a naturally deep basin of about 8.50 m depth, used by clinker and other bulk for lightering to the river barges.

7.7.2 Anchorage Points

496. There are seven moorings, in-stream buoys and 14 anchorage areas. Five ships can take berth at mooring buoys and 8 at anchorage berths. The anchorage areas are mainly situated at Fairway Buoy, Akram Point and Harbaria.

497. The Bathymetric map shown in **Figure 7-23** has been prepared on the basis of latest hydrographic charts (2015) of the Mongla Port Authority. For navigational purpose, the channel can be divided into following three sections:

Section 1: Fairway Buoy to Akram Point (Downstream to upstream)

498. The available water depth at Fairway Buoy is above 20-25 m. This depth gradually decreases as ships approach to the river channel due to draft restriction at the outer bar. The shoals along the Outer Bar in the southern section of about 11 km restrict entrance of larger vessels of above 8.5 m draft.

Section 2: Akram Point to Harbaria

499. The available water depth at Akram Point anchorage is ranging from 7.5 to 12 m. As the channel proceeds, the depth further decreases from Harbaria to Port Jetty ranging from 5.00 m to 8.50 m.

Section 3: Harbaria Anchorage to Power Plant Site

500. Available water depth at Harbaria Anchorage is ranging between 7.5 m to 12.0 m. As the channel proceeds, the depth further decreases from Harbaria to Port Jetty ranging between 4.0 m to 5.5 m. This trend continues up to the proposed power plant jetty at Rampal. Minimum water depth of this stretch is about 3 m, only ordinary inland vessels can negotiate with this depth.

7.7.3 Traffic Movement

501. Fairways and channels those approach Mongla Port are unique in comparison to other maritime ports in terms of traffic. Channels are characterized by traffic movement of various types of ships, vessels and crafts. Fairways and channels are not only used for maritime transport but also shared by inland navigation, traffic of Bangladesh-India IWT Protocol, vessels for tourism in the Sundarbans and a large number of non-standard boats and crafts engaged in fishing, passenger carrying, goods carrying, tourism, diesel carrying and distribution, etc. Traffic movement in the study area may be classified into following groups:

- a. Maritime traffic which includes mother vessel and lighter vessels,
- b. Bangladesh-India IWT Protocol which includes vessels that operate under bilateral provisions,
- c. Movement of inland vessels to and from or within the study area which include cargo vessels, oil tankers, passenger vessels, cruise vessels, technical vessels, survey vessels, inspection vessels etc.
- d. Movement of mechanized boats and crafts.

7.7.4 Maritime Traffic

502. Mother vessels calling at or sailing from the Mongla Port are mainly bulk carriers, container ships and Ro-Ro vessels. Most of the bulk carriers are served at anchorage while container ships and Ro-Ro vessels are served at the Port jetty.

503. Of the three anchorage points, bulk carriers are mainly served at Harbaria in all seasons, few ships are served as well at Fairway Buoy during fair weather period of five (5) months from November to March. Statistical information collected from the Mongla Port manifests a significant growth of maritime traffic. In the fiscal year (FY) of 2014-15, the number of ships calling at Port was 416 as against 345 in the previous year, growth of about 20%. During the first six (6) months of current FY of 2015-16, this figure was 241.

504. General descriptions of mother vessels calling at Mongla Port are as follows:

LOA: 120-200 m.

Beam: 25-32 m.

Draft: 5-11 m.

BHP: 10,000-15,000

505. Growth of traffic was also reflected in the total tonnage of the Port. In the FY of 2014-15 total cargo handled at the Port was 4,530,279 tons while in the previous FY of 2013-14 volume was 3,543,949 tons. Growth of tonnage is about 28%. During the first half of the current FY of 2015-16, Mongla Port handled a total of 2,939,129 tons of cargo. The following **Table 7-18** describes the volume of cargo handled at Mongla Port during the last five years.

Table 7-18: Cargo handled at Mongla Port

Year	Import cargo (MT)	Export Cargo (MT)	Total (MT)
2010-11	2529853	166418	2696271
2011-12	2482432	137465	2619897
2012-13	2946222	201352	3147574
2013-14	3402402	141547	3543949
2014-15	4429449	100830	4530279
2015-16 (up to December)	2888447	50682	2939129

Source: Mongla Port Authority

506. The shipping agents reveal that a mother vessel stays for six days on an average in the Port and during its stay she uses a volume of 15 tons of fuel on an average for its main engine and generator engine. On the basis of above, the following number of mother vessels and fuel used by mother vessels has been estimated and presented in **Table 7-19**.

Table 7-19: Statistics of mother vessels and fuel used

Year	No. of ships called at Mongla Port	Fuel Used (lit)	No. of ships sailed from Mongla Port	Fuel Used (lit)	Total Fuel Used (lit)
2010-11	272	2,040,000	268	2,010,000	40,50,000
2011-12	234	1,755,000	239	1,792,500	35,47,500
2012-13	282	2,115,000	275	2,062,500	41,77,500
2013-14	345	2,587,500	354	2,655,000	52,42,500
2014-15	416	3,120,000	406	3,045,000	6,165,000

Source: Mongla Port Authority

Note: Two mother vessels have been capsized in the MPA jurisdiction; one at Baniashanta and other one at Outer Bar in last 60 years.

7.7.5 Movement of Lighter Vessels

507. Mongla Port is characterized by lighterage service at the anchorage. Most of the mother vessels take berth at Harbaria anchorage during all seasons and few at Fairway Buoy only during fair weather period from November to March. Lighters take load from mother vessels and then proceed to Port jetty, Roosevelt Jetty at Khulna or to any destination beyond limit of Mongla Port.

508. Services of lighter vessels are regulated by a private trade body called Khulna Divisional IWT Owners' Group. This private body prepares a serial for lighterage on first come first serve basis. Owners of lighters are members of this Group. The Study Team had comprehensive discussions with the leaders of the Group.

509. This private body disclosed following information to the Team:

- i. A list of all mother vessels is prepared immediately before its arrival at anchorage and allocates appropriate number of lighter vessels to take load from the mother vessel.

- ii. The list includes the name of the mother vessel, category of goods and quantity to be unloaded.
- iii. The registrar does not maintain the record of the lighter vessels that took loads from the mother vessel.
- iv. About 800 lighter vessels (300 from Khulna region and 500 from other regions) are engaged in lightering service in the Mongla Port.
- v. Lighter vessels have an average loading capacity of 600 tons.
- vi. Some large industrial companies have their own fleet of lighter vessels. This fleet provides dedicated service to its company only and cannot take part in carriage of goods of other companies, enterprises or whatsoever. Movement of such vessel is not regulated by the private trade body.

510. The Team collected data and information of mother vessels and quantity of goods unloaded to lighters at anchorage points in Mongla Port from the register of the trade body from 1st July 2014 to 29th February 2016. Month wise volume of goods was divided by 600 tons as indicated average carrying capacity by trade body and derived the total number of lighter vessels (ships).

511. More information was collected from the Owners' Group that these lighters are ordinary vessels having draft ranging from 3 m to 4.5 m and almost all the vessels have twin engines of 400 BHP each. For voyage to and from mother vessel at anchorage, one lighter vessel takes 7 hours on average in the study area. For each such voyage, lighter vessel is required to use 65 liter of diesel per hour.

512. According to the above data and information, **Table 7-20** was prepared which illustrates month wise movement of lighter vessels and fuel used. The following Table reveals that during the first eight months of the current FY of 2015-16 a total number of 4,778 lighter vessels provided services with the use of about 2174 tons of diesel while during the corresponding period of previous FY the number of lighter vessels was 3,667 and volume of fuel used by vessels was about 1,668 tons, about 30% above than those of the previous year.

Table 7-20: Movement of lighter vessel and fuel used

Month	2014-2015		2015-2016	
	No. of trips/vessels	Fuel Used (Liter)	No. of trips/vessels	Fuel Used (Liter)
July	525	2,38,875	230	1,04,650
August	402	1,82,910	614	2,79,370
September	324	1,47,420	463	2,10,665
October	486	2,21,130	876	3,98,580
November	458	2,08,390	766	3,48,530
December	643	2,92,565	589	2,67,995
January	648	2,94,840	827	3,76,285
February	181	82,355	413	1,87,915
March	345	1,56,975	N/A	-
April	541	2,46,155	N/A	-
May	314	1,42,870	N/A	-
June	312	1,41,960	N/A	-
Total	5,179	23,56,445	4,778	21,73,990

Source: Khulna Divisional IWT Owners' Group

7.7.6 Movement of Inland Vessels

513. A large fleet of inland vessels share the river routes within the study area. Most of these vessels do not call at Mongla Port for loading / unloading. These vessels include:

- Vessels for trans-boundary inland navigation under the Bangladesh-India Protocol on IWT. Among those about 600 fly ash carrying vessels from India sails to the Passur River through Sibsa-Dhaki-Chunkuri route. When Rampal Maitree STPP will go on operation, such quantity of fly ash would not be required to import from India vis-a-vis transport through the Sibsa- Dhaki –Chunkuri route to Passur River. This will not only reduce the import cost of fly ash but will also reduce the vessel movement through the Passur River. Therefore, the emission from those vessels will be reduced and reduce the possibility of accident as well and will keep the environment cleaner.
- Passenger vessels traveling through the routes in the study area.
- Cargo vessels and oil tankers.
- Cruise Vessels.
- Vessels owned by public authorities for different purposes.

514. Most of these vessels are registered under the Inland Shipping Ordinance, 1976. There are as many as 600 such vessels and according to size and dimension they may be grouped as follows in **Table 7-21**:

Table 7-21: Dimension of inland vessels

Group	Average LOA (m)	Average Beam (m)	Draft (m)	Percentage (%)
A	45	8.5	Up to 3.50	47
B	50	9.00	3.51-4.00	41
C	55	9.50	More than 4.00	12

Source: Expert's estimation

515. The above table was prepared by Experts examining dimensions of 300 inland vessels operated through the Mongla-Ghasiakhali Canal.

516. We may classify these vessels into two categories:

- Vessels that operate under Bangladesh-India Protocol on IWT.
- Other vessels.

7.7.7 Vessels of Bangladesh-India Protocol on IWT

517. There are certain designated routes under the existing Protocol on Inland Water Transit & Trade (PIWT&T) between Bangladesh and India. Under the provisions of Protocol vessels of either country take part in the cargo carriage of (I) inter-country trade and (II) transit trade. For both the cases vessels will have to pass through the routes under the study for destination. Vessels of Maitree Power Plant project will follow the MPA guidelines and protocol thus ensuring the causing no hindrance to PIWT&T Vessels.

518. Routes under study taken by such vessels are (I) Mongla-Chalna with the distance of 16.5 km and (II) Chalna to Nalian with the distance of 25 km. The channel between Nalian and Chalna is very narrow and characterized by frequent sharp bents. This poses threats of accidents and vessels are to negotiate in this stretch of the River Sibsa with extra caution.

As such, vessels take more travel time. Masters of such vessels informed that for traveling between Nalian and Mongla, it takes an average steaming time of six (6) hours.

519. Carrying capacity of such vessels ranges from 700 to 1,200 tons with draft between 3.5 to 4.2 m. The vessels mostly have twin engines of 500 BHP each. Masters also informed that such vessels require 80 liter of diesel on an average per hour. Number of vessels operated under the Protocol was collected from the BIWTA. Volume of fuel used by those vessels was calculated on the basis of above data and information was collected from the navigators. Accordingly, **Table 7-22** shows the movement of vessels under the Bangladesh-India Protocol on IWT and fuel used by the vessels.

Table 7-22: Movement of vessels under Bangladesh-India IWT protocol

Year	Trips/Vessels	Fuel Used (liter)	Year	Trips/Vessels	Fuel Used (liter)
2010-11	4,168	20,00,640	1013-14	4,726	22,68,480
2011-12	4,138	19,86,240	2014-15	4,710	22,60,800
2012-13	4,018	19,28,640	-	-	-

Source: BIWTA

7.7.8 Movement of other Vessels

520. Commercial vessels loaded with goods and passengers take the routes under study for their usual movement. Major IWT stations like Khulna, Noapara and others in the south-western region of Khulna Division are connected by waterways with other parts of the country through the Mongla Port area. Besides commercial vessels, there are a large numbers of vessels in the category of technical, survey, inspection, patrolling and, etc. owned by different Government agencies that sail through the routes under the present study.

521. Number of trips of such vessels was collected from BIWTA. Average BHP of each vessel is 800. Average steaming hour of each vessel in the study area is six (6) hours. Each vessel requires 65 liter of diesel per hour. Accordingly, **Table 7-23** shows the movement of other vessels and fuel used:

Table 7-23: Movement of other vessels through study area

Year	Trips/Vessels	Fuel Used (liter)	Year	Trips/Vessels	Fuel Used (liter)
2010-11	6130	23,90,700	2013-14	4364	17,01,960
2011-12	4746	18,50,940	2014-15	4213	16,43,070
2012-13	4092	15,95,880	-	-	-

Source: Data estimated in consultation with BIWTA

7.7.9 Movement of Mechanized Boats and Crafts

522. A large number of small boats and crafts with pump engines operate in the study area for fishing, goods and passenger carrying, diesel vending, tourism and etc. Construction or movement of such boats and crafts are not under any legal framework. The MPA have no data on the movement of such boats and the BIWTA does not maintain any record as well.

523. But, movement of such boats and crafts and diesel burnt by those have a significant contribution to air pollution. As data and information were not available with any agency, CEGIS had to undertake a traffic survey to estimate an objective picture of the movement and fuel used by these boats.

524. For conducting the traffic survey mechanized boats and crafts were categorized into the following groups: (i) Fishing boat, (ii) Cargo (Coastal) boat, (iii) Passenger boat, (iv) Oil carrier and (v) Tourist boat.

525. In consultation with boat owners and users, boat centers and cargo, passenger and fish consolidation stations were selected for counting boats, collecting data and information of movement and fuel used for the movement. Enumerators were appointed for this purpose and they collected data and information for five days continuously at each station. Schedule of survey at each station was decided keeping the weekly local market day (*Hatbar*) in the middle. Survey stations that were selected were as follows: (i) Station A: Bajua Bazar, (ii) Station B: Laudove, (iii) Station C: Baniashanta Bazar, (iv) Station D: Chila Bazar, (v) Station E: Kantakhali Sundartola, (vi) Station F: Chandpai Sela, and Station G: Banshtola (**Figure 7-28**).

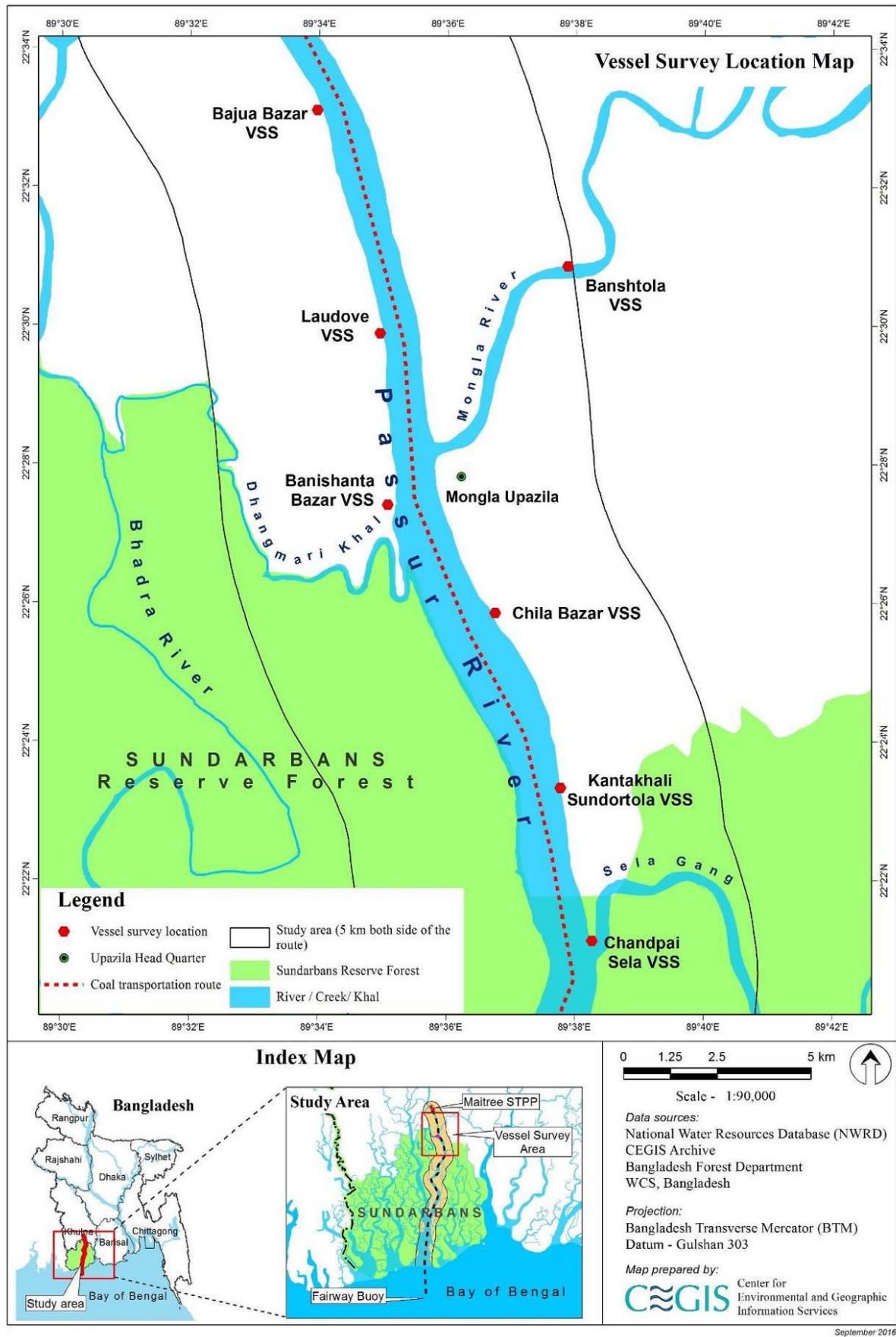


Figure 7-28: Vessel survey stations

526. Survey sheets were compiled and evaluated and the number of boats of each category, plying time, BHP of engines, fuel used for engines and etc were calculated. This survey was held from 8th March to 12th March, 2016. Month wise intensity of movement of each category was determined in consultation with boat owners. For example, movement of fishing boat is marginalized after the month of March and continues up to August. Tourist boats mainly operate during good weather conditions. During the months of festivals, movement of passengers increases significantly. Movement of oil carriers is influenced by the movement of other categories. Based on the data and information collected from primary source and considering the above factors. **Table 7-24** was prepared, which shows the movement of boats and crafts in 2015-16:

Table 7-24: Movement of boats and crafts through study area (2015-16)

Sl. No.	Category of Boat	No. of Boat	Operational Days	Fuel Used (Lit/Year)
1	Fishing Boat	292	200	13,16,426
2	Passenger Boat	146	345	12,00,045
3	Cargo Boat	102	345	41,20,790
4	Oil Carrier	35	340	2,45,434
5	Tourist Boat	109	240	50,94,862
Total=				119,77,557

Source: Traffic survey conducted by CEGIS in March, 2016

7.7.10 Traffic Projection

Projection of Maritime Traffic

527. The following documents were reviewed for the projection of traffic to and from Mongla Port:

- TA 73890-BAN: Port and Logistics Efficiency Improvement, Final Report, Section-1 by the Asian Development Bank, 2011.
- Bangladesh Port and Logistics Efficiency Improvement, Final Report, Section-2 by the Asian Development Bank, 2011, Prepared by Global Maritime and Port Services Pte Ltd. in association with Drewry Maritime Services (Asia) Private Ltd, Singapore, IDRG Consultancy Services, India and Institute of Water Modelling, Bangladesh.
- Total tonnage handled at Mongla Port during recent years was reviewed to determine the growth of traffic.
- Drivers of traffic growth in Bangladesh, economic growth, population, Foreign Direct Investment in Bangladesh, sea borne trade volume projection etc were reviewed.
- Implementation of major transport infrastructures like the Padma Bridge, railway connectivity to Mongla Port and Project for development of Air Port was reviewed.

528. On the basis of the current trend of traffic to and from the Mongla combined with implementation of transport infrastructure projects and indications made by above Reports, year wise projection of total tonnage up to 2030 was estimated. As Mongla Port may emerge in competition with the major maritime Port of Chittagong, 15% traffic growth may continue over the period up to 2030. Further, growth from 2030-31 to 2033-34 will be 9%, from 2034-35 to 2036-37 6% and from 2037-38 to 2039-40 growth will be 4%.

529. To determine the number of mother vessels, total tonnage was divided by the average capacity of mother vessels. Capacity of mother vessels is mostly influenced by

navigational quality of fairways. In this respect, the following three development projects of Mongla Port were considered:

- Completed Project for dredging at the harbor area in the Passur channel to facilitate berthing of 7.5 m draft ships at Port jetty and mooring buoy (volume 35.11 lac cum).
- Planned Project for dredging at the Outer Bar in the Passur channel aiming at increasing navigability at Outer Bar to facilitate easy access and maneuvering of more than 10.5/11 m draft ships at anchorage area (volume 103.95 lac cum).
- Ongoing Project for Capital Dredging from Jetty no. 9 to 13 km upstream of the Passur channel with the objective of development of navigability up to 13 km upstream in the river route to ensure smooth and safe movement of vessels bound for coal power plant at Rampal, Bagerhat.

530. It may be assumed that with the implementation of these projects the size of the mother vessels calling at this Port will gradually be larger in size. But the present fleet with an average capacity of 22,000 tons each may continue up to 2019-20. It is forecasted that from 2020-21 to 2024-25, vessels with an average capacity of 25,800 tons will dominate. Beyond 2024-25 up to 2040, the average capacity of vessels will be 30,000 tons each. As the vessels will be larger gradually, volume of fuel used will increase but ton-km requirement of fuel will decrease. The first group of mother vessels would use about 15 tons of fuel per call, the second group about 17 tons and the third group about 19 tons of fuel per call.

531. Similar situation may not happen in case of lighter vessels. Operation of lighter vessels is regulated and controlled by private owners' group. They would continue with existing fleet up to 2021-22. After that year, the existing lighter vessels may be replaced by larger vessels. Every lighter vessels would use 455 liter of fuel per trip up to 2021-22 and then up to 2029- 2030, 600 liter per trip. After that year lighterage service in Mongla Port will be decreased compared to growth of tonnage due to following reasons:

- More penetration of container ships up to container jetty.
- Development of navigability of fairways will enable more bulk carriers to take berth at Port Jetty reducing need for lighterage.

532. It is estimated that the number of lighters will remain more or less the same as 2029-30 up to 2040. But size of lighters will continue to be larger gradually and as such fuel to be used per lighter between 2030-31 and 2034-35 will be 700 liter and beyond that year up to 2040, 800 liter per lighter.

533. In view of the above, the number of mother vessels and lighters and volume of fuel to be used by those vessels has been projected up to 2030 in **Table 7-25**.

Table 7-25: Projection of traffic: mother vessel and lighter vessel

Year	Mother Vessel		Lighter Vessel	
	Number	Fuel Use (liter)	Number	Fuel Use (liter)
2014-2015	411	6,165,000	5,179	2,356,445
2015-2016	473	7,095,000	5,956	2,709,980
2016-2017	544	8,160,000	6,850	3,116,750
2017-2018	626	9,390,000	7,877	3,584,035
2018-2019	719	10,785,000	9,059	4,121,845
2019-2020	827	12,405,000	10,417	4,739,735

Year	Mother Vessel		Lighter Vessel	
	Number	Fuel Use (liter)	Number	Fuel Use (liter)
2020-2021	926	15,556,800	11,667	5,308,485
2021-2022	1,037	17,421,600	13,067	5,945,485
2022-2023	1,162	19,521,600	14,635	8,781,000
2023-2024	1,301	21,856,800	16,392	9,835,200
2024-2025	1,457	24,477,600	18,358	11,014,800
2025-2026	1,603	29,655,500	20,194	12,116,400
2026-2027	1,763	32,615,500	22,214	13,328,400
2027-2028	1,940	35,890,000	24,435	14,661,000
2028-2029	2,134	39,479,000	26,878	16,126,800
2029-2030	2,347	43,419,500	29,566	17,739,600
2030-2031	2,558	47,323,000	29,566	20,696,200
2031-2032	2,788	51,578,000	29,566	20,696,200
2032-2033	3,039	56,221,500	29,566	20,696,200
2033-2034	3,313	61,290,500	29,566	20,696,200
2034-2035	3,512	64,972,000	29,566	20,696,200
2035-2036	3,722	68,857,000	29,566	23,652,800
2036-2037	3,946	73,001,000	29,566	23,652,800
2037-2038	4,104	75,924,000	29,566	23,652,800
2038-2039	4,268	78,958,000	29,566	23,652,800
2039-2040	4,439	82,121,500	29,566	23,652,800

Source: Expert's estimation

Trans-boundary Inland Navigation

534. From the current record of traffic under the Protocol, Inland Water Transit and Trade between Bangladesh and India, in terms of volume of goods carried registered a growth. Closure of Mongla-Ghasiakhali canal had little effect on the carriage of trade.

535. Fly ash required for manufacturing of cement is the main “goods” shared and accounts for more than 80% of total tonnage. With the commissioning of the Power Plant at Rampal, import demand would decline substantially, but that may not affect transport demand by river. Fly ash will still originate either from India or Rampal Power Plant, river routes within Mongla Port will be followed in either case.

536. Recent developments and extension of bilateral cooperation between Bangladesh and India in respect of inland shipping and coastal shipping will have a significant influence on trans-boundary inland navigation. Commissioning of Ashuganj as a trans-shipment point for transit traffic between mainland India and the North Eastern states through waterways of Bangladesh, is in the offing. Routes within Mongla Port fall under the transit route as mentioned. This will also create significant growth of traffic within Mongla Port.

537. It may be mentioned here that constraint of navigability through Mongla-Ghasiakhali (MG) Canal was resolved through dredging to some extent and vessels under the Protocol have started voyages through the canal with regular maintenance activities.

538. For forecasting future traffic under the Protocol the following Reports were reviewed:

- a) Revival of IWT in Bangladesh: Options and Strategies by the World Bank, 2007.
- b) Inland Water Transport Master Plan Study by Planning Commission, GoB, 2009.

In view of above, traffic growth under the Protocol was estimated to be:

- 5% growth per annum up to 2018.
- 3% growth per annum between 2019 and 2022.
- 2.25% growth from 2023 to 2030.
- 1.75% between 2031 and 2040

539. Even with the growth of traffic, size of the vessels will not be larger due to draft restrictions along the long route. Number of vessel was calculated by total tonnage. Each vessel would have an average travel time of six (6) hours in the routes using 80 liter of fuel per voyage. Accordingly, total estimated fuel use is presented in **Table 7-26**.

Table 7-26: Projected movement of vessels under Indo-Bangla IWT Protocol

Year	Number of Vessels	Fuel to be used (Ton)	Year	Number of Vessels	Fuel to be used (Ton)
2015	4,710	2,260,800	2028	7,014	3,366,720
2016	4,946	2,374,080	2029	7,172	3,442,560
2017	5,193	2,492,640	2030	7,333	3,519,840
2018	5,453	2,617,440	2031	7,461	3,581,437
2019	5,616	2,695,680	2032	7,592	3,644,112
2020	5,785	2,776,800	2033	7,725	3,707,884
2021	5,958	2,859,840	2034	7,860	3,772,772
2022	6,137	2,945,760	2035	7,997	3,838,796
2023	6,275	3,012,000	2036	8,137	3,905,975
2024	6,416	3,079,680	2037	8,280	3,974,329
2025	6,561	3,149,280	2038	8,425	4,043,880
2026	6,708	3,219,840	2039	8,572	4,114,648
2027	6,859	3,292,320	2040	8,722	4,186,654

Source: Data of base year from BIWTA. Growth estimated by expert.

Projected Movement of other Vessels

540. For estimation of movement of other vessels through the routes under the present study, growth of IWT as indicated in the World Bank Report on Revival of IWT in Bangladesh and Inland Water Transport Master Plan Study Report were reviewed. On-going projects and planned projects for augmentation of navigability in the waterways were taken in to consideration. Development of navigability in the MG Canal was reviewed.

541. Accordingly, it was estimated that movement of other vessels in the routes under study may have a growth per annum as follows:

- 7% up to 2018
- 3% between 2019 and 2030
- 2% between 2030 and 2040

542. Size of the vessels will remain almost the same over the period of projection due to the same reasons as mentioned in case of vessels under Protocol. Each vessel will have an average travel time of six (6) hours in the study area and would require about 65 liter of diesel on average per hour. Accordingly, total fuel to be used by other vessels was estimated and is given in **Table 7-27**:

Table 7-27: Projected movement of other vessels

Year	Number of Vessels	Fuel to be used (Ton)	Year	Number of Vessels	Fuel to be used (Ton)
2015	4,213	1,643,070	2028	6,937	2,705,430
2016	4,508	1,758,120	2029	7,145	2,786,550
2017	4,824	1,881,360	2030	7,359	2,870,010
2018	5,162	2,013,180	2031	7,506	2,927,410
2019	5,316	2,073,240	2032	7,656	2,985,958
2020	5,476	2,135,640	2033	7,809	3,045,678
2021	5,640	2,199,600	2034	7,966	3,106,591
2022	5,809	2,265,510	2035	8,125	3,168,723
2023	5,984	2,333,760	2036	8,287	3,232,097
2024	6,163	2,403,570	2037	8,453	3,296,739
2025	6,348	2,475,720	2038	8,622	3,362,674
2026	6,538	2,549,820	2039	8,795	3,429,928
2027	6,735	2,626,650	2040	8,971	3,498,526

Source: Data of base year gathered from BIWTA. Growth estimated by expert

Projected Movement of Boats and Crafts

543. Movement of mechanized boats and crafts was estimated for the entire year of 2015-16 through a traffic survey of plying time of those boats in the Rivers under study. It was assumed that the number of fishing boats would remain almost the same as the baseline scenario in the projected period up to 2029-30. For projection of other categories of boats and crafts, the population growth of Bangladesh is considered. The projection of boats and crafts moving through the study area is given in **Table 7-28**:

Table 7-28: Projection of movement of boats and crafts through study area

Fiscal Year	Fishing Boat			Passenger Boat			Cargo Boat			Oil Carrier			Tourist Boat			Total Fuel Used (Lit)
	No.	Operational Days	Fuel Used (Lit)	No.	Operational Days	Fuel Used (Lit)	No.	Operational Days	Fuel Used (Lit)	No.	Operational Days	Fuel Used (Lit)	No.	Operational Days	Fuel Used (Lit)	
2015-16	292	200	13,16,426	146	345	12,00,045	102	345	41,20,790	35	340	2,45,434	109	240	50,94,862	119,77,557
2016-17	292	200	13,16,426	148	345	12,16,485	103	345	41,77,245	36	340	2,48,797	111	240	51,64,662	121,23,615
2017-18	292	200	13,16,426	150	345	12,33,151	105	345	42,34,473	36	340	2,52,205	112	240	52,35,418	122,71,673
2018-19	292	200	13,16,426	152	345	12,50,045	106	345	42,92,485	36	340	2,55,660	114	240	53,07,143	124,21,760
2019-20	292	200	13,16,426	154	345	12,67,171	107	345	43,51,292	37	340	2,59,163	115	240	53,79,851	125,73,903
2020-21	292	200	13,16,426	156	345	12,84,531	109	345	44,10,905	37	340	2,62,713	117	240	54,53,555	127,28,131
2021-22	292	200	13,16,426	158	345	13,02,129	110	345	44,71,334	38	340	2,66,313	119	240	55,28,268	128,84,471
2022-23	292	200	13,16,426	161	345	13,19,969	112	345	45,32,592	39	340	2,69,961	120	240	56,04,006	130,42,953
2023-24	292	200	13,16,426	163	345	13,38,052	113	345	45,94,688	39	340	2,73,660	122	240	56,80,781	132,03,607
2024-25	292	200	13,16,426	165	345	13,56,383	115	345	46,57,635	40	340	2,77,409	124	240	57,58,607	133,66,461
2025-26	292	200	13,16,426	167	345	13,74,966	117	345	47,21,445	40	340	2,81,209	125	240	58,37,500	135,31,546
2026-27	292	200	13,16,426	170	345	13,93,803	118	345	47,86,129	41	340	2,85,062	127	240	59,17,474	136,98,894
2027-28	292	200	13,16,426	172	345	14,12,898	120	345	48,51,699	41	340	2,88,967	129	240	59,98,543	138,68,533
2028-29	292	200	13,16,426	174	345	14,32,255	121	345	49,18,167	42	340	2,92,926	130	240	60,80,723	140,40,497
2029-30	292	200	13,16,426	177	345	14,51,877	123	345	49,85,546	42	340	2,96,939	132	240	61,64,029	142,14,817

Source: Expert opinions

7.7.11 Projection for Coal Transportation

544. For selecting suitable anchorage points for the transshipment of coal to be used by the proposed power plant at Rampal, current condition of the Passur channel, implementation of on-going projects for dredging, and the planned project were reviewed. Accordingly, following observations were made:

- Fairway Buoy and Mazhar Point would be suitable anchorage points to accommodate mother vessels loaded with coal.
- Mazhar Point is suitable for transshipment operation round the year.
- Fairway Buoy may operate five months (November-March) and Mazhar Point may operate seven months (April-October) in a year.
- Fairway Buoy may accommodate Capesize vessels with capacity of 80,000 tons each while at Harbaria, Handysize vessels with the capacity of about 25,000-30,000 tons each will be served.
- At Fairway Buoy anchorage 26 Capesize mother vessels may unload a total of 2,080,000 tons of coal (80,000 tons each) during five months. Stay time at anchorage will be six (6) days for each vessel. During stay, generator engine will require 24 tons of fuel at a rate of 167 lit per hour. Total fuel to be used for generator engines of these 26 vessels will be 624 tons. These vessels will not require any steaming time and no fuel for main engines.
- At Mazhar Point Anchorage, 117 Handysize vessels would call with a total of 2,920,000 tons of coal (25,000 tons each) during seven months. Stay time at anchorage will be three (3) days each for each vessel. A round trip of each vessel between Fairway Buoy and Mazhar Point (49 NM or 91 km) would require eight (8) hours steaming time. As such, each vessel will use eight (8) tons of fuel per round trip at a rate of 1000 lit per hour. A total of 936 tons of fuel will be used by 117 vessels. Stay time at anchorage of each vessel will be three (3) days. During stay, the generator engine will require six (6) tons of fuel at a rate of 83 lit per hour. As such a total volume of 702 tons of fuel will be used by 117 vessels for operations of generator engines.
- 208 barges will run between Fairway Buoy anchorage point and power plant jetty at Rampal (143 km or 77 NM) during four months. Steaming time for a round trip by each barge will be 20 hours. Each barge will use 12 ton of fuel per round trip at a rate of 600 lit of fuel per hour. As such, 208 vessels will use about 2,496 tons of fuel.
- 292 barges will operate between Mazhar Point and the proposed power plant jetty at Rampal (56 km or 30 NM). Steaming time for a round trip will be eight (8) hours per vessel. Each vessel will use 4.8 tons of fuel per round trip at a rate of 600 lit per hour. 292 barges will use a total of 1,402 tons of fuel.
- It is assumed that the trans-shipper (FTS) will operate 340 days per year. To run the generator engine at the rate of 4 ton/day of fuel, the volume of total fuel to be used annually will be 1360 tons. Besides, for running the main engine for replacement of FTS a total of 30 tons of fuel will be required annually. A total of 1390 tons of fuel will be used by FTS per year.

545. Detail estimation of fuel regarding coal transportation is annexed in **Annex 7-2**. **Table 7-29** has been prepared to illustrate the annual fuel to be used by the mother vessel, barges, and FTS for transportation of coal to the proposed power plant. Percentage of increase vessel for coal transportation is given in **Table 7-30**.

Table 7-29: Volume of fuel to be used annually for coal transportation

Sl. No.	Logistics	Nos.	Anchorage Point	Volume of Fuel (MT)	Comments
1	Mother Vessel (Capesize)	26	Fairway Buoy	624	Only for operation of generator engines
2	Mother Vessel (Handysize)	117	Mazhar Point (Harbaria)	1,638	For round trip between Fairway Buoy and Mazhar Point and for Generator engine
3	Barge	208	Fairway Buoy	2,496	For round trip between Fairway Buoy and Plant Jetty
4	Barge	292	Mazhar Point	1,402	For round trip between Mazhar Point and Plant Jetty
5	FTS	1	Both	1,390	For generator engine and main engine
Total=		644		7,550	

Table 7-30: Percentage of increase vessel for coal transportation

Vessel Type	No. of Projected Vessels (in 2019-20)	No. of Vessel for Coal Transportation (in 2019-20)	% of Increase of Vessels	No. of Projected Vessels (in 2029-30)	No. of Projected Vessels (in 2039-40)
Mother Vessel	684	143	20.9	2,204	4,296
Lighter Vessel	9,917	500	5.0	29,066	29,066
Bangladesh-India IWT Protocol	5,785	-	-	7,333	8,722
Other Vessel and FTS	5,476	1	-	7,359	8,971
Mechanized Boat	705	-	-	766	-
Total=	23,210	644	2.8	46,728	51,055

Note: Increase of vessel along the coal transportation route is 2.8% in 2019-20.

546. However, the aggregated number of vessels indicated in Table 7-29 above may vary year to year basis depending on Plant operational system.

7.8 Ecological Resources

7.8.1 Bio-ecological Zone (BEZ)

547. The proposed coal transportation route along the Passur River traverses the tidal ecosystems and two Bio-ecological zones, such as 7a (The Sundarbans) and 10 (Saline Tidal Floodplains), **Figure 7-29**. Salient features of these two zones are as follows:

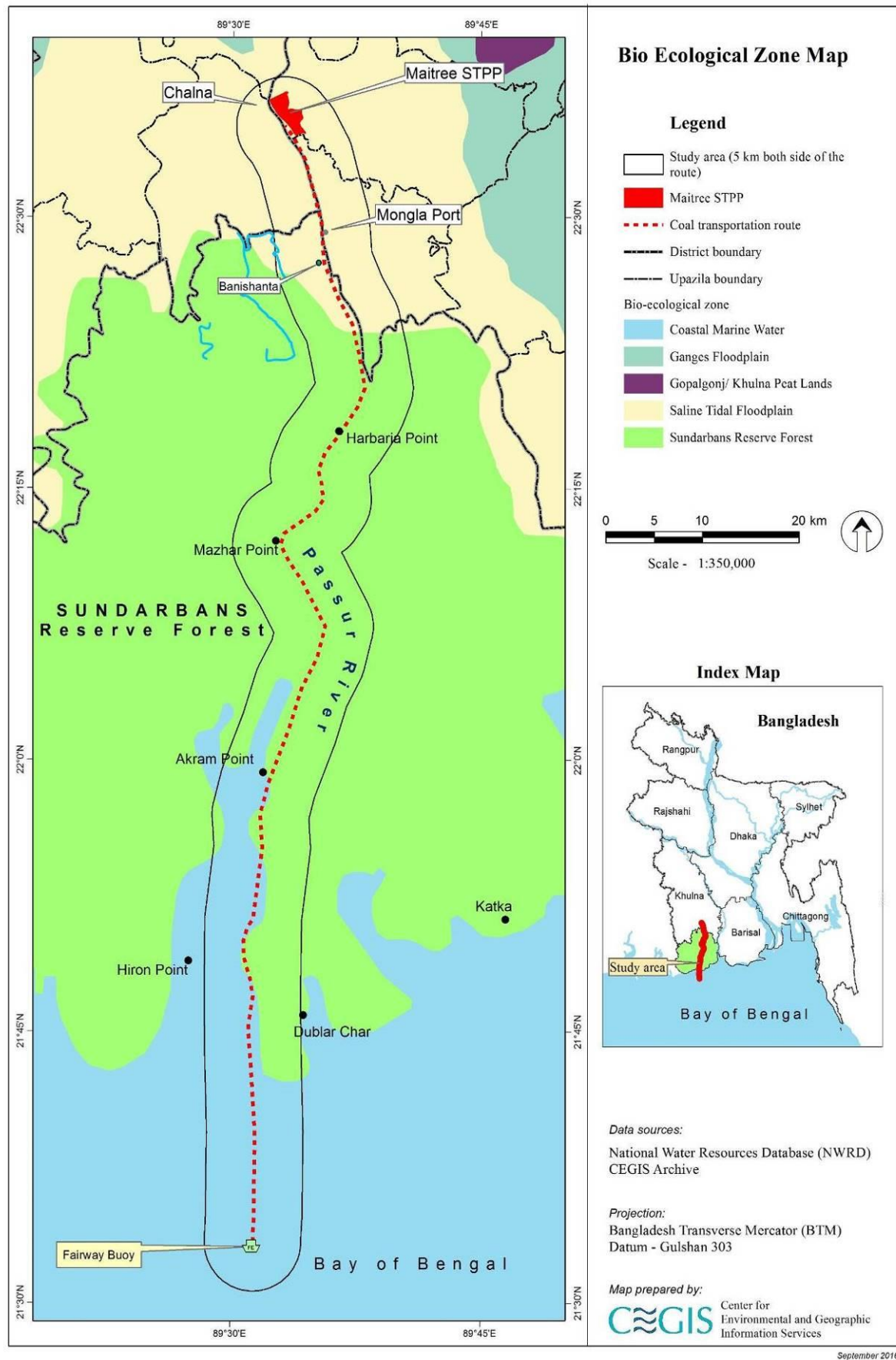


Figure 7-29: Bio-ecological zone showing the study area

Saline Tidal Floodplains (BEZ- 10)

548. Physiographically, this zone falls in the Ganges Tidal Floodplain, where mixing of upstream freshwater flow and downstream tide influenced saline water flow occurs and develops a transitional ecosystem. This ecosystem is predominantly characterized by non-calcareous floodplain saline soils with non-calcareous and calcareous gray floodplain soils having land use of variety of rice seasonally and natural and planted mangrove forest. The dominant floral and faunal species of this zone are:

Flora:

549. Hargoza (*Acanthus illicifolius*), Narikel (*Cocos nucifera*), Khejur (*Phoenix sylvestris*), Bhadi (*Lannea coromandelica*).

Fauna:

550. Jackal (*Canis aureus*), Smooth-coated otter (*Lutrogale perspicillata*), Gray mark shrew (*Suncus murinus*), Small Indian Civet (*Viverricula indica*) [Mammals]; Sarus crane (*Grus antigone*), Black wing stilt (*Himantopus himantopus*), Little grebe (*Tachybaptus ruficollis*), Red-wattled lapwing (*Vanellus indicus*) [Birds]; Ring lizard (*Varanus salvator*), Banded sea snake (*Hydrophis fasciatus*), Estuarine sea snake (*Hydrophis obscura*) [Reptiles]; and Maculated tree frog (*Polypedates maculates*), Tree frog (*Polypedates leucomystax*), Cricket frog (*Limnonectes limnocharis*) [Amphibians].

The Sundarbans (BEZ- 7a)

551. This zone, also physiographically falls in the Ganges Tidal Floodplain, is characterized by a unique mangrove ecosystem. The ecosystem is predominantly characterized by non-calcareous gray floodplain soils and acid sulphate soils facilitate land use of natural mangrove forest. It functions as an effective breeding grounds of marine and riverine aquatic organisms. The dominant floral and faunal species of this zone are:

Flora:

552. Sundari (*Heritiera fomes*), Gewa (*Excoecaria agallocha*), Keora (*Sonneratia apetala*), Sada Baen (*Avicennia alba*) [Trees]; Golpata (*Nypa fruticans*), Hental (*Phoenix paludosa*) [Palms]; Tiger fern/Hoda (*Achrostichum aureum*) [Fern] and Hargoza (*Acanthus illicifolius*) [Shrubs], etc.

Fauna:

553. Bengal Tiger (*Panthera tigris*), Spotted Deer (*Cervus axis*), Irrawaddy Dolphin (*Orcaella brevirostris*), Common Tree Shrew (*Tupaia glis*), Rhesus macaque (*Macaca mulatta*), Smooth-coated otter (*Lutrogale perspicillata*), etc. [Mammals]; White bellied Sea Eagle (*Haliaeetus leucogaster*), Mangrove Whistler (*Pachycephala grisola*), Lesser Adjutant (*Leptoptilos javanicus*), Masked Finfoot (*Heliopais personata*), Mangrove Pitta (*Pitta megarhynca*), etc. [Birds]; Estuarine Crocodile (*Crocodylus porosus*), River Terrapin (*Batagur baska*), King Cobra (*Ophiophagus hannah*), Bibronos Softshell Turtle (*Pelochelys bibroni*), White bellied Mangrove Snake (*Fordonia leucobalia*), Spot-tailed Pit Viper (*Trimeresurus erythrurus*), Glossy Marsh Snake (*Gerardia prevostianus*) [Reptiles]; and Green Frog (*Euphlyctis hexdactylus*), Ornate Microhylid (*Microhyla ornata*), Boulenger's Frog (*Rana alticola*), Common Toad (*Bufo melanostictus*) [Amphibians]. The survey locations of biological issues like aquatic and forest ecosystem and fisheries resources are presented in **Figure 7-30**.

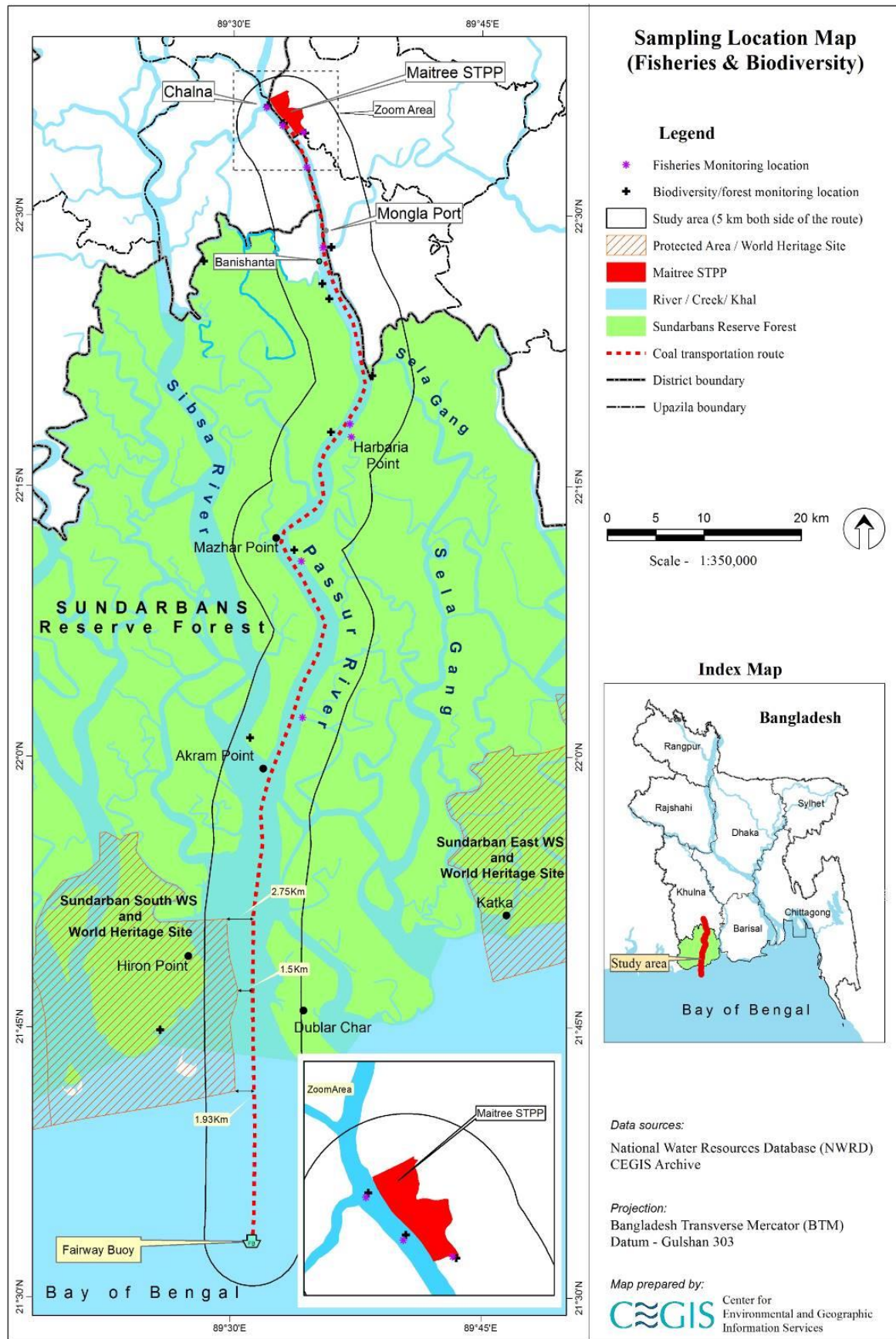


Figure 7-30: Sampling locations of biological issues

7.8.2 Hot Spots/Area of Conservation Significance

554. The concerned study area (including the transportation route) is spread over an area of conservation significance or hot spots including the Sundarbans Reserve Forest (SRF) and/or RAMSAR site, Ecologically Critical Area (ECA), passe by the Sundarbans South Wildlife Sanctuary (SWS), which is also a World Heritage Site (WHS). The SRF, ECA, RAMSAR site, SWS have their own conservation management and differ in richness of biodiversity.

The Sundarbans Reserve Forest (SRF)

555. The Sundarbans are home to many iconic and endangered species including the Bengal tiger (*Panthera tigris tigris*), critically endangered; Ganges river dolphin (*Platanista gangetica*), vulnerable; Irrawaddy dolphin (*Orcaella brevirostris*), near threatened; finless porpoise (*Neophocaena phocaenoides*), near threatened; small clawed otter (*Aonyx cinerea*), endangered; smooth coated otter (*Lutrogale perspicillata*), critically endangered; estuarine crocodile (*Crocodylus porosus*), endangered; masked fin foot (*Heliopais personatus*), endangered; fishing cat (*Prionailurus viverrinus*), Pallas' fishing eagle (*Haliaeetus leucoryphus*), endangered, river terrapin (*Batagur baska*), critically endangered; and white-rumped vulture (*Gyps bengalensis*), critically endangered; and lesser adjutant (*Leptoptilos javanicus*), vulnerable as per IUCN Red List, 2015. There are many other threatened and endangered species in the SRF, including two amphibian, 14 reptile, 25 bird and five mammal species. Some of the most iconic species are on the verge of extinction in the SRF. Different environment and ecosystem conscious forums recognize many potential threats to these and other species living in the Sundarbans, either from natural sources, such as cyclones, storm surges, etc. and human sources, such as illegal poaching, polluting the environment, etc.

556. The SRF is home to dozens of endangered species, including two amphibian, 14 reptile, 25 bird and five mammal species (Laskar, 2000). Some of the most iconic species are on the verge of extinction. For example, the 1997 Statement of UNESCO (Outstanding Universal Value- OUV) estimates the population of Royal Bengal Tigers to be between 400 to 450 (UNESCO, Year) but by July 2015, biologists estimated that there were only around 106 tigers living in the Bangladeshi Sundarbans, and 76 in the Indian Sundarbans (Tiger Status Report, 2015). According to IUCN Red List, 2015 the northern (or "four toed") river terrapin is considered critically endangered in the Sundarbans. Only 100 estuarine crocodile were estimated to survive as of 1994, and only two animals were found in 2004 (Laskar, 2000). Apparently, the reptiles are dominated by two species of monitor lizards namely Bengal Monitor (*Varanus bengalensis*) and Ringed Monitor Lizard (*Varanus salvator*). The Sundarbans is home for a large diversity of snakes and notable among these are the King Cobra with other two species of Cobra, Indian Python, Pit Vipers, Vine snakes, Tree snake species, Dog-faced water snake species etc. Among Kraits, banded Krait and Common Krait seemed to be common in the Sundarbans. The Sundarbans is also home of the world's largest venomous snake-King Cobra (*Ophiophagus hannah*), vulnerable as IUCN Red List, 2015. The forest is represented by only one primate, which is Rhesus Macaque (*Macaca mulatta*) with considerable population [40,000 to 68,200, Hendricks, 1975 and Khan, 1986 and 126,200 derived by Gittings, 1981].

557. Aquatic species, such as the critically endangered northern river terrapin/Batagur turtle (*Batagur baska*) lives inside the creeks of the Sundarbans particularly in the Karamjal

area. It travels to sandy banks crossing substantial distance of about 50-60 km during breeding period only (Dec-Mar). It is reported that the River Terrapins return to the same beaches and sandbars year after year within the same time frame. With both the eggs and the nesting females such easy targets, this extensive annual harvest of breeding females and eggs, exacerbated further by the capture of turtles in fishing nets, has caused chronic precipitous declines in their populations. Most Batagur now owe their survival and recovery to intensive conservation and management programs.

558. The leather back sea turtle (*Dermochelys coriacea*) lives in the sea along the Sundarbans mangrove forest. It comes to sandy beach for nesting and laying eggs during breeding season. This turtle also nesting in the Sonadia and Kutubdia Islands. All sea turtles were listed in the revised Bangladesh Wildlife Preservation (Amendment) Act in 2010, giving them complete legal protection.

559. The endangered small-clawed otter (*Aonyx cinerea*) generally predares in the creeks. This species is confirmed to be vulnerable under criterion A2acde due to an inferred past population decline because of habitat loss and exploitation. In the last few decades, the range of small-clawed otter has shrunk particularly in the coastal part of the Sundarbans mangrove forest, as evident from the published literature. Given the extent of loss of habitat that is occurring in south and south-east Asia and the intensity of poaching the reduction in population has been observed in many parts of its range including India (Hussain 1993, Melisch et al. 1996, Meena 2001, Hussain 2002, Gonzalez 2010, Hussain et al. 2011). The threats to small-clawed otter are prominent in this area so that over the last 60 years its range has shrunk considerably (Hussain et al. 2011). Although quantitative data on population sizes or trends are lacking, it is inferred that the global population of the Asian Small-clawed Otter has declined by >30% over the past 30 years (three generations based on Pacifici et al. 2013).

560. In Bangladesh, possibly the largest population of Ganges River Dolphin (*Platanista gangetica*) lives in the Sundarbans and the world's largest population (about 6000) of Irrawaddy Dolphins (*Orcaella brevirostris*) lives in the Sundarbans and adjacent coastal waters (Alom 2013). The Ganges River dolphin is considered 'vulnerable' as per IUCN Red List, Bangladesh, 2015 and "endangered" as per IUCN Global Red List. Beside this, the Irrawaddy dolphin is considered 'vulnerable' as per IUCN Global Red List and 'near threatened' in the IUCN Red List Bangladesh, 2015. Both the Gangetic and Irrawaddy dolphins are protected by the Bangladesh Wildlife (Conservation and Security) Act, 2012 and occur together in waterways of the Sundarbans mangrove forest in large numbers (Smith et al., 2008). There are three dolphin sanctuaries in the Sundarbans. Out of three, two dolphin sanctuaries, i.e., Dhangmari and Shela River Dolphin Sanctuaries are connected with the Passur River along with the eastern boundary of the Sundarbans South Wildlife Sanctuary (**Table 7-31** and **Figure 7-31**). These indicate that the protected areas are within the influence area of the proposed coal transportation route.

Table 7-31: Jurisdictional details of the three new dolphin sanctuaries

Wildlife (Dolphin) Sanctuary	Administrative Location	Compartment, Station, Forest Range, River/ Khal	Comments/ Sanctuary Boundary
Chandpai	Mongla, Bagerhat	Compartment 27 & 28; Chandpai; 560 ha (12 km)	Reserve Forest: in the north Joymonirgul/ Chandpai Checkpost Mirgamari Khal bounded by Pussur River; south to Andermanik Khal opp. Mirgamari PP through Jhongra PP to Nandabala PP; east from Pussur River (east bank) - Joymonirgul/Mirgamari Khal and west to Pussur River bank (Comp.30).
Dhangmari	Dacope, Khulna	Compartment 31; Dhangmari; Chandpai; 340 ha (15 km)	Reserve Forest: northern boundary of SRF in the north
Dudmukhi	Sarankhola, Bagerhat	Compartment 2&3; Dudmukhi Patrol Post & Suputi; Sarankhola; 170 ha (5 km)	Reserve Forest: In the north from east bank of Betmor river to Bhola River west bank (Comp.2) to east bank of Betmor river in Comp.1 - south from Dudmukhi Patrol Post opposite confluence of Betmor river & Boro Sheola Khal to confluence of Bhola river and Boro Sheola Khal; east from confluence of Bhola River and Boro Sheola Khal and west Betmor River bank (east of Comp.12A)

Source: Forest Department, Wildlife Conservation Society, Bangladesh

Note: Chandpai and Dhangmari Dolphin sanctuary connected with the Passur River

Dolphin occurrence in two Dolphin Sanctuaries

561. Dolphin occurrences have been monitored in two designated dolphin sanctuaries (Dhangmari and Chandpai). The survey was conducted by boat transect along 27 km reaches of Dhangmari Gang and Shela Gang.

562. During the opportunistic dolphin survey at two dolphin sanctuary, high density of Ganges River Dolphin was observed in Dhangmari Gang. A total of 164 dolphin individuals have been recorded with an average encounter rate of 5 dolphins/km/hour. At Chandpai-Shela Gang Sanctuary, about 80 Ganges river dolphin individuals with an average encounter rate of 2 dolphins/km/hour were also recorded. Most of the dolphin groups are observed in the deep River pools and river-khal confluences. Dolphin occurrences in two dolphin sanctuaries, i.e., Dhangmari and Chandpai sanctuaries are shown in the **Figure 7-32** and **Figure 7-33** respectively.

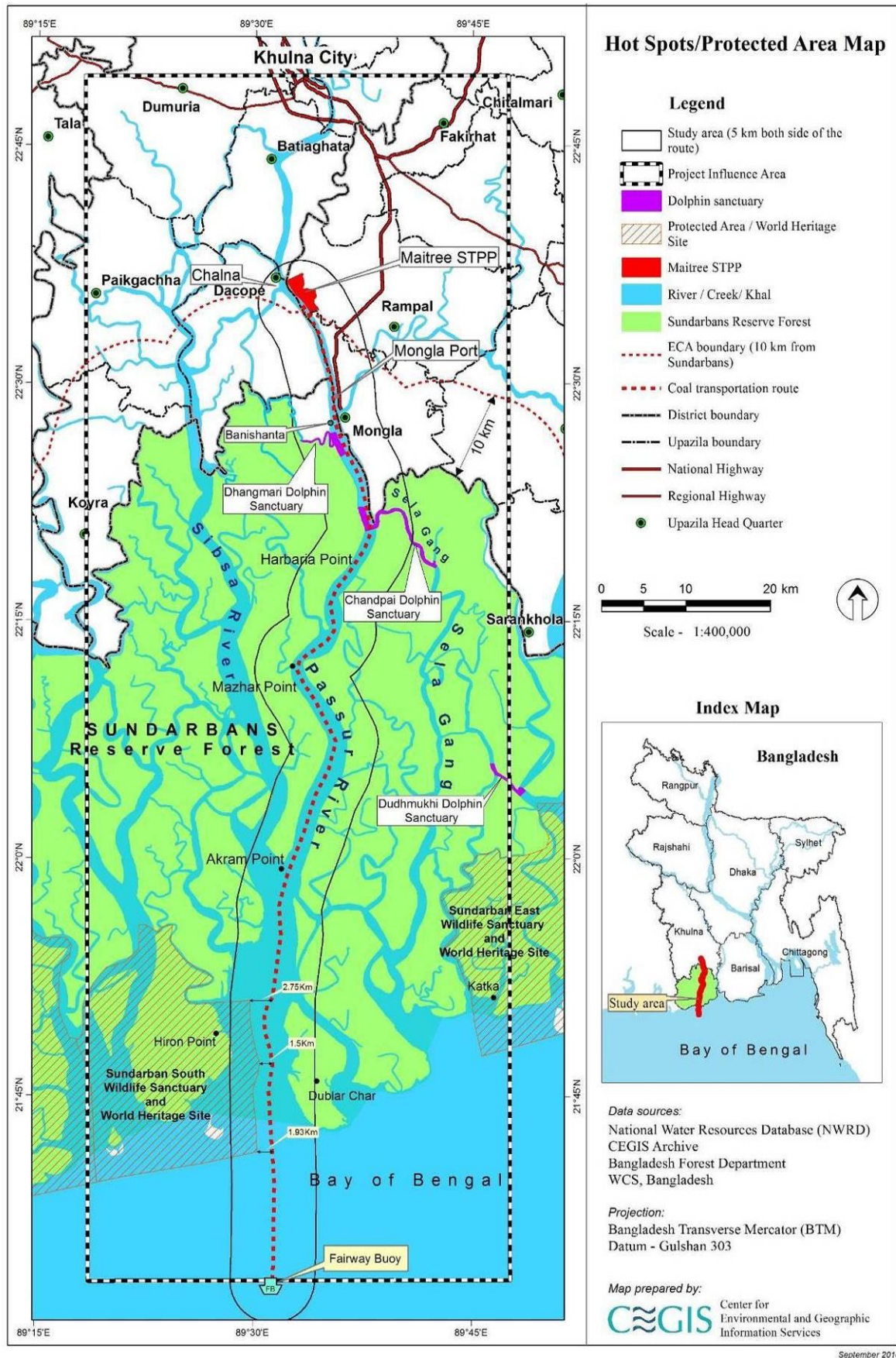


Figure 7-31: Hot spots/protected areas along the proposed Coal Transportation Route

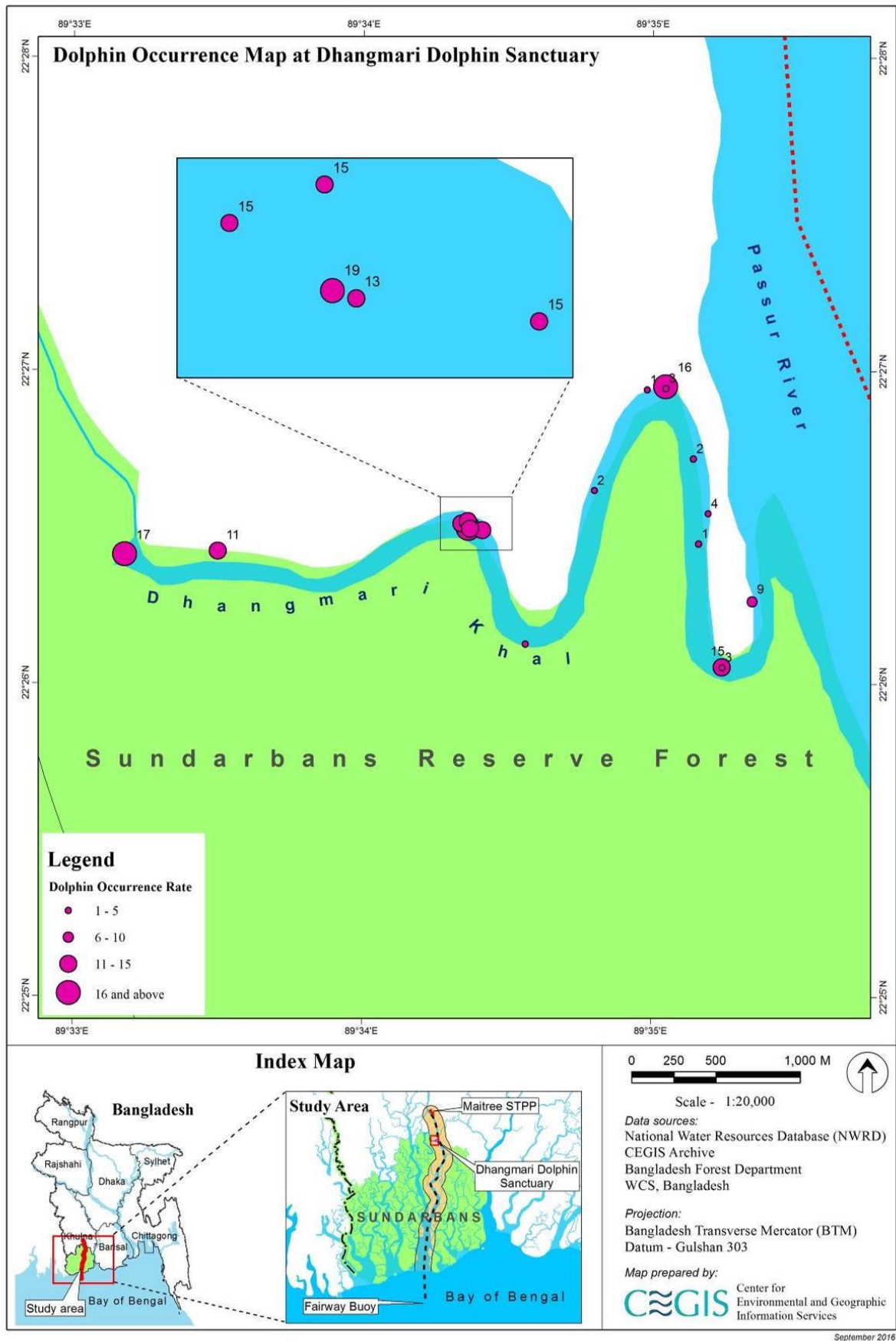


Figure 7-32: Dolphin distribution in Dhangmari wildlife sanctuary

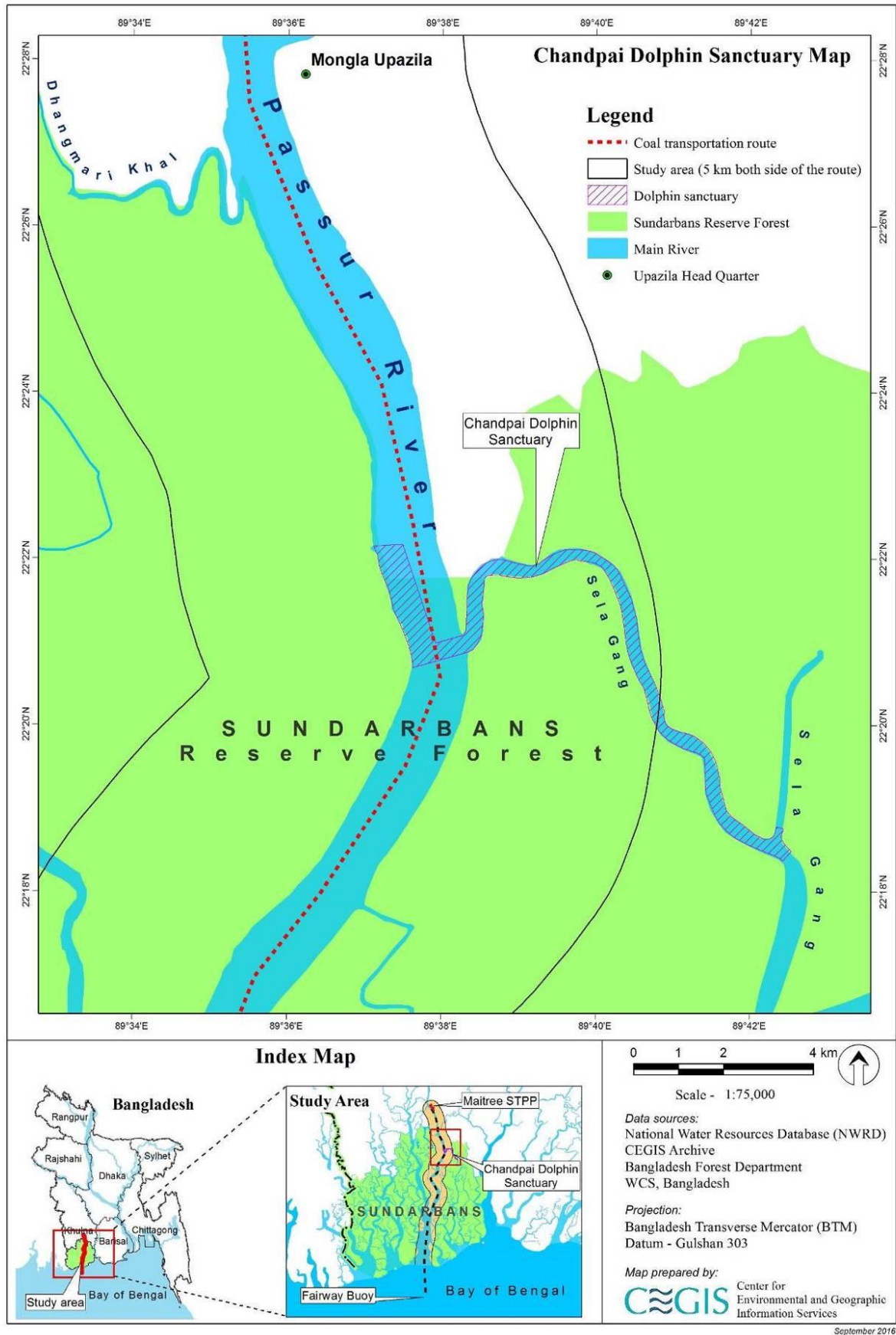


Figure 7-33: Dolphin distribution in Chandpai wildlife sanctuary

563. Floral community of SRF is one of the most biologically diverse in the world. Different authors tried to figure out biodiversity of SRF mainly through taxonomic surveys. Leech and Ali (1997) recorded 48 plant species, Bangladesh Center for Advance Studies (BCAS) registered 37 plant species from three protected areas (wildlife sanctuaries) of the Sundarbans (Rosario 1997), Islam 2014 recorded 63 plant species with 15 unidentified and the study recorded 29 plant species about 200m inside the forest from the Passur river bank **Table 7-32** and **Figure 7-34** is presenting floral composition of the Sundarbans. A detailed list of floral composition has been attached in **Annex 7-3**.

Table 7-32: Common floral species of SRF along 200m inside from Passur River

Plant Type	Common Species Name	Family name	Dominant species
	Karamjol		
Tree	Bruguiera sexangula(Kankra)	Rhizophoraceae	Bruguiera sexangula
	Heritiera fomes (Sundri)	Sterculiaceae	
	Avicennia officinalis (Bayen)	Avicenniaceae	
	Excoecaria agallocha (Gewa)	Euphorbiaceae	
	Xylocarpus mekongensis (Passur)	Malvaceae	
	Intsia bijuga (Bhaila)	Liguminosae	
	Amoora cucullata (Amur)	Meliaceae	
	Hibiscus tilliaceous (Bola)	Malvaceae	
	Honai		
Non Tree	Derris trifoliata (Kali Iota)	Liguminosae	Pandanus foetidas
	Pandanus foetidas (Keya Kata)	Pandanaceae	
	Sarcolobus globosus (Bawali Iata)	Asclepiadaceae	
	Phoenix paludosa (Hental)	Palmae	
	Nypa fruticans (Golpatta)	Palmae	
	Harbaria		
Tree	Heritiera fomes (Sundri)	Sterculiaceae	Heritiera fomes
	Excoecaria agallocha (Gewa)	Euphorbiaceae	
	Xylocarpus mekongensis (Passur)	Malvaceae	
	Amoora cucullata (Amur)	Meliaceae	
	Hurmui		
	Pentunga roxberghii (Narkali)	Rubiaceae	
Non Tree	Derris trifoliata (Kali Iota)	Liguminosae	Derris trifoliata
	Sarcolobus globosus (Bawali Iata)	Asclepiadaceae	
	Akram point		
Tree	Excoecaria agallocha (Gewa)	Euphorbiaceae	Excoecaria agallocha
	Heritiera fomes (Sundri)	Sterculiaceae	
Non Tree	Sarcolobus globosus (Bawali Iata)	Asclepiadaceae	Sarcolobus globosus
	Hiron Point		
Tree	Excoecaria agallocha (Gewa)	Euphorbiaceae	Excoecaria agallocha
	Heritiera fomes (Sundri)	Sterculiaceae	
	Sonneratia apetala(Kewra)	Sonneratiaceae	
Non tree	Ceriops decandra (Goran)	Rhizophoraceae	Ceriops decandra

Source: Plot sampling in SRF by CEGIS, 2014-15

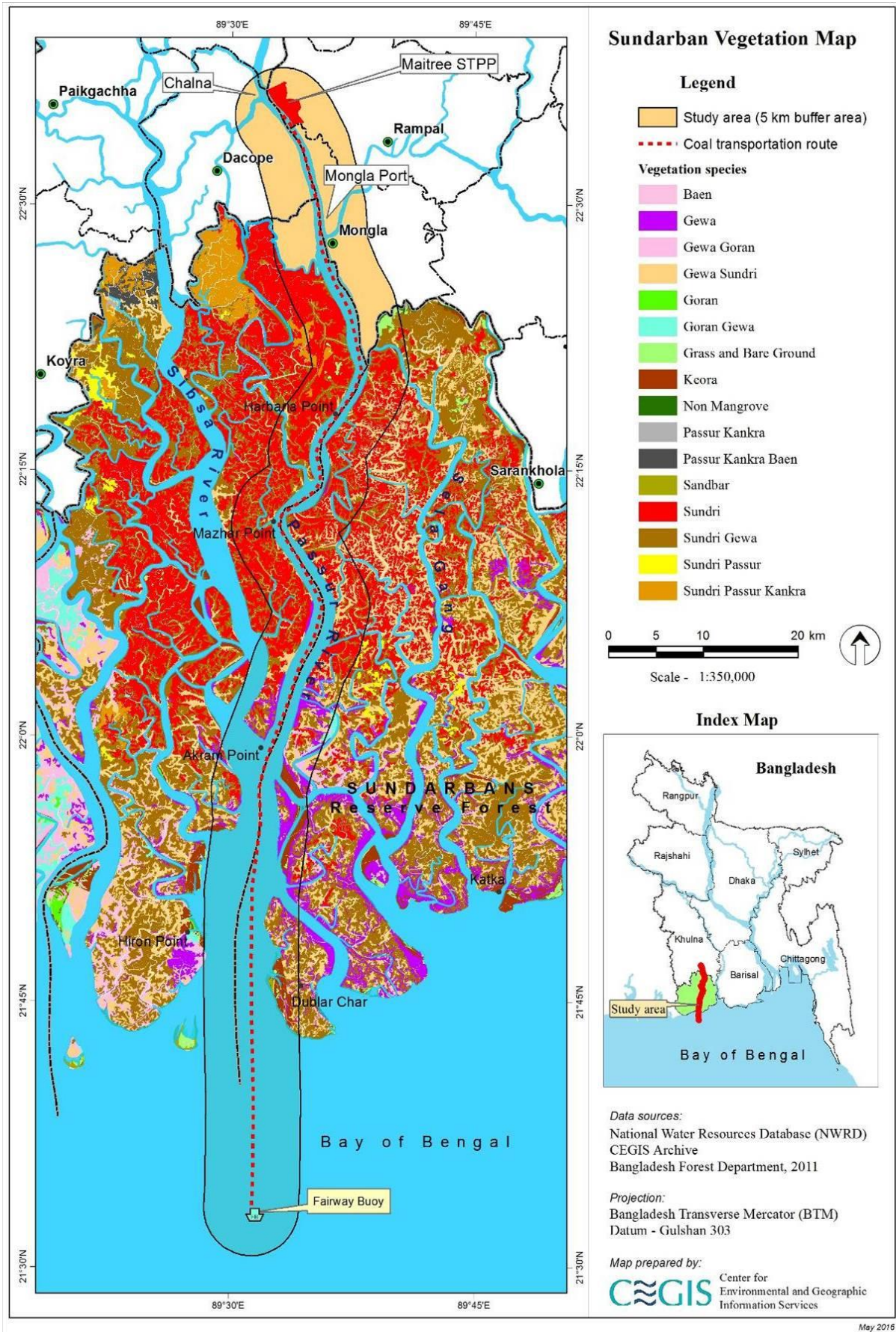


Figure 7-34: Major floral composition of SRF along the study area

564. The Passur is abundant with more than 46 species of benthos represented from 12 major groups. The abundance of benthos is more at upper part near Chalna, where identified 31 benthic species (CEGIS Field Monitoring, 2014). *Gammarus fasciatus*, *Palaemonetes paludosus*, *Ablabesmyia mallochi*, *Cryptochironomus fulvous*, *Epicordulia princeps* and *Limnodrilus hoffmeisteri* are the common observed benthos species.

565. The Passur and its adjoining rivers support more than 51 phytoplanktons and about 17 species of zooplanktons. *Coscinodiscus lineatus*, *Melosira moniliformis*, *Coscinodiscus granii* and *Melosira granulata*, are abundant. Species composition of benthos and planktons in Passur River is included in **Annex 7-4**.

World Heritage Site

566. There are three wildlife sanctuaries in the Sundarbans having an area of 139,700 hectares, out of which the Sundarbans South Wildlife Sanctuary extends over an area of 36,970 hectares (91,400 acres). It is considered as a core breeding area for a number of endangered species. There is evidently the greatest seasonal variation in salinity levels and possibly represents an area of relatively longer duration of moderate salinity where *Gewa* (*Excoecaria agallocha*) is the dominant woody species. It is often mixed with Sundri (*Heritiera fomes*), which is able to displace in circumstances such as artificially opened canopies where Sundri does not regenerate as effectively. It is also frequently associated with a dense understory of Goran (*Ceriops tagal*) and sometimes Passur. The distance between the nearest ridge of the core forest and the proposed coal transport vessel alignment is over 4 km. Similarly, the distance from the boundary of the Sundarbans South Wildlife Sanctuary as well as the World Heritage Site is about 2 km. The property is the only remaining habitat in the lower Bengal Basin for a wide variety of faunal species. Its exceptional biodiversity is expressed in a wide range of flora; 334 plant species belonging to 245 genera and 75 families, 165 algae and 13 orchid species. It is also rich in fauna with 693 species of wildlife which includes; 49 mammals, 59 reptiles, 8 amphibians, 210 white fishes, 24 shrimps, 14 crabs and 43 mollusks species. The varied and colourful bird-life found along the waterways of the property is one of its greatest attractions, including 315 species of waterfowl, raptors and forest birds including nine species of kingfisher and the magnificent white-bellied sea eagle.

567. Both the natural beauty and scientific value of the Sundarbans World Heritage site and the greater ecosystem is deteriorating due to anthropogenic activities, including timber extraction, illegal hunting, agriculture, and industry. Industrial development has also increased shipping and dredging of the Passur River, which pose additional threats to the Sundarbans. The World Heritage Committee's Statement of OUV recognizes many of these threats, noting that: "Over exploitation of both timber resources and fauna, illegal hunting and trapping, and agricultural encroachment also pose serious threats to its values and its overall integrity." The 2015 State of Conservation report of the World Heritage Committee also notes that "non-renewable energy facilities, salinity, and dredging of the Passur River are a threat to the site."



(source: Internet)

Royal Bengal Tiger



Shipping along the Passur River at Harbaria



Mangrove Forest



Irrawaddy dolphins (one pictured dead found after the 2014 oil spill) and Ganges river dolphins of the Sundarbans (source: Internet)

Figure 7-35: Important features along the coal transportation route

568. Many of the species are recognized as part the site's OUV, as well as the mangrove forests, which are in serious decline.

Ecologically Critical Area (ECA)

569. The proposed transportation route crosses across the Ecologically Critical Area (ECA) of the Sundarbans, a strip of 10km width from the boundary of SRF. In addition, the eastern bank of the Passur River is used for industrial development. However, this area is under threats for unplanned industrialization and saline water shrimp farming. The floral pattern of the ECA at countryside is mixed mangrove vegetation with planted homestead flora. Intertidal riverbanks are vegetated with small mangrove patches, which are threatened by sand filling (for use in industries).

Flora:

570. Most common dominated plants on homestead platforms are Rendi Koro (*Albizia saman*) Narikel (*Cocos nucifera*) and Khejur (*Phoenix sylvestris*). Gewa (*Excocharella agallocha*) and Tiger fern are exclusively grown at the homestead ridges. Golpata (*Nypa*

fruticans) is also found in pond and ditch sides of some homesteads. Soil condition of this area is not suitable for good succession of saline susceptible plants.

Fauna:

571. The study area is blessed with rich faunal resources, which inhabit mangrove ecosystems. The ECA is dominated by local avifauna and some other higher vertebrate groups. Sandpipers (*Actitis hypoleucos*), least concern; wagtails (*Motacilla alba*), least concern; egrets and herons are the common avifauna that are found along the riverside. Population of other vertebrates are comparatively low when compared with other parts of the country due to changes of landuse caused by saline water shrimp culture.

572. The Ministry of Environment and Forest (MoEF) has placed restrictions on the following activities in the Ecologically Critical Area: (i) Hunting; (ii) Fishing; (iii) All activities that could result in the destruction of floral or faunal habitats; (iv) Activities that could destroy natural characteristics of water and soil; (v) Activities detrimental to fishery; (vi) Installation of polluting industrial units; and (vii) Discharge of domestic/ industrial liquid waste.

Major Fauna along the Proposed Transportation Route

573. The major wildlife that inhabit the area along the proposed coal transportation route are: Royal Bengal Tiger, Estuarine Crocodile, River Terrapin, Wild Pig, Rhesus macaque, Lesser Adjutant, Smooth-coated Otter, etc. The recent Tiger Status Report (October, 2015) shows that the route crosses a low to moderate density of Tiger signed area. Similarly, the route goes through the low density area of spotted deer and Rhesus macaque while there is a higher density of Estuarine Crocodile Smooth-coated Otter and Wild Pig. Alorkol at Dubla Char area is also has a high density of occurrence of Lesser Adjutant Stork. Dolphin sanctuaries are mentioned earlier section. Maps of major wildlife census are given in Figure (a-h) in **Annex 7-5**.

Goods and Services

574. The environmental benefits of mangroves, as well as their commercial uses, have made mangrove forests very important ecosystems. The benefits of the mangrove ecosystem in terms of goods and services are shown in **Figure 7-36**. Mangrove forests serve as a diverse habitat for many species, including fish, birds, reptiles, amphibians, mollusks, crustaceans and many other invertebrates. Mangroves act as the root of sea and, if there is no mangrove forest along the coast, there will be no or fewer fish in the coastal sea area. Mangroves provide nursery grounds for fish, prawns and crabs, and support fisheries production in coastal waters. The exposed prop roots and pneumatophore provide ample hiding places for fish. Many commercial shrimp and fish species are commonly available here. Mangroves produce leaf litter and detritus matter, from the leaf of mangrove trees which are valuable sources of food for animals in coastal waters. Up to 80% of global fish catches are directly or indirectly dependent on mangroves (Fujimoto, 2000).

575. From the Sundarbans mangrove forests, an average of 6000 ton/ha of litter is released per year, which provides a great source of natural food (Hossain, 2009). Mangroves serve as recreational grounds for bird watching and observation of other wildlife since it provides shelter for local and migratory wildlife. Mangroves are a good source of wood, timber and housing materials, firewood, charcoal and poles for fish traps. Fish, crustaceans and mollusks can be harvested from mangroves. Aquaculture and commercial fisheries also depend on mangroves for juvenile and mature fish species. Last but not least;

mangroves are sources of tannin, alcohol and medicine. Mangrove forests offer good opportunities for ecotourism and economic benefits to local coastal communities of Bangladesh.



(Courtesy: Hossain, 2009 modified)

Figure 7-36: The productive and protective role of mangrove forest as goods and services

7.8.3 Alien Invasive Species of the Sundarbans

There are 23 invasive species recorded, which belong to 18 families and 23 genera. Among the identified species, three species are highly invasive, six species are moderately invasive and the remaining are potentially invasive. Climbers (6 out of 23) were the most frequently encountered invasive species followed by trees (5 out of 23) and shrubs (4 out of 23). The

three highly invasive plants were *Derris trifoliata* (climber-Kalia Lata), *Eichhornia crassipes* (aquatic shrub- Kachuri Pana) and *Eupetorium odoratum*, respectively. Of the 23 invasive species only four are exotic or alien. Density of most invasive species is very low except for *Derris trifoliata* and *Eichhornia crassipes*. Density also differs significantly from the forest border inward. Among the identified invasive plants, *Derris trifoliata* and *Eichhornia crassipes* showed highest density followed by *Acrosticum aureum* and *Micania scandens* (Asam Lata) (Biswas, 2007).

7.8.4 Jetty Construction Site Vegetation

576. There is a small and shabby forest patch on the left bank of the Passur River close to the jetty construction site, which is dominated by the Keora (*Sonneratia apetala*) trees. The numbers of trees including sapling, juvenile and adult are approximately 150-200.

7.9 Fisheries Resources

577. The Passur River will be used for coal transportation route and it will also function as the major hydrological network of the SRF and other specialized conservation areas, e.g., the Sundarbans South Wildlife Sanctuary (SWS) also known as World Heritage Site (WHS), Ecologically Critical Area (ECA), etc. These are all the integral parts of the Sundarbans mangrove forest except the ECA and only differ in nature of conservation management and richness of fish species diversity. The Sundarbans is also considered to be a RAMSAR protected site. The forest is nationally and internationally considered to be of critical conservation significance for its goods and services and biodiversity (Mentioned in Ecology Section). The Sundarbans consists of a complex network of tidal waterways, mud flats and small islands of salt tolerant mangrove forest. During high tides, the area is partly flooded with brackish water mixing with river freshwater.

578. Fisheries resource is considered a major output of the Passur River System along with diversified resident fish species. In developing benchmark conditions of the fisheries resources, monitoring data has been used in some areas. The fishing activities in this system generally depend on the lunar phase and tide condition. The survey, therefore, has been conducted to find low tide conditions when large scale fishing is done. Fish susceptibility to fishing is generally less during high tide condition in this system. Fisheries resources are described in the following sections:

7.9.1 Habitat Description

579. Open water fish habitats in the Passur River System shown in **Figure 7-37** and **Figure 7-38** are influenced by the inter-tidal variation and River morphology. Various morphological changes (described in water resources section) of these rivers control the physical condition, primary productivity and habitat classification of fish habitats in the Sundarbans.



Figure 7-37: Fish habitat in the Passur River System

Physical condition of Fish Habitat

580. The combined effect of tidal prism with the monthly lunar phase and eutrophication resulting from shrimp/crab culture practice and agriculture runoff causes the habitats to have a higher TDS, lower dissolved oxygen (DO) and higher pH (basic trend) which then make them less suitable for soft-bodied fish species like Punti, Mola, Chela, etc. while suitable for Chingri, Mud Skipper, Chewa, etc. The connectivity of hydrological network depends on tidal prism, tidal range and season.

Primary Productivity of Fish Habitat

581. The present physical condition with soil characteristics of riverine fish habitat support a diversified food ecosystem including phytoplankton (shown in the **Annex 7-4**), followed by most common crustaceans consumers (rotifers, copepods, cladocerans, etc.) group support the presence of hard-environment tolerant fish species (like *Penaeus monodon*), planktivores (Paisa, Hilsha, Chapila, etc.). Besides, the order of Coleoptera, Crustacea, Diptera, Ephemeroptera, Gastropoda, Hemiptera, Megaloptera, Odonata, Oligochaeta, Bivalvia, Plecoptera, Trichoptera, etc. form the major zoo benthos community also play an important role in the food web of benthic fish species (Bhetki, Banshpata, Phesa, etc.). Moreover, the land type, soil characteristics, saline water with low DO and higher pH support the autonomous food ecosystem suitable for shrimp/crab culture practice. However, primary productivity is under threat of anthropogenic hazards through eutrophication.

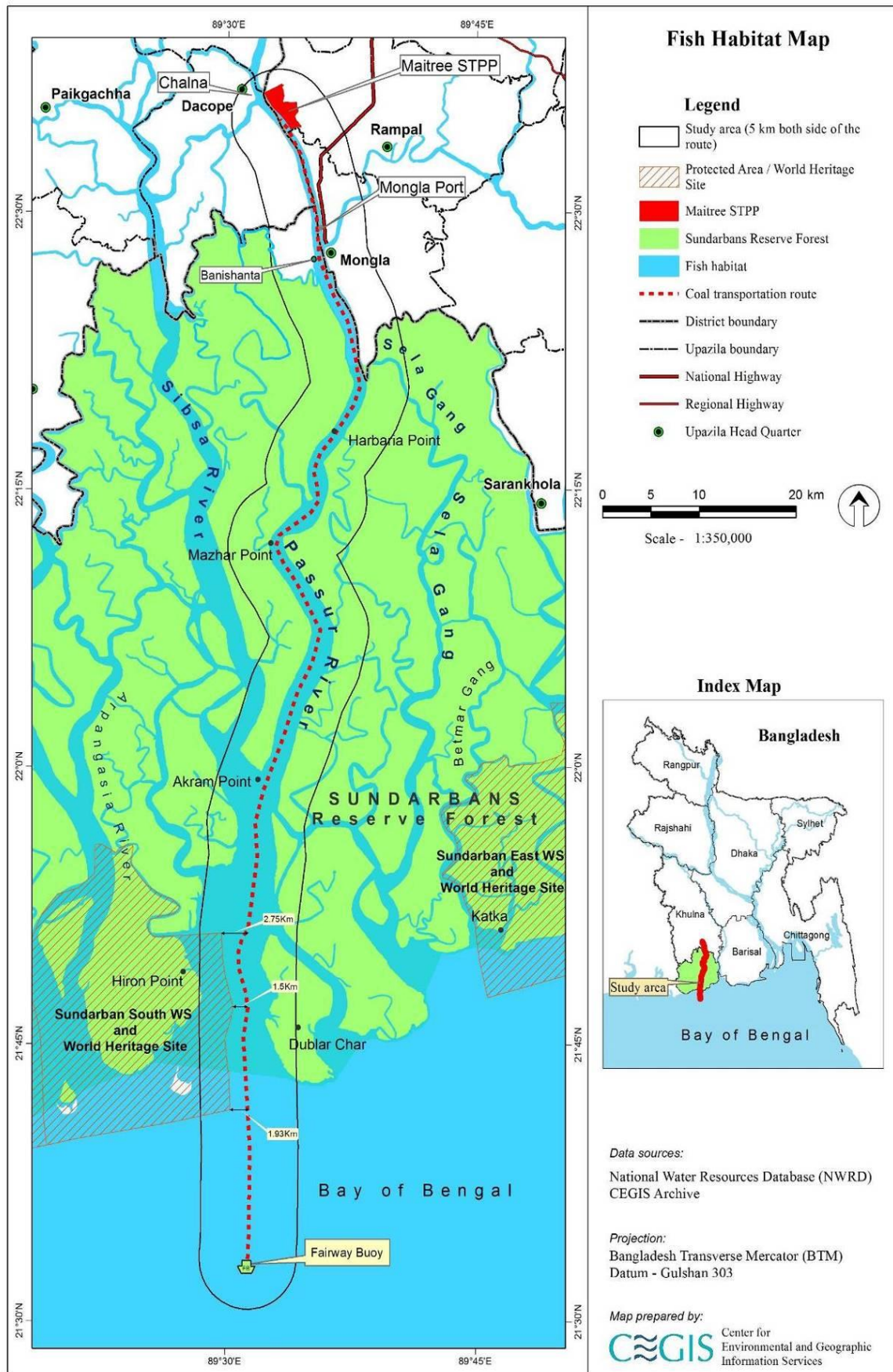
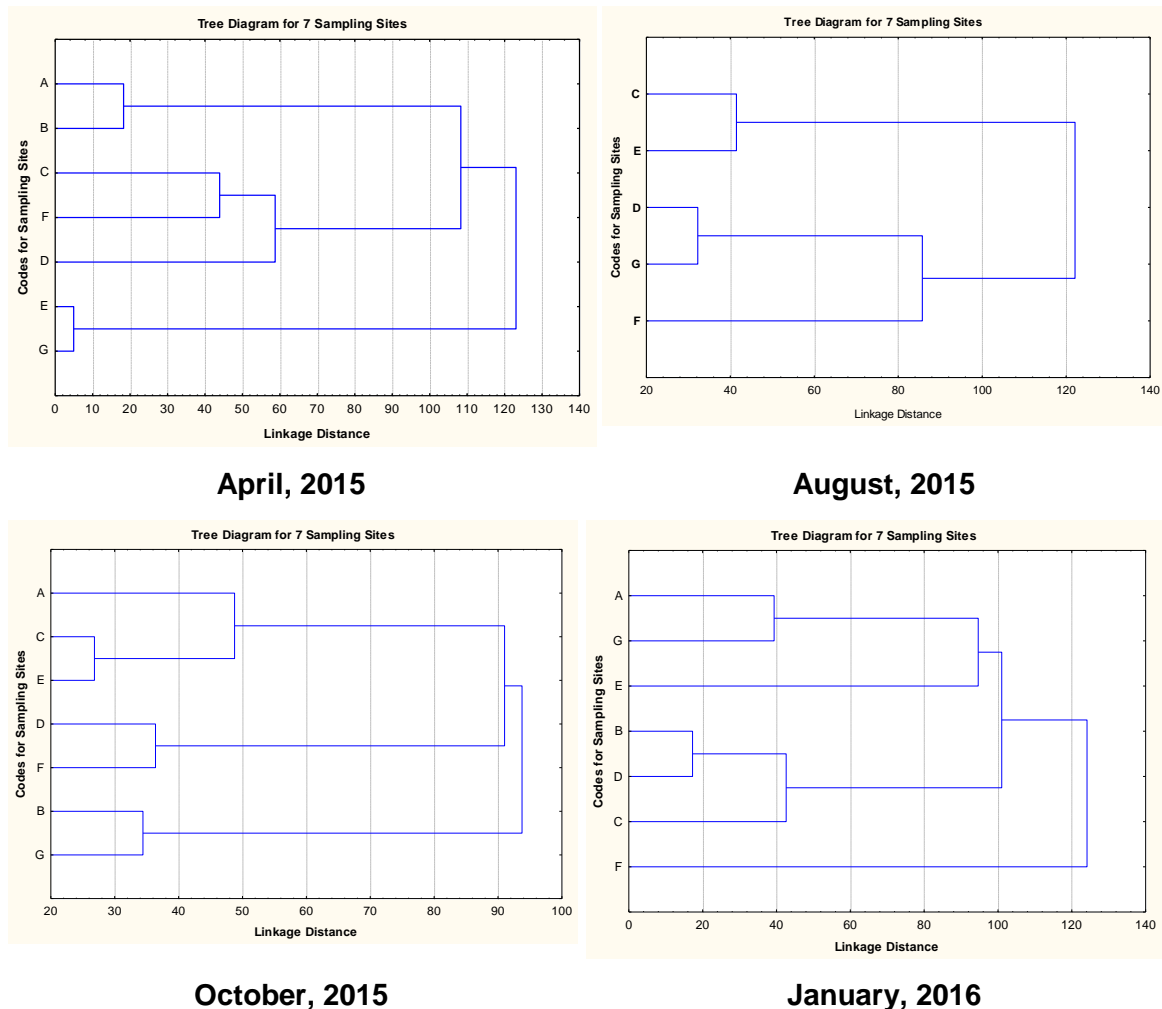


Figure 7-38: Fish habitat map of the study area

7.9.2 Habitat Classification

582. Habitat classification is analyzed by using the length-wise distribution of different fish species in the seven sampling sites along the Passur River; three sites in the upper reaches, one in middle and three in the lower reaches. Linkage distance is then calculated considering the similarity in distribution among sampling sites. The entire stretch of the Passur River System consist of five major behavioural habitats having seasonal dimensions, such as, grazing/feeding, nursery, breeding & spawning and grow up grounds.

583. Major habitats identified during the 1st quarter (Jan-Feb-Mar) of the year are: i) grazing ground, ii) nursery ground; and iii) spawning and nursery; 2nd quarter (Apr-May-Jun) are: i) grazing and breeding ground and ii) spawning and nursery ground; 3rd quarter (Jul-Aug-Sep) are: i) grazing ground, ii) nursery ground and iii) growing and feeding ground; and 4th quarter (Oct-Nov-Dec) are: i) nursery and feeding ground and ii) feeding and growing ground as shown in the **Figure 7-39**.



(Note: Life stage is identified through length measurement of the fish individuals)

Figure 7-39: Life stage based habitat classification of fish species

7.9.3 Fish Catch and Effort

584. According to the Catch Assessment Survey (CAS), the highest catch was observed in the Passur River at Akram Point during benchmark field investigation in early 2016 while the lowest catch was observed in the Maidara-Passur River Confluence (**Table 7-33**).

585. Fishing gears, such as *Charpata*, *Behundi* and *Net Jal* are frequently used to catch fish with the target of commercial harvest. The *Charpata Jal* has the highest efficiency of fishing (276 kg/haul). The following table also shows that *Behundi Jal* and *Net Jal* are commonly used in upper reach and *Charpata Jal* in lower reach of the Passur River.

Table 7-33: Total catch in different gears in the sampling sites

Sl. No.	Site	Habitat	Gear Name/Type	Haul Duration (hr)	No. of Haul	Total Catch (kg)	kg/haul
A	Akram Point	Kukilmoni Khal	Charpata Jal	19	1	276	276
B	Haldikhali	Haldikhali Khal	Jhaki Jal	1	40	13	0.3
C	Harbaria	Harbaria Khal	Charpata Jal	11	1	174	174
D	Chandpai	Sheola Khal	Behundi Jal	6	4	113	28.5
			Charpata Jal	12.3	1	76	76.0
E	Mongla Point	Passur River	Behundi Jal	6	1	7.8	7.8
F	Maidara	Maidara River	Net Jal	1.3	1	-*	-
G	Chalna Point	Passur River	Thela Jal	1	20	70	3.5

Source: Catch assessment survey, CEGIS (2016);

* Note: Net gear/jal is generally used for catching Post Larvae (PL) of shrimp, which is not measured in weight.

586. Fish production of the Sundarbans habitats is about 18,400 ton (DoF, 2015). Analysis of time series fish production data (1988-2014 of FRSS, DoF) of the Sundarbans shows that the fish production of the Sundarbans has been increasing adding on an average about 667 ton fish per year (**Figure 7-40**). It is also observed that the production share of the Sundarbans fisheries haul has a marginally incremental trend. On the contrary, the share of inland and country total fish production has a decreasing trend.

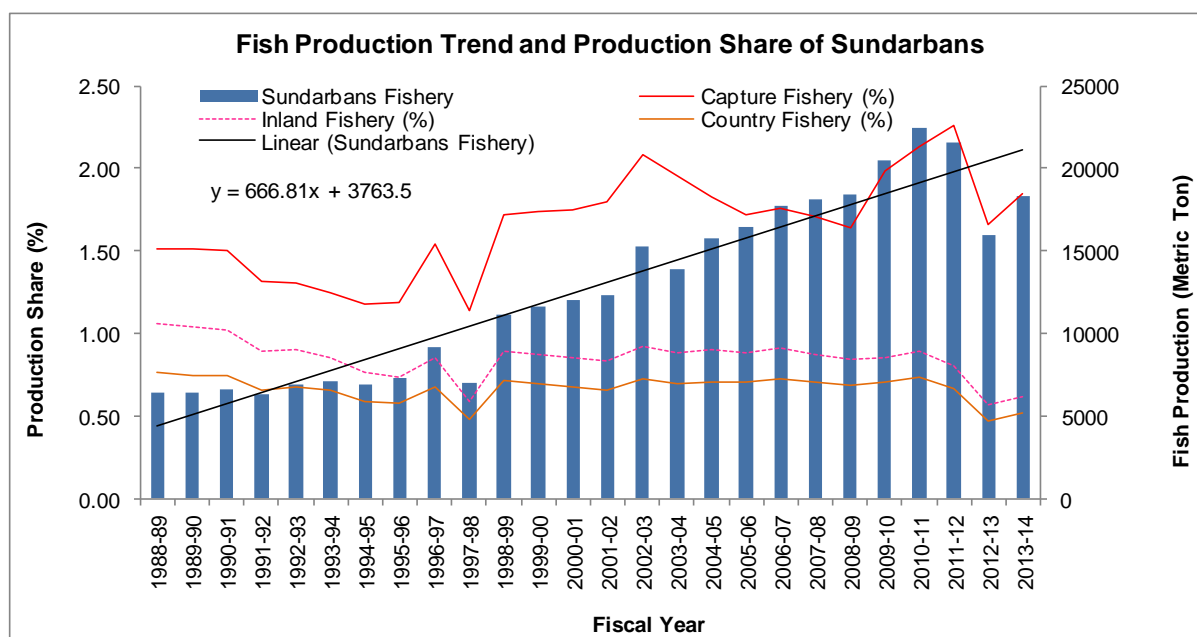


Figure 7-40: Fish Production Trend and Production Share of the Sundarbans

7.9.4 Fish Migration

587. Migratory species have been identified by analyzing the common species available in the regular catch from the sampling sites. Fish species like Paissa attains the maximum abundance among the migratory fish species observed during benchmark and successive field visits. The relative abundance of the migratory species is given below in **Figure 7-41**.

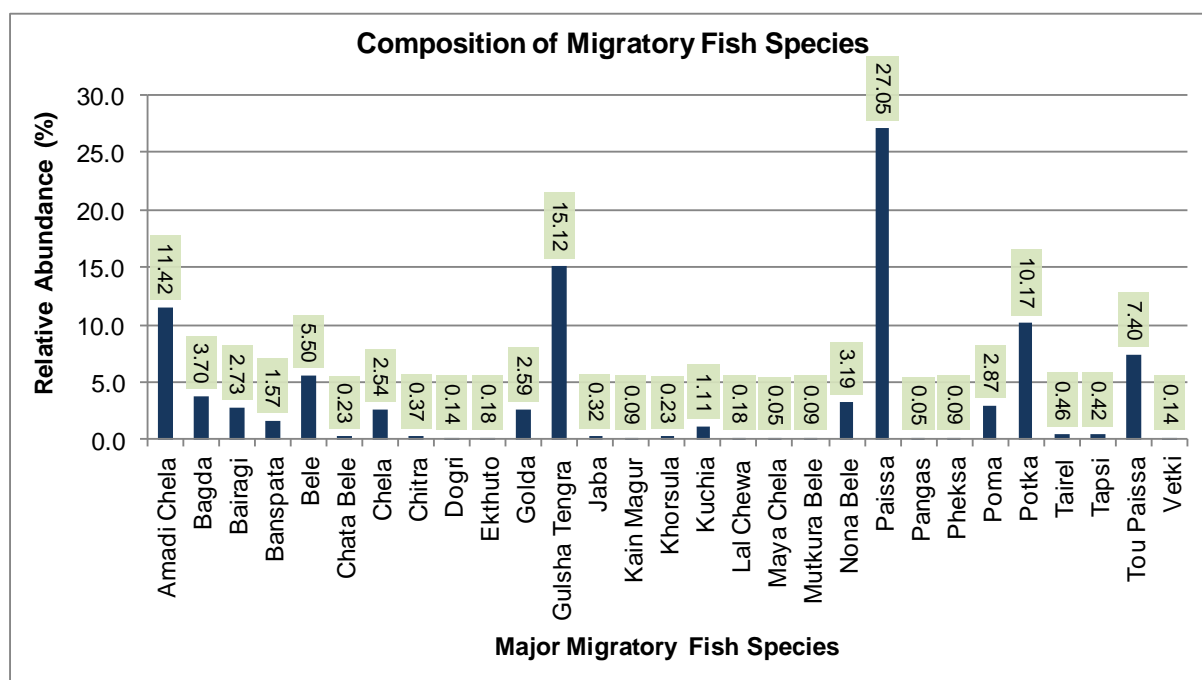


Figure 7-41: Relative abundance of major migratory fish species in sampling sites

Migration Extent, Time and Purpose

588. Major fish species showed an interesting pattern in distribution for exploiting different purposes mentioned in the following table all along the sampling sites. Four (4) fish species were found to be the most common in most of the sites. Only three species, e.g., Bagda, Poma and Bele have been observed indicating long range of distribution (**Figure 7-42**).

589. It is interpreted from the findings that in the month of January fish species migrate to the upper reaches of the Passur River mainly for feeding purpose and middle reaches for nursing.

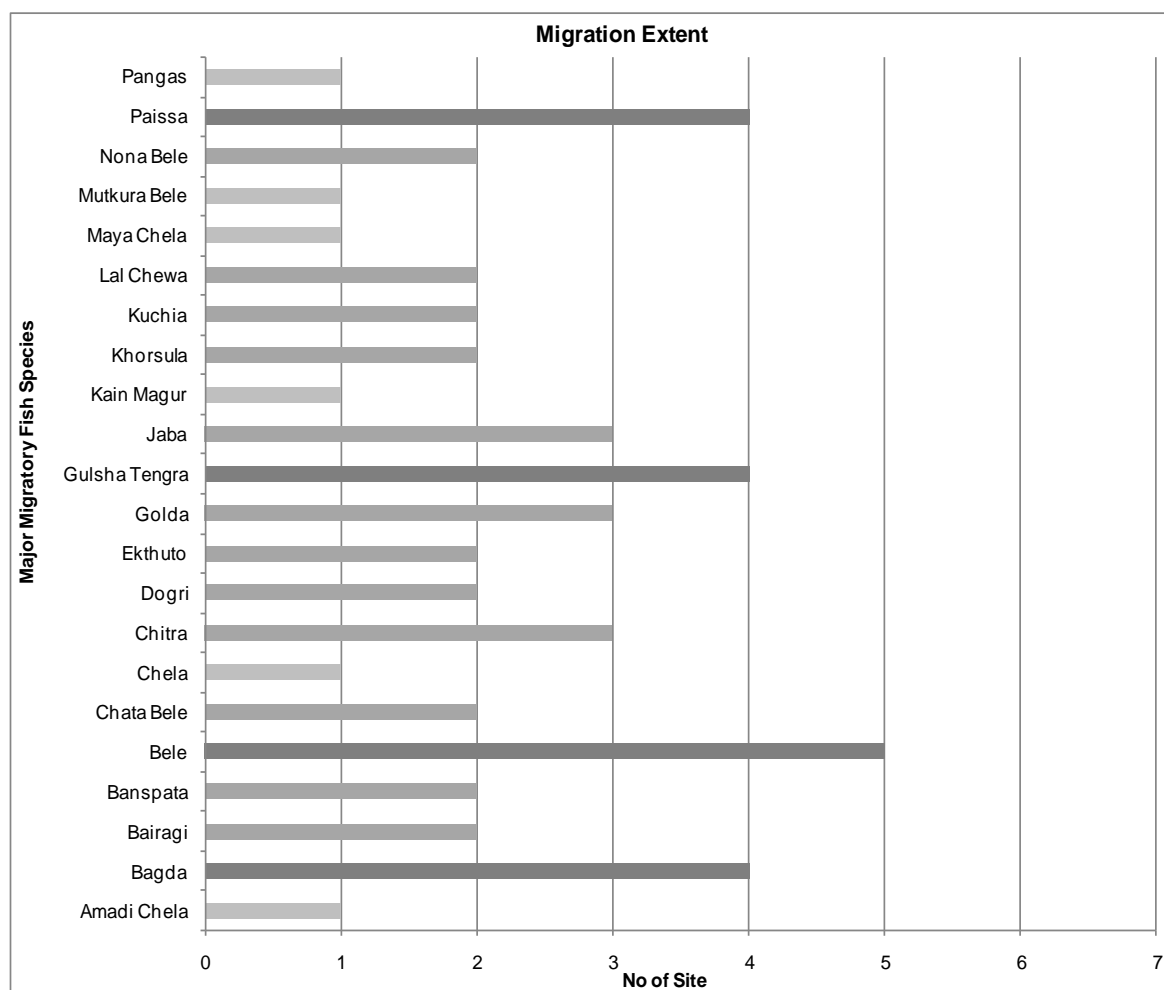


Figure 7-42: Migration extent of major migratory fish species in sampling sites

7.9.5 Fish Diversity

590. The fish habitats are in the range of inland fresh water to marine, moderate to rich in species diversity. There are about 210 fish species, 120 species of fish are commonly caught from the Sundarbas area. There are eight (08) commercially important species of finfish, shrimp and crabs, and at least 11 species of bivalves in estuarine areas. There are also about 3 species of snail and 4 species of cuttle fish and squids in the Sundarbans (Aziz, 2015) and the study area as well.

Species Evenness

591. Based on the benchmark field investigation from late December, 2015 to early January, 2016, highest Shannon-Weiner index is found at Chalna Point (0.81) indicating that fish species are highly evenly distributed. On the contrary, lowest evenness is found at Mongla Port (0.41), **Table 7-34**.

Table 7-34: Site wise species diversity using Shannon–Weiner Index

Site	Species No				Shannon-Weiner Index*			
	April	August	October	January	April	August	October	January
A	3	-	10	15	0.96	-	0.55	0.44
B	0	-	11	3	0.00	-	0.56	0.58
C	11	26	18	24	0.78	0.59	0.54	0.67
D	27	24	20	25	0.65	0.72	0.51	0.71
E	6	16	9	9	0.15	0.73	0.85	0.41
F	10	8	14	6	0.67	0.39	0.77	0.65
G	18	3	8	6	0.18	0.95	0.72	0.81

*According to Shannon-Weiner Index, 0-0.30: Low diversity/equally distribution (VH); 0.31-0.50: Moderate Diversity (M); 0.51-0.80: High Diversity (HD) and 0.80-1.0: Very High Diversity (VHD)

Fish Species Richness (FSR)

592. Fish species richness has been identified through Simpson's Index¹⁰. A considerable difference is noticed in the fish species richness (FSR) in different habitat classes (**Table 7-35** and **Figure 7-44**).

593. During the benchmark survey, maximum FSR is obtained in Shela Khal at Chandpai (n=7), while very low FSR is recorded at Akram Point, Haldikhali, Mongla Point and Maidara sampling sites (n=2). The species richness is found to be more or less the same in both the monitoring years (2015 & 2016) in the same span of time. Among habitats located upstream of the Passur River, the adjoining area of the Mongla Port Jetty has been home to a rich assemblage of Amadi Chela and Bagda; Maidara River at Baro Durgapur was of Bagda and Golda; and Chalna Point is home to Bele, Chali Chingri, Goda Chingri and Horina Chingri. Among the habitats at downstream, Chandpai is rich in Paissa, Chela, Gulsha Tengra, Horina Chingri and Nona Bele; Harbaria is home to Baisakhi Chingri, Bele, Chami Chingri, Horina Chingri, Motka Chingri and Tou Paissa; Haldikhali Khal has been observed in Chaka and Chamu and in Akram Point. The **Table 7-36** attributes fish species with IUCN status. Fish species diversity of the Sundarbans is given in **Annex 7-6**.

¹⁰Simpson's index is a method to calculate the community characteristics of fish in a particular habitat. It is mainly used to know about the species richness of a particular habitat to tell how many species are rich in their abundance. The value of this index ranges from 0 to 1. There is other kind of value which is described in the methodology section. The second value is mainly used to measure the species richness in the sampling sites.

Table 7-35: Site wise dominant species number

Site	Location	2015-2016			
		April	August	October	January
A	Akram Point	3	-	3	2
B	Haldikhali	0	-	3	2
C	Harbaria	4	4	3	6
D	Chandpai	5	8	3	7
E	Mongla Point	3	6	4	2
F	Maidara at Baro Durgapur	4	2	4	2
G	Botiaghata, Chalna Point	1	3	3	4

Source: Field data



Adult Poma



Bagda Fry



Khorsula



Gagla Tengra

Gulsha Tengra,
Bele, Aswine Bele
and Paissa

Vetki



Menu



Kain Magur



Bele



Golda



Harina Chingri



Telcupa

Figure 7-43: Regularly caught fish species

Table 7-36: Fish species status at regular catches

Local Name	Scientific Name	Local Status	Apr	Jul	Oct	Jan	Local Name	Scientific Name	Local Status	Apr	Jul	Oct	Jan
Amadi	<i>Coilia dussumieri</i>	LC	-	-	+	+	Kakila	<i>Xenentodon cancila</i>	LC	+	-	-	-
Hilsa	<i>Tenualosa ilisha</i>	LC	-	-	+	-	Chapila	<i>Gudusia chapra</i>	VU	+	+	-	-
Sagor Baim	<i>Anguilla bengalensis</i>	VU	+	-	-	-	Khorsula	<i>Rhinomugil corsula</i>	LC	+	+	+	-
Baim	<i>Pisodonophis cancrivorus</i>	LC	-	-	-	-	Kuchia	<i>Monopterusuchia</i>	VU	+	+	-	+
Bacha	<i>Eutropiichthys vacha</i>	LC	+	-	-	-	Loitta	<i>Harpodon nehereus</i>	NT	+	+	+	-
Bagda Chingri	<i>Penaeus monodon</i>	LC	+	+	+	+	Motka Chingri	<i>Macrobrachium villosimanus</i>	DD	+	+	+	+
Banspata	<i>Ailia coila</i>	LC	+	+	+	+	Mud Crab	<i>Scylla serrata</i>	LC	+	-	+	+
Kukurjib	<i>Cynoglossus lingua</i>	LC	+	-	-	-	Tular Dandi	<i>Sillaginopsis panijus</i>	LC	+	-	+	-
Bele	<i>Glossogobius giuris</i>	LC	+	+	+	+	Paira Chanda	<i>Scatophagus argus</i>	DD	+	-	-	-
Boiragi	<i>Coilia dussumieri</i>	LC	+	+	+	+	Paissa	<i>Liza parsia</i>	LC	+	+	+	+
Boishakhi Chingri	<i>Macrobrachium villosimanus</i>	LC	-	+	-	-	Pangas	<i>Pangasius pangasius</i>	EN	+	-	+	-
Chammu Chingri	<i>Metapenaeus brevicornis</i>	LC	+	+	+	-	Tak Chanda	<i>Leiognathus equulus</i>	NT	+	-	-	-
Chaka Chingri	<i>Penaeus indicus</i>	LC	+	+	-	+	Phessa	<i>Setipinna phasa</i>	LC	+	+	+	+
Ghora Chela	<i>Securicula gora</i>	NT	+	-	-	-	Poma	<i>Poma poma</i>	NT	+	+	+	+
Sada Chewa	<i>Trepauchen vagina</i>	LC	+	-	+	-	Potka	<i>Chelonodon patoca</i>	DD	+	+	-	+
Lal Chewa	<i>Odontamblyopus rubicundus</i>	LC	+	+	+	+	Shilong	<i>Silonia silondia</i>	LC	+	-	+	-
Chhuri	<i>Trichiurus muticus</i>	LC	+	-	+	-	Tailla	<i>Eleutheronema tetradactylum</i>	DD	+	-	-	-
Sagor Chela	<i>Megalops cyprinoids</i>	LC	+	-	-	-	Tapse	<i>Polynemus paradiseus</i>	DD	+	+	+	-
Purabi Chela	<i>Thryssa purava</i>	LC	+	-	-	-	Shole	<i>Channa striatus</i>	LC	-	-	-	+
Kabashi Tengra	<i>Mystus cavasius</i>	NT	+	-	-	-	Magur	<i>Clarias batrachus</i>	LC	-	-	-	+
Gulsha Tengra	<i>Mystus bleekery</i>	DD	+	+	-	+	Koi	<i>Anabas testudineus</i>	LC	-	-	-	+
Harina Chingri	<i>Metapenaeus ensis</i>	DD	+	+	+	+	Vetki	<i>Lates calcarifer</i>		-	-	-	+
Ekthuto	<i>Hyporhamphus limbatus</i>	NO	+	-	+	+	-	-	-	-	-	-	-

Source: IUCN Red List, 2015 and Filed Data

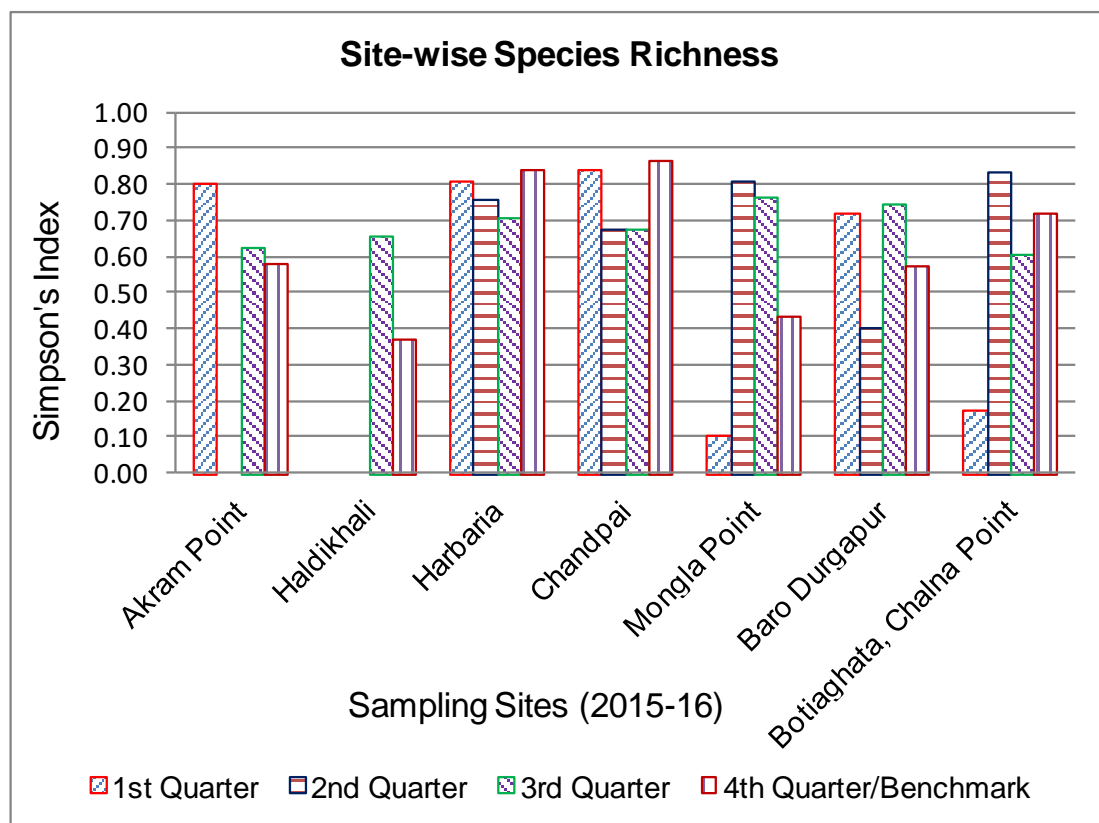
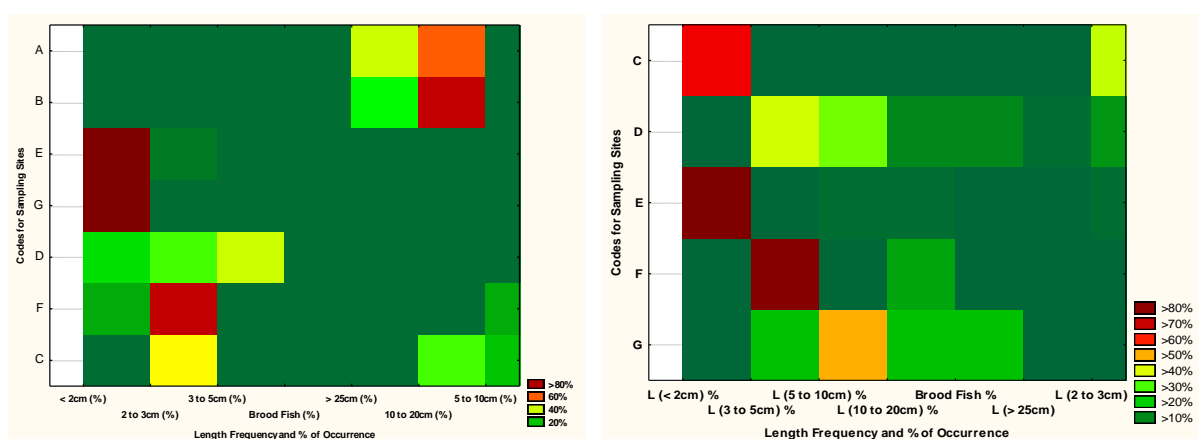
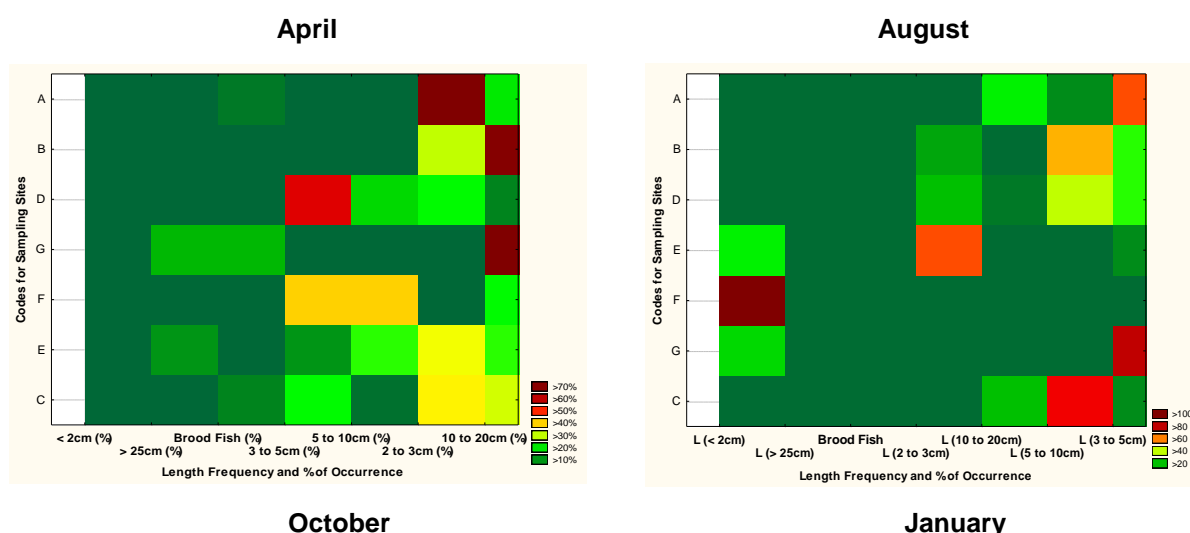


Figure 7-44: Site-wise fish species richness (FSR) in the Passur River System

Fish Community Structure

594. The fish community structure has been analyzed through counting the length-wise fish individuals (**Figure 7-45**). **Table 7-36** and the figure give the benchmark condition (fourth quarter for the monitoring study) and show that juvenile of fin fishes were more widely distributed among the middle and lower reaches of the Passur River. Among these Bagda, Bele, Golda Chingri and Horina Chingri fishes were widely distributed among the sampling sites. Moreover, fry fish of Poma, Khorsula and Amadi Chela were found at Mongla Port, Bagda at Maidara and Mongla Port), Bele and Chali Chingri at Chalna Point and Maidara, Daitna and Golda Chingri at Maidara and Tit Punti at Chalna Point. However, no brood female fish are observed in the sampling sites during the benchmark survey.





Note: N.B.: Color ranges from deepest green to deepest red. 0-4.99% Occurrence signifies Deepest Green; 5-9.99%-Shaded Green; 11-14.99%-Normal Green; 15-19.99%-Light Green; 20-24.99%; 25-29.99%-Lightest Green; 30-34.99%; 35-39.99%; 40-44.99; 45-49.99; 50-54.99-Light Magenta; 55-59.99-Deep Magenta; 60-64.99%; 65-69.99%; 70-74.99%; 75-79.99%-Light Red; 80-84.99%-Deep Red; 85-89.99%; 90-94.99%; 95-100%-Deepest Red.

Figure 7-45: Habitat distribution of different life stages of fish species, 2015-16

Shell Fish Status

595. A total of 14 shellfish species have been recorded in the Passur River with the species belonging to three orders and seven families. The species are as follows: *Alpheus euphrosyne*- Pinna Chingri (Alpheidae- 1 sp.); *Episesarma chengtongense*- Kankra (Grapsidae- 1 sp.); *Exopalaemon styliferus*- Motka Chingri, *Leptocarpus fluminicola*- Choto Chingri, *Macrobrachium dayanum*- Kathali chingri, *Macrobrachium rosenbergii*- Goda Chingri, *Macrobrachium rude*- Goda Chingri, *Macrobrachium villosimanus*- Boishakhi (Palaemonidae- 6 spp.); *Metapaeneus monoceros*- Harina Chingri, *Penaeus indicus*- Chaka Chingri, *Penaeus monodon*- Bagda Chingri (Penaeidae- 3 spp) and *Scylla serrata*- Kankra (Portunidae- 1 sp) under Order- Decapoda; *Oratosquilla perpensa*- Lobster (Squillidae) under Order- Stomatopoda and *Carcinoscorpius rotundicauda*- Raj Kankra (Limulidae) under Order- Xiphosura. The family wise percentage analysis of the shellfish species showed the highest occurrence belongs to the family Palaemonidae (43%), followed by Penaeidae, Alpheidae, Grapsidae, Portunidae, Squillidae and Limulidae as shown in **Figure 7-46**. The observed species were categorized in four statuses and obtained as available (50%), less available (22%), rare (14%) and very rare (14%), Gain, 2014. The present status of shell fish is reducing, showing a declining trend of riverine shellfishes in the habitat.

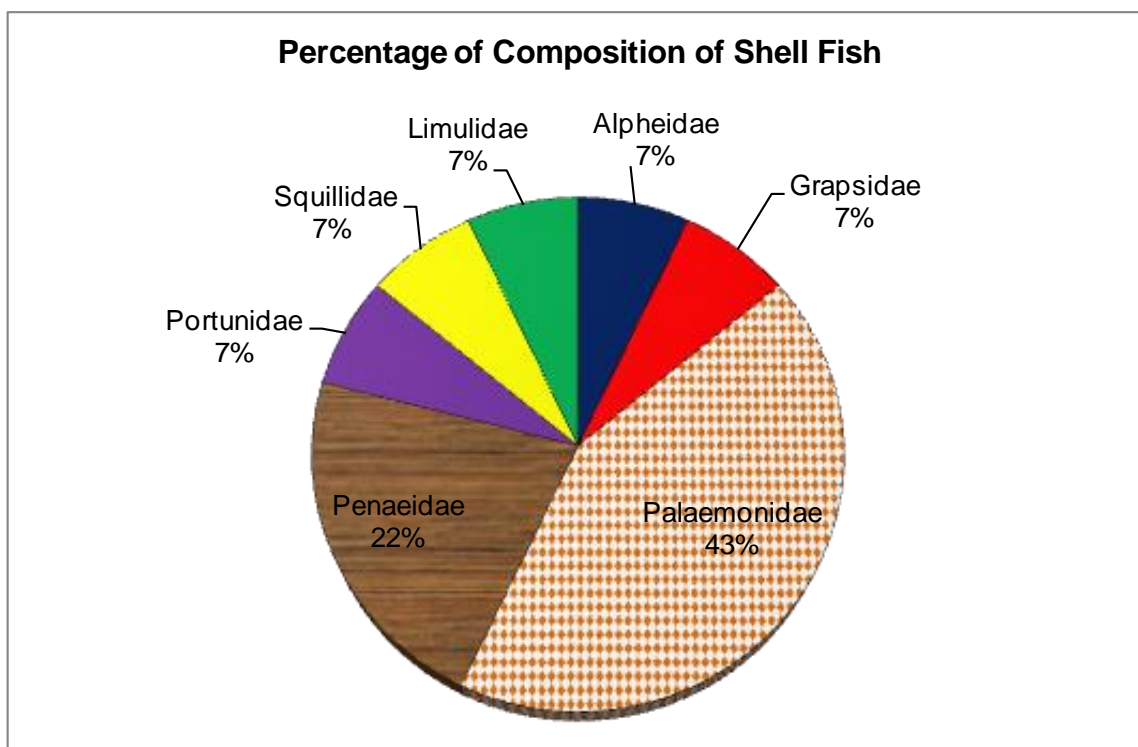


Figure 7-46: Composition of shellfish in different families from the Passur River

7.9.6 Breeding and Nursery Ground

596. The Sundarbans is one of the largest natural nursing and breeding ground (Huq et al., 2001). Various types of fish, including, shellfish largely depend upon the Sundarbans estuaries as a nursery ground as well as shelter and a source of their food, e.g. *Penaeus monodon*, *Macrobrachium rosenbergii*. The mangrove forest and mudflats of the Sundarbans provide vital breeding and nursery ground for fish, crustaceans, and mollusks. Total stock of fish in the areas of SRF has been estimated at 10.34 ton/km², which contributes 0.5% of the total fish harvest of Bangladesh (DoF, 2015). The Passur River mainly functions as a longitudinal migratory route of good number of brackish water fish species. They usually breed in the tributaries and distributaries commonly known as creeks of the Sundarbans. The creeks also function as nursery grounds of the resident and non-resident fish species, and also having high recruitment potential.

597. The Sundarbans ecosystem is extremely important both ecologically and economically as a nursery and breeding area for key fisheries including those of the Bay of Bengal. In recent years, concerns have been voiced by fishermen over the apparent declining stocks and productivity of fisheries in and around the Sundarbans. There are also indications of wide spread illegal collection of crustacean larvae. Hilsa fishery of the Sundarbans area is influenced by the Hilsa breeding ground located at the south-eastern periphery of the Sundarbans in the Baleswar River mouth on the Bay of Bengal (**Figure 7-47**). The Sundarbans functions as a grazing and nursing ground for the Hilsa fish and thus the abundance of Jatka is observed in the down most part of the Sundarbans during November to January and inside the Sundarbans in different rivers during January to March (**Figure 7-48**). Purpose, timing and extent of migration for different year-class of major fish species are given in **Annex 7-7**.

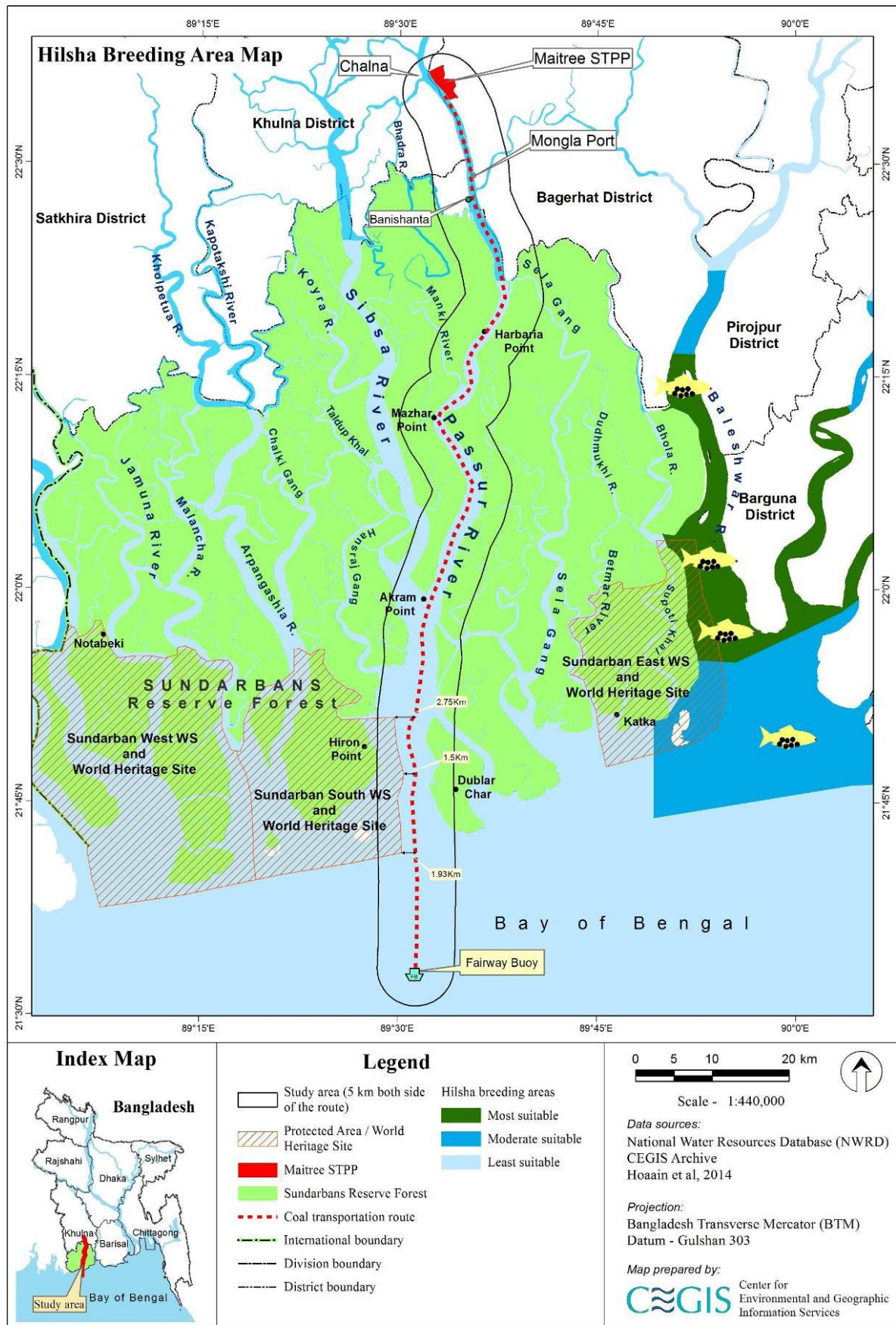


Figure 7-47: Hilsa fish breeding grounds

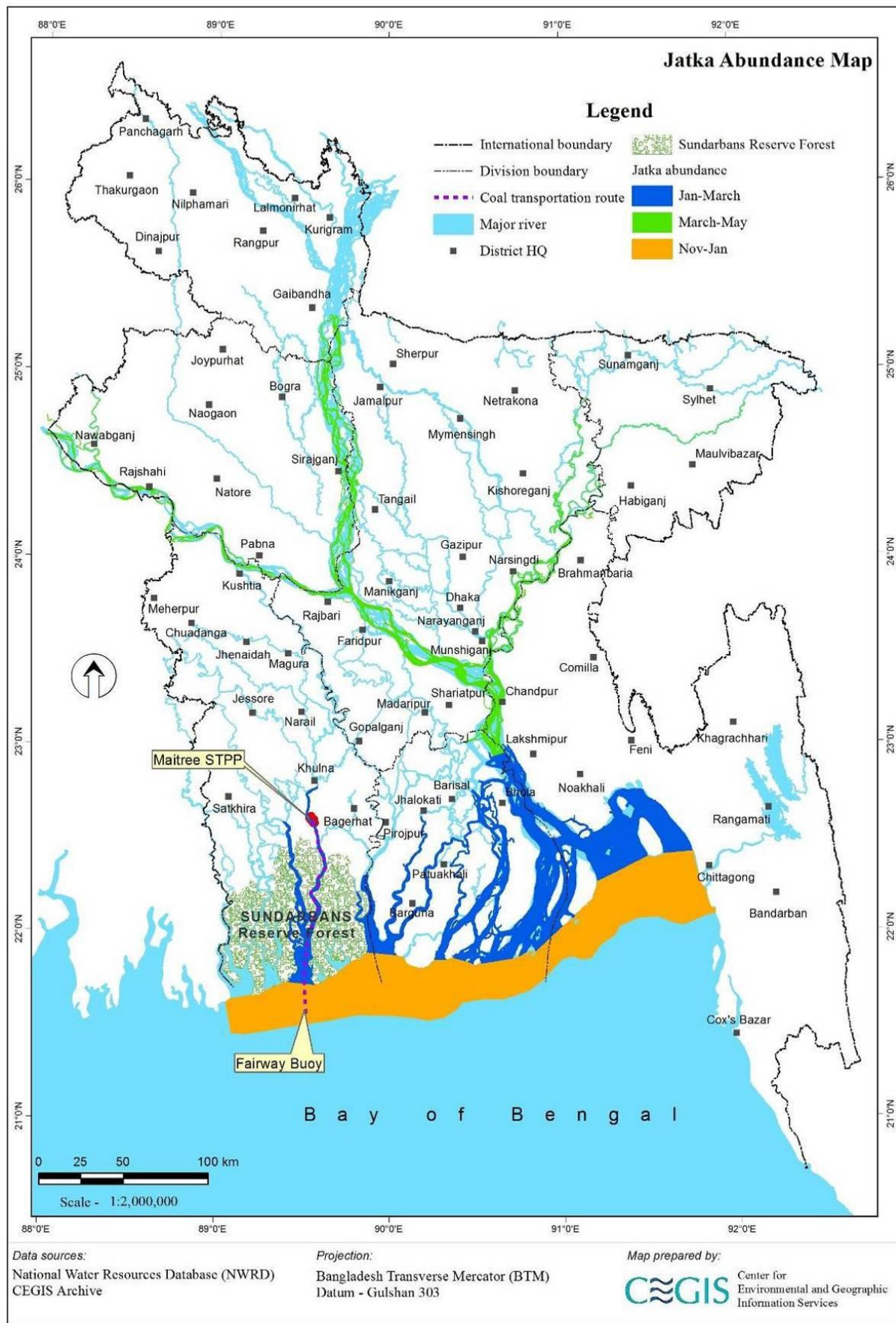


Figure 7-48: Abundance of Jatka fish

7.9.7 Dolphin-Fish Prey Interaction

598. There are two types of dolphins that live along the coal transportation route through the Passur River, e.g., (i) Gangetic dolphin (fresh to brackish water); and (ii) Irrawaddy dolphin (brackish to saline water). The Gangetic dolphins are usually solitary creatures and are essentially blind. They hunt by emitting ultrasonic sounds, which bounce off of fish and other prey, enabling them to “see” an image in their mind to detect food and navigate. Individuals tend to swim with one flipper trailing along the substrate, and will root around with their beak to disturb and detect the shrimp and fish upon which they feed. This dolphin prefers areas of the River where fish are plentiful and the water current is slower.

599. The Ganges River dolphins share the freshwater fringes of their mangrove channel habitat in the Sundarbans with Irrawaddy dolphins (*Orcaella brevirostris*) whose distribution extends farther southwest in the mangrove forest and offshore to the freshwater-affected coastal waters of the Bay of Bengal (Smith et al., 2006).

600. There is plenty of food that the Irrawaddy dolphin feeds upon. They include fish, crustaceans, and cephalopods. During foraging periods, herds of dolphins circle around prey and trap their victim. These prey entrapment occur slightly below the water surface level. Feeding together in groups they can dive for up to 12 minutes to feed on bony fish, crustaceans, cephalopods and fish eggs. Irrawaddy dolphins are known to spit water to herd fish.

7.9.8 Fisheries Management

601. The management history of the Sundarbans mangrove is very old and proven. Mangrove forests of India and Bangladesh have been managed since 1769 and detailed work-plans were prepared during 1893–1894 (Chowdhury & Ahmed 1994). The major objective is to achieve sustainable management of the mangrove in order to yield different important resources including wood, fish, wildlife as well as recreation services and non-wood products (Choudhury 1997). However, mangroves are now degrading rapidly. Forest cover, species diversity and ecosystem function have been declining, even though several forest policies, laws and management plans have been enacted to protect them. The effectiveness of these policies and plans is limited by the poor implementation capacity of the implementing agencies (Iftekhar & Islam 2004). Although, the Forest Department tried to undertake certain conservation planning initiatives such as Environmental Policy, National Conservation Strategy and National Environmental Management Active Plan followed by the implementation of programs on alternate income generating activities (AIGAs) for the dependent populace (FD, 2015) to protect mangrove ecosystems since 1960 to 2001, management strategies based on logical and scientific basis have not been developed till today. Adequate research efforts have not yet been conducted to find out effective management policies (Islam & Wahab 2005).

602. Furthermore, thousands of coastal poor people, including women, are engaged in fishing for wild post larvae (PL) of freshwater prawn (*Macrobrachium rosenbergii*) along the coastline during a few months each year. However, indiscriminate fishing of wild PL, with high levels of by-catch of juvenile fish and crustaceans, may impact negatively on the production and biodiversity in coastal ecosystems. The imposition of restrictions on PL collection has not been firmly enforced because of the limited availability of hatchery-raised larvae, the lack of an alternative livelihood for people involved in PL fishing, and weak enforcement of rules and regulations.

7.9.9 Regulations on Restricted Fishing Areas in the Sundarbans

603. There are over 222 species of fish in the SRF and 120 species are harvested on regular basis. The Fish are also feed for other aquatic animals. The management aspect of fisheries in SRF only covers revenue collection, although some Acts/Regulations exist (**Table 7-37**). The management of fisheries resources in SRF from a technical point of view was started in 1989 with the restriction of fishing in 18 canals in all four ranges to accelerate fish breeding (FAO, 1994). Closed season and wildlife sanctuary regulations were introduced recently. Management measures taken are not used at the present time, which includes control on gear dimension, limit on fishing time, control on fish catch and access limitation. A year round fishing ban has also been imposed on in three wildlife sanctuaries World Heritage Sites, e.g., (i) the Sundarbans West Wildlife Sanctuary (71,500 ha), (ii) the Sundarbans South Wildlife Sanctuary (37,000 ha), and (iii) the Sundarbans East Wildlife Sanctuary (31,000 ha) along with the canals (**Figure 7-49**). In addition, measures for selective fishing and protection of brood areas have been undertaken.

Table 7-37: Existing fisheries management and conservation rules in SRF

Legislation	Summary of regulations	Implementing agencies
Indian Forest Act, 1878	Empowers the Forest Department to manage the inshore and offshore fisheries in the Sundarbans and near shore 20 km marine waters.	Forest Department
Hunting and Fishing Rules, 1959	<ul style="list-style-type: none"> • A fishing permit is required to fish in reserved or protected forests. • Royalty may be levied on fish caught in tidal waters of reserved and protected forests. • It is illegal to use poison, explosives or fixed engine fishing gears, or to dam or bale water in reserve and protected forests. 	Forest Department
Major Fisheries Regulations for SRF	<ul style="list-style-type: none"> • Khal Closure Regulation (1989): closes 18 khals permanently for fishing to ensure natural fish breeding. • Collection and Export of Live Crab Regulation (1995): closes the entire SRF for crab fishing from December to February to ensure crab breeding. • Closed Season Regulation (2000): closes fishing in the entire SRF for five species (P. pangasius, P. canius, L. calcarifer, M. rosenbergii, S. serrata) during 1st May to 30th June to ensure natural breeding. 	Forest Department
Wildlife Sanctuary Regulations, 1999	Fishing is permanently prohibited in the three wildlife sanctuaries of SRF.	Forest Department
Other Regulations for Fisheries in SRF	<ul style="list-style-type: none"> • It is illegal to place nets across a khal and thereby completely block it. • It is illegal to sting a rope transversely across a khal. 	Forest Department

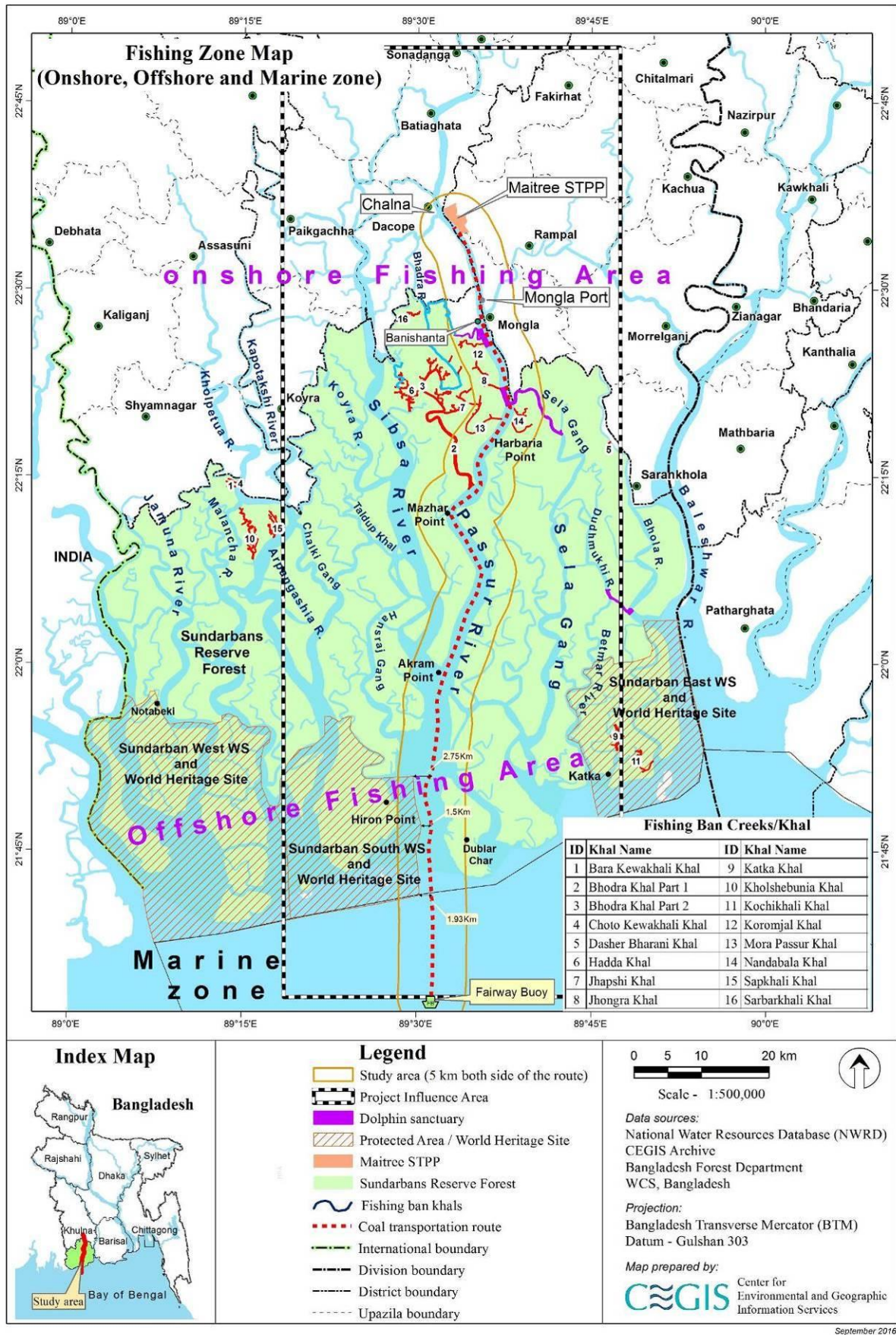


Figure 7-49: Fishing protected areas

7.9.10 Fishing Community

604. Fish in the SMF are harvested by between 110,000 and 291,000 fishermen using approximately 25,000 registered small fishing boats. The fishermen catch fish both in inshore fishing area, which covers an area of 1,874 km², and offshore fishing area (20 km wide marine zone), which covers 1,603 km². A seasonal winter fishery of Dubla Island operates in this zone, consisting of about 30,000 fishermen and associated people. The productivity of the marine zone is better than that of the inshore fishing area. Apart from the obvious structural complexity of this fishing area, the fishing area is strongly influenced by climate: fishing in the offshore area is very hazardous from May to August due to severe weather conditions. Fishermen pass through a hardship period from July (Ashar) to October (Aswin) because of less availability of fish in this period.

7.10 Land and Agriculture Resources

7.10.1 Land Resources

605. Land is the primary input and factor of production, which is not consumed, but without it any production is not possible, which comprises the natural resources e.g. soil, water, minerals and biota. These components are organized in ecosystems which provide a variety of services essential to the maintenance of the integrity of life-support systems and the productive capacity. Land resources are used for a variety of purposes which may include organic agriculture or crop production, reforestation and water resource management. Baseline condition of land resources has been established through collection of secondary data/information from Land Resources Appraisal of Bangladesh for Agricultural Development, Report 2: Agro-ecological Regions of Bangladesh, FAO/UNDP; 1988, BARC; 2012, RapidEye image analysis, 2015 as well as Landsat image 2010 and SOLARIS-SRDI, 2006 software analysis data.

7.10.2 Agro-Ecological Zone (AEZ)

The study area is covered by one AEZ: Ganges Tidal Floodplain (AEZ13) and two sub-regions: A) Non-saline, calcareous and non-calcareous and B) Saline, calcareous and non-calcareous. The first sub-region occupies the major part of the study area, but the second one occurs in minor areas. Agro-ecological zone and sub-regions of the study area is presented in **Figure 7-50**.

Non-Saline, Calcareous and Non-Calcareous Sub-Region

This sub-region occupies the north eastern part of the study area where grey or dark grey, calcareous, silt loams to silty clays occupy river banks and basin margins and grey to dark grey, non-calcareous, heavy silty clays occupy basin centers.

Saline, Calcareous and Non-Calcareous Sub-Region

606. The soil of this sub-region is mainly saline in the dry season. Calcareous silt loams to silty clays occupy river banks and basin margins, and non-calcareous silty clays occupy river basin centers.

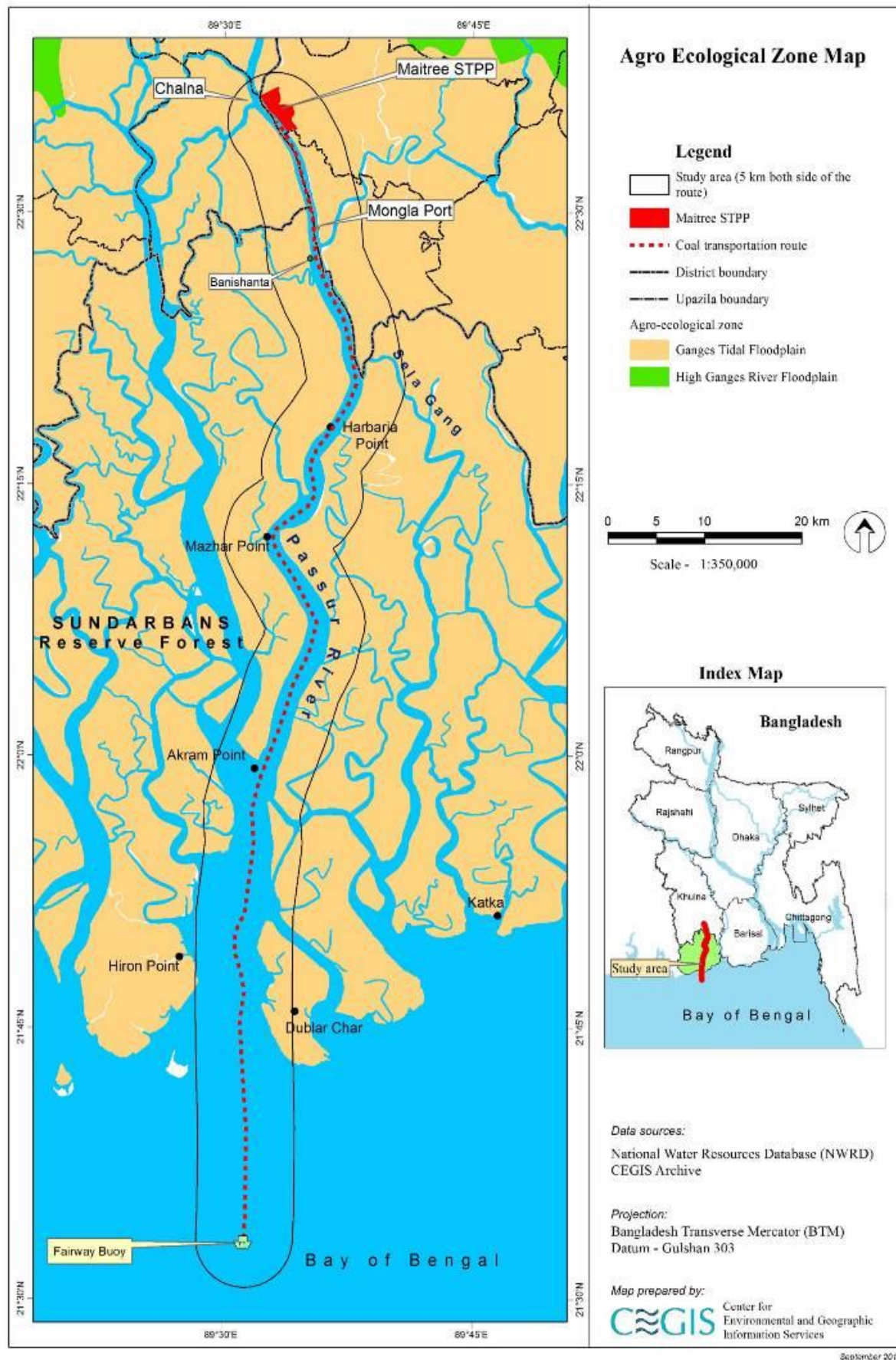


Figure 7-50: Agro-Ecological Zones

7.10.3 Soil Quality

607. The forestland soil is grey in color, finely textured and the subsoil is stratified, compacted at greater depth. At the eastern part of the soil (having good supply of fresh sediments), the top 15 cm soil layer is soft and fertile, whereas in the western part (with little fresh sediments), the soil is a hard mass (Siddiqi, 2001). Na content of soils varies from 5.7 to 29.8 meq/100g, where the lower value is found in the eastern part. Mg varies from 4.1 to 9.9 meq/100g. Chloride is a dominant anion varying from 5.7 to 23.2 meq/100g, and the high concentration is found in the southern and western parts. Potassium content varies from 0.3 to 1.3 meq/100g. The high value of the Na and Mg hampers plant growth. Organic matter ranges between 4% and 10%. Soils are neutral to mildly alkaline (7.01 to 8.0 pH), **Table 7-38**.

608. Soil salinity in the mangroves is regulated by inundations, freshwater discharge, rainfall, soil types, topography, etc. The Bangladesh part of the Sundarbans Mangrove Forests (BSMF) soil salinity is low compared to other mangroves of the world (exceeding that of sea water) (Khan, 1983).

609. Soil samples were collected from five locations namely Sutarkhali, Karamjol, Harbaria, Akram Point and Hiron Point. The Samples were analyzed at the laboratory of Soil Science Discipline, Khulna University, Khulna. The mean bulk density, Soil pH, soil salinity, OC%, N and P contain across the five monitoring sites were given in the following table. The bulk density, pH and P contain of soil across the depth intervals in the five monitoring locations showed a similar figure. The mean bulk density of the monitoring sites was slightly higher than that of the range of bulk density of SRF (1.18- 1.27 g cm⁻³). Lower bulk density indicates that the site have more organic matter. According to this fact the Harbaria site's soil contained more organic matter, less compact, and more porous. Soil salinity was found highest in Akram Point (4.98±0.50 ms cm⁻¹), while this figure was lowest in Sutar Khali (3.07±0.66 ms cm⁻¹). The N concentration was found similar in Karamjol, Harbaria and Akram Point. Lowest N concentration was found at Hiron Point, the most seaward site while moderate N concentration was observed at Sutar Khali site. Organic carbon and nitrogen are in the range of 1.51-3.56 and 0.26-0.73%, respectively

Table 7-38: Soil quality of the Sundarbans Reserve Forest at different locations

Soil depth (cm)	Soil parameters					
	Bulk density (g cm ⁻³)	Soil pH	Soil Salinity ms cm ⁻¹	OC %	N (mg g ⁻¹)	P (mg g ⁻¹)
Sutar Khali						
0-15	1.50±0.08	7.60±0.17	2.64±0.33	1.85±0.33	0.43±0.11	0.53±0.04
15-30	1.56±0.10	7.59±0.33	2.49±0.29	2.70±0.88	0.45±0.20	0.43±0.18
30-50	1.46±0.09	7.83±0.07	3.19±0.84	3.15±1.48	0.51±0.15	0.51±0.03
50-100	1.39±0.21	7.78±0.25	3.94±0.91	2.72±0.90	0.56±0.47	0.51±0.09
0-100	1.48±0.07	7.70±0.13	3.07±0.66	2.60±0.54	0.49±0.06	0.50±0.04
Karamjol						
0-15	1.58±0.17	7.07±0.08	3.29±1.18	2.55±0.02	0.53±0.13	0.53±0.06
15-30	1.60±0.03	7.01±0.19	3.53±0.92	2.65±0.62	0.53±0.08	0.53±0.02
30-50	1.67±0.09	7.16±0.34	4.15±0.43	2.89±0.85	0.59±0.27	0.52±0.02
50-100	1.78±0.35	7.38±0.33	4.56±1.53	3.50±1.07	0.68±0.53	0.51±0.07
0-100	1.66±0.09	7.16±0.16	3.88±0.58	2.90±0.43	0.58±0.07	0.52±0.01
Harbaria						
0-15	1.49±0.13	7.23±0.46	3.04±0.22	3.56±1.78	0.60±0.25	0.51±0.03
15-30	1.45±0.13	7.45±0.45	3.21±1.05	2.40±0.87	0.61±0.59	0.51±0.01

Soil depth (cm)	Soil parameters					
	Bulk density (g cm ⁻³)	Soil pH	Soil Salinity ms cm ⁻¹	OC %	N (mg g ⁻¹)	P (mg g ⁻¹)
30-50	1.40±0.30	7.02±1.00	3.00±0.80	2.69±1.18	0.73±0.29	0.52±0.04
50-100	1.40±0.23	7.20±0.62	3.19±1.95	3.41±0.88	0.47±0.26	0.51±0.01
0-100	1.43±0.04	7.23±0.18	3.11±0.11	3.01±0.56	0.60±0.11	0.51±0.00
Akram Point						
0-15	1.45±0.08	7.52±0.23	5.42±1.93	2.88±0.35	0.52±0.47	0.49±0.03
15-30	1.76±0.20	7.53±0.18	4.34±1.55	2.41±0.91	0.59±0.24	0.50±0.04
30-50	1.36±0.21	7.47±0.33	5.33±1.92	3.01±1.54	0.68±0.42	0.46±0.15
50-100	1.61±0.14	7.49±0.32	4.81±1.31	2.48±1.02	0.59±0.31	0.51±0.05
0-100	1.55±0.18	7.50±0.03	4.98±0.50	2.69±0.30	0.59±0.06	0.49±0.02
Hiron Point						
0-15	1.72±0.23	7.49±0.32	2.98±2.42	1.51±1.17	0.39±0.55	0.83±0.42
15-30	1.59±0.32	7.11±0.30	3.61±0.68	1.84±0.33	0.26±0.17	0.63±0.12
30-50	1.70±0.06	7.33±0.37	4.40±0.63	2.03±0.58	0.43±0.12	0.53±0.04
50-100	1.75±0.05	7.48±0.35	3.40±1.18	1.88±0.35	0.42±0.20	0.51±0.07
0-100	1.69±0.07	7.36±0.18	3.60±0.60	1.82±0.22	0.37±0.08	0.63±0.15

Source: Rampal Power plant monitoring report; June 2015-August 2015

7.10.4 Agriculture Resources

610. The gross study area is 320,499 acre of which 18,107 acre are being used for agriculture. The percentage of net cultivable area is 5.65% of the total gross area.

7.10.5 Farming practices

611. There are two distinct cropping seasons in a year. They are the Kharif and the Rabi seasons. The Kharif season starts from March and ends in October while the Rabi season starts from November and ends in February. Based on crop adaptability and crop culture, the Kharif season has been further sub-divided into Kharif-I (March-June) and Kharif-II (July-October) season.

612. The Kharif-I is characterized by high temperature, low humidity, high evaporation, high solar radiation and uncertainty of rainfall of low alternating dry and wet spells. In this season, mainly HYV Aus, Sesame, Pulses and Vegetables are grown. The Kharif-II season is characterized by high rainfalls, lower temperatures, high humidity, low solar radiation and high floods that recede towards the end of the season. Rice is the predominant crop grown during this season due to the submergence of soil. Excessive soil moisture also restricts other crops suitable for a high temperature regime. High Yielding Varieties of transplanted Aman and Lt. Aman (HYV Aman and Lt. Aman) rice and vegetables are grown in Kharif-II season in the study area. The Rabi/Boro season are favored with high solar radiation, low humidity and temperature, but lack of adequate soil moisture depresses the crop yield because of very low or evens no rainfall throughout the season. Wide ranges of crops can be grown in this season. HYV Boro, Vegetables, Pulses, Watermelon are being practiced in this season. However, there are occasional overlaps such that the Kharif-I season crops (HYV Aus, Sesame, Pulses and Vegetables) are harvested in Kharif-II season, the Kharif-II season crops (Aman and Vegetables) are harvested in Rabi season and Rabi season crops (HYV Boro, Pulses, Vegetables and Water melon) are harvested in Kharif-I season. Farmers of the study area cultured fish during Kharif-I and Kharif-II season.

7.10.6 Existing Cropping Pattern and intensity

613. In the study area, major cropping pattern is Fallow- Lt. Aman-Fallow which covers about 48.1% of the NCA. Detailed cropping patterns are shown in **Table 7-39**.

Table 7-39: Existing major cropping pattern in the study area

Kharif-I (March-June)	Kharif-II (July-October)	Rabi (November-February)	Study area(acre)	
			Area (acre)	% NCA
Fallow	Lt. Aman	Fallow	8,709	48.1
Fish	Lt. Aman	HYV Boro	235	1.3
Fish	Fish	HYV Boro	181	1
Vegetables	Fallow	Vegetables	1,086	6
Vegetables	Vegetables	Vegetables	598	3.3
Fallow	Lt. Aman	Water melon	1,050	5.8
HYV Aus	Lt. Aman	Water melon	561	3.1
Fallow	Lt. Aman	Pulses	380	2.1
Sesame	Lt. Aman	Fallow	398	2.2
HYV Aus	Lt. Aman	Fallow	1,086	6
Fallow	HYV Aman	Pulses	453	2.5
Fallow	HYV Aman	HYV Boro	561	3.1
Fallow	HYV Aman	Fallow	1,267	7
Pulses	HYV Aman	Fallow	181	1
Fallow	HYV Aman	Vegetables	235	1.3
Vegetables	HYV Aman	Pulses	199	1.1
Fallow	Lt. Aman	HYV Boro	923	5.1
		Total	18,107	100
Cropping Intensity (%)			151	

Source: DAE and Field survey, 2016

614. The single, double and triple cropped area is about 56%, 36% and 8% of the NCA respectively. The cropping intensity of the study area is about 151%, which is much below the national average of 191%.

7.10.7 Crop Production

615. In the study area, major agricultural production is coming from the non- rice crops. The total annual rice production stands at 16,995 tons. Among the rice crops, HYV Aus, Lt. Aman, HYV Aman and HYV Boro is contributing 10%, 55%, 19% and 17% respectively of the total rice production. A significant agriculture production is also coming from non-rice crops especially in the Polder areas of Decope Upazila. The non-rice crops are Water melon (33,842 tons), summer vegetables (20,838 tons), winter vegetables (18,426 tons), Sesame (971 tons) and Pulses (378 tons) respectively. Detail crop production of the study area is presented in **Table 7-40**.

Table 7-40: Cropped area and production of the study area

Crop name	Area (acre)	Yield (ton/acre)	Production (tons)	% of production contribution
HYV Aus	1,648	0.98*	1,615	10
Lt. Aman	13,345	0.7*	9,341	55
HYV Aman	2,897	1.1*	3,187	19
HYV Boro	1,901	1.5*	2,852	17
Total rice	19,791	0	16,995	100

Crop name	Area (acre)	Yield (ton/acre)	Production (tons)	% of production contribution
Water melon	1,612	17	27,396	40
Summer vegetables	2,481	8.4	20,838	31
Winter vegetables	1,919	9.6	18,426	27
Pulses	1,213	0.8	971	1
Sesame	398	0.95	378	1
Total non-rice	7,623	0	68,008	100
Total	27,414	0	85,003	0

Source: Estimation from field information; 2016 *Cleaned rice



Photo 6.7: View of Local Aman rice field in the study area



Photo 6.8: View of HYV Aman rice field in the study area

7.10.8 Agricultural Input Use

Seed and Labour

616. The agriculture inputs include seed, labour, fertilizer, pesticides, etc. The following **Table 7-41** attributes the agriculture input pattern of the area.

Table 7-41: Seeds, Labour, Fertilizer and Pesticides used in the study Area

Name of Crops	Seed used (kg/acre)	Labour (No./acre)	Fertilizer used (Kg/acre)			Pesticides		
			Urea	TSP	MP	No. Application	Liquid (ml/ acre)	Granular (kg/ acre)
HYV Aus	14.0	70	75	30	10	1-2	200	0.80
Lt. Aman	16.0	60	50	20	5	1-2	150	0.80
HYV Aman	14.0	70	75	30	10	1-2	200	0.80
HYV Boro	14.0	80	100	50	25	1-2	400	1.20
Summer vegetables	2.0	80	140	60	20	2-3	500	-
Winter vegetables	1.0	75	150	60	25	2-3	500	-
Water Melon	0.2	60	180	50	50	2-3	500	-
Pulses	20.0	50	60	-	-	-	-	--
Sesame	10.0	40	50	-	-	-	-	-

Sources: Based on field survey and DAE; 2016

7.11 Socio-Economic Environment

617. This section describes the baseline condition of social and economic resources of the study area. A number of socio-economic indicators were analyzed based on the available data. Analysis is done on administrative units for the land part and some analysis is also done for the forest part which belongs to the study area boundary of 5 km on either sides of the coal transportation route.

7.11.1 Administrative Bounding

618. The study area spreads over a number of administrative units, such as Mongla and Rampal upazilas of Bagerhat district, and Batiaghata, Dacope and Koyra upazilas of Khulna district. There are 20 unions and 2 paurashavas in the mentioned 6 upazilas. The coverage of the unions in percentages by upazila is stated in the **Table 7-42**.

Table 7-41: Locations of the study area along with coverage of unions

Districts	Upazilas	Name of Unions	Area Covered (%)
Bagerhat	Mongla	Chandpai Range	11.5
		Burirdanga	94.2
		Chandpi	34.3
		Chila	98.3
		Mongla Port Paurashava	99.1
	Rampal	Rajnagar	87.3
		The Sundarbans	5.5
		Suniltala	5.0
		Gaurambha	27.0
		Hurka	58.1
		Rampal	2.2
Khulna	Batiaghata	Bhanderkote	2.5
		Gangarampur	6.4
	Dacope	Bajua	99.7
		Banishanta	100.0
		Chalna Paurashava	72.7
		Dacope	20.2
		Kailasganj	14.5
		Khulna Range	20.6
		Laudubi	99.7
	Dacope	Pankhali	18.7
	Koyra	Nalian Range	5.5

Source: NWRD of WARPO processed by CEGIS, 2016

7.11.2 Basic Demography

Population and Household

619. It needs to be mentioned here that reliable household and population information of two unions namely Chandpai Range and Khulna Range were not available. As such the demographic information of Chandpai Range and Khulna Range unions are not mentioned in the following table (**Table 7-43**). These two unions are recognized as forest areas. Excluding the demographic information of these two unions there are 8,626 households having a total of 36,104 people in the study area which includes 18,409 (51%) males and 17,698 females (49%) in 2016. These demographic figures for 2016 are estimated based on a population growth rate of 1.37 (BBS, 2011). The household size of the study area is 4.2.

The average male-female ratio¹¹ is 104 i.e. there are 104 males per 100 females in the study area which is higher than the national figure of 100.3 (BBS, 2011). The density of population on average is 1015 persons per square kilometer which is equivalent to the national population density rate (1015).

Table 7-42: Demographic scenario of the study area

Union	Total Households	Population			Sex Ratio	Population density [sq. km]
		Total	Male	Female		
Chandpai	517	2148	1067	1082	99	1024
Chila	532	2551	1472	1079	136	1097
Mongla Port Paurashava	1086	4846	2628	2218	119	-
Rajnagar	318	1300	662	639	104	1011
The Sundarbans	520	2048	1016	1032	98	973
Suniltala	297	1074	522	552	95	895
Gaurambha	554	2286	1145	1141	100	1020
Hurka	195	764	391	373	105	967
Rampal	717	2953	1480	1473	100	1017
Bhanderkote	482	1926	960	967	99	987
Gangarampur	566	2210	1095	1115	98	965
Bajua	435	1916	962	954	101	1085
Banishanta	413	1777	887	890	100	1061
Chalna Paurashava	420	1726	859	866	99	-
Dacope	222	857	430	427	101	954
Kailasganj	419	1766	873	893	98	1039
Laudubi	248	1122	556	566	98	1116
Nalian Range	200	809	410	400	103	-
Pankhali	454	1894	929	965	96	1030
Burirdanga	31	131	65	66	99	-
Total	8626	36104	18409	17698	104	1015

Source: Population Census 2011, BBS and CEGIS estimation, 2016

620. The inhabitants of the study area belong to three main religious groups; i.e. Muslim (about 58%), Hindu (about 38%) and Christian (about 4%). There are no ethnic minorities within the study area of the coal transportation route.

Age Structure

621. Age groups of 0-14 years is defined as children, 15-24 years as early working age, 25-54 years as prime working age, 55-64 years as matured working age and 65 years and over as elderly people (source: World Fact Book, CIA12). This classification is important as the size of young population (under age 15) would need more investment in schools, while size of older populations (ages 65 and over) would need for more investment in health sector. In the study area the highest number of population (30%) belongs to the age category of 30 to 49 years old and about 26% of total population are children (age ranges up to 14 years). Only 3.2% people are in 60 to 64 years category.

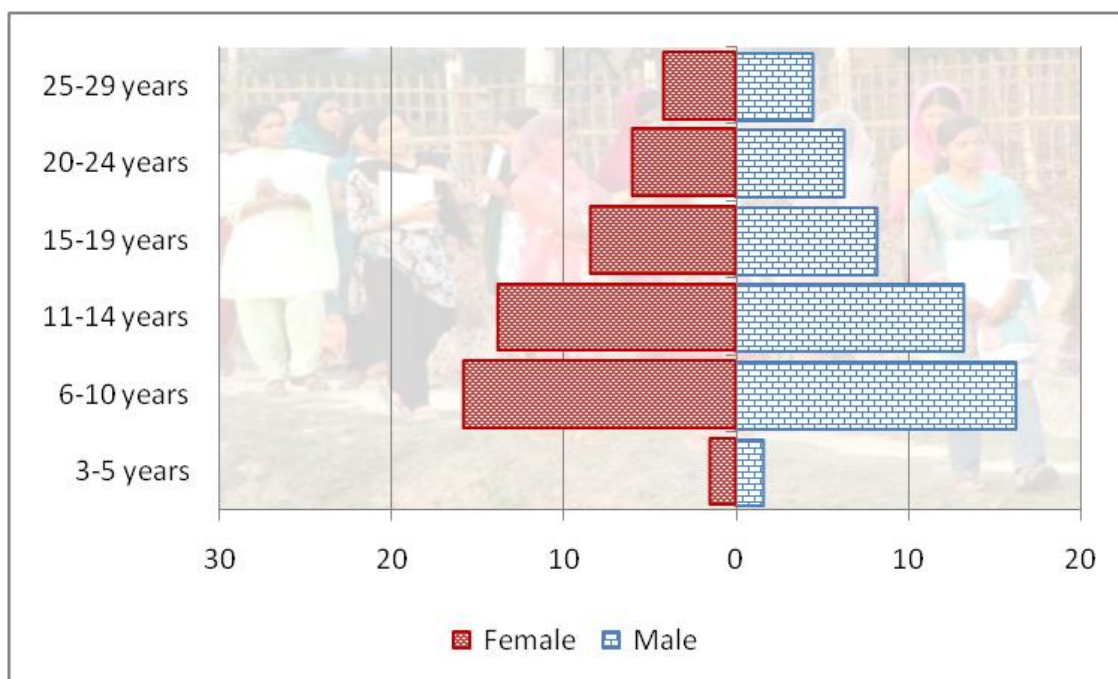
622. Population of 15 to 64 years category is considered as labour force whereas, populations below 14 years and above 65 years are considered as dependent.

¹¹Number of males per 100 females in a population, using the formula: Sex Ratio SR = M x 100 / F

¹² Retrieved on 30/06/2015 from <https://www.cia.gov/library/publications/the-world-factbook/docs/notesanddefs.html>

Education

623. School attendance is a major indicator to measure the current and future status of a society. According to BBS 2011, School attendance rate is measured from 3 years to 29 years by six clusters of age groups. 3 to 5 years is defined as pre-school attendance, 6 to 10 as primary, 11 to 19 years as secondary and higher secondary and finally 20 to 29 years as higher as well as advanced level attendance at educational institutions. Comparative scenario of attending and not attending rate shows that net attendance rate is the highest (16.28%) at Primary education (6-10 years) level than the rate starts reducing gradually, **Figure 7-51.**



Source: Housing and Population Census, BBS, 2011

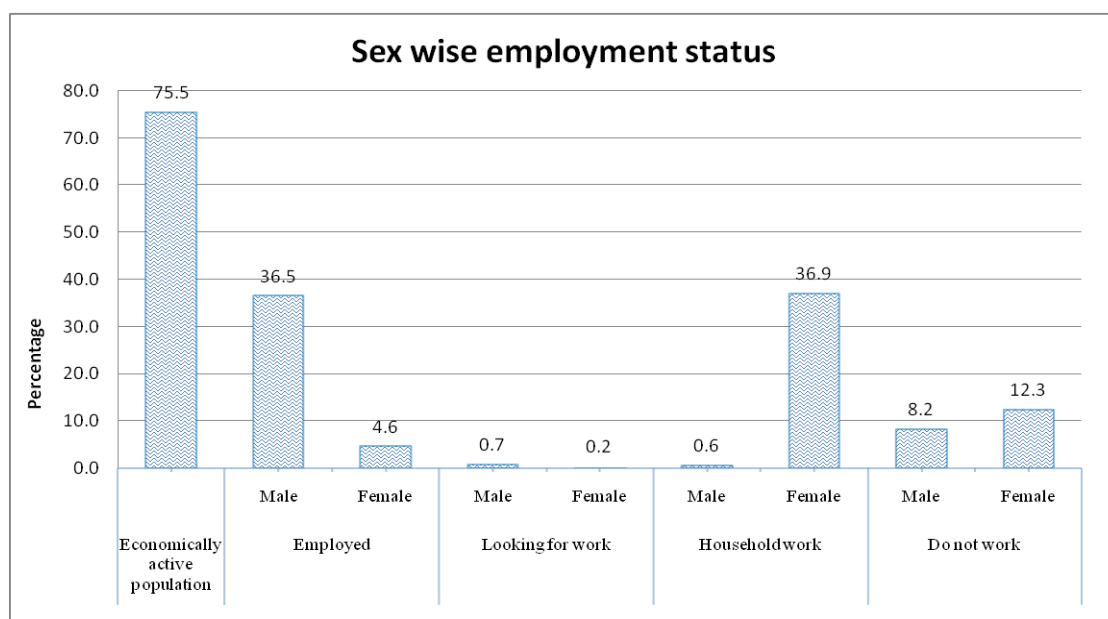
Figure 7-51: Comparative pyramids of male-female school attendance

Status of Education

624. The average literacy rate in the study area, based on a definition of “ability to write a letter in any language” is 56.2%, where for males is 59.7% and female 51.4%. The rate of literacy reported above is for population of 7 years and above. Data confirms that like the national picture of Bangladesh (Male 54.1% and Female 49.4% and both 52.0%), in the study area the male populations are more educated than their female counterparts.

7.11.3 Occupation and Livelihood

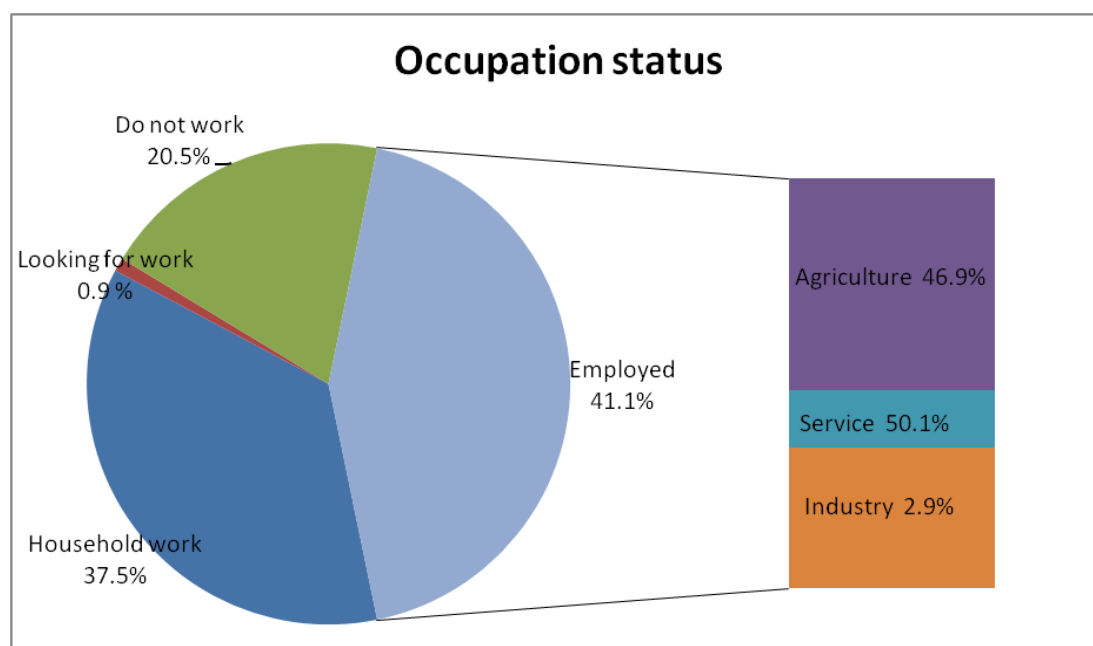
625. About 75.5% of the populations is economically active, where about 41% are employed, about 1.0% are looking for work, and about 58% are engaged in household work. The economically active population includes those who are aged 7 and over and not attending school at reference period of Housing and Population Census, 2011. The occupational status of the area is given in **Figure 7-52.**



Source: Housing and Population Census, BBS, 2011

Figure 7-52: Employment status of the study area

626. Distributing employed population (41.1%) at reference period of census, it is found that 46.9% are engaged in agricultural activities, 2.9% in industry and 50.1% in service (Figure 7-53).



Source: Housing and Population Census, BBS, 2011

Figure 7-53: Occupation status among the studied population

Livelihood Options

627. The populace in and around the Sundarbans are engaged in primary occupations like agriculture, daily labor, fishing, forest related work, petty trade, salaried employment, cash for work, handicrafts (cotton garments, pottery, etc.) shrimp or fish processing, work on

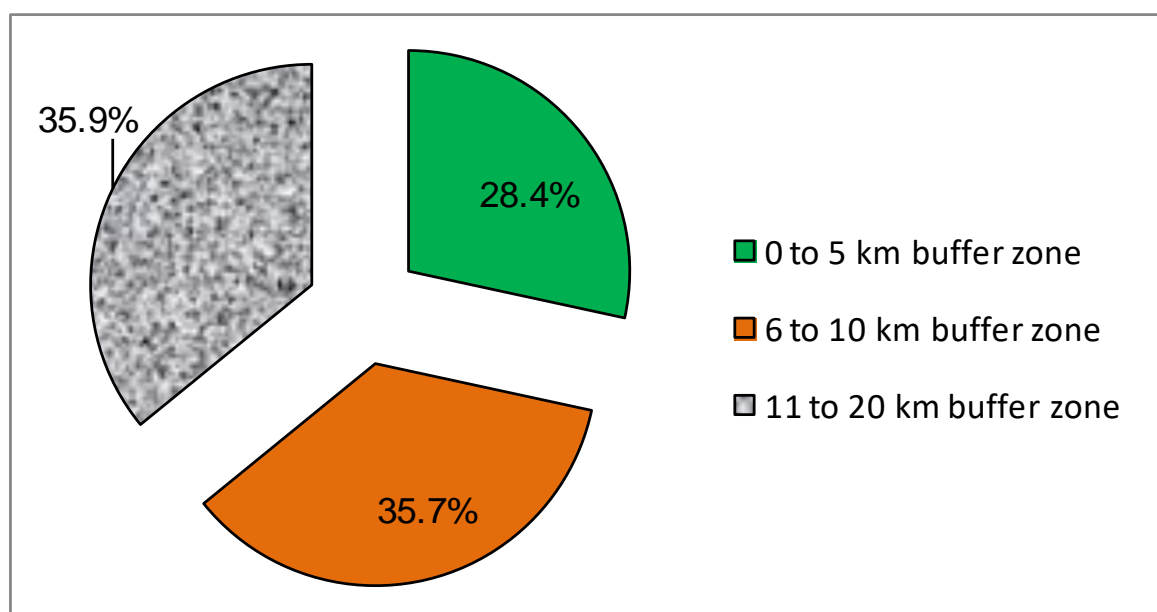
canoes boats and barges, household help and other manual services. The spatial distribution of primary occupation varied due to the difference in proximity from the SRF. **Table 7-44** illustrates the percentage of households by spatial stratum.

Table 7-44: Spatial distribution of primary occupation in different buffer areas

Occupation	Different Strata of the Sundarbans		
	0-5 km	6-10 km	11-20 km
	% of HHs	% of HHs	% of HHs
Cultivation on own or leased land	17.10	34.10	48.80
Agricultural labor in other people's land	30.20	33.00	36.80
Fishing	57.10	27.80	15.20
Forest related work	73.80	15.50	10.70
Traders or vendors	24.40	35.70	39.90
Salaried employment	19.40	41.00	39.60
NREGS or cash for work	26.80	37.00	36.20
Handicrafts like cotton garments, pottery, etc.	22.90	45.80	31.30
Shrimp or fish processing	35.10	43.20	21.60
Work on canoes, boats and barges	38.90	27.80	33.30
Household help and other manual services	30.10	34.30	35.60
Other	23.20	40.90	35.80

Source: Households Survey, BCAS.

628. The largest percentage (35.90%) of households, without any secondary occupation is living in the 11 to 20 km buffer zone while the lowest percentage (28.40%) is living in the 0 to 5 km buffer zone (**Figure 7-54**).



Source: Households Survey 2011, BCAS.

Figure 7-54: Spatial distribution of households without any secondary occupation

Livelihood Groups Dependent on the Sundarbans

629. According to the Forest Department in 2016, around 10 lakh people were directly and indirectly dependent on the Sundarbans for their livelihood. Of that figure, the number of fishermen is more than 70 thousand.

630. There are 10 livelihood groups in the Sundarbans which are: Bawali (wood cutter), Nypa collectors (Golpata used as roof materials), Mawali (honey and bee wax collector), Jele (Fisher), Majhi (Boatman), Crab collector, Medicinal plant collector, Shrimp fry collector, Chunery (oyster and snail collector). Activities of Bawali are December to March (for timber) and Mid November to mid-March (for Nypa palm, grass, reed); Mawali in March to June (for honey, bee wax) and Jele are year round (for fish, prawn fry, oyster, snail, crab).

631. About 25,00,000 people live in the villages around the Sundarbans; about 3,00,000 people depend directly on the forest. Up to 50,000 people per day enter into the forest to cut timber, collect honey and catch shrimp larvae. Migratory fishermen also enter the forest to stay temporarily there during the dry season. About 14% numbering 2, 25,000 of the people both male and female of all ages live inside 10 km from the periphery of the Sundarbans participate in shrimp fry collection. The secondary traders also numbers about 20,000. The number of hilsa fishermen and people involved in fish drying is also very high however; these people are migratory and come from outside the Sundarbans (IPAC, 2010).

7.11.4 Labour Market

632. The maximum wage rate in the study area for male farming labor is Tk. 400 whereas the lowest was found to be Tk. 300. The farming labors are mostly engaged in crop cultivation and salt farming. On the other hand, female farming labors are mostly engaged in earthwork. The maximum wage rate of female is 300 taka. And minimum wage rate is 200 taka.

7.11.5 Public Health and Piracy

633. Access to health services and facilities refers to the availability and adequacy of supply, affordability, physical accessibility and socio-cultural acceptability. There are Union Sub-Centers, Community Clinics, Private Clinics, NGO Clinics etc in the study area. In addition to this, they receive peripheral health services from Khulna medical college at Khulna District, Bagherhat District Hospital.

634. According to Upazila Health Bulletin 2015, most of the people of the study area receive health services from Upazila Health Complex, **Table 7-45**.

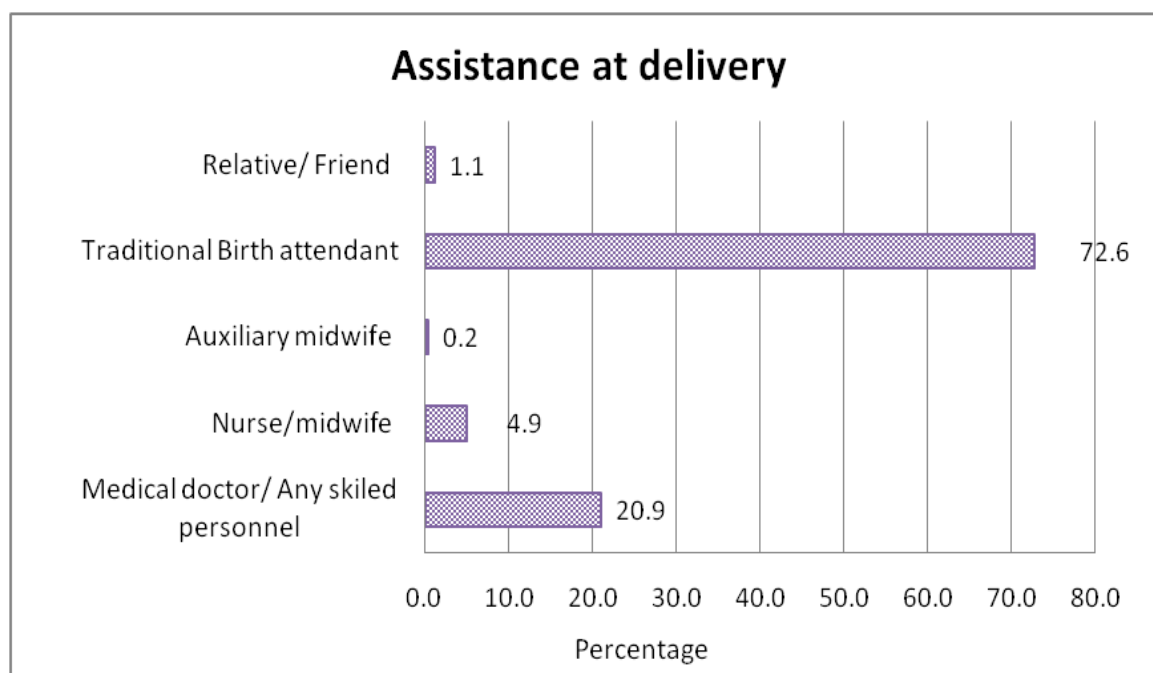
Table 7-45: Receive health facilities of OPD and Emergency at health complexes

Health Complexes	OPD		Emergency	
	Below 5 Yr	Above 5 Yr	Below 5 Yr	Above 5 Yr
Upazila Health Complex	21.1	4.2	1.3	0.2
Union Sub-Centres	5.6	0.6	0	0
Union Health and Family Welfare centre (belongs to DGFP)	6.4	2.8	0	0
Community Clinics	42.8	9.7	0	0
Private Clinics/Facilities	0.9	0.4	0.2	0
NGO Clinics/Facilities	3.4	0.4	0.1	0

Source: Upazila Health Bulletin 2015 and CEGIS Assess

Child and Mothers' Health

635. The average Infant mortality rate (IMR¹³) of the area is 16.53. On the other hand, Under Five Years Child Mortality Rate (U5MR¹⁴) is 19.95 on an average. In addition, Maternal Mortality Ratio (MMR¹⁵) is 198.6 where the National average is 197 (Source: Maternal Mortality and Health Care Survey 2010) that indicates the number of death of infants under five years old per 100,000 live births. **Figure 7-55** shows the status of the women getting birth assistance during delivery.



Source: Progotir Pathay, MICS, 2009 and Upazila Health Bulletin 2015

Figure 7-55: Percentage of women getting birth assistance during delivery

Prevalence of Diseases

636. The major common diseases of the area are waterborne diseases, coldness, common fever, respiratory and skin diseases. The health profile of the local people is presented in **Table 7-46**.

Table 7-46: Common diseases in the study area

Disease	Ranking by incidence of diseases in the study area*	Disease	Ranking by incidence of diseases in the study area*
Gastric	3	Diabetes	6
Rheumatic fever	5	Common fever	1
Hypertension	4	Skin disease (eczema)	8
Asthma	10	Diarrhea	7
Heart diseases	9	Cough/cold	2

*Source: CEGIS fieldwork, 2016

¹³ Infant mortality rate (IMR) per 1000 live births

¹⁴ Under-five mortality rate (U5MR) per 1000 live births

¹⁵ Mother mortality rate (MMR) per 100000 live births

Knowledge about HIV/AIDs

637. One of the most important prerequisites for reducing the rate of HIV infection is accurate knowledge of how HIV is transmitted and strategies to prevent its transmission. Misconceptions about HIV are common and can confuse young people and hinder prevention efforts. A key indicator used to measure country responses to the HIV and AIDS epidemic is the proportion of young people aged 15-24 who know two methods of preventing HIV infection (MICS 2009, BBS & UNICEF). Comprehensive knowledge of HIV and AIDS among young women of the area is given in **Table 7-47**.

Table 7-47: Comprehensive knowledge of HIV and AIDS among young women

District	Upazila	Percentage of women aged 15-24 years who have comprehensive knowledge of HIV and AIDS					
		Knows 2 ways to prevent HIV transmission		Correctly identify 3 misconceptions about HIV transmission		Have comprehensive knowledge (identify 2 prevention methods and 3 misconceptions)	
		2009	2006	2009	2006	2009	2006
Bagerhat	Mongla	57.90	N/A	25.60	N/A	17.60	N/A
	Morrelganj	66.90	N/A	36.90	N/A	30.20	N/A
	Rampal	40.70	N/A	66.00	N/A	27.30	N/A
	Sarankhola	29.80	N/A	22.20	N/A	5.30	N/A
	Total	52.90	49.00	38.80	22.00	25.40	16.90
Khulna	Paikgachha	54.70	N/A	24.50	N/A	21.00	N/A
	Dacope	48.90	N/A	25.00	N/A	15.70	N/A
	Koyra	37.40	N/A	29.20	N/A	19.50	N/A
	Total	43.50	53.00	34.50	20.80	22.70	17.00
National		35.30	37.30	23.70	16.40	14.60	12.20

Source: Multiple Indicator Cluster Survey, 2009 & 2006, BBS & UNICEF. *The upazila-wise data for the year 2006 was not available.

Semen Haven

638. There is a Semen Haven at Banishanta nearby Mongla Upazila of Bagerhat which is generally explored by the vessel crews and local people. There is a risk of sexually transmitted diseases like HIV/AIDS, Gonorrhea, etc. To prevent the spread of HIV/AIDS, it is necessary to supply condoms as one of the contraceptives or protection from sexual diseases to sex workers and other groups at risk so that they could save themselves from the risk of HIV/AIDS. As the part of the prevention program Bangladesh Association for Sustainable Development (BASD) provided treatment support to STD patients in these areas. Skill development training along with rehabilitation to sex workers and their boys and girls is another component of this HIV/AIDS awareness and prevention program. (<http://www.basdbd.org/>).

Piracy at/near the Bay of Bengal

639. The piracy problem at and near the Bay of Bengal is really alarming. Areas around Mongla Port areas have now become a golden heaven for pirates. About 7 such incidents recorded in 2001 at Mongla Port area. In Bangladesh, the pirate attacks are mainly observed at berthed ships and anchored ships. Under the cover of darkness between 0000 to 0500hrs, the pirates attack the ships. Normally, they hide themselves as fishermen at a low profile watercraft, near the targeted ship and wait for the opportunity. Once the opportunity arrives, they attack the ship with knives, swords. Sometimes they take the advantage of low tide, when they can disappear quickly with high speed current of low water. Except a few

examples, the piracy attacks in Bangladesh can be treated as a category of Low Level Armed Robbery (LLAR), where in most cases they try to act as thieves to steal the mooring ropes, paints, wires, cargoes etc or any other loose gears available on or near the deck.

640. On 15 March 2002, a bulk carrier anchored in the Pusur River suffered two attacks. At 7:55 that morning, armed pirates stole a wire rope. Slightly over an hour later, three armed robbers boarded from a small boat by means of the anchor chain and tried to steal mooring lines. On 22 August 2003, an LPG carrier was obstructed in its passage of the Pusur River by ten men in small fishing boats who attempted to board, even after the master increased the ship's speed. On 3 March 2003, passengers aboard a salt-laden trawler on the Chittagong–Khulna route were assaulted by a gang that stole salt, fuel, and cash. In response to this threat, the government launched Operation GOLDEN TIGER on 12 July 2003 for combating the situation. In July 2003, five fishing trawlers were “suddenly attacked by the pirates near Narikelbaria of Pathergata upazila of the district. During 2007, the number of robberies continued, and the percentage of kidnap-for- ransom attacks appeared to increase. On 8, 11, and 12 July 2007, “pirates looted fishing nets and fish worth over Tk 5 million from twenty-eight trawlers and kidnapped over a hundred fishermen for ransom. The government of Bangladesh should consider the maritime issue as an important aspect of national security and economic prosperity.

7.11.6 Standard of Living

641. The standard of living indicates the level of wealth, comfort, material goods and necessities available to the studied population. The overall housing condition¹⁶ is not satisfactory. The statistics shows that the majority of houses are kutcha houses (81.4%) followed by semi-pukka household is 8.6%, jhupri 5.5% and pukka 4.7%. The electricity coverage is poor, which is about 31%. About 25% of households are now using solar electricity. Sanitation¹⁷ studies show that about 80% of households use sanitary latrines followed by about 33% use non water-sealed sanitary latrines and about 13% of households use non-sanitary latrines. Water is an inevitable part and parcel of every human as well as other species.

642. According to BBS, 2011 about 38 percent of households use tube wells while about 60% of households use other sources like pond and rain water for drinking water.

¹⁶BBS distinguishes housing structures into four classes such as- i) **Jhupri**: House, which consist mud walls of 1.5 to 3.0 ft thickness, which carry the roof load. Earthen floor, thatch or CI sheets are used as roofing materials. . There is no monolithic joint between the wall and the roof. ii) **Kutcha**: Walls: Organic materials like jute stick, catkin grass, straw, and bamboo mats. Split are bamboo framing. In some areas wall are made by earth. Foundation: Earthen plinth with bamboo or timber posts. Roof: Thatch-rice or wheat or maize straw, and catkin grass, with split bamboo framing; iii) **Semi-pukka**: Walls: Bamboo mats, CI sheet, Timber or bamboo framing. In some areas wall are made by earth, sometimes part or full brick. Foundation: Earthen plinth; Brick perimeter wall with earth infill; Brick and concrete also use. Roof: CI sheet with timber or bamboo framing; and iv) **Pukka**: House which is made by fully concrete, cement, and iron

¹⁷BBS defined four types sanitation in Bangladesh such as (i) **Sanitary (water-sealed)**: A water-sealed latrine is simply a pit latrine that has a water barrier to prevent odors. These latrines are simply pits dug in the ground in which human waste is deposited. (ii) **Sanitary (not water-sealed/ring slab)**: latrine with a slab or other secure cover over the drop hole, or a polyethylene flap preventing in-sects from flying into or coming out of the pit; (iii) **Non-sanitary (Kucha)**: latrine is a frame or platform extending over earth or water; an “open pit latrine” does not have a squat platform or slab on the pit and (iv) **No facilities**: Defecation in bushes or fields or other outdoor locations.

7.11.7 Poverty

643. Analyzing the poverty status, it is found that about 28% households are multidimensional poor (index value 0.37 out of 1= MPI). About 43% of the population lives in these poor households [poverty head count =H] and on average 85% poor people are deprived of any indicator (intensity of deprivation=A).

644. The highest deprivation is found in the dimension of standard of living (61.7%). Among them 21% population has no access to improved sanitation facilities, 86% people are living on dirt floored households (considering kutchra and jhupri), 90% of people are using dirt fuel (considering all types of traditional fuel), 69% households have no grid electricity coverage and 60% households are still collecting drinking water from unsafe sources (ponds, river etc.)

645. The second highest deprivation (34.53%) is found in the dimension of education. Considering two dimensions it is found that 43% household members have not completed at least Six years of schooling, and 30% school-age children (up to grade 6) are not attending school.

646. In case of the dimension of health, it has an indicator (child mortality), as nutrition data is not available. It contributes 3.78% in overall poverty as 4% children found to be dead per 1000 live births child in the households within the five years prior to the survey (considering both IMR and U5MR). The indicators and the threshold for defining poverty and methodology Multidimensional Poverty Index in **Annex 7-8**.

7.11.8 Gender and Women

647. Field observations suggests that the study area is male dominated. Role of women in both decisions making at the household level and economic contribution to household income are insignificant. Traditional belief is very strong in the area, which infers generally males make all major household decision and at the same time, they contribute to household income more than females. Very few women work as day labour but in that case wage discrimination is very common where male labor get 400 to 300 and women labors get 180 to 120 taka.

648. The mortality rate of pregnant mothers during the delivery period has been reduced in the area to 185.9/100,000. About 15 percent of women are living with a good health condition and the rest are suffering from various diseases such as low blood pressure and premature delivery (CEGIS fieldwork, 2016). Statistics shows the male literacy rate is higher than the female rate. However, the literacy rate for both male and females are increasing.

8 Hazard and Risk Identification and Management

8.1 Introduction

649. Those that can cause harm or have the potential to cause harm are considered as **Hazard**; whereas, **Risk** is the likelihood of hazard to occur and its severity. Thus, a risk assessment is conducted, to carefully examine the potential hazards, how they occur and the measures to prevent such hazards. Mismanagement of one particular hazard can have consequences that simultaneously impact to a varying degree on several risk types.

650. In this EIA report, assessment has been carried out to identify and mitigate the potential hazard associated with coal transportation to the Maitree Power Plant through the Passur River; so that those potential hazards can be avoided or mitigated.

651. This chapter describes and assesses the unplanned events that could potentially cause risks to workers and public safety as well as harm to the natural environment.

8.2 Hazard Assessment Process

652. Potential hazards from the project activities are identified and discussed in detail along with risk assessment. An inclusive safety management plan has also been developed accordingly. The steps followed in assessing the hazards and risks are listed below:

1. Identification of Hazards
2. Analysis of Causes
3. Assessment of Likelihood
4. Identification of Existing Safeguards
5. Risk Ranking for Prioritization of Corrective Actions
6. Recommended Actions and Safety Measures

8.3 Identification of Hazards

653. Many factors are associated with the anticipated accidental events of coal transportation, e.g., stability, hull strength, operating practices, adequacy of weather tight closures, hatch cover strength, coal flaming, possible grounding, vessel design, loading practices, vessel collision, and weather condition. Different kinds of disruptions and threats to coal transportation may require different tools of analysis and courses of action for anticipation, prevention, mitigation and restoration. The following table is characterizing the causes and disruptions to coal transport system. Useful distinctions can be made between internal and external causes of disruption and between accidental events and intentional interferences. This distinction is related to the separation between safety and security in transport.

Cause	Accidental Events	Intentional Interference
Internal	Technical failures, mishaps	Labour market conflicts
External	Adverse weather conditions, natural disasters	Pranks, antagonistic attacks

654. Internal threats may originate from mistakes and accidents caused by staff or users, technical failures, components that break down, faulty constructions, overload, etc. They

could also be intentional, such as labour market conflicts. External threats may be related to natural phenomena including various degrees of adverse weather and natural disasters: heavy rains, thunderstorms, cyclones, storm surges, tsunamis, etc. One specific long-term threat in-between internal and external is global warming, which is partially a consequence of human activities in the transport sector (Koetse and Rietveld, 2009; National Research Council, 2008). External threats also include antagonistic actions ranging from pranks, sabotage, terrorist actions to acts of war. During transport and fleeting incidents like vessel collision, sinking, grounding, fire, breakaway, rain/incidental water, spillage of loose cargo, etc. and loading and unloading incidents like barge breakaway, barge fire, spillage of cargo, wind spillage, collision by another vessel, etc. could cause major risks and disasters.

655. The potential hazards have been classified based on the activities during coal transportation process. The potential hazards based on hazard classification and their possible sources are listed in **Table 8-1**.

Table 8-1: Identification and sources of hazards

Activity	Associated Hazards	Source of Hazard
Mother and lighterage vessel carrying coal passes through inland waterway and on return	Coal in bulk may spontaneously combust and leachate may corrode ship walls and bottom.	Coal at ship cargo hold
	Ship may hit ground or get stuck with underwater roots/vegetation/mud/sand or collide with other ships/barges due to low visibility and fog conditions or tidal conditions.	Underwater roots/vegetation/mud /sand, other ships/barges at sea and river
	Movement of unfit or uncertified ship	Unfit/uncertified Ship
	Ship may capsize	Faulty/unfit ship, collision with other ships/barges, entangled with riverbed
	Dispersion of coal dust and coal spillage on surrounding environment	Coal at ship cargo hold
	Tidal Surge / Tsunami /Cyclone	Natural (temperature, humidity, atmospheric pressure, rainfall etc.)
Berthing and Transshipment	Workers may inhale accumulated Carbon Monoxide, Methane, etc. from the coal cargo	Coal at ship cargo hold
	Coal in bulk may spontaneously combust	Coal at ship cargo hold
	Coal may spill in water	Coal vessel and transshipper
	Accumulation of Coal-washed water	Coal vessel, transshipper and jetty
	Faulty operation of lifting devices	Trans-shipper – faulty cranes, booms, mast etc.
	Coal dust may be exposed and inhaled by worker	Ship cargo hold, Grabber during trans-shipment process
	Injury from mechanical / moving parts	Cranes, Grabbers, other machineries and equipments – during coal trans-shipment process
	Repetitive Stress Injuries (RSI)	Machines and equipments involved in coal trans-shipment process
	Fire from engine motors and other electrical equipments and lighter / matches	Ship engines and motors, carelessness from workers
	Accumulation of Oil / Oily effluent from engine other parts	Ballast water accumulated at ship holds

Activity	Associated Hazards	Source of Hazard
Health hazard – Personnel Accommodation, Food supply, Sanitation and Crew-change at Transshipper	Food / Sewage / Household waste	Kitchen, waste bins, food storage rooms, rotten food items, toilets etc.
	Personal hygiene / sickness	Prior sickness/illness, crew members, crew dormitories, shower rooms, toilets etc.
	Foreign workers venturing outside working boundaries may contact indigenous diseases	Foreign workers – lack of awareness on local diseases
	Physical & Mental Stress / Seasickness	Crew members/seafarers, long working hours
	Service boat Accidents: Capsize, Collision with bank / other boats / damage	Faulty/unfit boats; not following marine traffic guidelines; collision with other ships/barges, collision with ground, underground muds/sediments etc.
	Accidents due to use of uncertified service boat	Uncertified service boat
	Invasion of Pirates	Pirates
Unloading of Coal at Plant Jetty to conveyor to coal stackyard	Injury from mechanical/moving parts	Machineries and equipments (conveyor belts, grabbers etc.) used during coal unloading process
	Coal dust may spread from coal stackyard	Coal at coal stackyard
	Spontaneous combustion of coal at coal stackyard	Coal at coal stackyard

8.4 Hazard Consequence and Likelihood Scales

656. The potential impacts of the project have been scaled and prioritized based on the magnitude of those potential impacts and the likelihood of them occurring. The consequence of the said impacts are classified and illustrated in **Table 8-2**.

Table 8-2: Parameters for determining Risk/Impact Scale

Parameter	4 (Major)	3 (Moderate)	2 (Minor)	1 (Minimal)
Duration of potential impact	Long term (more than 15 years)	Medium Term (5 to 15 years)	Limited to construction period	Temporary with no detectable potential impact
Spatial extent of the potential impact	Widespread far beyond project boundaries	Beyond immediate project components, site boundaries or local area	Within project boundary	Specific location within project component or site boundaries with no detectable potential impact
Reversibility of potential impacts	Potential impact is effectively permanent, requiring considerable intervention to return to baseline	Potential impact requires a year or so for recovering with some interventions to return to baseline	Baseline returns naturally or with limited intervention within a few months	Baseline remains almost constant
Compliance to Legal Standards	Breaches national standards and or international	Complies with limits given in national standards but	Meets minimum national standard limits	Not applicable

Parameter	4 (Major)	3 (Moderate)	2 (Minor)	1 (Minimal)
before Mitigation Measures	guidelines/ obligations	breaches international lender guidelines in one or more parameters	or international guidelines	
Likelihood of potential impacts occurring	Occurs under typical operating or construction conditions (Certain)	Occurs under worst case (negative impact) or best case (positive impact) operating conditions (Likely)	Occurs under abnormal, exceptional or emergency conditions (occasional)	Unlikely to occur

657. Criteria for determining the likelihood of potential impacts of the Project are outlined in **Table 8-3**.

Table 8-3: Criteria for determining likelihood of the potential risks

Sensitivity Determination	Definition
Very High	Vulnerable receptor with little or no capacity to absorb proposed changes or minimal opportunities for mitigation.
High	Vulnerable receptor with little or no capacity to absorb proposed changes or limited opportunities for mitigation.
Medium	Vulnerable receptor with some capacity to absorb proposed changes or moderate opportunities for mitigation.
Low	Vulnerable receptor with good capacity to absorb proposed changes and/or good opportunities for mitigation.

8.5 Developing Risk Matrix

658. Following impact consequence and likelihood analysis, a risk matrix can be developed. **Table 8-4** shows the risk matrix for the potential impacts and their likelihood for occurrence. **Table 8-5** shows the risk evaluation based on the type of activities and potential hazards.

Table 8-4: Matrix of impact significance

Magnitude of Risk/ Impact	Sensitivity of Receptors			
	Very High (4)	High (3)	Medium (2)	Low (1)
Major (4)	Critical (16)	Major (12)	Moderate (8)	Minor (4)
Moderate (3)	Major (12)	Major (9)	Moderate (6)	Minimal (3)
Minor (2)	Moderate (8)	Moderate (6)	Minor (4)	Minimal (2)
Minimal (1)	Minor (4)	Minimal (3)	Minimal (2)	Minimal (1)

Color Legend:

Red (13-16)	≡ Catastrophic/ Critical	: Action with follow-up Verification & Validation by Authority needed before allowing work
Orange (9-12)	≡ Major	: Action needed under follow-up supervision before allowing work
Yellow (6-8)	≡ Moderate	: Need maintaining with routine monitoring and reporting
Blue (4)	≡ Minor	: Only for awareness
Green (1-3)	≡ Minimal	: No action needed to start work

659. The risks for the potential impacts are evaluated based on the combination of the magnitudes of the impact and their likelihood. In order to calculate the potential risk, the likelihood of impact is multiplied with their magnitudes. As for example, Level 1 of likelihood of an impact (low) is multiplied with Level 1 of impact (low) to give a total score of 1 ($1 \times 1 = 1$) and so on. In that regards a score between 1 to 3 is considered minimal risk, a score of 4 is considered minor risk, a score between 6 to 8 is considered moderate risk, a score between 9 to 12 is considered major risk, and a score between 13 to 16 is considered catastrophic or critical. Major risks and hazards are assessed and presented in **Table 8-5**. **Annex 8-1** presents good practices of river transport and trans-shipment of coal.

Table 8-5: Hazard and Risk Ranking and Management Measures

SI No	Activity	Associated Hazards	Magnitude Without Safeguard	With Existing Safeguard	Risk Ranking	Preparedness/Prevention/Management Measures
1	Mother and lighterage vessel carrying coal passes through MPA route and on return	a. Coal in bulk may spontaneously combust	4	2	Mo	<ul style="list-style-type: none"> • Transport coal following IMSBC Code in Cargo B, coal can create flammable atmospheres, may heat spontaneously, may deplete the oxygen concentration and may corrode metal structures. • When the master is concerned that the cargo is showing any signs of self-heating or spontaneous combustion, such as an increase in the concentration of methane or carbon monoxide or an increase in temperature, the following actions shall be taken: <ul style="list-style-type: none"> ✓ Consult with the ship's agent at the loading port. The Company's designated person ashore shall be advised immediately. ✓ Check the seal of the cargo space and re-seal the cargo space, as necessary. ✓ Do not enter the cargo space and do not open the hatches, unless the master considers access is necessary for the safety of the ship or safety of life. When any ship's personnel have entered into a cargo space, re-seal the cargo space immediately after the personnel vacate the cargo space. Increase the frequency of monitoring the gas composition, and temperature when practicable, of the cargo.
		b. Leachate may corrode ship walls & bottom	2	1		<ul style="list-style-type: none"> • The proponent should confirm whether the vessel has applicable corrosion checking certificate as per MARPOL.

SI No	Activity	Associated Hazards	Magnitude Without Safeguard	With Existing Safeguard	Risk Ranking	Preparedness/Prevention/Management Measures
		c. Ship may hit ground or get stuck with underwater roots/vegetation/mud/sand or collide with other ships/barges due to low visibility and fog conditions or tidal conditions	4	3	Ma	<ul style="list-style-type: none"> Night operations will follow lighting and personnel (pilot) requirements. Navigation assistance through VHF communication based on radar information to adverse weather condition, restricted visibility, changes in pilot services, or any other dangerous situation for the vessel. Appropriate equipment to be selected in accordance with specific weather conditions and vessel load characteristics Regular tug inspections to ensure they meet transport requirements. Coal barges are to be compartmentalized to reduce the potential severity of the impacts.
		d. Movement of unfit or uncertified ship	4	2	Mo	<ul style="list-style-type: none"> Enforce IMO convention of International Convention for the Safety of Life at Sea (SOLAS), 1974.
		e. Ship may capsize	4	2	Mo	<ul style="list-style-type: none"> Anchor vessel in a safe place during anticipated bad weather condition. Follow Emergency Preparedness and Response Plan.

SI No	Activity	Associated Hazards	Magnitude Without Safeguard	With Existing Safeguard	Risk Ranking	Preparedness/Prevention/Management Measures
		f. Dispersion of coal dust and coal spillage on surrounding areas	4	3	Ma	<ul style="list-style-type: none"> • Add water to wet the coal to prevent dusting. • Specific design and material handling procedures will be used to minimize the loss of coal in the marine environment during handling and transport activities: <ul style="list-style-type: none"> ✓ Grabs in floating transfer station will be equipped with dust cover plates. • Avoid barge operation in such a high wind speed as suggested in the IMO rules and regulations. • Maintenance of facilities, including daily cleaning, is proposed to reduce the build-up of dust that could become a source of sediment during rain events. • A detailed habitat monitoring plan will be developed and implemented in consultation with Forest Department (FD), Department of Fisheries (DoF), local fishers and DoE. The habitat monitoring plan will be designed to achieve DoF's guiding principle and accordingly corrective measures will be carried out. • Coal is not a chemical of concern in its raw form and its deposition is expected to be minimal and localized through the application of various mitigation measures stated above. As a result, it is not anticipated that any coal or coal dust deposited in the marine environment from the Project will affect the mortality risk or health of fish and invertebrates.
		g. Tidal Surge / Tsunami /Cyclone	4	2	Mo	<ul style="list-style-type: none"> • Communicate with nearby Port Authority for weather forecast • Anchor vessel in a safe place during anticipated bad weather condition • Training & Drills on Emergency Response & Disaster Preparedness

SI No	Activity	Associated Hazards	Magnitude Without Safeguard	With Existing Safeguard	Risk Ranking	Preparedness/Prevention/Management Measures
2	Berthing and Transshipment	a. Workers may inhale accumulated Carbon Monoxide, Methane, etc. from the coal cargo	3	2	Mo	<ul style="list-style-type: none"> Avoid personnel entering vessel or standing near bulk a few minutes after opening the cover in Mother Vessel for proper ventilation
		b. Coal in bulk may spontaneously combust	4	3	Ma	<ul style="list-style-type: none"> Transport coal following IMSBC Code in Cargo B, coal can create flammable atmospheres, may heat spontaneously, may deplete the oxygen concentration and may corrode metal structures. When the master is concerned that the cargo is showing any signs of self-heating or spontaneous combustion, such as an increase in the concentration of methane or carbon monoxide or an increase in temperature, the following actions shall be taken: <ul style="list-style-type: none"> Consult with the ship's agent at the loading port. The Company's designated person ashore shall be advised immediately. Check the seal of the cargo space and re-seal the cargo space, as necessary. Do not enter the cargo space and do not open the hatches, unless the master considers access is necessary for the safety of the ship or safety of life. When any ship's personnel has entered into a cargo space, re-seal the cargo space immediately after the personnel vacate the cargo space. Increase the frequency of monitoring the gas composition, and temperature when practicable, of the cargo.

SI No	Activity	Associated Hazards	Magnitude Without Safeguard	With Existing Safeguard	Risk Ranking	Preparedness/Prevention/Management Measures
		c. Coal may spill on water	4	3	Ma	<ul style="list-style-type: none"> Implementation of management plans to mitigate effects of drainage and discharge. Ensure dry residues and/or the wash water that contains residues from an HME discharged at adequate port reception facilities. Numerous studies concluded that PAHs are not bioavailable because of the source of PAH in the sediments was from pitch globules and coal particles to which the PAHs were tightly bound. The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is expected to control dust throughout the transportation chain. Daily site cleaning to prevent build-up of dust that could become a source of sediment during rain events, and as needed during the wet season to prevent mud build-up.
		d. Accumulation of Coal-washed water	2	1	Mn	<ul style="list-style-type: none"> Dispose effluent following applicable IMO Convention [International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto and by the Protocol of 1997(MARPOL)].
		e. Faulty operation of lifting devices	2	1	Mn	<ul style="list-style-type: none"> Refer to Annex 8-1 : “Good Practices”, item 2 for Lifting operations

SI No	Activity	Associated Hazards	Magnitude Without Safeguard	With Existing Safeguard	Risk Ranking	Preparedness/Prevention/Management Measures
		f. Coal dust may get exposed and inhaled by worker	4	3	Ma	<ul style="list-style-type: none"> As a secondary dust mitigation measure, water will be sprayed on the barges in a controlled manner (i.e., approximately five minutes every 30 minutes), as deemed necessary by the operations superintendent or the Environmental Coordinator. The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is expected to control dust throughout the transportation chain. Avoid barge operation in such a high wind speed as suggested in the IMO rules and regulations. Implement Air Quality Management Plan.
		g. Injury from mechanical / moving parts	4	2	Mo	<ul style="list-style-type: none"> Ensure regular maintenance of machineries, equipments and cranes Ships' cargo handling gear and machinery should not be subjected to loads beyond the certified safe working load. Routine inspection of all machineries, equipments and cranes must be made as per Standard Operating Procedure (SOP). In case of identification of any mechanical fault, stop-work must be administered for that unit and prompt repair should be made. Use proper Personal Protective Equipments Supply sufficient First Aid kits Ensure proper radio communication with MPA in case of medical emergency
		h. Repetitive Stress Injuries (RSI)	2	1	Mn	<ul style="list-style-type: none"> Refer to Annex 8-1: "Good Practices", item 6 for Musculo-skeletal disorders (MDS) / Repetitive Stress Injuries (RSI)

SI No	Activity	Associated Hazards	Magnitude Without Safeguard	With Existing Safeguard	Risk Ranking	Preparedness/Prevention/Management Measures
		i. Fire from engine motors and other electrical equipments and lighter / matches	3	1	Mn	<ul style="list-style-type: none"> • Ensure regular maintenance of machineries, equipments and cranes • Routine inspection of all machineries, equipments and cranes must be made as per Standard Operating Procedure (SOP). • In case of identification of any mechanical fault, stop-work must be administered for that unit and prompt repair should be made. • Firefighting equipments / extinguishers / hydrants in strategic places • Trainings of crew members on Firefighting and Emergency Response Plan
		j. Accumulation of Oil / Oily effluent from engine other parts	4	3	Ma	<ul style="list-style-type: none"> • Strictly follow MARPOL Convention, as applicable Annex V on the Prevention of Pollution by Garbage from Ships, the IMO introduced new classification criteria to enable identification of substances harmful to the marine environment (HME).The discharge of residues of certain cargoes into the sea will no longer be allowed when the cargo is classified as a substance harmful to the marine environment. For such cargoes the dry residues and/or the wash water that contains residues from an HME must be discharged at adequate port reception facilities. • Coal transportation shall be carried out using existing navigational route of MPA and BIWTA. • Responsible authorities will properly enforce applicable rules and regulations of MPA and MARPOL in the management of bilge and ballast water, oily water discharge, waste and waste water.

SI No	Activity	Associated Hazards	Magnitude Without Safeguard	With Existing Safeguard	Risk Ranking	Preparedness/Prevention/Management Measures
3	Health hazard - Personnel Accommodation, Food supply, Sanitation and Crew-change at Transshipper	a. Food / Sewage / Household waste	4	3	Ma	<ul style="list-style-type: none"> Strictly follow MARPOL Convention, as applicable Annex V on the Prevention of Pollution by Garbage from Ships, the IMO introduced new classification criteria to enable identification of substances harmful to the marine environment (HME). The discharge of residues of certain cargoes into the sea will no longer be allowed when the cargo is classified as a substance harmful to the marine environment. For such cargoes the dry residues and/or the wash water that contains residues from an HME must be discharged at adequate port reception facilities. Coal transportation shall be carried out using existing navigational route of MPA and BIWTA. Responsible authorities will properly enforce applicable rules and regulations of MPA and MARPOL in the management of bilge and ballast water, oily water discharge, waste and waste water.
		b. Personal hygiene / sickness	3	2	Mo	<ul style="list-style-type: none"> General housekeeping of work place and resting places Keep PPEs clean & tidy Ensure regular cleaning of toilets and sanitation Avoid consuming stale food Keep provision for personnel shower Ensure proper radio communication with Port Authority in case medical emergency
		c. Non-local workers mixing outside working boundaries may catch indigenous diseases	3	2	Mo	<ul style="list-style-type: none"> Regulate permission of crew venture beyond work-boundary.

SI No	Activity	Associated Hazards	Magnitude Without Safeguard	With Existing Safeguard	Risk Ranking	Preparedness/Prevention/Management Measures
		d. Physical & Mental Stress / Seasickness	3	2	Mo	<ul style="list-style-type: none"> • BIFPCL or Contractor should administer Fit-for-Duty medical check-up of workers. • Maintain 2 weeks duty & 2 Weeks off / rest of all site workers or as admissible under the Labor Law. • Keep provisions for appropriate resting place • Ensure communication media (e.g. Satellite Mobile Phone) for all workers to talk with respective families • Sleeping, Dining & Recreational facilities
		e. Service boat Accidents: Capsize, Collision with bank / other boats / damage	2	1	Mn	<ul style="list-style-type: none"> • MPA to enforce Safe Speed Limit of Vessels [Restrict vessel speed¹ minimum 8 knot up to 135 m LOA and 10 knot having maximum 170m LOA] as per MPA rules (MPA Traffic Guidelines). • MPA to Conduct Periodical Bathymetric Survey. • MPA to Perform Dredging if required.
		f. Accidents due to use of uncertified service boat	4	2	Mo	<ul style="list-style-type: none"> • Enforce MPA and/or other concerned Authority's Regulations in selecting the service boat. • Enforce IMO convention of International Convention for the Safety of Life at Sea (SOLAS), 1974 • Ensure licensing and fitness certification of Ship, Barges and involved equipment.

¹ https://autoliners2.hoegh.com/web/basic/hal_commoncontacts.nsf/docId/1FB7AE392A163F8DC1257C23003DADC2?open&Close=True&docMode=internet
Preview

SI No	Activity	Associated Hazards	Magnitude Without Safeguard	With Existing Safeguard	Risk Ranking	Preparedness/Prevention/Management Measures
		g. Invasion of Pirates	3	2	Mo	<ul style="list-style-type: none"> Continued consultations with the local leaders and local community representatives on security matters. Security at the work sites and camps. Issuance of identity cards to workers and checking them properly when enter into the workplace. Access to the camps and accommodation facilities must be controlled through gated entrances and entrance and exit logs with security personnel shall be maintained at each entrance. Preparation and implementation of the contractor's Communication plan to engage local leaders and community. Implement ECP 14: Construction and Operation Phase Security.
4	Unloading of Coal at Plant to Jetty conveyor	a. Injury from mechanical/moving parts	4	2	Mo	<ul style="list-style-type: none"> Ensure regular maintenance of machineries, equipments and cranes In case of identification of any mechanical fault, stop-work must be administered for that unit and prompt repair should be made. Regular inspection of all machineries, equipments and cranes must be made as per SOP. Use proper Personal Protective Equipments Supply sufficient First Aid kits Ensure proper radio communication with Port Authority in case medical emergency <ul style="list-style-type: none"> Refer to Annex 8.1: "Good Practices", item 6 for Musculo-skeletal disorders (MDS) / Repetitive Stress Injuries (RSI)

SI No	Activity	Associated Hazards	Magnitude Without Safeguard	With Existing Safeguard	Risk Ranking	Preparedness/Prevention/Management Measures
		b. Coal dust may spread from coal stackyard	4	3	Ma	<ul style="list-style-type: none"> • Use recommended dust control measures for loading coal • Water/mist system used to spray coal during the unloading process. • Cover all receiving pits except for entry/exit points. • Minimize drop heights and curved chutes at transfer points. • Use enclosed conveyor system equipped with water and chemical agent spraying nozzles. • Use of mechanical profiling of coal in conveyors to limit exposure to air flow.
		c. Spontaneous combustion of coal at coal stackyard	4	3	Ma	<ul style="list-style-type: none"> • Implement a Fire Safety Plan and train all employees in regards to this plan. • Conveyor belts are designed with fire taps with valves at regular intervals. • Fire resistant hydraulic fluids and fire resistant belting will be used for the conveyor system. • Regular scheduled checks and maintenance of process area equipment (i.e., conveyor system). • No open flame/ignition source/hot work is permitted in the process areas without following proper procedural controls.

Note: Ma: Major, Mo: Moderate, Mi: Minor, Mn: Minimal

9 Environmental Impact and Mitigation Measure

9.1 General

660. Environmental values for the Project are described in this section. The information provided is a summary of the technical assessment of coal logistics study completed by BIFPCL over the course of 2014 and 2015. Existing information from the technical documents coal sourcing study air quality assessment; noise level assessment; inland water transport assessment; baseline biodiversity assessment; government databases; and field study also contribute to this section.

661. In addition, the Consultant has also consulted with multiple stakeholders, expert/institute, local residents and community focused groups, general public, environmental groups, and the client to seek feedback on various issues of environmental and social concern. Such environmental issues of concern include:

- Air quality;
- Bed material and marine environment;
- Water resources;
- Fish, fish habitat and species with special status; and
- Vegetation and wildlife, and species with special status in the Sundarbans Reserve Forest.

662. The Socio-economic Effects Assessment describes the following socio-economic and socio-community topics and effects:

- Noise and vibration effects;
- Light effects;
- Increased vessel traffic;
- Disaster risk and emergency response; and
- Effects on livelihood dependent on the Sundarbans.

663. The Health Effects Assessment, including Human Health and Ecosystem Health Assessment present the following issues in detail:

- Health effects of coal dust
- Health effects of fugitive dust/particulate matter

9.2 Impact Assessment Methodology

664. Potential environmental and social impacts were identified on the basis of the review of feasibility reports, field visits, environmental quality baseline monitoring, ecological and fisheries surveys, stakeholder consultations, air quality dispersion modeling using USEPA approved CALPUFF, and noise modeling using SoundPlan. The significance of potential impacts was assessed using the criteria and methodology given below.

9.2.1 Impact Magnitude

665. The potential impacts of the project have been categorized as major, moderate, minor or nominal based on consideration of the parameters such as: i) duration of the impact; ii) spatial extent of the impact; iii) reversibility; iv) likelihood; and v) compliance to Legal Standards before Mitigation Measures.

666. The magnitude of potential impacts and risks of the Project has generally been identified according to the categories outlined in **Table 8-2**.

9.2.2 Sensitivity of Receptor

667. The sensitivity of a receptor has been determined based on review of the population (including proximity / numbers / vulnerability) and presence of features on the site or the surrounding area and values of the receptors. Each detailed assessment has defined sensitivity in relation to the topic. Criteria for determining receptor sensitivity to the Project activities and significance of impacts are mentioned in Table 8-3 and Table 8-4 respectively.

9.3 Assessment of Environmental and Social Impacts

668. The study has considered the activities to be involved in the coal transportation in three phases, i.e., feasibility and design, project implementation, and operation and maintenance. In addition, there will be associated components, such as, navigability of the Passur River, designated route of the Mongla Port, for which Mongla Port Authority will take initiative as part of their mandate. The activities with brief description are dealt in phases as follows:

9.3.1 Feasibility and Design Phase

- Selection of coal transportation logistics: considers transportation route, anchorage point and transshipper.
- Long-term contract with suppliers/shippers of coal: considers compliance suppliers/shippers of coal with International Convention for the Prevention of Pollution from Ships.

9.3.2 Project Implementation Phase

- Plant jetty construction: include jetty construction in the acquired land.
- Civil work for jetty: Construction of Lay down areas and workers camp (inside the Maitree Power Project), receiving heavy power plant equipment, internal roads, site drainage, excavation for foundations work, buildings, etc.
- Civil work for coal stackyard: Construction of Lay down areas and workers camp (inside the Maitree Power Project), internal roads, coal conveyor belt, site drainage, excavation for foundations work, buildings, etc
- Procurement and transportation of power plant equipment: will include transportation of construction materials, construction machinery and equipment for the jetty through the existing access road and the jetty via the Passur River.
- Installation of jetty equipment and coal stackyard: will include installation of jetty platform and terminal, conveyor system and coal stock yard, etc.

- Construction of on-site and off-site work facilities: including site office, sanitation and labour accommodation.
- Establishment of waste management system, OHS, rescue facilities and emergency medicare and treatment facilities.

9.3.3 Operation and Maintenance Phase

- Sailing of coal borne vessel: will include coal borne mother vessel ply through the Passur up to anchorage point and lighterage vessel from the anchorage point to the jetty site.
- Transshipment of coal: will include transhipper for transshipment of coal from mother vessel to the lighterage vessel.
- Unloading and conveying of coal: operation of coal unloading at jetty and conveying coal to the covered stackyard using covered conveyor belt.
- Pollution control: operation of dust suppression and other pollution control system.
- Waste receiving: ensuring the presence and operation of waste receiving and disposal system at the area(s) of jurisdiction of the MPA.

9.4 Assessment of Impacts, Significance and Prescription of Measures

669. The project's potential impacts and their significance have been assessed using the methodology described in Section 8.4 and Section 8.5. A summary of these impacts and their significance is presented in **Table 9-1**.

Table 9-1: Potential impacts and their significance

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Environmental and Social Impacts during Feasibility and Design Phase (A):								
Negative Impacts								
Selection of coal logistics	The Sundarbans Ecosystem	A1. Adverse impacts on the Sundarbans ecosystem if improper route is selected for coal logistics (i.e., transportation route, and anchorage point and trans-shipper).	<ul style="list-style-type: none"> The anchorage points were selected by the MPA based on river draft and other relevant factors. ○ Mazhar Point will be used for trans-shipment of coal due to its present draft and closeness to the power plant jetty site. ○ At present, Harbaria is being used as trans-shipment point for Mongla Port. • Additionally, Fairway Buoy will also be used during the fair weather as a trans-shipment point. 	<p>High (3)</p> <ul style="list-style-type: none"> • Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans, which is a protected area of unique plant and wildlife species. However, the UNESCO World Heritage Site is about 2.0 km away from the proposed alignment of coal transportation route (Figure: 5-6). Considering the geographical proximity of the route to these 	<p>Moderate (3)</p> <p>Findings of alternative analysis reveal that the designated route of the Mongla Port Authority (MPA) along the Passur River is the best feasible route, which will have less environmental impacts compared to other alternatives. While the other routes require dredging, longer distance, and smaller vessels with more traffic.</p>	Major adverse (9)	<ul style="list-style-type: none"> • Preparation of the plans and required institutional set up for their implementation to minimize impacts in the Sundarbans. <ul style="list-style-type: none"> ○ Construction Environmental Action Plan (CEAP)/ ○ Social and Environmental Management Plan (SEMP) and ○ Emergency Response Plan (ERP) system and ○ Grievance Redressal Mechanism (GRM). • The project also considers the selected anchorage points (Mazhar Point in the Sundarbans) in view of avoidance of close-proximity of World Heritage Site and in accordance with national guidelines to entail minimal disturbance to the 	<p>Residual Significance: Moderate (6)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minor (2)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
				protected areas, the sensitivity for the receptor (The Sundarbans) is kept high.			Sundarbans ecosystem. • Reduce trans-shipment points from two to one to minimize impacts in the Sundarbans.	
Selection of coal transportation route	Dolphins and other aquatic organisms	A2. Dolphins, including vulnerable Gangetic dolphin (<i>Platanista gangetica</i>) and near threatened Irrawaddy dolphin (<i>Orcaella brevirostris</i>) and other aquatic species, such as fishes, i.e., vulnerable tiger goby (<i>Eugnathogobius oligactis</i>) and crustaceans can be impacted by an improper route selection.	<ul style="list-style-type: none"> Route selection was finalized with the intention of avoiding dolphin sanctuary in Shela and Dhangmari. Primary survey on dolphin abundance was conducted in both Chandpai and Dhangmari sanctuaries to assess the impacts. The anchorage points (at Mazhar Point) are already being used by vessels of MPA route) has been selected for transshipment during rough weather season (April-October). 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high, as the proposed coal transportation route is passing more than 500 m away from the dolphin sanctuaries. Moreover, wildlife sanctuaries (Dhangmari and Chandpai-Shela gang) connected to the Passur Channel have been marked on the map (Figure 7-32 and Figure 7-33). The nearest Dolphin sanctuary (Chandpai-Shela Gang) is 	<p>Minor (2)</p> <ul style="list-style-type: none"> Dolphin habitat suitability has been studied and found that dolphins are mostly congregated in the tributaries of the Passur for preying facilities (Para: 564-566). Fishing nets induced casualty of dolphins is dominant factor in this area. Due to increased movement of vessel would discourage fishing nets in the Passur 	Moderate adverse (6)	<ul style="list-style-type: none"> Reduce trans-shipment points from two to one to minimize impacts in the Sundarbans. Research on dolphins conservation may be promoted as a part of Corporate Social Responsibility (CSR) as measures beyond compliance. 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
				about 19 km away from the Mazhar Point-1: H8. • Considering the geographical proximity of the route to these sanctuaries, the sensitivity for the receptor (Dolphins) is kept high.	Channel, USAID ¹⁹ , 2005. • Usually, the vessels sail in the Passur Channel avoiding these habitats. Therefore, collision of dolphin with the vessel in the Passur Channel is rare.			
Selection of coal transportation route	Species of conservation significance	A3. Aquatic species, such as the critically endangered northern river terrapin/Batagur turtle (<i>Batagur baska</i>) lives inside the Sundarbans but travels to sandy banks crossing	• Route selection was finalized with the intention of avoiding the habitat of northern river terrapin, leatherback sea turtle and small clawed otter. • The anchorage points were	Very High (4) • Sensitivity is considered very high, as the proposed coal transportation route is passing close to the northern river terrapin/Batagur turtle (Batagur	Minor (2) • Batagur turtle is generally available in the Karamjal canal, which is inside the Sundarbans and falls on the Passur River. There	Moderate adverse (8)	• Proper management of bilge water of the lighterage should be carried out for avoiding contamination of water. • Research on Batagur turtle, small clawed otter, etc. conservation may be promoted as a part of Corporate Social Responsibility (CSR) as measures beyond	Residual Significance: Minimal (3) The reason for the change in residual significance is because of the

¹⁹ Quote from the study captioned under “Abundance estimation of Ganges River dolphins (*Platanista gangetica gangetica*) and Irrawaddy dolphins (*Orcaella brevirostris*) using independent concurrent counts in waterways of the Sundarbans Mangrove Forest, Bangladesh” conducted by WCS for USAID in 2005. Quotation “This was despite indications of increasing threats to cetaceans in the area from incidental killing in gill net fisheries, destruction of fish-spawning habitat through mangrove deforestation, toxic contamination from large human population centers located upstream (e.g., Dhaka and Calcutta), non-selective catch of fish fingerlings and crustacean larvae in small mesh “mosquito nets” and increased vessel traffic (Reeves et al. 2003)”.

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		substantial distance (50-60 km) during breeding period only (Dec-Mar). The leatherback sea turtle (<i>Dermochelys coriacea</i>) lives in the sea but comes to sandy beach during breeding. The endangered small clawed otter (<i>Aonyx cinerea</i>) generally predate in the creeks and can be impacted by an improper route selection.	selected by the Proponent based on river draft and other relevant factors. • Reduce trans-shipment points from two to one to minimize impacts in the Sundarbans.	baska) habitat; across the breeding travel route of leather back sea turtle (<i>Dermochelys coriacea</i>) and close to small clawed otter (<i>Aonyx cinerea</i>) habitat (Section 7.8.2; Para: 561-563). • Considering the geographical proximity of the route to these habitats, the sensitivity for the receptors (river terrapin, leatherback sea turtle and small clawed otter) are kept very high.	is also a captive breeding area of Batagur turtle. The route is about 500 m away from the confluence of Karamjal canal and the Passur River. • Almost for the last 60 years, ships have been sailing through the MPA's designated route. So far, no quantifiable impact on Batagur turtle has been noticed.		compliance.	change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minor (1)
Selection of coal logistics	Fisheries habitat	A4. Improper selection of coal logistics (i.e., transportation route, anchorage point and trans-shipment activities) may lead to	• The anchorage points were selected by the MPA based on river draft and other relevant factors. • The project also considers the	High (3) • Sensitivity is considered high, as the proposed coal transportation route is passing through the	Minor (2) • Fishing survey has been done and found that fishing are mostly occurred in	Moderate adverse (6)	• No fishing and catching of shrimp post larvae (PL) is allowed in the transportation route of the MPA. • Due to frequent movement of vessel, illegal fishing and catching of PL will be	Residual Significance: Minimal (3) The reason for the change in residual significance

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		disturbance to the wildlife habitat including loss of fish and shrimp and other valuable aquatic species' habitat, on which many people depend on for their livelihoods.	selected anchorage points (Mazhar Point in the Sundarbans) in view of avoidance of close-proximity of World Heritage Site and in accordance with national guidelines to entail minimal disturbance to wildlife habitat including loss of fish and shrimp and other valuable aquatic species of the Sundarbans ecosystem. • Reduce trans-shipment points from two to one to minimize impacts on the water quality thus wildlife, fisheries in the Sundarbans. • At present, Harbaria is being used as trans-shipment point	Sundarbans, a unique habitat of the Royal Bengal Tiger along with other wildlife species and along the Passur River, habitat of fishes, shrimp and other aquatic wildlife (Section 7.8.2, 7.9.1; Figure 7-5). Considering the geographical proximity of the route to these habitats, the sensitivity for the receptors (Fisheries Resources) are kept high.	the tributaries and creeks. Fishes use Passur River mainly for movement and migration. Fishing is legally prohibited in the Passur River. Due to increased movement of vessel would discourage fishing in the Passur Channel. • Almost for the last 60 years, ships have been sailing through the MPA's designated route. So far, no quantifiable impact on fisheries resources for vessel movement is concretely		discouraged as such, fish production will be increased in the wild. If regular monitoring demonstrates disruption of habitat due to coal transportation vessel and corresponding decline of shrimp and fish production, necessary measures need to be undertaken for restoration of habitat and also to address the alternative livelihood opportunities of the affected fisher's community.	is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			for Mongla Port. • Additionally, Fairway Buoy will also be used during the fair weather as a tran-shipment point.		established. • Propelling of vessel facilitate water with more dissolved O ₂ .			
Contract with Suppliers/ shippers of coal	Marine environment and safe transport	A5. Suppliers/ shippers of coal are obliged to comply with International Convention for the Prevention of Pollution from Ships to prevent pollution of the marine environment (water contamination induced aquatic wildlife, fisheries and other aquatic organisms) and International Maritime Solid Bulk Cargoes (IMSBC) Code, which has the objective of ensuring safe transport of solid bulk cargoes	<ul style="list-style-type: none"> • The Project is committed to make contract with the suppliers/shipper s having modern double hull vessels with environment friendly discharge and other management facilities. • Shippers will maintain updated documents in compliance with the requirements of applicable MARPOL and the IMSBC Code with respect to coal cargoes. • Maintain documents with a comprehensive review of the 	<p>High (3)</p> <ul style="list-style-type: none"> • Sensitivity is considered high, as the coal carrying vessels would follow the proposed coal transportation route, which is passing through the Sundarbans and also the World Heritage Site (WHS). Careless discharge of pollutants (e.g., bilge water, etc.) and reckless plying of vessel may cause contamination to marine environment 	<p>Minor (2)</p> <ul style="list-style-type: none"> • Even taking care of all possible measures by the shippers/suppliers, there may be a chance of sinking vessel and spillage of oil, grease, oily bilge water, coal dust and coal to the open water. 	Moderate adverse (6)	<ul style="list-style-type: none"> • Shippers will be responsible for assessing and declaring whether cargoes are harmful to the marine environment (HME) using specific environmental classification criteria. • Maintenance of environment friendly operation of vessel with low noise, low air emission, and ante-oil spillage technology. 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minor (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		including coal.	properties of coal like GCV, moisture, ash, sulphur content, etc. • Maintain documents of bilge and ballast water and other waste disposal records.	and sinking of vessel. • Considering the significance of the accidental sinking of vessel and contamination to marine environment, the sensitivity for the receptors (aquatic wildlife, fisheries and other aquatic organisms) is kept high.				
Social Impacts during Project Implementation Phase (B):								
Positive Impacts								
Jetty construction	Employment generation	B1. Generation of employment opportunity for about 150-200 people of different working levels and expertise during engineering design and jetty construction, which will promote	• The proponent is committed to employ local people in different expertise levels during engineering survey and construction of jetty.	Medium (2) Sensitivity is considered as medium, as engineering design and construction of jetty will involve local and migrant work force in the Project. Considering the workload of jetty	Moderate (3) • Employment of a moderately big number of local and migrant workforces of about 150-200 people in different levels, i.e.,	Moderate beneficial (6)	• In employing workforces in different Project activities during construction, it is suggested to involve largely the local people particularly the Project-affected Persons (PAPs) directly or indirectly.	Residual Significance: Moderate beneficial (8) The reason for the change in residual significance is because of the

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		livelihood.		construction 150-200 new employment will be generated temporarily (Para: 347), the sensitivity for the receptors (Livelihood) are kept medium.	unskilled, semi-skilled, skilled, technicians, etc. temporarily and permanently during construction of plant jetty will be encouraged by the EPC Contractor. <ul style="list-style-type: none"> • Also, employment of local people during engineering surveys. • Moreover, for supplying daily commodities to the workforce and the Project Management personnel including EPC Contractor and OE more employment will be 			change in magnitude with implementation of suggested enhancement measures. <i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Major (4)

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					generated.			
Jetty construction	Economic activity	B2. Increased economic activity due to involvement of about 150-200 workers and about 50 officials and consultants in the Project site, selling of local construction materials, traders, food supply, etc. This will improve the local socio-economic condition and life style.	•No embedded control measure is considered.	Medium (2) Sensitivity is considered medium, as local farmers, producers, traders and other services will involve more local people other than 150-200 people/worker involved in the engineering survey and jetty construction (Para: 354). Considering the potential economic activities during jetty construction, life style of the local people, the sensitivity for the receptors (Lifestyle) are kept medium.	Moderate (3) •New trading facilities will be developed, which will facilitate local produces, more sales and services, and income and revenue generation during jetty construction activities. •As a result of the influx of a workforce, there shall be a higher demand for locally produced food, goods and services benefiting local farmers, producers, traders including small shops within the project area	Moderate beneficial (6)	•The Proponent should provide temporary/ permanent market place facilities and the EPC Contractor or the Labour Contractor will facilitate the access of the workforce to shopping in that market place.	Residual Significance: Moderate beneficial (8) The reason for the change in residual significance is because of the change in magnitude with implementation of suggested enhancement measures. <i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Major (4)

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					and thereby reduce dependency of locals on the Sundarbans for their livelihoods. • Due to increased transportation of materials and goods through MPA's maritime route and its jurisdiction, revenue of the MPA/DG Shipping will be increased by and large.			
Negative Impacts								
Jetty construction	Worker's health and safety	B3. Risk of accidents and unsafe working conditions for workforce and health issue due to unhygienic	• The Proponent intends to appoint EPC Contractor having ISO 9000 for construction related issues	High (3) Sensitivity is considered high, as the nature of work with such huge equipment	Minor (2) • Improper ventilation and living space may lead the	Moderate adverse (6)	• Occupational Health and Safety (OHS) Plan to be implemented based on ECP 13 20 : Workers Health and Safety and World Bank Group's Environment,	Residual Significance: Minimal (3) The reason for the

²⁰ Environmental Codes of Practices (ECPs) are general and non-site-specific measures to address general construction and operation matters identified as moderate and minor in significance prior to mitigation.

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		accommodation facilities.	including risk protection measures and ISO 14001 for the implementation of Environmental Management Plan (EMP). • EPC Contractor will appoint Labour Contractor, who maintains ILO Guidelines and having risk coverage facilities. The Proponent will also appoint Owner's Engineer who will supervise the all-out activities of the work to be done by the EPC Contractor. • Labour camp with proper ventilation and living space will be built on the highland within the Project premise.	having high susceptibility of risking the workforce even to casualty. Also health issue may arise from the accommodation facilities (Receptor is workforce).	workers in unhealthy condition. This in turn may hamper the Project work and the livelihood of the workers as well. • Untrained worker may be more susceptible to accidental events. • Poor management of kitchen waste (54-68 kg/day) to be generated from the official dorms and labour camp (Para: 355).		health and Safety (EHS) Guidelines. • Ensure the use of Personal Protective Equipment (PPE). • Emergency Response Plan (ERP) to be implemented. • Observance of mock drills on OHS and ERP plans at regular interval. • Contractor should follow relevant IFC Performance Standard (PS) like PS-2 on Labor and Working Conditions; PS-3 on Resource Efficiency and Pollution Prevention and PS-4 on Community Health, Safety, and Security. • Kitchen waste should be dumped in defined bins by category and sent to the landfill.	change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			<ul style="list-style-type: none"> Safety training for all workers should be ensured prior to commencing the work. 					
Jetty construction	Worker's and asset's security	B4. Security risks for workers and project staffs, especially from thieves/pirates and bandits who are known to roam the area and carry-out stealing of worker's belongings and kidnappings for ransoms.	<ul style="list-style-type: none"> EPC Contractor will appoint Labour Contractor, who maintains ILO Guidelines and having mechanism of labour's asset security where Project Proponent/ EPC contractor will facilitate the security issue. 	<p>Medium (2)</p> <ul style="list-style-type: none"> Sensitivity is considered medium, as the labour camp will be built inside the Project premise having security boundary where ones entrance and exit will be checked. There may be a susceptibility of kidnappings but the law enforcement agency cordons in and around the Project area. (Receptor is worker's asset and money). 	<p>Moderate (3)</p> <ul style="list-style-type: none"> The movement of the workers mostly will be within the Project premise, more specifically to the labour camp and construction site. Entrance of outside people is highly restricted. Outside movement (if required) will be facilitated by the Contractor's vehicle. 	Moderate adverse (6)	<ul style="list-style-type: none"> Continued consultations with the local leaders and local community representatives on security matters. Keep close liaison with the Law Enforcement Authorities (for pirates, the scope will be under the jurisdiction of regulatory authorities, e.g. coast guards, MPA and Police). Ensure the presence of armed and trained security guards at the work sites and camps. Issuance of identity cards to workers and checking them properly when enter into the workplace. Access to the camps and accommodation facilities must be controlled through gated entrances and entrance and exit logs with security personnel shall 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity: Medium (2)</i> <i>Magnitude: Minimal (1)</i></p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
							be maintained at each entrance. • Preparation and implementation of the contractor's Communication plan to engage local elected representative and community. • Implement ECP 14: Construction and Operation Phase Security. • Every labour camp should have lockers for safe keeping of money, stuffs and belongings for labour.	
Jetty construction	Worker's and asset's security	B5. Inadequate construction site security poses risk to assets, construction materials and property. Theft/vandalism of assets, materials and property would increase construction costs and cause delays in project completion.	• The Proponent intends to appoint EPC Contractor having ISO 9000 for construction related issues including risk protection measures and ISO 14001 for the implementation of Environmental Management Plan (EMP). • EPC Contractor	Medium (2) • Sensitivity is considered medium, as the construction equipment and construction materials will be aggregated at the construction site.	Minor (2) • The construction site is located in a protected area within the Project premise. Entrance of outside people is highly restricted. The law enforcement agency	Minor adverse (4)	• Ensure security at the work sites and camps. • Employ night watchman for periods of significant on-site storage or when the area necessitates. • Ensure there is proper fencing around construction site perimeter. • Pre-employment screening investigations should be used to verify the applicants relating to their employment, education and criminal history background.	Residual Significance: Minimal (2) The reason for the change in residual significance is because of the change in magnitude with implementation of

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			will appoint Labour Contractor, who maintains the Guidelines of ILO having risk coverage facilities. The construction site will be built in the protected area within the Project premise.		cordons in and around the Project area.		<ul style="list-style-type: none"> • Issuance of identity cards to workers. • Implement ECP 14: Construction and Operation Phase Security. 	<p>suggested mitigation measures.</p> <p><i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)</p>
Jetty construction	Community and worker's culture	B6. Both local and migrant workers will be involved in the construction works. Migrant workers (around 50-60%) are not culturally acquainted with local community. There may be a crisis of social and cultural harmony between communities and workers.	<ul style="list-style-type: none"> • EPC Contractor will appoint Labour Contractor, who maintains the Guidelines of ILO having cultural and human behaviour related good practices. The labour camp will be built in the protected area within the Project premise. Having chance of mixing with the locales during shopping in the market. 	<p>Medium (2)</p> <ul style="list-style-type: none"> • Sensitivity is considered medium, as the workers will be given cultural and behavioural training for increasing power of communication and patience of handling local people prior getting involved in the work (Receptor is community). 	<p>Moderate (3)</p> <ul style="list-style-type: none"> • The construction site is located far away (about 1.9 km to the south and 2.28 km to the west) from the community and settlements. Only chance of mixing of community and the workers is in the market place. 	Moderate adverse (6)	<ul style="list-style-type: none"> • Conduct awareness campaign and develop Code of Conduct for workers on local cultural. • Develop and function the grievance redressal mechanism along with formation of grievance redress committee. • Develop and implement the disclosure system and strong community participation plan. 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> Medium (2)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
								<i>Magnitude:</i> Minimal (1)
Jetty construction	Worker's health and safety	B7. Risks of HIV/AIDS and STI due to the flow of migrant workers.	<ul style="list-style-type: none"> The Project will involve local women in relevant working areas based on skill and thus empowering them for combating the poverty. 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high, as the diseases if contaminated has very low chance of recover. (Receptor is community and worker). 	<p>Minor (2)</p> <ul style="list-style-type: none"> Adoption of cultural and behavioural training and self reliance of the local women jointly will lower the chance of susceptibility of contamination of such ignoble and deadly diseases like HIV/AIDs and STI. 	Moderate adverse (6)	<ul style="list-style-type: none"> Awareness creation on HIV/AIDS infection and diseases through a well-designed campaign implementation plan targeting all risk-prone groups. The awareness programme will be conducted by EPC contractor at the time of induction training and periodic update on HIV/AIDS shall also be shared as and when received from the Govt agencies or NGOs. Hand Leaflet and posters/ banners in using Bangla/ English shall be issued. Empowering women as much as possible through employment in the construction and other official work as eligible. Unskilled and semi-skilled workers should be engaged from the affected communities so that they can be close proximity of their 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
							families and reduce the risk of mixing with other genders.	
Jetty construction	Social facilities and utilities	B8. Increased pressures on local social facilities (i.e., drinking and service water, mosque, trading, communication, electricity, health care facilities,) due to in-flux of such a huge number of migrant labourers/workers (50-60%).	<ul style="list-style-type: none"> The Project Proponent will develop separate social facilities and utilities including health center for the Project officials, OE, EPC and Labour Contractor's officials and workers. 	<p>Medium (2)</p> <ul style="list-style-type: none"> Sensitivity is considered medium, as there is a limited chance of keeping pressure on the local social facilities and utilities. (Receptor is social facilities and utilities). 	<p>Minor (2)</p> <ul style="list-style-type: none"> The Project considers Reverse Osmosis (RO) plant for drinking and other personal level requirements of water. It also creates facilities for health center (which is not only catering to the project workers and staffs but also to nearby communities), market place, trading, mosque, etc. 	Minor adverse (4)	<ul style="list-style-type: none"> Construction contractors will provide all required facilities for workers; provide maintenance and repairing of damages of existing infrastructure facilities, if any due to project activities to minimize pressure on local social facilities. Community engagement plan will be prepared by the EPC Contractor as part of the CEAP and made functional for bringing cultural and communal harmony between the community and the workers. 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)</p>
Jetty construction	Community health and safety	B9. Health and safety risk of the community due to the existence of a construction site(s) and the storage and use	<ul style="list-style-type: none"> The Proponent intends to appoint EPC Contractor having ISO 9000 for construction related issues 	<p>Medium (2)</p> <ul style="list-style-type: none"> Sensitivity is considered medium, as the construction site and storage 	<p>Moderate (3)</p> <ul style="list-style-type: none"> Chance of contamination of hazardous chemicals is less because 	Moderate adverse (6)	<ul style="list-style-type: none"> The Contractor shall follow WBG EHS guidelines and PS-4 on Community Health, Safety, and Security. Exposed stockpiles of materials will be 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		of hazardous chemicals.	including risk protection measures and ISO 14001 for the implementation of Environmental Management Plan (EMP). EPC Contractor will appoint Labour Contractor who maintains the Guidelines of ILO having risk coverage facilities. The construction site will be built in the protected area within the Project premise at a distance of about 2.0 km from the community. Storage of hazardous chemicals should be done safely in a secured place as per the applicable rules and guidelines.	of hazardous chemicals is in the protected area and far away from the local community settlements and also from the labour camp (Receptor is community).	of spillage protection measures.		covered with tarpaulin or impervious sheets before a rainstorm occur. <ul style="list-style-type: none"> • Disposal of hazardous materials following environment friendly manner. • During construction phase the contractor site camps should be properly managed and should maintain proper housekeeping. 	residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)
Jetty	Land use	B10. Around	• EPC Contractor	Medium	Minor	Minor	• The Contractor will seek	Residual

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
construction		150-200 workers will be required during construction of jetty. About 0.31 acres of land will be required for the establishment of workforce/ labour camp temporarily for construction period. This may bring change in existing land use.	will appoint Labour Contractor, who maintains ILO Guidelines and having international standard accommodation arrangement for the workers with all required facilities. As per land requirement for labour camp, the Proponent will allocate 0.31 acres of land to Labour Contractor in the Project premise (Para: 347). • Land has already been acquired as part of the power plant development.	(2) • Sensitivity is considered medium, as the proposed land area for the labour camp is a raised land having no economically important land use or having limited environmental concern. (Receptor is land use).	(2) • The proposed land use is temporary in nature having no or limited disturbance to the environmental components. No significant vegetation and wildlife as well.	adverse (4)	permission for a parcel of rasied land from the Proponent for conducting temporary construction activities for avoiding further disturbances to environmental components. • In case of permission required for river front activities, the Proponent will seek permission from the competent authority in accordance with the law of the land. • Greenery should be developed in the open space allocated for labour camp. • Site closing, decommissioning and proper site remediation works.	Significance: Minimal (2) The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)
Jetty construction	Community health and safety	B11. Safety hazards due to increased road traffic carrying construction materials especially for children and	• A dedicated road is being constructed by the LGED for connecting the proposed Rampal STPP with the Khulna-	High (3) • Sensitivity is considered high, as the road is open to all. Usually rural people	Minor (2) • The road will be provided with proper road marking and traffic aids.	Moderate adverse (6)	• ECP 10: Traffic Management Plan including community friendly traffic schedule for addressing general access to be implemented. • Most of the construction	Residual Significance: Minimal (3) The reason for the change in

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		elderly people.	Mongla Highway Road with the provision for usage by the local community and Project vehicles without affecting each other. The Proponent plays keep active role in proper road marking, signalling and installing other traffic aids.	particularly children and elderly ones sometimes cross the road without noticing vehicle and understanding the speed and thus remains huge susceptibility to accidental event. (Receptor is children and elderly people).			materials will be transported using inland water transport instead of road transport. • Safety and security actions and procedures to protect local community during construction phase.	residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)
Jetty construction	Consumptive water requirement	B12. Considering the water consumption of 50 litre/capita/day (IFC, 2007) for 150-200 workers and 50 officials and Consultants will require about 11-13 metric tons of water per day (Para: 354). This may create extra pressure on the already depleted groundwater source and may	• The Proponent will make adequate consumptive water facilities for the official, personnel and workers to be involved in the Project activities through Reverse Osmosis (RO) Plant as the ground water is scarce and surface water is saline.	High (3) • Sensitivity is considered high, as the drinkable and other consumptive water is scarcely available in the Project site. (Receptor is office personnel and workers)	Minor (2) • The required water for consumptive use will be distributed through pipeline system from the RO Plant. But the sludge of the RO Plant may be contaminant to the environment	Moderate adverse (6)	• Considering the poor quality of surface water and low availability of ground water, it is suggested to avoid abstraction of ground water for non-potable and other uses in the labour camp instead it is recommended to continue with Reverse Osmosis (RO) Plant throughout the Project period. • Effective and efficient use of water should be ensured. • Reuse of water with due	Residual Significance: Minimal (3) The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		lead to ground water mining.			merits sludge management.		treatment in suitable water use area. • Sludge collection sump should be built.	measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)
Jetty construction	Sewage/ solid waste management facilities	B13. Considering sewage waste generation rate of 0.29 kg/person/ day (CCAC Municipal Solid Waste Initiative; www.unep.org/ccac) for 150-200 labours in the camp for about three (03) years, about 41-55 metric tons of sewage/organic solid waste would be generated which would require sound management (Para: 355). Failure of management may pollute the surrounding environment, loose aesthetic	<ul style="list-style-type: none"> • EPC Contractor will appoint Labour Contractor, who maintains ILO Guidelines having international standard of sewage management expertise of the workers and others. • Solid waste generated during construction will be segregated in following category: <ul style="list-style-type: none"> ○ Compostable ○ Re-cycleable ○ Land fill • Accordingly, three facilities will be developed for above categories, i.e., Composting 	<p>High (3)</p> <ul style="list-style-type: none"> • Sensitivity is considered high, as the improper management of sewage may be the source of diseases to the officials, consultants and workers and to local inhabitants and messy outlook. (Receptor is office personnel, workers and local inhabitants). • Latrines and septic tanks are close (within 100 m) to the workforce accommodation facilities and 	<p>Minor (2)</p> <ul style="list-style-type: none"> • The Proponent will build 3-year full scale capacity septic sewage tank for the people involved in different Project activities. 	Moderate adverse (6)	<ul style="list-style-type: none"> • The tentatively required dimension of sewage/organic solid waste tank should be 25 m³ (L-4mXW-2.75mXH-2.25m) for capacitating the 41-55 metric tons of organic solid waste in three years. • The tank should be septic tank for better absorption of liquid by the soil. • Maintain hygienic condition of the water closet (WC) for the next person's use. • Dismantling of septic should be done with proper care and release gases arrested in the tank carefully for avoiding casualty. • Proper sanitation will be maintained according to environmental standards. 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		value and may cause diseases to labours and local inhabitants. Generation of solid waste (kitchen waste) of about 54-68 kg/day for 200-250 workers and Project officials) to be generated from the official dorms and labour camp.	facility, Re-cycle facility and landfill facility. • No untreated liquid waste will be discharge to any water body. • EPC contractor will develop Sweage treatment Plant.	about 2 km away from the community settlement.				
Environmental Impacts during Project Implementation Phase (B):								
Negative Impacts								
Movement of construction materials carrying vehicles	Ambient air condition	B14. Emissions of dust and air pollution will be generated from operation of construction equipment and vehicles, material transport, and site clearance.	<ul style="list-style-type: none"> Most of the construction materials and plant equipment will be transported using water vessels. Movement of Heavy Vehicle shall be mostly confined to project area which is about 1.7-2.0 km away from the local community. Modern and efficient 	High (3) <ul style="list-style-type: none"> Sensitivity is considered High as vulnerable receptor (air quality) has little capacity to absorb proposed changes. 	Minor (2) <ul style="list-style-type: none"> EPC contractor shall prepare the dust suppression and control measures. EPC contractor will continuously monitor the ambient air quality and shall take appropriate measures. 	Moderate Adverse (6)	<ul style="list-style-type: none"> Water the soil surface and any non-asphalted roads, especially in the dry season. Water the soil before starting excavation. The storage and handling of spoil, subsoil, topsoil and materials will be carefully managed to minimize the risk of wind-blown material and dust. Cover hauling vehicles carrying dusty materials moving outside the construction site. 	Residual Significance: Minimal (3) The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			construction equipment will be used in construction activities.				<ul style="list-style-type: none"> • Fit vehicles with appropriate exhaust systems and emission control devices. • Implement Air Quality Management Plan. • Use wind fencing in construction areas that are frequently subjected to high winds. • Reduce activities that create fugitive dust during windy conditions. 	measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)
Jetty construction	Lighting	B15. Increased lighting during construction will impact the surrounding wildlife and birds.	<ul style="list-style-type: none"> • Construction period of Jetty is about three years in two phases including erection period). <ul style="list-style-type: none"> ○ 1st Phase: Jetty construction for unloading of heavy equipment of Power Plant; and ○ 2nd Phase: Jetty construction for unloading of coal and lime, and loading of ash. 	Medium (2) <ul style="list-style-type: none"> • The sensitivity is considered Medium as vulnerable receptor (wildlife and birds) has moderate opportunities for mitigation. 	Moderate (3) <ul style="list-style-type: none"> • Closest terrestrial wildlife habitation areas (small and shabby patches of forest on the left bank of the Passur) are situated on the southeast just beside the Jetty and on the northwest about 700-800 m away from the Jetty. • Construction 	Moderate adverse (6)	<ul style="list-style-type: none"> • Minimize night-time construction activity (where practical). • Use light on an “as and when needed” basis. • Direct lighting toward the ground on working areas, reducing the height of lighting to the extent possible and minimizing the number of lights required through strategic placement. • Use fittings on lamps to direct light and confine the spread of light. • Follow lighting plans. • Halogen bulb/light can be used for its longevity, higher efficiency, money saving, etc. 	Residual Significance: Minimal (2) The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> Medium (2)

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					activity mostly shall be limited to day time.		<ul style="list-style-type: none"> Avoid mercury vapour lamp. 	<i>Magnitude:</i> Minimal (1)
Jetty construction	Soil, air and water quality	B16. Contamination of soil and surface water due to the accidental spills and leakage of fuels and chemicals.	<ul style="list-style-type: none"> Fuel oil and other hazardous materials will be kept in safe and isolated place away from water body. EPC contractor will develop and implement a Hazardous materials management plan in line with international practice. 	<p>High (3)</p> <ul style="list-style-type: none"> The sensitivity is considered High as vulnerable receptor (soil, air and water) has little capacity to absorb the proposed changes. 	<p>Minor (2)</p> <ul style="list-style-type: none"> Hazardous waste will be disposed of following environment friendly and ISM system by designated contractors. Good housekeeping will be adopted to reduce generation of construction wastes and the potential water pollution. 	Moderate adverse (6)	<ul style="list-style-type: none"> Contractor will prepare and implement Pollution Prevention Plan as part of the CEAP. Implement ECP 2: Fuels and Hazardous Goods Management. Contractor to confine the contaminants immediately after such accidental spillage. Contractor to collect contaminated soils and washouts containing petroleum products treat and dispose them in environment friendly manner. All areas intended for storage of hazardous materials to be protected and provided with adequate facilities to combat emergency situations complying all the applicable statutory stipulation. 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)</p>
Disposal of construction waste during Jetty	Soil, air and water quality	B17. Indiscriminate and unplanned disposal of solid	<ul style="list-style-type: none"> Solid/kitchen waste (54-68 kg/day for 200-250 people) 	<p>Medium (2)</p> <ul style="list-style-type: none"> The sensitivity is considered 	<p>Minor (2)</p> <ul style="list-style-type: none"> Hazardous waste will be 	Minor adverse (4)	<ul style="list-style-type: none"> Implement ECP 1 Waste Management. Siting of fuel and hazardous material 	Residual Significance: Minimal (2)

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
construction		and liquid waste may affect local environment adversely.	generated during construction will be segregated in following category: <ul style="list-style-type: none"> ○ Compostable ○ Re-cycleable ○ Landfilling (Para: 352) <ul style="list-style-type: none"> • Accordingly, three facilities will be developed for above categories, i.e., Composting facility, Re-cycle facility and landfill facility. • No untreated liquid waste will be discharged to any water body. 	Medium as vulnerable receptor (environmental elements) has moderate opportunities for mitigation.	disposed of following environment friendly and ISM system by designated contractors. <ul style="list-style-type: none"> • Good housekeeping will be adopted to reduce generation of construction wastes and the potential water pollution. 		storage sites, including refueling facilities, batching plants and construction yards are to be located inside the flood embankments. <ul style="list-style-type: none"> • Hazardous waste will be disposed of following environment friendly manner by designated contractors. • Good housekeeping will be adopted to reduce generation of construction wastes and the potential water pollution. 	The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)
Vegetation clearance for jetty construction	Aquatic wildlife and fisheries habitat	B18. Impact on river habitats by sediment flow (i.e., general habitat and passage of dolphins, fishes and other animals) from construction activities, including clearance of a	<ul style="list-style-type: none"> • Silt curtains along river training works and/or other industry good practice management controls will be used to restrict the spread of sediment released during construction of 	High (3) <ul style="list-style-type: none"> • The sensitivity is considered is high as the vulnerable receptor (wildlife and fisheries) has little capacity to absorb proposed changes. 	Minor (2) <ul style="list-style-type: none"> • The Passur Channel is a tidal river. Lot of natural silt and sediment are generally carried by the river. • Restricted sediment control with 	Moderate adverse (6)	<ul style="list-style-type: none"> • Control of sediment flow from the construction activities. • Silt curtains along river training works and/or other industry good practice management controls will be used to restrict the spread of sediment released during construction of Terminal/Jetty/Materials Offloading Facility 	Residual Significance: Minimal (3) The reason for the change in residual significance is because of the change in magnitude

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		shabby patch of river bank vegetation.	Terminal/Jetty/ Materials offloading facility earthen causeway.		compared to huge flow of river will have minimal effect.		earthen causeway. • Minimize and restrict clearing of river slope and river bank vegetation as much as possible. • Implement ECP 8 Protection of Fauna for species with conservation significance especially endangered and near threatened.	with implementation of suggested mitigation measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)
Pile driving during Jetty construction	Species of conservation significance	B19. In case of pre-cast pile driving activities following concern may arise: Overpressure and sound from pile driving activities will harm riverine animals, including dolphins inhabited in the confluence of the Moidara and the Passur Rivers.	<ul style="list-style-type: none"> There is very little chance of using pre-cast driven piles. Jetty will be developed on cast in-situ type pile driving. 	High (3) <ul style="list-style-type: none"> The dolphin congregated area is at the Moidara and Passur River confluence, which is about 2.0 km downstream of the jetty construction site. Sensitivity is considered High as vulnerable receptor (Species of conservation significance/dol 	Minor (2) <ul style="list-style-type: none"> As Pile driving activity is not envisaged generation of noise shall be minimal. 	Moderate adverse (6)	<ul style="list-style-type: none"> In case of pre-cast pile driving activities following measures will be applicable: <ul style="list-style-type: none"> Pile driving will be completed using Best Management Practices for Pile Driving and Related Operations. Conferring with appropriate organizations to determine the preferred timing and methods of the pile driving. 	Residual Significance: Minimal (3) The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> High (3)

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
				phin) has little capacity to absorb proposed changes.				<i>Magnitude:</i> Minimal (1)
Pile driving during Jetty construction	In-water noise level	B20. Most of the piles will be cast in-situ type. So, underwater noise from piling activities will be remote. In case of pre-cast pile driving activities following concern may arise: Noise from in-water construction along with pile driving generates intense underwater sound pressure waves that will adversely affect riverine organisms including vocalization and behavior of fish, dolphins and other animals concentrated in the confluence of the Moidara and	<ul style="list-style-type: none"> • There is very little chance of using precast driven piles. • Jetty will be developed on cast in-situ type pile driving. 	<p>High (3)</p> <ul style="list-style-type: none"> • Sensitivity is considered High as vulnerable receptor (noise-sensitive aquatic animals and swim bladderless fishes) has little capacity to absorb proposed changes. 	<p>Minor (2)</p> <ul style="list-style-type: none"> • As Pile driving activity is not envisaged generation of noise shall be minimal. 	Moderate adverse (6)	<ul style="list-style-type: none"> • In case of pre-cast pile driving activities following measures will be applicable: • Use of vibratory hammers instead of impact hammers • Monitoring of underwater noise levels and use of underwater air bubble curtains, metal or fabric sleeves to surround the piles to reduce noise levels if required. • A large bubble curtain consists of a hose with drilled holes, supplied with compressed air. The hose is placed on the river bed and the air escaping from the holes forms the bubble screen. [Single bubble curtain reduce noise by: 12 dB (SEL), 14 dB (peak); Double bubble curtain by 17 dB (SEL), 21 dB (Peak)] • Hydro Sound Damper 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		the Passur Rivers, which is about 2.0 km downstream of the jetty construction site.					<p>consists of fishing nets with small balloon filled with gas and foam - tuned to resonant frequencies fixed to it. It can be applied in different ways. [Hydro Sound Damper reduce noise by 4 - 14 dB (SEL)]</p> <ul style="list-style-type: none"> • Setting up cofferdam which consists of a rigid steel tube surrounding the pile. Once the pile is stabbed into the cofferdam, the water is pumped out. [Cofferdam up to 22 dB (SEL) and 18 dB (Peak)] • Conduct pile driving during low tides in intertidal and shallow subtidal areas. • Implement seasonal restrictions when necessary to avoid construction-related impacts to habitat during species' critical life history stages (e.g., spawning and egg development periods). • Reduce sound pressure impacts during pile installation by using 	

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
							<p>wood or concrete piles, rather than hollow steel piles which produce intense, sharp spikes of sound that are more damaging to fish and dolphins having air cavities.</p> <ul style="list-style-type: none"> Underwater noise during piling activities could be carried out with a hydrophone sensor which is normally placed in a water column at least 1 metre deep, with the sensor located at a depth of 0.5 metre above bottom of the water column. 'Reference sound levels from pile driving normally are reported at a fixed distance of 10 meters'. 	
Movement of construction materials carrying vessels	Species of conservation significance	B21. Risk of dolphin collision with construction vessels in River.	<ul style="list-style-type: none"> Construction vessels will follow maritime MPA route being used for last 50-60 years Moreover, collision with dolphin by vessels plying in the channels has 	<p>High (3)</p> <ul style="list-style-type: none"> Grazing of dolphin in and around the proposed jetty site is found nominal. Most congregations of dolphins are observed in the 	<p>Minor (2)</p> <ul style="list-style-type: none"> Dolphin habitat suitability has been studied and found that dolphins are mostly congregated in the 	Moderate adverse (6)	<ul style="list-style-type: none"> Restrict the vessel speeds [minimum speed 8 knot up to vessel, 135 m LOA and 10 knot vessel having maximum 170 m LOA] may be as per MPA rules (MPA Traffic Guidelines). Restrict boat movement within safe distance 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			not been reported.	confluence of the Moidara and the Passur Channel, which is about 2 km away from the jetty site. • The sensitivity is considered High as the receptor (endangered species/dolphin) has little capacity to absorb proposed changes.	tributaries of the Passur for preying facilities. Usually, the vessels sail in the Passur Channel avoiding these habitats. Therefore, collision of dolphin with the vessel in the Passur Channel is rare.		around the construction site if river width permits. Avoid areas where Dolphins are known to congregate at the confluence of Moidara and Passur River, which is 2.0 km away from the jetty site.	change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)
Jetty construction	Vegetation and trees	B22. Clearing of natural vegetation and trees (about 10-15 sapling to medium sized trees will be felled out of about 150-200) during construction activities of jetty in Project areas (Para: 580).	<ul style="list-style-type: none"> • Jetty construction area has very little vegetation & trees. • Avoid felling of ecologically important tree species and those that are protected, along with those that act as nesting and breeding sites. • Tree plantation will be carried out in and around the 	<p>Medium (2)</p> <ul style="list-style-type: none"> • The sensitivity is considered Medium as vulnerable receptor (Vegetation and dependent wildlife) has moderate opportunities for mitigation. 	<p>Minor (2)</p> <ul style="list-style-type: none"> • More trees will be planted in Jetty area. 	Minor adverse (4)	<ul style="list-style-type: none"> • Vegetation clearance shall be limited to the extent required for execution of works. • Contractor will follow ECPs 7 and 8 on Protection of Flora and Fauna while tree felling. • Include environmental management and awareness as part of training for employees during construction. 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			suitable areas in the Project area in adequate numbers of new trees for tree felling (overall tree plantation programme for 0.2-0.3 million trees with the cooperation of Forest Department, Bangladesh).					mitigation measures. <i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)
Construction of camp, access route and jetty	Wildlife habitat	B23. Loss of faunal habitat at locations of construction works, camp, and on access/haul routes due to the felling of trees.	<ul style="list-style-type: none"> A minimum number of trees (10-15) shall be required to fell down at a location of jetty construction work while labour camps and haul routes are devoid of any trees. 	<p>High (3)</p> <ul style="list-style-type: none"> The sensitivity is considered High as the receptor (wildlife habitat) has little capacity to absorb proposed changes. 	<p>Minor (2)</p> <ul style="list-style-type: none"> As the most construction area are devoid of trees the Loss of faunal habitat at locations of construction works, camp, and on access/haul routes due to the felling of trees shall be very minimal 	Moderate adverse (6)	<ul style="list-style-type: none"> Minimize construction or civil works in the shabby patch of plants where birds take shelter. Use of existing access road. Implement ECP 8 Protection of Fauna for species with conservation significance especially endangered and near threatened. Plantation of native trees for restoring the lost habitats of birds and other wildlife. MoU has already been signed with Forest Department for plantation of 0.2-0.3 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
							million native tree species under Greenbelt Development Programme.	<i>Magnitude:</i> Minimal (1)
Earthworks for Jetty construction	Top soil	B24. Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth.	<ul style="list-style-type: none"> Excavation work mostly shall be limited to already developed land. The land was developed by river dredged materials. 	<p>Medium (2)</p> <ul style="list-style-type: none"> The sensitivity is considered Medium as vulnerable receptor (top soil) has moderate opportunities for mitigation 	<p>Minor (2)</p> <ul style="list-style-type: none"> As the area has little vegetation the loss of habitats especially the terrestrial invertebrates shall be minimum. 	Minor adverse (4)	<ul style="list-style-type: none"> Strip the top soil to a depth of 35 cm and store in stock piles of height not exceeding 2m. Remove unwanted materials from top soil like grass, roots of trees and others. Spread the topsoil to maintain the physico-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites. Contractor will prepare Top Soil Management plan as part of the CEAP/SEMP. 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)</p>
Trenching for civil construction of jetty	Terrestrial habitat	B25. Excavation works will impact on the loss of habitats especially the terrestrial	<ul style="list-style-type: none"> Excavation work mostly shall be limited to already developed land. The land was developed by 	<p>Medium (2)</p> <ul style="list-style-type: none"> The sensitivity is considered Medium as vulnerable 	<p>Minor (2)</p> <ul style="list-style-type: none"> As the area has little vegetation the loss of 	Minor adverse (4)	<ul style="list-style-type: none"> Avoid construction during effective rainy days in the monsoon. Minimize digging of trenches and vegetation clearance to minimum 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		invertebrates that live on the ground.	river dredged materials.	receptor (terrestrial invertebrates) has moderate opportunities for mitigation	habitats especially the terrestrial invertebrates shall be minimum.		required level.	change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)
Traffic on local roads for jetty construction	Community health and safety	B26. A large portion of the materials and goods will be transported by river. So, the increment of road transport would be moderate due to coal transportation project. However, there may be little affect access to the trading centre and, houses	<ul style="list-style-type: none"> • Jetty area is situated 2.5-3 km away from the local community to have an impact on health and safety. • Movement of Heavy Vehicle shall be mostly confined to project area which is 1.7-2.0 km away from the local community 	<p>High (3)</p> <ul style="list-style-type: none"> • Sensitivity is considered High as vulnerable receptor (community) has little capacity to absorb proposed changes. 	<p>Minor (2)</p> <ul style="list-style-type: none"> • Six (06) lane access road will be constructed [two (02) lane already constructed] which is passing mainly through non habitat area. 	Moderate adverse (6)	<ul style="list-style-type: none"> • Contractor will implement traffic management plan to ensure uninterrupted traffic movement during construction. • Restrict truck deliveries, where practicable, to day time working hours. • Restrict the transport of oversize loads. • Use covered trucks to avoid spreading of dust. • Ensure proper maintenance of vehicles and roads. • Enforce on-site speed 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		close to the road, deteriorate safety (especially the school children), spillage of fuels and chemicals, and damage to infrastructures and properties due to vibration.					limit, especially close to the sensitive receptors, schools, health centers, etc. <ul style="list-style-type: none"> Implement ECP 10: Traffic Management Inspect structures within the close proximity of construction site for damages. 	mitigation measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)
Movement of heavy equipment and construction vehicle	Community health and safety	B27. Little increase of equipment carrying heavy vehicle movement of on the road may cause noise and vibration affecting workers, project staff and the nearby community. Most of the construction materials and plant equipment will be transported using water vessels.	<ul style="list-style-type: none"> Most of the construction materials and plant equipment will be transported using water vessels. Movement of Heavy Vehicle shall be mostly confined to project area which is away from the local community. 	High (3) <ul style="list-style-type: none"> Sensitivity is considered High as vulnerable receptor (community) has little capacity to absorb proposed changes. 	Minor (2) <ul style="list-style-type: none"> Six (06) lane access road will be constructed [two (02) lane already constructed] which is passing mainly through non habitat area. 	Moderate adverse (6)	<ul style="list-style-type: none"> Construction vehicle movement near settlements will be limited to day time mostly. High noise producing equipment will be provided with mufflers or acoustic hood/enclosures. Install acoustic enclosures around generators and install temporary noise control barriers where appropriate to reduce noise levels. Fit high efficiency mufflers to appropriate construction equipment. Notify affected communities in advance regarding major noisy operation. Implement Noise 	Residual Significance: Minimal (3) The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
							Management Plan.	
Refilling of pools by construction soil or gravel	Terrestrial breeding pools and pans	B28. Loss of temporary breeding pools and pans especially of frogs due to refilling of such pools by construction soil or gravel while constructing the jetty and coal stack yard.	<ul style="list-style-type: none"> Coal Stack yard will be developed in already developed area which was filled by river dredged materials. 	High (3) <ul style="list-style-type: none"> Sensitivity is considered High as vulnerable receptor (breeding pools and pans) has little capacity to absorb proposed changes. 	Minor (2) <ul style="list-style-type: none"> Not much such breeding pools are reported along the river bank. 	Moderate adverse (6)	<ul style="list-style-type: none"> Schedule trench construction during dry season to reduce impact since the amphibian populations will be low during non-breeding season. Fence off the trenches with nets to prevent amphibians falling into the trap. Implement ECP 8 Protection of Fauna for species with conservation significance especially endangered and near threatened. 	Residual Significance: Minimal (3) The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. Sensitivity: High (3) Magnitude: Minimal (1)
Quarry/borrowing activities for civil structure	Land requirement and dispersion of dust	B29. Quarry/borrowing activities for river protection works and associated pilling up of extracted earth may require additional land	<ul style="list-style-type: none"> No new area will be acquired for Quarry and borrowing activity. Excavated earth will be used as borrow materials. 	Medium (2) <ul style="list-style-type: none"> The sensitivity is considered Medium as vulnerable receptor (land and dust) has moderate 	Minor (2) <ul style="list-style-type: none"> Borrow/quarry areas will be developed close to the project area for extraction of earth 	Minor adverse (4)	<ul style="list-style-type: none"> Borrow/quarry areas will be developed close to the project area for extraction of earth material and aggregates for river protection works. No private lands or agriculture lands will be 	Residual Significance: Minimal (2) The reason for the change in residual significance

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		and spread of dust particles respectively.		opportunities for mitigation.	material and aggregates for river protection works. • No private lands or agriculture lands will be used for borrowing.		used for borrowing. • Minimize volume of borrow material by using dredged material generated from the associated component of the Project. • Control dust and air pollution by application of watering. • Photographs recorded of each borrow area showing pre-construction baseline for comparison with after rehabilitation.	is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)
Quarry/ borrowing activities for civil structure	Archaeological site	B30. Damage to unidentified archaeological asset(s) during quarry activities for trenching of civil structure and river protection works.	• No archaeological sites are present within the construction areas.	Medium (2) • The sensitivity is considered Medium as vulnerable receptor (archaeological site) has moderate opportunities for mitigation.	Minor (2) • No archaeological sites are reported within the construction areas. However, in case of any artefact or site of archaeological, cultural, historical, or religious significance are	Minor adverse (4)	• In case of any artefact or site of archaeological, cultural, historical, or religious significance are discovered during construction activities, the works will be stopped in that area, and the appropriate department will be informed. • Contractor will develop a procedure for management of 'Chance Finds'. THE ANTIQUITIES ACT, 1968 of Bangladesh (Draft ANTIQUITIES ACT, 2015) and IFC's	Residual Significance: Minimal (2) The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					discovered during construction activities, the works will be stopped in that area, and the appropriate department will be informed.		PS 8- Cultural Heritage will be followed by the Contractor.	<i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)
Social Impacts during Operation and Maintenance (O & M) Phase (C):								
Positive Impacts								
Operation of Coal transport vessel and others	Employment generation	C1. Generation of employment.	<ul style="list-style-type: none"> Project influenced area has limited employment opportunity (about 50-75 workers and officials in the Jetty and Coal Stack Yard areas; many people are dependent on the Sundarbans for their livelihoods. 	<p>High (3)</p> <ul style="list-style-type: none"> According to the Forest Department in 2016, around 0.1 million people were directly and indirectly dependent on the Sundarbans for their livelihood. Of that figure, the number of fishermen is more than 70,000. (Para: 633) Sensitivity is 	<p>Major (4)</p> <ul style="list-style-type: none"> It will be a major boost to the study area. Increased economic activity will bring out economic opportunities to local people, so impact is considered as high. 	Major beneficial (12)	<ul style="list-style-type: none"> Employment for local workers and technicians, local unskilled labors during operation of the coal transportation and handling. New employment opportunities in shipping and related businesses. Due to availability of quality and uninterrupted electric supply, lots of industries will be developed in Khulna area, which will create a huge employment opportunities and economic activities. 	<p>Residual Significance: Major beneficial (12)</p> <p>With the generation of additional employment opportunity and benefit from the project the residual significance shall be maintained.</p> <p><i>Sensitivity:</i> High (3)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
				considered high, as people have very high expectation from the Project.				<i>Magnitude:</i> Major (4)
Operation of Coal transport vessel and others	Economic activity	C2. Increased economic activity.	<ul style="list-style-type: none"> The major economic activities to be offered by the Project include supply of potable water, collection of oily bilge water from ship, supplying of food and other stuffs, providing workers based on skill, etc. Presently the area is devoid of economic opportunity. Large section of people are living around the project area are living in poor condition with lack of infrastructure facilities. Analyzing the 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high, as people have very high expectation from the project. 	<p>Major (4)</p> <ul style="list-style-type: none"> At present about 4.5 million tons of materials and goods area being handled by MPA per year. During operation of this project, MPA would handle more than 4.5 million tons of materials and goods for this project only. As such, MPA would be able to generate a substantial amount of income from this project. 	Major beneficial (12)	<ul style="list-style-type: none"> At present about 4.5 million tons of materials and goods area being handled by MPA per year. During operation of this project, MPA would handle more than 4.5 million tons of materials and goods for this project only. As such, MPA would be able to generate a substantial amount of income from this project. Establishment of new private businesses and commercial enterprises in shipping and at the anchorage points. Increase in local business opportunities due to shipping. 	<p>Residual Significance: Major beneficial (12)</p> <p>With the enhanced shipping activity, economic activity will get a major boost and local people will get its benefit. The residual significance shall be maintained.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Major (4)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			poverty status, it is found that about 28% households are multidimensional poor (index value 0.37 out of 1= MPI). About 43% of the population lives in these poor households [poverty head count =H] and on average 85% poor people are deprived of any indicator (intensity of deprivation=A). (Para: 647).					
Operation of Coal transport vessel and others	Fishery productivity	C3. Increased movement of vessel may cause disturbance to post larvae (PL) catching which in turn will facilitate wild shrimp production, mixing of oxygen into water and increase in dissolved oxygen.	<ul style="list-style-type: none"> Only at best two (02) vessels per day will be added to the regular traffic in the Passur Channel. 	<p>High (3)</p> <ul style="list-style-type: none"> A section of people in the Sundarbans is engaged in catching of fry and post larvae, which act as detrimental to growth of fish population. About 70,000 people are engaged in 	<p>Medium (3)</p> <ul style="list-style-type: none"> With the regular movement of Vessels, the activity of catching of fry & post larvae will come down which intern help in growth in fish population. 	Major beneficial (9)	<ul style="list-style-type: none"> Since catching of fish and post larvae will be discouraged during operation of the project, as such, the production of shrimp and fish will be increased in the area. If regular monitoring demonstrates decline of shrimp and fish production, necessary measures need to be undertaken to address the alternative livelihood 	<p>Residual Significance: Major beneficial (9)</p> <p>With increase in fish production alternative livelihood restoration of post larvae catcher, the residual</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
				fishing activities in the Sundarbans. • Sensitivity is considered high as population of fisherman are substantial and large section are engaged in catching of fry and post larvae.			opportunities of the affected fisher's community. • Shrimp post larvae catching dependent livelihood will be restored in different phases of power plant construction and operation and also in the industries to be developed in the EPZ, Mongla. • Government should bring the post larvae catchers into the social safety net program.	significance shall be maintained. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Major (3)
Negative Impacts								
Operation of Coal transport vessel and others	Community disturbance	C4. Social disturbance due to non-fulfilment of peoples' expectation from the project.	• Local people has been given first priority for employment based on their skill; • Capacity building programmes like computer training, sewing/tailoring training have been giving to the local community; • Health facilities are being	Medium (2) • Sensitivity is considered medium as the local people are getting social benefits from the Project and in turn boost their socio-economic condition.	Minor (2) • It is expected that local economy will get major boost and with increased economic activity will bring job opportunity and various economic and social opportunities.	Minor adverse (4)	• Make formal arrangement for continued communication and engagement with local stakeholders, in the form of a community engagement cell. • An independent monitoring team will conduct regular monitoring of various socio-environmental parameters. • Disclosure of monitoring results with appropriate methods.	Residual Significance: Minimal (3) With the further enhancement measure suggested residual significance will reduced to minimal. <i>Sensitivity:</i> Medium (2)

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			extended to local community.				<ul style="list-style-type: none"> Ensure consistent communication with local communities, national stakeholders even if they are opponents of the Project. 	<i>Magnitude:</i> Minimal(1)
Operation of Coal transport vessel and others	The Sundarbans and world heritage site ecosystem	C5. Coal dust may affect the vegetation and wildlife of the Sundarbans and world heritage site.	<ul style="list-style-type: none"> Coal would be transported in a covered vessel through the MPA designated route, (Figure 4-1). Vessels will be GPS navigated and assisted by piloting by MPA. Transshipment will be carried out using an environment friendly transhipper/ floating transfer station (FTS). A typical Transfer Station is supported by 2 cranes of grab, 2 hoppers, 2 barge loaders with a loading capacity of 1,000 t/h each. An unloading rate of 16,000 - 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans which is a protected area. However, the UNESCO world heritage site is more than 2 km away from the proposed route in the southern portion of the Sundarbans. Considering the geographical proximity to these protected areas, the sensitivity for the receptor is 	<p>Minor (2)</p> <ul style="list-style-type: none"> Considering coal will be transported in a covered vessels using environment friendly transhipper/ floating transfer station (FTS), follow IMO regulation, having appropriate class vessels, low noise, GPS assisted and navigational piloting aided magnitude of impact will be asserted as minor. Coal transportation 	Moderate adverse (6)	<ul style="list-style-type: none"> Shipping vessel would follow MPA and applicable IMO conventions when transporting coal. Monitor and review of shipping impacts on a regular basis and work with stakeholders to help minimize impacts on protected areas. Periodic audits for the compliance of IMO regulation of coal vessels. 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal(1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			20,000 t/d or 5.00 million t/year can be achieved from mother vessel by using an FTS. (Para: 146-147)	kept high.	route will follow maritime MPA route being used for last 50-60 years, which is 1.5 to 2.75 km away from the outer periphery of the World Heritage Site. As such, no significant/qu antifiable impact is apprehended on the WHS due to transportation of coal.			
Operation of Coal transport vessel and others	Water quality and livelihood	C6. Water quality deterioration due to increase in shipping may impact fish and shrimp growth, on which livelihood of local communities depend on.	<ul style="list-style-type: none"> Covered vessels will be used for coal transportation. Transshipment will be carried out using an environment friendly transhipper/floati ng transfer station (FTS). 	<p>Medium (2)</p> <ul style="list-style-type: none"> Sensitivity is considered medium as Passur is a tidal river and this channel is being used for last 50-60 years for plying cargo vessels and the receptor (local community) has 	<p>Minor (2)</p> <ul style="list-style-type: none"> Deterioration present water quality is unlikely as increase in additional numbers of vessels due to coal transportation is very small compared to 	Minor adverse (4)	<ul style="list-style-type: none"> Monitor and review of potential impacts of vessel movement on a regular basis and work with stakeholders to help minimize pollution. Aware fisherman about the coal vessel movement and potential collision with vessels and consequences. Ensure vigilance and monitoring of pollution due to vessel 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in residual significance is because of the change in magnitude with</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
				some capacity to absorb proposed changes and has moderate opportunities for mitigation	present vessels load. • Increase of vessel for coal transportation is 2.8% and number of Projected Vessels (in 2019-20) is estimated about 23000 (Table 7-30)		movement. • All vessels should comply with the applicable MARPOL and IMSBC conventions.	implementation of suggested mitigation measures. Like ensuring of no discharge of waste water to the Passur river by coal carrying vessels. <i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal(1)
Operation of Coal transport vessel and others	The Sundarbans and world heritage site ecosystem	C7. Increase in shipping, coal transshipment, and coal transport can increase collision induced risk and subsequent spillage, which can affect the functionality of the Sundarbans ecosystem and affect the growth of forestry products (such	• Coal would be transported in a covered vessel through the MPA designated route, (Figure 4-1). • Vessels will be GPS navigated and assisted by piloting by MPA. • Transshipment will be carried out using an environment friendly transhipper/floati	High (3) • Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans which is a protected area. However, the UNESCO world heritage site is more than 2 km	Minor (2) • The project is designed for uses of class vessels with GPS navigation with piloting facility, will keep the magnitude at minor level.	Moderate adverse (6)	• Review of potential impacts of vessel movement on a regular basis and work with stakeholders to help minimize impacts. • Review and update the Sundarbans Forest Management Plan to mitigate potential impacts on livelihood. • Implement Emergency Response plan. A framework of the ERP is developed in the EMP for the MPA to develop	Residual Significance: Minimal (3) The reason for the change in residual significance is because of the change in magnitude with implementation of

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		as timber, honey, medicinal plants, Golpata- Nipa palm and etc.) on which livelihood of local people depend on.	ng transfer station (FTS).	away from the proposed route in the southern portion of the Sundarbans. Considering the geographical proximity to these protected areas, the sensitivity for the receptor (The Sundarbans and World Heritage Site) is kept high.			<p>a comprehensive ERP with appropriate resources, management structure, and effective communication in order to manage any emergency events associated with coal transportation.</p> <ul style="list-style-type: none"> • There should be commitment of MPA and adequate budgetary provision to implement ERP with due diligence. • There should be commitment of the Forest Department (FD) and adequate budgetary provision to implement the prescribed EMP with due diligence. 	<p>suggested mitigation measures and implementation of Emergency Response plan.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal(1)</p>
Environmental Impacts during Operation and Maintenance Phase								
Negative Impacts								
Contract with Suppliers/ shippers of coal	Marine environment and safe transport	C8. Proper documentation of suppliers/ shippers of coal complying with applicable MARPOL and IMSBC Code.	<ul style="list-style-type: none"> • All vessels including both mother and lighterage will comply with the applicable revised Convention for the Prevention of Pollution from Ships (MARPOL) and the 	<p>Medium (2)</p> <ul style="list-style-type: none"> • Sensitivity is considered medium as receptor (marine environment) has moderate opportunities for mitigation. 	<p>Moderate (3)</p> <ul style="list-style-type: none"> • MPA has experience of enforcing international laws as it has been operation for such long time close to 50 to 60 	Moderate adverse (6)	<ul style="list-style-type: none"> • Verify compliance documents of applicable MARPOL and IMSBC Code during cargo clearance from Mongla Port Authority. • Verify documents indicating properties of coal, like GCV, moisture, ash, sulphur content, etc. • Monitor whether liquid 	<p>Residual Significance: Minor (4)</p> <p>The reason for the change in residual significance is because of the change in</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			International Maritime Solid Bulk Cargoes Code (IMSBC). (Para: 182)		years.		residues of coal vessel discharge into the marine environment. • Ensure dry residues and/or the wash water that contains residues from an HME discharged at adequate port reception facilities of the MPA.	magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minor (2)
Operation of Coal transport vessel and others	Noise level	C9. Generation of noise from vessels and transhipper may affect surrounding environment and wildlife at a distance of not more than 1 km, including resident and migratory birds. Sudden and periodic noises may affect animals behaviourally and physiologically. In extreme cases, loss of	<ul style="list-style-type: none"> All vessels including both mother and lighterage vessels will be low noise type engine (98-105 dB; Ref. megasorber.com). 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered High as vulnerable receptor (wildlife) has little capacity to absorb proposed changes. 	<p>Minor (2)</p> <ul style="list-style-type: none"> The noise levels were recorded at 11 locations in the study area during the monitoring period of April, 2014 to January, 2016. (Para: 442) The vessels will move following a narrow channel, which is 2-3 km away from the banks. 	Moderate adverse (6)	<ul style="list-style-type: none"> Coal being unloaded from barges will have minimal drop heights. Adhere to transhipper's environmental control measures recommended in this EIA. Adherence to a comprehensive equipment maintenance program to maintain equipment, and to maximize efficiency and reliability, which will help limit noise levels associated with the operation. System components will be maintained to operate below maximum operating noise levels 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. Like Noise Management</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		hearing through inner ear damage has been observed in laboratory mammals. Furthermore, high levels of noise for fairly short durations have produced significant effects on sexual function, blood chemistry, auditory function and susceptibility to seizures. Neural and hormonal processes may be stressed. Since acoustic signals play a major role in survival, viable behaviour and population dynamics may be disturbed if communication is obscured by					<p>wherever feasible.</p> <ul style="list-style-type: none"> • Maintenance records will be maintained for review by BIFPCL's O/M department. • Noisy mobile equipment supporting the operation will be removed from service wherever practical and replaced with a less noisy alternative. • Noise Management plan for ships/barges will be implemented. • Restrict blowing of whistle within the Sundarbans territory. • Switch off / throttle down of all equipment when not in use • For the life of the operation, BIFPCL will evaluate noise levels and onsite activities to identify opportunities for using less noisy equipment and / or making changes to day to day operations that may reduce overall noise levels. 	<p>plan for ships/barges will be implemented</p> <p><i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal(1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		background noise ²¹ .						
Operation of Coal transport vessel and others	Lighting	C10. Increased lighting from ships/barges can create disturbances to the surrounding wildlife at a distance of more than 1 km, including resident and migratory birds, the Masked Fin foot, Spoon Billed Sandpiper, White Rumped Vulture, Slender-billed Vulture, White-headed Duck, and Greater Spotted Eagle are considered to be endangered.	<ul style="list-style-type: none"> All vessels including both mother and lighterage vessels will use low beam of light during night operation. 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high as vulnerable receptor (endangered wildlife) has little or no capacity to absorb proposed changes. 	<p>Minor (2)</p> <ul style="list-style-type: none"> The vessels will move following a narrow channel, which is 2-3 km away from the banks in straight line path with directed low beam of light. Vessels will have facility of piloting minimising the high beam of light. 	Moderate adverse (6)	<ul style="list-style-type: none"> Minimize night-time activity (where practical). Use light on an “as and when needed” basis. Use fittings on lamps to direct light and confine the spread of light. Ensure lights are in good condition at all times. Adoption of EMP Sub-plan 2: Biodiversity Management Plan. 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>
Operation of Coal transport vessel and others	Water quality	C11. Contamination risk from effluents (residue of ballast water,	<ul style="list-style-type: none"> All vessels including both mother and lighterage vessels will 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high, as the 	<p>Minor (2)</p> <ul style="list-style-type: none"> The IMO introduced new 	Moderate adverse (6)	<ul style="list-style-type: none"> Strictly follow MARPOL Convention, as applicable Annex V on the Prevention of Pollution by Garbage 	<p>Residual Significance: Minimal (3)</p> <p>The reason</p>

²¹ Glover, T. O., Hinkley, M. E., and Riley, H. L. (1970); Unit Train Transportation of Coal: Technology and Description of Mine Representative Operations, US Bureau of Mines, Information Circular, 8444, pp. 109.

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		bilge water, oil, lubricant, garbage, domestic waste, food and kitchen waste, coal leachate, sewage, etc.) from ships.	follow the IMO & MARPOL convention as applicable and all vessels are self contained.	proposed coal transportation route is passing through the Sundarbans which is a protected area. However, the UNESCO world heritage site is more than 2 km away from the proposed route in the southern portion of the Sundarbans. Considering the geographical proximity to these protected areas, the sensitivity for the receptor (water quality and aquatic organisms) is kept high.	classification criteria to enable identification of substances harmful to the marine environment (HME). The discharge of residues of certain cargoes into the sea will no longer be allowed when the cargo is classified as a substance harmful to the marine environment. For such cargoes the dry residues and/or the wash water that contains residues from an HME must be discharged at adequate port reception facilities.		<p>from Ships, the IMO introduced new classification criteria to enable identification of substances harmful to the marine environment (HME).</p> <ul style="list-style-type: none"> • Coal transportation shall be carried out using existing navigational route of the MPA. • Responsible authorities will properly enforce rules and regulations of MPA and MARPOL in the management of bilge and ballast water, oily water discharge, waste and waste water. • MPA should ensure adequate port waste (solid and liquid) reception facilities. • Results of monitoring and enforcement should be disclosed through appropriate method and means. 	<p>for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>
Operation of	Aquatic	C12. Pollution	• All vessels	High	Minor	Moderate	• Ensure dry residues	Residual

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Coal transport vessel and others	habitat	from ships may affect aquatic habitats and reduce fish and crustacean production and recruitment. There will be risk to aquatic species, including species of conservation significance of estuarine/coastal animals such as Batagur turtle and otter.	including both mother and lighterage vessels will follow the IMO & MARPOL convention as applicable and all vessels are self contained.	(3) • Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans which is a protected area. However, the UNESCO world heritage site is more than 2 km away from the proposed route in the southern portion of the Sundarbans. Considering the geographical proximity to these protected areas, the sensitivity for the receptor is kept high.	(2) • The IMO introduced new classification criteria to enable identification of substances harmful to the marine environment (HME). The discharge of residues of certain cargoes into the sea will no longer be allowed when the cargo is classified as a substance harmful to the marine environment. For such cargoes the dry residues and/or the wash water that contains residues from an HME must be discharged	adverse (6)	and/or the wash water that contains residues from an HME discharged at adequate port reception facilities (that has to be ensured by the MPA). • A facility to be developed in the MPA designated area for receiving the bilge for lighterage that will be calling at the plant jetty. • Follow applicable MARPOL Convention for all shipping activities, which is the main International convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. • Responsible authorities will properly enforce rules and regulations of MPA and applicable MARPOL in the management of bilge and ballast water, oily water discharge, waste and waste water. They will be discharged at adequate port reception facilities.	Significance: Minimal (3) The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					at adequate port reception facilities		<ul style="list-style-type: none"> • Use of class lighterage vessels for transporting coal from the anchorage points to the jetty. • Implement EMP Sub-plan 2: Biodiversity Management Plan • Impact of vessel movement on water, mangrove forest, riverine species, etc. are being monitored and is suggested to continue the monitoring activities till the end of the power plant project life. Based on the monitoring report, appropriate measures should be taken for mitigating impacts, if any. 	
Operation of Coal transport vessel and others	Wildlife and other aquatic animals	C13. Enhanced maritime traffic may have impact on dolphins, fish, and crustaceans.	<ul style="list-style-type: none"> • Route selection was finalized with the intention of avoiding dolphin sanctuaries in the Chandpai-Shela Gang and the Dhangmari. • Primary survey on dolphin abundance was conducted in both Chandpai and Dhangmari 	<p>High (3)</p> <ul style="list-style-type: none"> • Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans which is a protected area. However, the UNESCO word 	<p>Minor (2)</p> <ul style="list-style-type: none"> • Dolphin habitat suitability has been studied and found that dolphins are mostly congregated in the tributaries of the Passur for preying 	Moderate adverse (6)	<ul style="list-style-type: none"> • Implement EMP Sub-plan 2: Biodiversity Management Plan. • Vessel movement should be through a fixed alignment of the river (optimization of the lane and dimension of the fairways) designated by the MPA. • Encourage the use of bow thrusters for all coal vessels or use pingers for repelling aquatic 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			<p>sanctuaries to assess the impact pattern.</p> <ul style="list-style-type: none"> Wildlife sanctuaries (Dhangmari and Chandpai-Shela Gang) connected to the Passur Channel have been marked on the map (Figure 7-32 and Figure 7-33). 	<p>heritage site is more than 2 km away from the proposed route in the southern portion of the Sundarbans. Considering the geographical proximity to these protected areas, the sensitivity for the receptor (wildlife and aquatic animals) is kept high.</p>	<p>facilities. Fishing nets induced casualty of dolphins is dominant factor in this area. Due to increased movement of vessel would discourage fishing nets in the Passur Channel.</p> <ul style="list-style-type: none"> Usually, the vessels sail in the Passur Channel avoiding these habitats. Therefore, collision of dolphin with the vessel in the Passur Channel is rare. 		<p>animals.</p>	<p>implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>
Operation of Coal transport vessel and others	River traffic	C14. Enhanced maritime/river traffic (presence of barges and associated vessels) may	<ul style="list-style-type: none"> The vessels will move following a narrow channels (about 200 m). Vessels will have facility of GPS 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high, as the proposed coal 	<p>Minor (2)</p> <ul style="list-style-type: none"> Effective increase in number of traffic due to 	Moderate adverse (6)	<ul style="list-style-type: none"> Provide navigation aids for the barges and associated vessels. Provide proper navigational lighting. Check all navigational 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		pose a risk to local river traffic.	and piloting.	transportation route is passing through the Sundarbans and beside the World Heritage Site.	coal transportation is small considering the total no of vessels plying through the channel.		lights routinely to ensure that they are working properly.	change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. Sensitivity: High (3) Magnitude: Minimal (1)
Operation of Coal transport vessel and others	River traffic	C15. Movement of bulk carriers and class lighterage carrying coal and limestone may generate wave on sea and inland water that might cause erosion along seashore and riverbank, including more than 1 km from route. It might also increase the rate	<ul style="list-style-type: none"> The vessels will move following a narrow channel (about 200 m), which is at safe distances from the bank (0.5 km to several kilometers at places) and maintaining the speed limits imposed by MPA. 	<p>Medium (2)</p> <ul style="list-style-type: none"> Sensitivity is considered medium as vulnerable receptor (vessels) has some capacity to absorb changes. 	<p>Minor (2)</p> <ul style="list-style-type: none"> Effective increase in number of traffic due to coal transportation is small considering the total no of vessels plying through the channel 	Minor adverse (4)	<ul style="list-style-type: none"> Erosion along the banks of the Passur River to be monitored routinely by the concerned authorities like the MPA, etc. In general, restriction on vessel speed limits risk of erosion. Vessel speed in the route of the Mongla Port is guided by the MPA [minimum speed 8 knot up to vessel, 135 m LOA and 10 knot vessel having maximum 170 m LOA]. 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		of erosion at existing erosion prone areas.						measures. <i>Sensitivity:</i> Medium(2) <i>Magnitude:</i> Minimal (1)
Operation of Coal transport vessel and others	Deep pools as refuge areas of aquatic fauna	C16. Erosion caused by vessel wakes results in excessive sedimentation in the deep pools where larger fishes and dolphins congregate for feeding and as refuge areas.	<ul style="list-style-type: none"> The vessels will move following a narrow channels, which is 2-3 km away from the banks maintaining the speed limits imposed by MPA. 	Medium (2) <ul style="list-style-type: none"> Sensitivity is considered medium as vulnerable receptor (aquatic fauna) has some capacity to absorb changes. 	Minor (2) <ul style="list-style-type: none"> Effective increase in number of traffic due to coal transportation is small considering the total no of vessels plying through the channel 	Minor adverse (4)	<ul style="list-style-type: none"> Maintain speed limit of vessel sailing through the MPA route. Take special precaution and maintain safe distance while passing close to the dolphin sanctuaries. Erosion on both sides of the MPA route to be monitored routinely and accordingly measures to be taken 	Residual Significance: Minimal (2) The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> Medium(2) <i>Magnitude:</i> Minimal (1)
Operation of Coal transport vessel and others	Species diversity and composition	C17. Movement of foreign vessels can risk of invasion of alien species. Alien	<ul style="list-style-type: none"> All vessels including both mother and lighterage vessels will 	High (3) <ul style="list-style-type: none"> Sensitivity is considered high, as the 	Minor (2) <ul style="list-style-type: none"> The IMO introduced new 	Moderate adverse (6)	<ul style="list-style-type: none"> Quarantine inspection should be conducted. Responsible authorities will regularly inspect shipping and barging 	Residual Significance: Minimal (3)

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		species might come through ballast water, hull-fouling, and by contact of vessel body, these species may compete with native species and therefore threaten biodiversity of the Sundarbans and their abundances.	follow the IMO & MARPOL convention as applicable and all vessels are self contained.	proposed coal transportation route is passing through the Sundarbans and the WHS. Thus the vulnerable receptor (Species diversity) with little capacity to absorb proposed changes.	classification criteria to enable identification of substances harmful to the marine environment (HME). The discharge of residues of certain cargoes into the sea will no longer be allowed when the cargo is classified as a substance harmful to the marine environment.		activities to detect introduced species early. <ul style="list-style-type: none"> • Standard operational practice, including IMO Conventions and ECR 1997 shall be followed by the transportation agency. • Prevent the introduction of species, especially from ballast water and hull-fouling. • The outcome of disclosure of inspection of vessels and enforcement records should be made through appropriate method and means. 	The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)
Operation of Coal transport vessel and others	The Sundarbans and world heritage site ecosystem	C18. Movement of coal and limestone vessels and transshipment process may have impacts on the surrounding the Sundarbans Ecosystem (including, terrestrial wildlife, aquatic fauna	<ul style="list-style-type: none"> • Coal would be transported in a covered vessel through the MPA designated route, (Figure 4-1). • Vessels will be GPS navigated and assisted by piloting by MPA. • Transshipment will be carried out using an 	<p>Very High (4)</p> <ul style="list-style-type: none"> • Sensitivity is considered very high, as the proposed coal transportation route is passing through the Sundarbans which is a protected area and proximity of 	<p>Minor (2)</p> <ul style="list-style-type: none"> • Findings of alternative analysis reveal that the designated route of the Mongla Port Authority (MPA) along the Passur River is the 	Moderate adverse (8)	<ul style="list-style-type: none"> • Ensure enforcement of ECA, 1995 (as amended in 2010) and ECR, 1997 (as amended in 2005), Forest Protection Act, and other rules, regulation and treaties for conserving the Sundarbans and Ecological Critical Areas. • Coal will be transported 	<p>Residual Significance: Minimal (4)</p> <p>The reason for the change in residual significance is because of the change in magnitude</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		and nearby World Heritage Site).	<p>environment friendly transhipper/floati ng transfer station (FTS).</p> <ul style="list-style-type: none"> • All vessels including both mother and lighterage will comply with the applicable revised Convention for the Prevention of Pollution from Ships (MARPOL) and the International Maritime Solid Bulk Cargoes Code (IMSBC). • The vessels will move following a narrow channel, which is 2-3 km away from the banks maintaining the speed limits imposed by MPA. 	UNESCO word heritage site.	best feasible route, which will have less environmental impacts compared to other alternatives. This is a maritime route. This route is in use for last 50-60 years. All type of cargo vessels including substantial coal cargo in open are regularly plying through this route. Moreover, effective increase in number of traffic due to coal transportation is small considering the total no of vessels plying through the		<p>in covered class vessels.</p> <ul style="list-style-type: none"> • Every kind of discharge from ship should follow applicable MARPOL Convention. • Restrict outside lighting of the water vessel during navigation across the Sundarbans. • Restrict the beaming of search light on Forest area/Sea Shores/ Protected Beach/ Protected Areas. • Use low beam of search light during navigation across the Sundarbans/Bird Colony Annex 9-1. • Restrict blowing of whistle within the Sundarbans • Introduce speed limitation for vessels in the Sundarbans • Anchorage of water vessel only in designated sites. • Implement Biodiversity Management Plan. • Results of monitoring and enforcement should be disclosed through appropriate method and 	<p>with implementati on of suggested mitigation measures.</p> <p><i>Sensitivity:</i> very High (4) <i>Magnitude:</i> minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					channel.		means.	
Operation of Coal transport vessel and others	Ambient air quality	C19. Impact of gaseous emissions from vessels and transhipper on ambient air quality	<ul style="list-style-type: none"> Air Quality modeling assessment for project case shows ambient air quality will remain much below the National Ambient Air Quality Standards after the implementation of project. 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans and the WHS. Thus the vulnerable receptor (air) with little capacity to absorb proposed changes. 	<p>Minor (2)</p> <ul style="list-style-type: none"> To assess the cumulative impact, including future proposed developments in the airshed. USEPA regulatory model CALPUFF is used to predict the effect on ambient air quality for SO₂, NO_x, CO, PM_{2.5} and PM₁₀ emissions. (Para: 756) The emissions of air pollutants and greenhouse gases have been estimated using USEPA AP-42 and 	Moderate adverse (6)	<ul style="list-style-type: none"> Air Quality modeling assessment for project case shows ambient air quality within the National Ambient Air Quality Standards. Implementation of Air Quality Management Plan. All vessels will comply with applicable international and national standards, e.g., IMO conventions, MARPOL, HNS Convention, etc. 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					<p>IPCC emission factors. In such estimates, coal transportation systems including mother vessels, lighterage and transhipper have been used and for coal power plant 80% plant factor was used. Table 9-7.</p> <ul style="list-style-type: none"> • Table 9-17 shows Predicted Maximum Concentration s of NO_x (Baseline & Project Case) • Table 9-24 shows the Predicted maximum concentration s of SO₂ (Baseline & 			

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
					Project Case)			
Transshipping of coal from mother vessel to trans-shipper to lighterage	Aquatic habitat	C20. Accumulation of fugitive coal dust and coal spills on riverbed during loading and unloading by trans-shipper at the mooring area.	<ul style="list-style-type: none"> Coal spillage and pollution will be prevented by the following devices in a floating transfer station: Duly designed hoppers: larger hoppers facilitate the operation of the crane driver. Hoppers are provided with ante-spillage plates so that the cargo spillage, if any, is collected inside the hoppers instead of falling into the sea. Grabs equipped with dust cover plates. Closed conveyor belts: all belts and the loading boom are covered to avoid wind borne dust and are kept clean by means of scrapers. Storage: an 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans and the WHS. Thus the vulnerable receptor (aquatic habitat) with little capacity to absorb proposed changes. 	<p>Minor (2)</p> <ul style="list-style-type: none"> Transshipment will be carried out using an environment friendly trans-shipper/floating transfer station (FTS). Coal has a property of not mixed with water chemically only physically in its raw form and its deposition is expected to be minimal and localized through the application of various mitigation measures stated above. As a result, it is not anticipated that any coal or coal dust 	Moderate adverse (6)	<ul style="list-style-type: none"> Accumulation of coal dust in the transshipment point of coal will be periodically monitored. Based on the findings, mitigation measures (if required) will be carried out. Add water mist to wet the coal to prevent dusting. Specific design and material handling procedures will be used to minimize the loss of coal in the marine environment. Maintenance of facilities, including daily cleaning, is proposed to reduce the build-up of dust that could become a source of sediment during rain events. 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			<p>emergency storage of coal for facilitating early leaving of the mother vessel.</p> <ul style="list-style-type: none"> • High-efficiency diesel generators: the internal combustion engines of the auxiliary generators are of high fuel efficiency type, thus minimizing emissions. • Sewage system: the sewage treatment unit is in accordance with Class Rules (Page 4-7). 		deposited in the marine environment from the Project will affect the mortality risk or health of fish and invertebrates. However, the concentration of coal dust in water and surroundings has to be monitored routinely and based on the monitoring report, mitigation measures are to be taken, if required.			
Transshipping of coal from mother vessel to transhipper to lighterage and to plant jetty	Water quality	C21. Impact of fugitive coal dust and coal spills on river water quality, particularly at Mazhar Point and Plant jetty during lighterage load-out and	<ul style="list-style-type: none"> • Coal will be unloaded using covered coal conveyor. • Coal spillage and pollution are prevented by the following devices in a floating transfer station: 	<p>High (3)</p> <ul style="list-style-type: none"> • Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans 	<p>Minor (2)</p> <ul style="list-style-type: none"> • Transshipment will be carried out using an environment friendly transhipper/floating transfer 	Moderate adverse (6)	<ul style="list-style-type: none"> • Use recommended dust control measures for loading coal. Specific design and material handling procedures will be used to minimize the loss of coal in the marine environment during handling and transport activities. 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		load-in, transshipper mooring, and lighterage transport.	<ul style="list-style-type: none"> • Duly designed hoppers: larger hoppers facilitate the operation of the crane driver. Hoppers are provided with ante-spillage plates so that the cargo spillage, if any, is collected inside the hoppers instead of falling into the sea. • Grabs equipped with dust cover plates. • Closed conveyor belts: all belts and the loading boom are covered to avoid wind borne dust and are kept clean by means of scrapers. • Storage: an emergency storage of coal for facilitating early leaving of the mother vessel. • High-efficiency 	and the WHS. Thus the vulnerable receptor (water quality) with little capacity to absorb proposed changes.	station (FTS).		<ul style="list-style-type: none"> • Water/mist system used to spray coal during the unloading process. • Cover coal stack yard except for entry/exit points. • Grabs in floating transfer station (transshipper) will be equipped with dust cover plates. • The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is expected to control dust throughout the transportation chain. • Maintenance of facilities, including daily cleaning, is proposed to reduce the build-up of dust that could become a source of sediment during rain events. • Minimize drop heights when using cranes. 	<p>of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			<p>diesel generators: the internal combustion engines of the auxiliary generators are of high fuel efficiency type, thus minimizing emissions.</p> <ul style="list-style-type: none"> • Sewage system: the sewage treatment unit is in accordance with Class Rules (Para: 180). 				<ul style="list-style-type: none"> • Implement Air Quality Management Plan. • Results of air quality monitoring and enforcement actions should be disclosed through appropriate method and means. 	
Transshipping of coal from mother vessel to transhipper to lighterage	Mangrove forest	<p>C22. Impact of coal dust emissions from unloading and loading and lighterage transport on biodiversity of the Sundarbans. Fugitive coal dust can coat mangrove leaves and reduce photosynthesis in the Sundarbans located more than 1 km from the source.</p>	<ul style="list-style-type: none"> • Coal will be unloaded using covered coal conveyor. • Coal spillage and pollution are prevented by the following devices in a floating transfer station: • Duly designed hoppers: larger hoppers facilitate the operation of the crane driver. Hoppers are provided with ante-spillage 	<p>High (3)</p> <ul style="list-style-type: none"> • Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans and the WHS. Thus the vulnerable receptor (mangrove forest) with little capacity to absorb 	<p>Minor (2)</p> <ul style="list-style-type: none"> • Transshipment will be carried out using an environment friendly transhipper/floating transfer station (FTS). 	Moderate adverse (6)	<ul style="list-style-type: none"> • As a secondary dust mitigation measure, water mist will be sprayed on the lighterage vessels in a controlled manner, as deemed necessary by the operations superintendent or the Environmental Coordinator. • The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			<p>plates so that the cargo spillage, if any, is collected inside the hoppers instead of falling into the sea.</p> <ul style="list-style-type: none"> • Grabs equipped with dust cover plates. • Closed conveyor belts: all belts and the loading boom are covered to avoid wind borne dust and are kept clean by means of scrapers. • Storage: an emergency storage of coal for facilitating early leaving of the mother vessel. • High-efficiency diesel generators: the internal combustion engines of the auxiliary generators are of high fuel 	proposed changes			<p>conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is expected to control dust throughout the transportation chain.</p> <ul style="list-style-type: none"> • Covered lighterage (class vessel) has been included in project design. • Grabs in floating transfer station (transshipper) will be equipped with dust cover plates. • Implement EMP Sub-plan 2: Biodiversity Management Plan • Implement Water Quality Management Plan (coal dust mitigation measures). • Results of water quality monitoring, sediment monitoring and enforcement actions should be disclosed through appropriate method and means. 	<p>measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			efficiency type, thus minimizing emissions. • Sewage system: the sewage treatment unit is in accordance with applicable Class Rules.					
Transshipping of coal from mother vessel to transhipper to lighterage and to plant jetty	Worker's health and safety	C23. Impact of fugitive coal dust from transshipment and transfer processes on human health (operation staffs) as there is no settlements close by.	• Coal spillage and pollution are prevented by the following devices in a floating transfer station: • Duly designed hoppers: larger hoppers facilitate the operation of the crane driver. Hoppers are provided with ante-spillage plates so that the cargo spillage, if any, is collected inside the hoppers instead of falling into the sea. • Grabs equipped with dust cover plates. • Closed conveyor belts: all belts	Medium (2) • Sensitivity is considered medium as vulnerable receptor (worker's health and safety) has some opportunities for mitigation.	Moderate (3) • The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is	Moderate adverse (6)	• Use recommended dust control measures for loading and unloading coal. • Water/mist system used to spray coal during the unloading and transfer processes. • Cover coal stack yard except for entry/exit points. • Grabs in floating transfer station (transshipper) will be equipped with dust cover plates. • The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting	Residual Significance: Minimal (2) The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			<p>and the loading boom are covered to avoid wind borne dust and are kept clean by means of scrapers.</p> <ul style="list-style-type: none"> • Storage: an emergency storage of coal for facilitating early leaving of the mother vessel. • High-efficiency diesel generators: the internal combustion engines of the auxiliary generators are of high fuel efficiency type, thus minimizing emissions. (Para: 180). 		expected to control dust throughout the transportation chain.		<p>and sprinkling at coal transfer and handling areas, is expected to control dust throughout the transportation chain.</p> <ul style="list-style-type: none"> • Minimize drop heights when using cranes and curved chutes at transfer points. • Use enclosed conveyor system equipped with water spraying nozzles. • Use of mechanical profiling of coal in conveyors to limit exposure to air flow. • Mandatory use of appropriate PPEs for all operation staffs. • Implement Air Quality Management Plan. • Results of air quality monitoring and enforcement actions should be disclosed through appropriate method and means. 	
Storing coal in the temporary coal storage or in the stack yard	Air quality	C24. Spreading of coal dust and dispersion of fugitive dust from coal storage may affect surrounding environment.	<ul style="list-style-type: none"> • All fully enclosed redundant belt conveyors, conveyor bridges and transferring towers needed to supply the coal to the coal yard will 	<p>Medium (2)</p> <ul style="list-style-type: none"> • Sensitivity is considered medium as Vulnerable receptor (Air Quality) has 	<p>Minor (2)</p> <ul style="list-style-type: none"> • The use of dust suppressants, in combination with misting 	Minor adverse (4)	<ul style="list-style-type: none"> • There will be fully covered coal storage except for entry/exit points. • Use recommended dust control measures for loading coal. • Water/mist system used 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			<p>be used.</p> <ul style="list-style-type: none"> • Four (4) portal reclaimers for longitudinal coal storages for reclaiming and blending the coal, fully equipped with water spray for dust suppression will be used. • Fully covered coal stack yard, consisting of 4 longitudinal coal storages, with a minimum capacity of ninety (90) days of total supply (BMCR operation with worst coal), including dewatering system and coal runoff pond will be used. • Water spray system for the coal stack yard for dust suppression will be used. • Full roof 	some opportunities for mitigation	and sprinkling at coal stack yard is expected to control dust throughout the coal receiving and supply chain.		<p>to spray coal during the unloading process.</p> <ul style="list-style-type: none"> • Cover all receiving stack yard except for entry/exit points. • Minimize drop heights and curved chutes at transfer points. • Plant vegetation around storage area to prevent wind from dispersing fugitive dust emissions. 	<p>residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			<p>coverage of the coal stock yard to prevent dust emissions and to protect against rain; Provision of direct feeding of coal from conveyor from jetty to bunkering path conveyor bypassing stock yard shall be provided (Para: 187)</p> <ul style="list-style-type: none"> • Dust extraction system shall be either wet type dust extraction system for Vibrating Grizzly Screen and Belt Feeder in crusher house. The dust extraction system shall be of Venturi scrubber system. One independent dust extraction system for each stream shall be provided (Total 2 nos. system to be 					

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			provided). Dust extraction system may have multiple Units in each of the independent dust extraction system. (Para: 286)					
Dust suppressants during coal transshipping	Water quality	C25. Discharge of contaminants through spills; discharge of coal to water bodies will release Polycyclic Aromatic Hydrocarbons (PAHs) into aquatic environment.	<ul style="list-style-type: none"> Coal spillage and pollution are prevented by the following devices in a floating transfer station: Duly designed hoppers: larger hoppers facilitate the operation of the crane driver. Hoppers are provided with ante-spillage plates so that the cargo spillage, if any, is collected inside the hoppers instead of falling into the sea. Grabs equipped with dust cover plates. Closed conveyor belts: all belts 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high as vulnerable receptor (water quality) with little capacity to absorb proposed changes. 	<p>Minor (2)</p> <ul style="list-style-type: none"> Numerous studies concluded that PAHs are not bioavailable because of the source of PAH in the sediments was from pitch globules and coal particles to which the PAHs were tightly bound. 	<p>Moderate adverse (6)</p>	<ul style="list-style-type: none"> Implementation of management plans to mitigate effects of discharge from spills. Numerous studies concluded that PAHs are not bioavailable because of the source of PAH in the sediments was from pitch globules and coal particles to which the PAHs were tightly bound. The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is expected to 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			and the loading boom are covered to avoid wind borne dust and are kept clean by means of scrapers. • Storage: an emergency storage of coal for facilitating early leaving of the mother vessel (Para: 180).				control dust and spills throughout the transportation chain. • Periodical monitoring of deposition of coal and coal dust on the river/channel bed at transshipment area. In case of noticeable coal dust deposition, they will be removed for safe disposal on land.	
Storing coal in the temporary coal storage or in the stack yard	Water quality	C26. Coal contaminated drainage run-off from coal storage will release PAHs into aquatic environment.	<ul style="list-style-type: none"> • Stockpile areas will be bunded to control runoff and prevent it from entering natural waterways. • Runoff will be directed through drainage systems fitted with sumps and settling ponds to reduce Leachate run-off. • Suitable sump pumps for dewatering all underground tunnels /installations 	<p>Medium (2)</p> <ul style="list-style-type: none"> • Sensitivity is considered medium as vulnerable receptor (water quality) has some opportunities for mitigation. 	<p>Minor (2)</p> <ul style="list-style-type: none"> • Combination of Control runoff, drainage systems fitted with sumps and settling ponds will help to limit the contamination at low level. 	Minor adverse (4)	<ul style="list-style-type: none"> • Separately collect coal drainage wastewater (including leachate, collected water, and exposed water) in a gravity driven settlement pond and implement ECP 1: Waste Management and Run-off collection and treatment to mitigate and to reduce the impacts of run-off into nearby waterways prior to it being recycled or discharged the same. 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			<p>shall be provided.</p> <ul style="list-style-type: none"> Run-off water from the coal yard (coming from dust suppression system) shall be directed to the coal settling pond through drainage system and decanted water from settling pond shall be pumped to tank of dust suppression pump house. Sump pump with sump shall be provided for all under ground tunnel, building. The capacity of each sump pump shall not be less than 50 m³/hr. Minimum 10% margin on capacity and 20% margin on computed head shall be considered for 					<p><i>Sensitivity:</i> Medium (2) <i>Magnitude:</i> Minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			selection of pumps. (Para: 198). Contaminated water would be decanted and separated from coal dust and water would be pumped to dust suppression pump tank for reusing. No water from this system would be released to the open water.					
Coal in the covered vessel	Fire risk of resources	C27. Risk of fire from spontaneous combustion and oxygen depletion from coal transport.	<ul style="list-style-type: none"> All vessels including both mother and lighterage will comply with the applicable revised Convention for the Prevention of Pollution from Ships (MARPOL) and the International Maritime Solid Bulk Cargoes Code (IMSBC). 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans and the WHS. Thus the vulnerable receptor (fire risk) with little capacity to absorb proposed 	<p>Minor (2)</p> <ul style="list-style-type: none"> As Transport of coal will take place following IMSBC Code in Cargo B, which has a prescription for control of such hazard. 	Moderate adverse (6)	<ul style="list-style-type: none"> Transport coal following IMSBC Code in Cargo B, coal can create flammable atmospheres, may heat spontaneously and may deplete the oxygen concentration. When the ship master is concerned that the cargo is showing any signs of self-heating or spontaneous combustion, such as an increase in the concentration of methane or carbon monoxide or an 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
				changes.			<p>increase in temperature, the following actions shall be taken:</p> <ul style="list-style-type: none"> • Consult with the ship's agent at the loading port. The Company's designated person ashore shall be advised immediately. • Check the seal of the cargo space and re-seal the cargo space, as necessary. • Do not enter the cargo space and do not open the hatches, unless the master considers access is necessary for the safety of the ship or safety of life. When any ship's personnel have entered into a cargo space, re-seal the cargo space immediately after the personnel vacate the cargo space. Increase the frequency of monitoring the gas composition, and temperature when practicable, of the cargo. 	<p>measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
Operation of Coal transportation and other vessels	Water pollution	C28. Risk of oil spill due to the collision between coal vessel and oil tanker.	<ul style="list-style-type: none"> Coal would be transported in a covered vessel through the MPA designated route, (Figure 4-1). All vessel both mother and lighterage vessels are of class vessels. All vessel will move through a narrow designated channel. Vessels will be GPS navigated and assisted by piloting by MPA. 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans and the WHS. Thus the vulnerable receptor (water quality) with little capacity to absorb proposed changes. 	<p>Minor (2)</p> <ul style="list-style-type: none"> All coal vessels will be operated under the supervision of the MPA designated pilot. 	Moderate adverse (6)	<ul style="list-style-type: none"> Precautionary measures will be taken by the Ship Masters to follow IMO procedures to operate the vessels. All coal vessels will be operated under the supervision of the MPA designated pilot. Implement emergency response plan recommended under this EIA for the MPA. Prevent the spread of oil spills and ensure the safety of onboard crew members Report oil spills to the proposed Mongla Port ERG immediately and ask for assistance ERG will involve local authorities (MPA, Navy, Coast Guard) in stopping oil spills as per the emergency response plan. 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>
Operation of Coal transportation and other vessels	Water pollution	C29. Risk of coal vessel sinking due to structural or mechanical failure and spilling oil and	<ul style="list-style-type: none"> All vessel both mother and lighterage vessels are of class vessels. All vessel will 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high, as the proposed coal 	<p>Minor (2)</p> <ul style="list-style-type: none"> All vessels will abide by International Maritime Solid 	Moderate adverse (6)	<ul style="list-style-type: none"> Avoid barge operation in such a high wind speed as suggested in the IMO rules and regulations. Transport coal following IMSBC Code in Cargo 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
		fuel into river.	move through a narrow designated channel. • Vessels will be GPS navigated and assisted by piloting by MPA.	transportation route is passing through the Sundarbans and the WHS. Thus the vulnerable receptor (water quality) with little capacity to absorb proposed changes.	Bulk Cargoes Code (IMSBC).		B. • Spill Response Containment plan to be implemented in case of accident. • The vessel route in the Passur River is considered sheltered and no significant wave height is anticipated. • Qualitative risk assessment shows minimal risk of sinking if coal transportation follows IMSBC Code in Cargo B.	change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures. <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)
Operation of Coal transportation and other vessels	Water pollution	C30. Risk of Collision, grounding impact during low visibility and fog conditions.	• All vessels both mother and lighterage vessels are of class vessels. • All vessels will move through a narrow designated channel. • Vessels will be GPS navigated and assisted by piloting by MPA.	High (3) • Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans and the WHS. Thus the vulnerable receptor (water quality) with little capacity to absorb	Minor (2) • As a result of GPS Navigation assistance through VHF communication which is based on radar information, the adverse weather condition, restricted visibility,	Moderate adverse (6)	• Night operations will as far as follow appropriate lighting and piloting arrangement. • Navigation assistance through VHF communication based on radar information to adverse weather condition, restricted visibility, changes in pilot services, or any other dangerous situation for the vessel.	Residual Significance: Minimal (3) The reason for the change in residual significance is because of the change in magnitude with implementation of

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
				proposed changes.	changes in pilot services, or any other dangerous situation for the vessel is largely averted.			suggested mitigation measures <i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)
Operation of Coal transportation and other vessels	Water pollution	C31. Risk of collision and grounding due to tidal conditions.	<ul style="list-style-type: none"> All vessel both mother and lighterage vessels are of class vessels. All vessels will move through a narrow designated channel. Vessels will be GPS navigated and assisted by piloting by MPA. 	<p>High (3)</p> <ul style="list-style-type: none"> Sensitivity is considered high, as the proposed coal transportation route is passing through the Sundarbans and the WHS. Thus the vulnerable receptor (water quality) with little capacity to absorb proposed changes. 	<p>Minor (2)</p> <ul style="list-style-type: none"> As a result of GPS Navigation assistance through VHF communication which is based on radar information, the adverse weather condition, restricted visibility, changes in pilot services, or any other dangerous situation for the vessel is largely averted. 	Moderate adverse (6)	<ul style="list-style-type: none"> Bathymetric survey of the transportation route to be carried out routinely by MPA. Use of appropriate navigation assistance through VHF communication based on radar information to counter adverse weather condition, restricted visibility or any other dangerous situation for the vessel. Coal barges are to be compartmentalized to reduce the potential severity of the impacts. 	<p>Residual Significance: Minimal (3)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> High (3) <i>Magnitude:</i> Minimal (1)</p>
Coal in the covered	Fire risk of resources	C32. Risk of fire from	<ul style="list-style-type: none"> An automatic fire detection and fire 	Medium (2)	Minor (2)	Minor adverse	<ul style="list-style-type: none"> Stakeholder should be aware of incubation time 	Residual Significance:

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
coal stack yard		spontaneous combustion of coal at stack yard.	<p>extinguishing system shall be provided for the electrical equipment enclosure. The fire extinguishing system shall comply with the relevant local legislation. (Para: 317).</p> <ul style="list-style-type: none"> The coal handling control room shall have a Fire alarm monitoring panel. (para 335) 	<ul style="list-style-type: none"> Sensitivity is considered medium as vulnerable receptor (fire risk) has some opportunities for mitigation. 	<ul style="list-style-type: none"> No open flame/ignition source/hot work is permitted in the process areas without following proper procedural controls. 	(4)	<p>to Spontaneous combustion.</p> <ul style="list-style-type: none"> Implement a Fire Safety Plan and train all employees in regards to this plan. Smoke detection and monitoring (as an indicator for the potential for fire). Periodic spray of water to minimize spontaneous combustion at coal stack yard. Emergency Response Plan (ERP) and Fire hazard management plan will be in place to handle such emergent situation. 	<p>Minimal (2)</p> <p>The reason for the change in residual significance is because of the change in magnitude with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> Moderate (2) <i>Magnitude:</i> Minimal (1)</p>
Coal in the covered conveyor belt	Fire risk of resources	C33. Risk of fire from spontaneous combustion of coal during conveyor transport.	<ul style="list-style-type: none"> Heat resistant conveyor belts according EN 12882 class 4 or fire retardant according to ISO 340 shall be provided for all conveyors. All splices are to be hot vulcanized. An automatic fire detection and fire 	<p>Medium (2)</p> <ul style="list-style-type: none"> Sensitivity is considered medium as vulnerable receptor (fire risk) has some opportunities for mitigation. 	<p>Minor (2)</p> <ul style="list-style-type: none"> Conveyor belts are designed with fire taps with valves at regular intervals. Fire retardant hydraulic fluids and fire resistant 	Minor adverse (4)	<ul style="list-style-type: none"> Implement a Fire Safety Plan and train all employees in regards to this plan. Regular scheduled checks and maintenance of process area equipment (i.e., conveyor system). No open flame/ignition source/hot work is permitted in the process areas without following 	<p>Residual Significance: Minimal (2)</p> <p>The reason for the change in residual significance is because of the change in magnitude</p>

Activities	VECs/ IESCs	Impact and Risk from various activities	Embedded Control	Sensitivity of the Resources/ Receptors	Magnitude of the Impact	Significance Prior to Mitigation	Mitigation and Enhancement Measure	Residual Significance
			<p>extinguishing system shall be provided for the electrical equipment enclosure. The fire extinguishing system shall comply with the relevant local legislation.</p> <ul style="list-style-type: none"> The coal handling control room shall will have a Fire alarm monitoring panel. (Para: 335) 		belting will be used for the conveyor system.		<p>proper procedural controls.</p> <ul style="list-style-type: none"> Emergency Response Plan (ERP) and Fire hazard management plan will be in place to handle such emergent situation. 	<p>with implementation of suggested mitigation measures.</p> <p><i>Sensitivity:</i> Moderate (2) <i>Magnitude:</i> Minimal (1)</p>

Associated Components (Capital and Maintenance Dredging)

Two separate EIA studies (i.e., one for the river reach from Mongla Port to the Project site and another for Outer Bar) for dredging have been conducted by the MPA and duly approved by DoE. They have identified the dredged spoil disposal area. Prior to the mobilization of dredging Contractors, MPA will ensure dredged spoil disposal sites those are identified in the mentioned studies whether for beneficial use or permanent land filling, in consultation with public representatives and concerned land owners. MPA should ensure all mitigation measures during all phases of dredging based on the approved EIA studies. They should prepare site-specific Dredged Material Management Plan with proper containment compartment and drainage provision. Notification to communities and river users prior to initiation of dredging. Erection of buoys in the area to alert river vessels passing the dredging site.

9.5 Environmental Impacts of the Project

670. Major adverse and important moderate adverse impacts are discussed in more detail in following sections and accordingly mitigation measures are suggested. It is expected that implementation of such measures would reduce the adverse impacts on the environment and society to insignificant level. It is also expected that minor and many moderate adverse impacts will be addressed through the implementation of Environmental Code of Practices (ECPs) by the contractor. The residual impacts which are moderate in significance may merit monitoring of planned mitigation measures. Impacts of noise level and air pollution on the environment and society are discussed in detail below:

9.6 Environmental and Social Impacts during Feasibility and Design Phase

671. The potential impacts and concerns that were addressed in the feasibility and design phase assessment are discussed in more detail below.

9.6.1 *Impacts on the Sundarbans due to Improper Route Selection (A1)*

672. The Sundarbans ecosystem in particular and the economy of the Project as well may be impacted due to selection of improper route for coal transportation, anchorage and transshipment points. Three possible routes were studied to assess the geometric overview, socio-economic profile, and environmental settings: (i) Passur River Route, (ii) Sibsa River Route, and (iii) Mongla-Ghashiakhali Route. The routes along the Sibsa and Mongla Ghashiakhali have a number of physical constraints with sharp bends and sign of sporadic erosions which may make the route difficult for the vessels to manoeuvre. This impact has been assessed as 'Major Adverse', as shown in Table 9-1.

Mitigation measures are:

673. Preparation of the plans and required institutional set up for their implementation to minimize impacts in the Sundarbans.

- Construction Environmental Action Plan (CEAP)/
- Social and Environmental Management Plan (SEMP) and
- Emergency Response Plan (ERP) system and
- Grievance Redressal Mechanism (GRM)
- The project also considers the selected anchorage points (Mazhar Point in the Sundarbans) in view of avoidance of close-proximity of World Heritage Site and in accordance with national guidelines to entail minimal disturbance to the Sundarbans ecosystem.
- Reduce transshipment points from two to one to minimize impacts in the Sundarbans.

674. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Moderate'. This impact merits monitoring of planned mitigation measures.

9.6.2 Impacts on Dolphins due to Improper Route Selection (A2)

675. Improper route selection can have impact on Dolphins, including vulnerable Gangetic dolphin (*Platanista gangetica*) and near threatened Irrawaddy dolphin (*Orcaella brevirostris*). This impact has been assessed as 'Moderate Adverse', as shown in **Table 9-1**.

Mitigation measures are:

- Reduce trans-shipment points from two to one to minimize impacts in the Sundarbans.
- Research on dolphins conservation may be promoted as a part of Corporate Social Responsibility (CSR) as measures beyond compliance.

676. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.6.3 Impacts on Turtle and Otter due to Improper Route Selection (A3)

677. The selected coal transportation route along the Passur River traverses tidal ecosystems and two Bio-ecological zones, the Sundarbans and Saline Tidal Floodplains, areas rich in aquatic life. There may be impacts on aquatic species, such as the critically endangered Batagur turtle (*Batagur baska*) and endangered small clawed otter (*Aonyx cinerea*) due to improper route selection for coal transport, anchorage and transfer points. The critically endangered Batagur turtle (*Batagur baska*) lives inside the Sundarbans but travels to sandy banks crossing substantial distance (50-60 km) during breeding period (Dec-Mar). The leather back sea turtle (*Dermochelys coriacea*) lives in the sea but come to sandy beach during breeding season. The endangered small clawed otter (*Aonyx cinerea*) generally predate in the creeks (Section 7.8.2; Paragraphs 561-563). This impact has been assessed as 'Moderate Adverse', as shown in Table 9-1.

Mitigation measures are:

- Proper management of bilge water of the lighterage should be carried out for avoiding contamination of water.
- Research on Batagur turtle, small clawed otter, etc. conservation may be promoted as a part of Corporate Social Responsibility (CSR) as measures beyond compliance.

678. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.6.4 Impacts on Fish and Shrimp habitat due to Improper Route Selection (A4)

679. Between 110,000 and 291,000 fisherman catch fish both in inshore fishing area, which covers an area of 1,874 km², and offshore fishing area (20 km wide marine zone), which covers about 1,603 km². Approximately 70,000 fishermen depend directly on the Sundarbans for their livelihoods. Shrimp Aquaculture Pond/Gher accounts for 15,688 acres (4.8%) of total land use in project area. There can be impacts on fish and shrimp, which many people depend on for their livelihoods, due to improper route selection for transportation, anchorage and transfer points. This impact has been assessed as 'Moderate Adverse', as shown in Table 9-1.

Mitigation measures are:

- No fishing and catching of shrimp post larvae (PL) is allowed in the transportation route of the MPA.
- Due to frequent movement of vessel, illegal fishing and catching of PL will be discouraged as such, fish production will be increased in the wild.

680. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.6.5 Compliance with MARPOL and IMSBC to Prevent Marine Impacts (A5)

681. Suppliers/shippers of coal need to comply with International Convention for the Prevention of Pollution from Ships to prevent pollution of the marine environment and International Maritime Solid Bulk Cargoes (IMSBC) Code, which has the objective of ensuring safe transport of solid bulk cargoes including coal. This impact has been assessed as 'Moderate Adverse', as shown in **Table 9-1**.

Mitigation measures are:

- Shippers will be responsible for assessing and declaring whether cargoes are harmful to the marine environment (HME) using specific environmental classification criteria.
- Maintenance of environment friendly operation of vessel with low noise, low air emission, and ante-oil spillage technology.

682. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7 Environmental and Social Impacts during Implementation Phase

683. The potential impacts and concerns that were addressed in the implementation phase assessment are discussed in more detail below:

9.7.1 Generation of Employment in the Project Area (B1)

684. Currently in the Project area, about 75% of the population is economically active, where about 41% are employed, about 1.0% are looking for work, and about 58% are engaged in household work. The project will employ unskilled and skilled construction workers. Contractors are encouraged to employ local workers and technicians to the extent possible. Employing local people will also diffuse the conflicts between migrant workers and local community and also prevent possible spread of HIV/AIDS infection due to the migrant workers. All these new opportunities for work for local residents will boost employment to about 150-200 people/worker at different skill level and improve the social and economic position of the population. This impact has been assessed as 'Moderate Beneficial', as shown in **Table 9-1**.

Enhancement measures are:

- In employing workforces in different Project activities during construction, it is suggested to involve largely the local people particularly the Project-affected Persons (PAPs) directly or indirectly.

685. **Residual Impact:** After the implementation of above enhancement measure the impact will enhance to 'Moderate Beneficial' at higher significance level.

9.7.2 *Increased Economic Activity in the Project Area (B2)*

686. The influx of workforce of about 150-200 at different skill level will stimulate the local economy. There will be a higher demand for locally produced food, goods and services benefiting local farmers and small businesses, such as hotels, shops, fruit sellers, tea cabins, and poultry stalls. These activities will involve more people into local economy. Also because of increased transportation of goods and materials through MPA's maritime route and its jurisdiction, revenue of the authority will be increased. This impact has been assessed as 'Moderate Beneficial', as shown in Table 9-1.

Enhancement measures are:

- The Proponent should provide temporary/ permanent market place facilities and the EPC Contractor or the Labour Contractor will facilitate the access of the workforce to shopping in that market place.

687. **Residual Impact:** After the implementation of above enhancement measure the impact will enhance to 'Moderate Beneficial' at higher significance level.

9.7.3 *Increased Risk of Accidents for Workers (B3)*

688. The Contractors will pay close attention to the increased risk of accidents, unsafe working conditions and health risks. Construction workers will be in risk if there is no proper safety protocol in place. Construction activities also pose safety hazards for the site staff. This impact has been assessed as 'Moderate Adverse', as shown in Table 9-1.

Mitigation measures are:

- Occupational Health and Safety (OHS) Plan to be implemented based on ECP 1322: Workers Health and Safety and World Bank Group's Environment, health and Safety (EHS) Guidelines.
- Ensure the use of Personal Protective Equipment (PPE).
- Emergency Response Plan (ERP) to be implemented.
- Observance of mock drills on OHS and ERP plans at regular interval.
- Contractor should follow relevant IFC Performance Standard (PS) like PS-2 on Labor and Working Conditions; PS-3 on Resource Efficiency and Pollution Prevention and PS-4 on Community Health, Safety, and Security.
- Kitchen waste should be dumped in defined bins by category and sent to the local municipality.

689. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

²² Environmental Codes of Practices (ECPs) are general and non-site-specific measures to address general construction and operation matters identified as moderate and minor in significance prior to mitigation.

9.7.4 Security Risks for Workers and Assets (B4)

690. There may be a security risk for construction staffs and workers, especially in Sundhrabans forest area due to pirates and bandits, who are known to roam the area and carry-out kidnappings for ransoms. Mongla port areas are a heaven for pirates, there were about 7 such incidents at Mongla port area in 2001. Other recorded incidents are, i.e., on 15 March 2002, a bulk carrier anchored in the Pusur River suffered two attacks. On 22 August 2003, an LPG carrier was obstructed in its passage of the Pusur River by ten men. On 3 March 2003, passengers aboard a salt-laden trawler on the Chittagong–Khulna route. In July 2003, five fishing trawlers were “suddenly attacked by the pirates near Narikelbaria of Pathergata. During 2007, the number of robberies continued, and the percentage of kidnap-for-ransom attacks appeared to increase. On 8, 11, and 12 July 2007, “pirates looted fishing nets and fish worth over Tk 5 million from twenty-eight trawlers and kidnapped over a hundred fishermen for ransom. Piracy attacks are mainly observed at berthed ships and anchored ships. Under the cover of darkness between 0000 to 0500hrs, is the mostly likely time for pirate attacks. The impact has been assessed as ‘Moderate Adverse’, as shown in Table 9-1. Latest information after 2007 on piracy could not be collected or not available.

Mitigation measures are:

- Continued consultations with the local leaders and local community representatives on security matters.
- Keep close liaison with the Law Enforcement Authorities (for pirates, the scope will be under the jurisdiction of regulatory authorities, e.g. coast guards, MPA and Police).
- Ensure the presence of armed and trained security guards at the work sites and camps.
- Issuance of identity cards to workers and checking them properly when enter into the workplace.
- Access to the camps and accommodation facilities must be controlled through gated entrances and entrance and exit logs with security personnel shall be maintained at each entrance.
- Preparation and implementation of the contractor’s Communication plan to engage local leaders and community.
- Implement ECP 14: Construction and Operation Phase Security.
- Every labour camp should have lockers for worker for safe keeping of money, stuffs and belongings.

691. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to ‘Minimal’.

9.7.5 Cultural Conflicts between Communities and Migrant Workforce (B6)

692. It is expected that around 150-200 labours (local and migrant workforce) will be engaged in jetty construction activities for a period of six (06) months to 36 months. There could be potential conflicts between the local community and the migrant workforce. Workers coming from other parts of Bangladesh may have norms and values in social behavior and religion that differ from those of the area’s resident population. The influx and

accommodation of a large work force will result in increased concerns for the health and safety of local population. The impact has been assessed as 'Moderate Adverse', as shown in Table 9-1.

Mitigation measures are:

- Conduct awareness campaign and develop Code of Conduct for workers on local cultural.
- Develop and function the grievance redressal mechanism along with formation of grievance redress committee.
- Develop and implement disclosure system and strong community participation plan.

693. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.6 Risks of HIV/AIDS, STI and TB due to Outside Workers (B7)

694. There is a risk of the likelihood of spread of HIV/AIDS, STD/STI and TB infection and diseases through interaction between migrant workers and community women during project construction. There is also a Semen Haven at Banishanta nearby Mongla Upazila of Bagerhat which is used by vessel crews and local people. According to WHO, 2009, HIV prevalence in Khulna area is in the range of 1-2.9 cases per one million population. According to Mr. Abu Mohammad Ali Zaved, administrator of Khulna Medical College "A total of 23 persons have been found infected with the disease since July 2015" (Dhaka Tribune, 21 May, 2016). There is a risk of sexually transmitted diseases like HIV/AIDS, Gonorrhea, etc. This impact has been assessed as 'Moderate Adverse', as shown in Table 9-1.

Mitigation measures are:

- Awareness creation on HIV/AIDS infection and diseases through a well-designed campaign implementation plan targeting all risk-prone groups.
- The awareness programme will be conducted by EPC contractor at the time of induction training and periodic update on HIV/AIDS shall also be shared as and when received from the Govt agencies or NGOs. Hand Leaflet and posters/ banners in using Bangla/ English shall be issued.
- Empowering women as much as possible through employment in the construction and other official work as eligible.
- Unskilled and semi-skilled workers should be engaged from the affected communities so that they can be close proximity of their families and reduce the risk of mixing with other genders.

695. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.7 Health and Safety Risk for Communities due to Construction Sites (B9)

696. About 2,500,000 people live in the villages around the Sundarbans. Construction activities, including hazardous waste and chemicals storage can potentially impact the residents of nearby villages. The distances from the construction site to nearest points of

villages range from 1.5-2.0 km. This impact has been assessed as 'Moderate Adverse', as shown in **Table 9-1**.

Mitigation measures are:

- The Contractor shall follow WBG EHS guidelines and PS-4 on Community Health, Safety, and Security.
- Exposed stockpiles of materials will be covered with tarpaulin or impervious sheets before a rainstorm occur.
- Disposal of hazardous materials following environment friendly disposal system.
- During construction phase the contractor site camps should be properly managed and should maintain proper housekeeping.

697. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.8 Safety Hazards for Children and Elderly People due to Increased Road Traffic (B11)

698. Road traffic injuries are the leading cause of fatalities to children and elderly people in Bangladesh. The coal would be transported through waterways. Only some construction materials may be transported through the road. The construction activities can potentially impact the residents of nearby villages, particularly the movement and safety of school children. This impact has been assessed as 'Moderate Adverse', as shown in Table 9-1.

Mitigation measures are:

- ECP 10: Traffic Management Plan including community friendly traffic schedule for addressing general access to be implemented.
- Safety and security actions and procedures to protect local community during construction phase.
- Most of the construction materials will be transported using inland water transport instead of road transport.

699. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.9 Consumptive Water Requirement for Project Site People (B12)

700. Considering the water consumption of 50 litre/capita/day (IFC, 2007) for about 150-200 workers and about 50 officials and Consultants will require about 10-13 metric tons of water per day. This may create extra pressure on the already depleted groundwater source and may lead to ground water mining. This impact has been assessed as 'Moderate Adverse', as shown in **Table 9-1**.

Mitigation measures are:

- Considering the poor quality of surface water and low availability of ground water, it is suggested to avoid abstraction of ground water for potable and other uses in the labour camp instead it is recommended to continue with Reverse Osmosis (RO) Plant throughout the Project period.
- Effective and efficient use of water should be ensured.

- Reuse of water with due treatment in suitable water use area.
- Sludge collection sump should be built.

701. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.10 Sewage/Solid Waste Facilities in the Labour Camp (B13)

702. Around 150-200 labours will be engaged in jetty construction activities for a period of six (06) months to 36 months. In addition to this, about 50 officials and Consultants will be accommodating there for monitoring the construction activities along with other routine jobs. About 41-55 metric tons of sewage/organic solid waste would be generated in three (03) years and about 54-68 kg/day kitchen/solid waste for 200-250 workers and Project officials to be generated from the official dorms and labour camp which would require sound management. There will be impact on surrounding communities and environment due to construction labour camps. The nearest villages are about 1.5-2.0 km away from the labour camp. This impact has been assessed as 'Moderate Adverse', as shown in Table 9-1.

Mitigation measures are:

- The tentatively required dimension of sewage/organic solid waste tank should be 25 m³ (L-4mXW-2.75mXH-2.25m) for capacitating the 41-55 metric tons of organic solid waste in three years.
- The tank should be septic tank for better absorption of liquid by the soil.
- Maintain hygienic condition of the water closet (WC) for the next person's use.
- Dismantling of septic should be done with proper care and release gases arrested in the tank carefully for avoiding casualty.
- Proper sanitation will be maintained according to environmental standards.

703. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.11 Emissions of Dust and Air Pollution (B14)

704. Air pollution may be caused by emissions from operation of construction equipment and vehicles, material transport, etc. This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- Water the soil surface and any non-asphalted roads, especially in the dry season.
- Water the soil before starting excavation.
- The storage and handling of spoil, subsoil, topsoil and materials will be carefully managed to minimize the risk of wind-blown material and dust.
- Cover hauling vehicles carrying dusty materials moving outside the construction site.
- Fit vehicles with appropriate exhaust systems and emission control devices.
- Implement Air Quality Management Plan.

- Use wind fencing in construction areas that are frequently subjected to high winds.
- Reduce activities that create fugitive dust during windy conditions.

705. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.12 Impact on Wildlife and Birds due to Increased Lighting (B15)

706. Major wildlife inhabit the area along the proposed coal transportation route include the Royal Bengal Tiger, Estuarine Crocodile, River Terrapin, Wild Boar, Rhesus macaque, Lesser Adjutant, Smooth-coated Otter, etc. All animals depend on a regular interval of daylight and darkness for proper functioning of behavioral, reproductive and immune systems. Many of these animals need the natural night to survive. For thousands of species, the natural dark night of the evolutionary past is an integral component of their continued existence. Artificial night lighting harms species directly by triggering unnatural periods of attraction or repulsion that lead to disruptions in reproductive cycles, by fixation, by disorientation or by interfering with feeding and sustenance. Increased lighting during implementation phase will have an impact on the surrounding wildlife and birds. This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- Minimize night-time construction activity (where practical).
- Use light on an "as and when needed" basis.
- Direct lighting toward the ground on working areas, reducing the height of lighting to the extent possible and minimizing the number of lights required through strategic placement.
- Use fittings on lamps to direct light and confine the spread of light.
- Follow lighting plans.
- Halogen bulb/light can be used for its longevity, higher efficiency, money saving, etc.
- Avoid mercury vapour lamp.

707. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.13 Potential Risk of Soil and Water Contamination (B16)

708. A large number of rivers connecting to the coal transportation route include the Passur River, the Sibsa River, idara- Ichamati River, Dhangmari, etc. During construction there is a risk of accidental spills and leakages from fuel and oil tanks, vehicles, machinery and stored chemicals that are used in construction areas, yards, batching plants, worker camps, and storage sites. These spills can pollute soils and contaminate surface and groundwater in the area. There was an accidental oil spill in December 2014 which released approximately 350,000 liters (Philips, 2014) of furnace oil into the River, which then spread over a 350 km² area (Welle, 2014). This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- Contractor will prepare and implement Pollution Prevention Plan as part of the CEAP.
- Implement ECP 2: Fuels and Hazardous Goods Management.
- Contractor to confine the contaminants immediately after such accidental spillage.
- Contractor to collect contaminated soils and washouts containing petroleum products treat and dispose them in environment friendly manner.
- All areas intended for storage of hazardous materials to be protected and provided with adequate facilities to combat emergency situations complying all the applicable statutory stipulation.

709. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.14 Impacts on Aquatic Wildlife and Fisheries Habitats from Construction Activities (B18)

710. There may be impact on aquatic wildlife and fisheries habitats, such as breeding and nesting sites from construction activities, riverine vegetation clearance and heavy equipment transportation. The transportation route will pass beside two dolphin sanctuary (Dhangmari and Chandpai-Sela Gang) and the World Heritage Site (WHS). The confluences of Dhangmari-Passur, Chandpai-Sela-Passur and Nilkamal Khal-Passur are abundant with fishes, crustaceans and cetaceans. This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- Control of sediment flow from the construction activities.
- Silt curtains along river training works and/or other industry good practice management controls will be used to restrict the spread of sediment released during construction of Terminal/Jetty/Materials Offloading Facility earthen causeway.
- Minimize and restrict clearing of river slope and river bank vegetation as much as possible.
- Implement ECP 8 Protection of Fauna for species with conservation significance especially endangered and near threatened.

711. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.15 Impact of Over Pressure from Pile Driving on Marine Animals (B19)

712. Most of the piles will be cast in-situ type. So, overpressure from piling activities will be remote. In case of pre-cast pile driving activities following concern may arise: overpressure produced from pile driving activities will harm riverine animals, including dolphins inhabited in the confluence of the Moidara and the Passur Rivers, which is about 2.0 km downstream of the jetty construction site. This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- In case of pre-cast pile driving activities following measures will be applicable:
- Pile driving will be completed using Best Management Practices for Pile Driving and Related Operations;
- Conferring with appropriate organizations to determine the preferred timing and methods of the pile driving.

713. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.16 Impact of Underwater Noise from Pile Driving on Riverine Animals (B20)

714. Most of the piles will be cast in-situ type. So underwater noise from piling activities will be remote. In case of pre-cast pile driving activities following concern may arise: underwater noise produced from pile driving activities may harm riverine animals including fish and dolphins and affects their vocalization behavior. The Project jetty will be built on the left bank of the Passur River, which is highly tidal in nature, having the abundance of aquatic organisms including fish, crustaceans and cetaceans in the confluence of the Passur and Moidara River. The confluence is about 2.0 km away from the jetty point. The cetaceans are mostly gangetic dolphin (*Platanista gangetica*) with some Irrawaddy dolphin (*Orcaella brevirostris*) and finless porpoise (*Neophocaena phocaenoides*), which have underwater noise sensitivity of minor disturbance to major disturbance in the range of 90 dB (minor), 140 dB (medium) and 155 dB (major).²³ This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

715. In case of pre-cast pile driving activities following measures will be applicable:

- Use of vibratory hammers instead of impact hammers
- Monitoring of underwater noise levels and use of underwater air bubble curtains, metal or fabric sleeves to surround the piles to reduce noise levels if required.
- A large bubble curtain consists of a hose with drilled holes, supplied with compressed air. The hose is placed on the river bed and the air escaping from the holes forms the bubble screen. [Single bubble curtain reduce noise by: 12 dB (SEL), 14 dB (peak); Double bubble curtain by 17 dB (SEL), 21 dB (Peak)]
- Hydro Sound Damper consists of fishing nets with small balloon filled with gas and foam - tuned to resonant frequencies fixed to it. It can be applied in different ways. [Hydro Sound Damper reduce noise by 4 - 14 dB (SEL)]
- Setting up cofferdam which consists of a rigid steel tube surrounding the pile. Once the pile is stabbed into the cofferdam, the water is pumped out. [Cofferdam up to 22 dB (SEL) and 18 dB (Peak)]
- Conduct pile driving during low tides in intertidal and shallow subtidal areas.

²²Marine Pollution Bulletin 60: 888–897, Elsevier Ltd.

- Implement seasonal restrictions when necessary to avoid construction-related impacts to habitat during species' critical life history stages (e.g., spawning and egg development periods).
- Reduce sound pressure impacts during pile installation by using wood or concrete piles, rather than hollow steel piles which produce intense, sharp spikes of sound that are more damaging to fish and dolphins having air cavities.
- Underwater noise during piling activities could be carried out with a hydrophone sensor which is normally placed in a water column at least 1 metre deep, with the sensor located at a depth of 0.5 metre above bottom of the water column. 'Reference sound levels from pile driving normally are reported at a fixed distance of 10 meters'.



Bubble curtains: Protect all aquatic life forms (Source: Internet)

716. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.17 Risk of Dolphin Collision with Construction Vessels (B21)

717. There is a potential risk of dolphins colliding with construction vessels in the River, especially in areas that are close to Dolphin habitats, such as the confluence of the Moidara and the Passur Rivers. Dolphins were observed along the coal transporation route, close to the two sanctuaries, in groups of 2-20 individuals. Most of the dolphin groups are observed in the deep River pools and river-khal confluences. This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- Restrict the motor boat speeds as per MPA rules (MPA Traffic Guidelines).
- Restrict boat movement within safe distance around the construction site if river width permits. Avoid areas where Dolphins are known to congregate at the confluence of Moidara and Passur River, which is 2 km away from the jetty site.

718. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.18 Impact on Faunal Habitats (B23)

719. The project area has rich and diverse faunal habitats, which are home to an abundance of wildlife, including the Royal Bengal Tiger, Estuarine Crocodile, River Terrapin, Wild Pig, Rhesus macaque, Lsser Adjutant, Smooth-coated Otter and etc. The route crosses a low to moderate density of Tiger signed area and goes through the low density area of

spotted deer and Rhesus macaque, while there is a higher density of Estuarine Crocodile Smooth-coated Otter and Wild Pig. Alorkol at Dubla Char area is also has a high density of occurrence of Lesser Adjutant Stork. Loss of faunal habitat at locations of construction works, camp, and on access/haul routes due to the felling of trees can lead to loss of critical habitats for resident and migratory birds and habitats for species that are of conservation significance. This impact of the project on overall avifauna is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- Minimize construction or civil works in the shabby patch of plants where birds take shelter.
- Use of existing access road.
- Implement ECP 8 Protection of Fauna for species with conservation significance especially endangered and near threatened.
- Plantation of native trees for restoring the lost habitats of birds and other wildlife.
- MoU has already been signed with Forest Department for plantation of 0.2-0.3 million native tree species under Greenbelt Development Programme.

720. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.19 Risk from Increased Traffic (B26)

721. Most of the materials and goods will be transported through water ways. So, the increment of road transport would be minor due to coal transport project. However, increased Traffic (i.e. trucks, transport vehicles, construction machinery) on local roads will affect access to the trading center and, houses close to the road, risking safety (especially the school children), spillage of fuels and chemicals, and damage to infrastructures and properties due to vibration. This impact has been characterized as 'Moderate Adverse', as in Table 9-1.

Mitigation measures are:

- Contractor will implement traffic management plan to ensure uninterrupted traffic movement during construction.
- Restrict truck deliveries, where practicable, to day time working hours.
- Restrict the transport of oversize loads.
- Use covered trucks to avoid spreading of dust.
- Ensure proper maintenance of vehicles and roads.
- Enforce on-site speed limit, especially close to the sensitive receptors, schools, health centers, etc.
- Implement ECP 10: Traffic Management
- Inspect structures within the close proximity of construction site for damages.

722. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.20 Noise and Vibration from Construction Equipment, Piling, Blasting and Vehicles (B27)

723. Most of the construction materials and plant equipment will be transported using water vessels and very little movement of heavy vehicle will take place in the plant jetty site. Construction will take place in the Project jetty site, which is far away from the Sundarbans Reserve Forest, ECA, Ramsar Site and WHS. However, due to construction activities noise and vibration will be generated by movement of construction vehicles, piling activities, blasting, earth and excavation works, headworks of pier, guide walls, river bank protection, machinery, concrete mixing, and movement of vessels. This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- Construction vehicle movement near settlements will be limited to day time mostly.
- High noise producing equipment will be provided with mufflers or acoustic hood/enclosures.
- Install acoustic enclosures around generators and install temporary noise control barriers where appropriate to reduce noise levels.
- Fit high efficiency mufflers to appropriate construction equipment.
- Notify affected communities in advance regarding major noisy operation.
- Implement Noise Management Plan.

724. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.7.21 Loss of Breeding Pools and Pans during Construction (B28)

725. There may be a loss of temporary breeding pools and pans particularly of amphibians (frogs, etc.), mongoose, etc. due to refilling of such pools by construction soil or gravel while constructing the jetty and coal stackyard. This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- Schedule trench construction during dry season to reduce impact since the amphibian populations will be low during non-breeding season.
- Fence off the trenches with nets to prevent amphibians falling into the trap.
- Implement ECP 8 Protection of Fauna for species with conservation significance especially endangered and near threatened.

726. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8 Social Impacts during Operation and Maintenance (O&M) Phase

9.8.1 Generation of Employment in Project Area (C1)

727. The project offers good opportunities for local residents to apply for employment as unskilled and skilled workers in the shipping and related businesses. Of the employed

population (41.1%) at reference period of census, it is found that 46.9% are engaged in agricultural activities, 2.9% in industry and 50.1% in services. Many people are dependent on the Sundarbans for their livelihoods. All these new opportunities for work for local residents could boost employment and improve the social and economic position of the population. Project influenced area has limited employment opportunity (about 50-75 workers and officials in the Jetty and Coal Stack Yard areas. This impact has been assessed as 'Major Beneficial', as given in Table 9-1.

Enhancement measures are:

- Employment for local workers and technicians, local unskilled labors during operation of the coal transportation and handling.
- New employment opportunities in shipping and related businesses.
- Due to availability of quality and uninterrupted electric supply, lots of industries will be developed in Khulna area, which will create a huge employment opportunities and economic activities.

728. **Residual Impact:** After the implementation of above enhancement measures the impact will enhance to 'Major Beneficial' at higher level.

9.8.2 Increased Economic Activity in Project Area (C2)

729. The major economic activities of the study area include fishing, crop cultivating, fish culturing, selling labour mainly in the industries and Mongla Port, forest product collecting like honey, wood, nipa palm, vessel sailing, portering, etc. This impact has been assessed as 'Major Beneficial', as given in Table 9-1.

Mitigation measures are:

- At present about 4.5 million tons of materials and goods area being handled by MPA per year. During operation of this project, MPA would handle more than 4.5 million tons of materials and goods for this project only. As such, MPA would be able to generate a substantial amount of income from this project.
- Establishment of new private businesses and commercial enterprises in shipping and at the anchorage points.
- Increase in local business opportunities due to shipping.

730. **Residual Impact:** After the implementation of above enhancement measures the impact will enhance to 'Major Beneficial' at higher level.

9.8.3 Increased Shipping will Cause Disturbance to Fish and Post Larvae Catching (C3)

731. Increased movement of vessel may cause disturbance to Post Larvae (PL) catching which in turn will facilitate wild shrimp production, mixing of oxygen into water and increase in dissolved oxygen. Since increased vessel movement will discourage catching of fish and post larvae as such, the production of shrimp and fish will be increased in the area. Shrimp post larvae catching dependent livelihood will be restored in different phases of power plant construction and operation and also in the industries to be developed in the EPZ, Mongla. This will have a 'Major Beneficial' impact on the biodiversity of the Sundarbans as given in Table 9-1.

Mitigation measures are:

- Since catching of fish and post larvae will be discouraged during operation of the project, as such, the production of shrimp and fish will be increased in the area.
- Shrimp post larvae catching dependent livelihood will be restored in different phases of power plant construction and operation and also in the industries to be developed in the EPZ, Mongla.
- Government should bring the post larvae catchers into the social safety net program.

Residual Impact: After the implementation of above enhancement measures the impact will enhance to 'Major Beneficial' at higher level.

9.8.4 Increased Coal Carrying Vessels can Impact the Sundarbans and World Heritage Site (C5)

732. Coal carrying vessels may cause overall inland traffic congestion along the route and may cause harm to the Sundarbans and the World Heritage Sites. However, coal would be transported in covered vessels through the MPA's designated route, which is 1.5 to 2.75 km away from the outer periphery of the World Heritage Site. Thus, this impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- Shipping vessel would follow MPA and applicable IMO conventions when transporting coal.
- Monitor and review of shipping impacts on a regular basis and work with stakeholders to help minimize impacts on protected areas.
- Periodic audits for the compliance of IMO regulation of coal vessels.

Residual Impact: After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.5 Impact on Livelihoods (Forestry Products) from Increased Shipping (C7)

733. About 1,000,000 (0.1 million) people are directly and indirectly dependent on the Sundarbans for their livelihood. Livelihood groups in the Sundarbans include: Bawali (wood cutter), Nypa collectors (golpata used as roof materials), Mawali (honey and bee wax collector), Jele (Fisher), Majhi (Boatman), Crab collector, Medicinal plant collector, Shrimp fry collector, Chunery (oyster and snail collector). Increase in shipping and coal transport may increase risk of collision with oil tankers and subsequent spillage may harm the growth of the Sundarbans ecosystem and affect the growth of forestry products (such as timber, honey, medicinal plants, Golpata and etc.) on which livelihood of local people depend on. This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- Review of potential impacts of vessel movement on a regular basis and work with stakeholders to help minimize impacts.
- Review and update the Sundarbans Forest Management Plan to mitigate potential impacts on livelihood.

- Implement Emergency Response plan. A framework of the ERP is developed in the EMP for the MPA to develop a comprehensive ERP with appropriate resources, management structure, and effective communication in order to manage any emergency events associated with coal transportation.
- There should be commitment of MPA and adequate budgetary provision to implement ERP with due diligence.
- There should be commitment of the Forest Department (FD) and adequate budgetary provision to implement the prescribed EMP with due diligence.

734. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.6 Pollution from and Risk of Marine Vessels due to Non-compliance (C8)

735. All marine transport vessels must comply with international shipping conventions in order to mitigate potential impacts on the Marine environment. Proper documentation of suppliers/ shippers of coal complying with applicable International Convention for the Prevention of Pollution from Ships (MARPOL) and International Maritime Solid Bulk Cargoes (IMSBC) Code will be required for all ships and associated shipping activities. The main goal of IMSBC is to ensure the safe stowage and shipment of solid bulk cargoes by providing information on dangers associated with the shipment of certain types of solid bulk cargoes, such as structural damage due to improper cargo distribution, loss or reduction of stability during a voyage, chemical reactions of cargoes like spontaneous combustion, emission of toxic or explosive gases, corrosion, etc. The IMSBC code also provides instructions on the procedures to be adopted when the shipment of solid bulk cargoes is contemplated and addresses hazards associated with shipment of solid bulk cargoes such as coal. MARPOL is the main international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. The main goal of MARPOL is the preservation of the marine environment through the complete elimination of pollution by oil and other harmful substances and the minimization of accidental discharge of such substances. It was specifically designed to minimize pollution of marine waters, including dumping, oil and exhaust pollution. This impact is characterized as Major adverse as given in **Table 9-1**.

Mitigation measures are:

- Verify compliance documents of applicable MARPOL and IMSBC Code during cargo clearance from Mongla Port Authority.
- Verify documents indicating properties of coal, like GCV, moisture, ash, sulphur content etc.
- Monitor whether liquid residues of coal vessel discharge into the marine environment.
- Ensure dry residues and/or the wash water that contains residues from an HME discharged at adequate port reception facilities of the MPA.

736. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.7 Impact of Noise on Surrounding Environment and Wildlife (C9)

737. Noise generated from vessels and transhipper may affect surrounding environment and wildlife, including resident and migratory birds. This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Noise Modeling in Ambient Air

738. Sound is created when the vessels movement vibrates and radiates energy as acoustic pressure or waves through a medium, such as air, water, or a solid. Sound and noise have many characteristics that are important to consider for impacts, including loudness (energy intensity), frequency, and fluctuations over time.

739. Noise often is not constant and fluctuates over time because of the characteristics of the source. For example, river traffic noise will fluctuate from changes in traffic volumes, vessel types, and vessel speeds. This fluctuation makes it difficult to describe adequately and classify them at the receiver point. Coal will be transported through mother vessel and lighterage through the Passur River. Mother vessels will anchor at Mongla Port Fairway buoy and Mazhar Point for transshipment of coal. After anchoring of the vessels during transshipment, only internal generator will be running but the main engine will be shut-off. Transshipper will operate with its generator running. Major sources of noise generated from different activities are presented in **Table 9-2**.

Table 9-2: Generation of Noise from different sources in dBA

Source of Noise Generation	Noise Level (dBA)	Source Type
Mother vessel	75-85	Line
Lighterage vessel	85-95	Line
Moored vessel	105-110	Area
Transhipper (Crane barge)	110-118	Point
Tug boat	100-110	Line
Helper tug boat	100-110	Line
Conveyors	85-95	Line
Radial Stacker-Barge	100-110	Line
Country engine boat	90-100	Line
Non-standard engine boat	85-100	Line

740. Sound pressure levels are measured in units of decibels (dB). The dB scale is logarithmic. To illustrate this, when two concurrent noise sources, each generating 60 dBA, will produce 63 dBA when estimating their cumulative effects.

741. The purpose of noise impact assessment is to determine whether noise levels at any sensitive receiver in the project area exceed applicable noise level standards. If so, abatement measures will be required to reduce the impact either at the source level through engineering design or provide PPEs to the workers if the source is a construction vehicle or equipment. The receivers are placed in the modeling at the point of ongoing monitoring, places with potential noise impacts, eco-sensitivity and social aspects. The sensitive receivers are listed in **Table 9-3**.

Table 9-3: Sensitive receivers with geo-coordinates

No	Receiver name	Coordinates in meter (UTM)		Receivers Characteristics	Receivers Position
		X	Y		
1	NW Corner of the Power Plant Project site	761802.2	2501926.2	Residential area	Left bank of Passur
2	Power Plant project site	763765.9	2500615.0	Power Plant Area	Left bank of Passur
3	SW corner of the Power Plant Project site	764846.3	2497963.1	Residential area	Left bank of Passur
4	Chunkuri-2, Bajua	764200.4	2493851	Community Inside the Polder	Right bank of Passur
5	Mongla Port area	767337.3	2487948	Industrial area	Left bank of Passur
6	Upper Harbaria Right Bank	769205.1	2471626.7	Present transshipment point	Right bank of Passur
7	Lower Harbaria Left Bank	767885.2	2465514.0	Near transshipment point	Left bank of Passur
8	Mazhar Point (River Bank)	763869.1	2457763.0	Near Proposed Transshipment Point, Reach in Tiger	Left bank of Passur
9	Akram Point	760514.2	2435499.0	Possible of impact	Right bank of Passur and inside the Sundarbans reserve forest
10	Alorkol	762464.6	2411942.9	Lesser adjutant stork reach area	Left bank of Passur
11	Hiron Point	755637.5	2411559.9	World Heritage Site , reach of Deer	Right bank of Passur
12	Fairway Buoy	762120.4	2387040.4	Transshipment Point	In the Bay of Bengal

Noise Level Prediction

742. SoundPlan essential is a noise modeling software, which concentrates on the simulation of noise. It has combined a simplified, intuitive user interface. The level of surface noise generated from the river/sea vessels are accounted through the SoundPLAN essential 3.0. Noise emitted by various sources propagates and disperses over a given terrain in accordance with the laws of physics. The majority of environmental noise simulations are small to medium projects tasked with checking the legal compliance of a planned route or an expansion to an industrial facility. Noise modeling software suited for these projects must be specially designed to quickly acquire the model data via an import interface or to allow digitizing the essential data on top of an aerial map. A number of standard processes can be calculated through this soundPlan model. ISO-9613 calculation process is used for this modeling purpose. Different factors are considered for predicting the noise level, such as, amount of noise generating from the source, number of vessels, frequency of movement, noise from transshipment, mooring area of vessels as area sources, ambient environment, transportation route width etc.

a) Prediction of Noise-Baseline Scenario

743. Passur River widens as it moves towards the sea. Sea going vessels or mother vessels or ships enters into the Passur River through Hiron Point. Presently, mother vessels are anchored at Harbaria and then transfer cargoes in smaller vessels (lighterage) to the Mongla Port. Every year about 400 mother vessels are called at Harbaria and unload cargoes using their own transshipper and carrying the goods by the lighterage the Mongla Port.

744. The frequency of fishing boat as well as transportation boat increases to the upstream areas of Passur River. The number of vessels reduces toward the mouth of Passur River. This fishing and other boats are mainly run by diesel engine which produces noise around 85-100 dBA to the ambient environment. Therefore, the noise generating line sources gradually increases downstream to upstream areas of Passur River and it has been included in the model.

745. The quarterly monitoring noise data are averaging for drawing the baseline situation of the study area. **Table 9-4** shows both measured baseline average data and model predicted data at the sensitive receptors in association with the standard values (Noise Control Rules, 2006). The baseline monitoring data was collected during the day time only. Among the receptors Lower Harbaria, Mazhar Point, Alorkol and Fairway Buoy were not monitored during the baseline monitoring study. However, the noise level data for those points were assumed depending on the proximity, position, similarity and nature of the receptors.

746. The measured as well as the model predicted baseline condition of noise were found relatively higher in the upstream of Passur River, e.g., Harbaria, Mongla and Power Plant Project area than the downstream. At every case, the measured baseline noise levels were observed higher compared to the predicted noise level at those locations. The limitations of noise model are: it cannot adopt all the ambient noise sources like birds chirping, river wave, wind flow, tree leaves, etc. during the modeling study. Therefore, predicted noise level only shows the contribution of vessels noise in the selected receptor locations. Around 115 dBA has been considered as point sources for the transshiper at three locations of Harbaria, SoundPlan essential model has been run for worst case scenario assuming that the vessel moves relatively near to the bank line of the transportation route. For modeling study, ambient temperature is considered 25-30°C and humidity is 75-90% and gird is 50m. The predicted noise levels for baseline scenario at different selected receivers are shown in the **Table 9-4**, (for day time) and (for night time). Measured baseline noise level condition of the selected site at Alorkol and Hiron Point are the contribution of multiple ambient sources like wind flow, wave, chirping of birds, forest leaves, etc. Since the measurement location is far away from the Mongla Port's desingnated route (line source) so vessel contribution in this point is low as the river width is increasing towards down. For this reason the predicted baseline noise level found much lower than those of other locations. The following **Figure 9-1** and **Figure 9-2** show the baseline noise level for transportation of the vessels for day and night time.

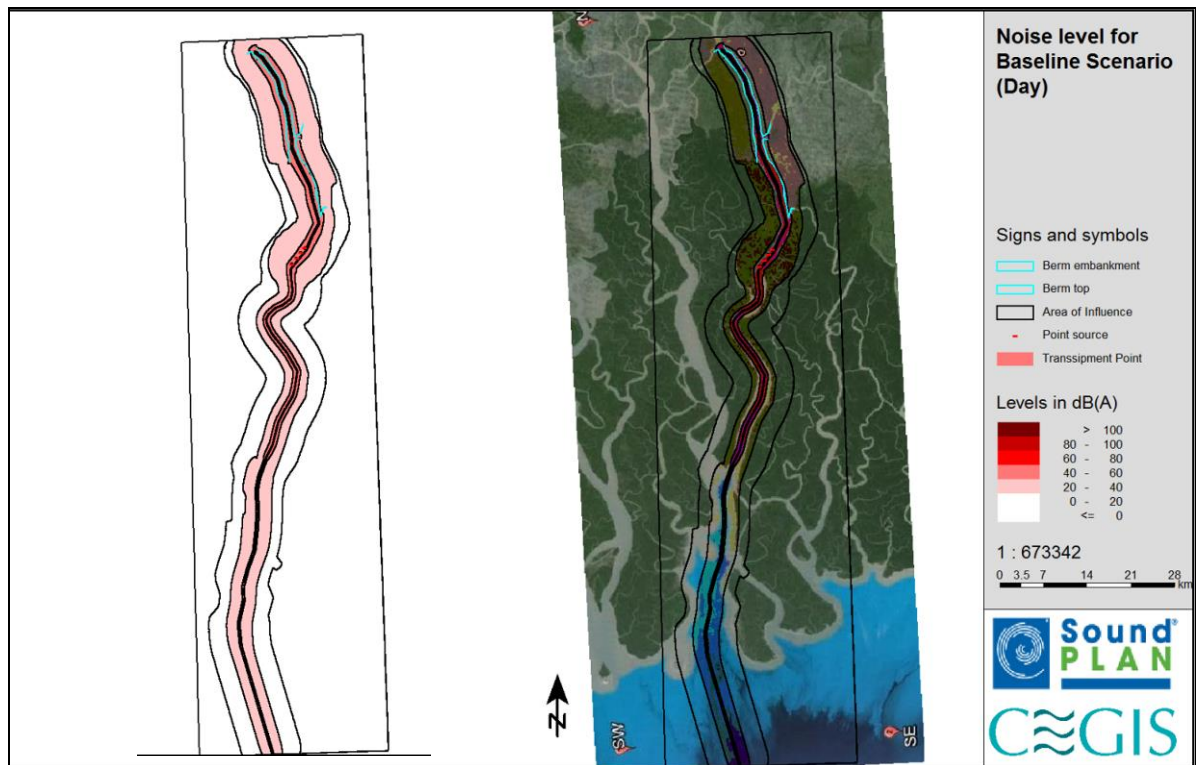


Figure 9-1: Predicted noise level at different sensitive receptors in day time (Baseline case)

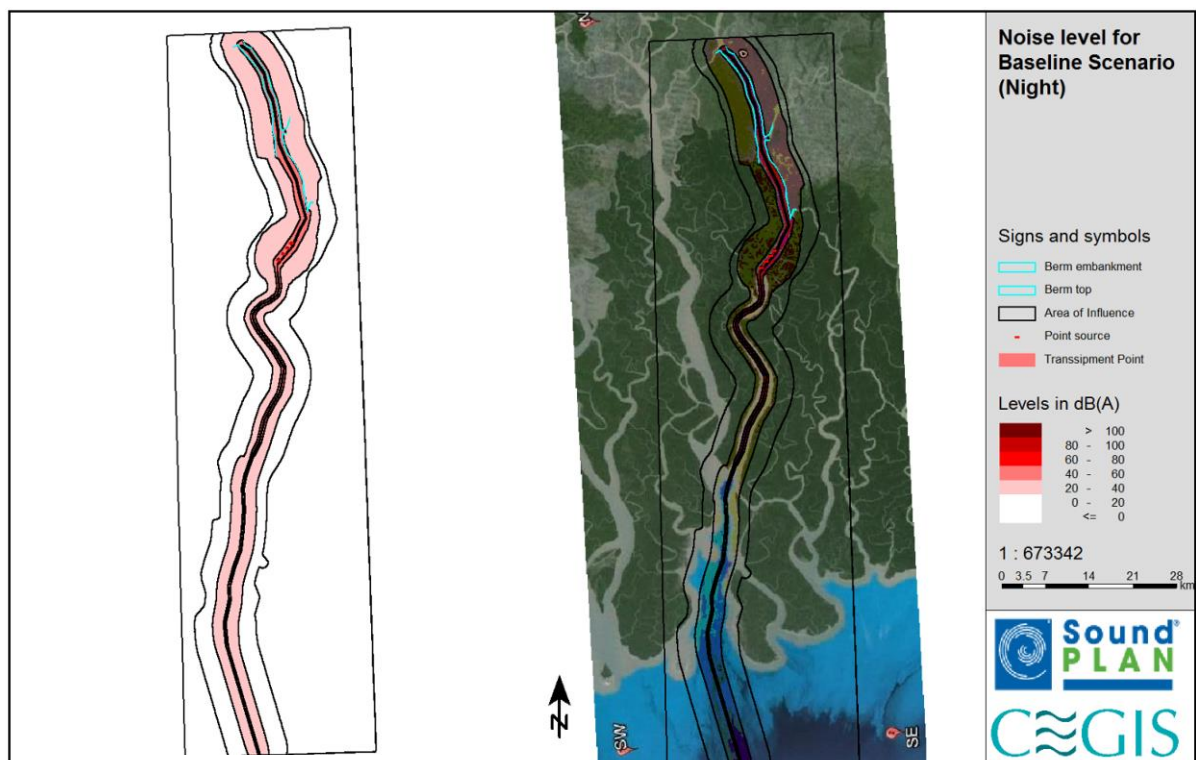


Figure 9-2: Predicted noise level at different sensitive receptors in night time (Baseline Case)

Table 9-4: Predicted noise level at selected receivers (Baseline Case)

No.	Receiver name	Noise Control Rule, 2006 (dBA)		Measured Baseline (dBA)	Predicted Baseline Noise Level (dBA)*	
		Day	Night	Day	Day	Night
1	NW Corner of the Power Plant Project site	70	60	44.0	38.2	35.2
2	Power Plant project site	70	60	47.2	37.5	34.5
3	SW corner of the Power Plant Project site	70	60	47.1	41.5	38.5
4	Chunkuri-2, Bajua	55	45	49.4	42.1	39.1
5	Mongla Port area	70	60	50.2	44.3	41.3
6	Upper Harbaria Right Bank	50	40	47.5	33.5	32.1
7	Lower Harbaria Left Bank	50	40	47.5	34.7	34.3
8	Mazhar Point (River Bank)	50	40	47.5	27.8	24.8
9	Akram Point	50	40	44.7	15.8	13.3
10	Alorkol	50	40	44.6	11.0	11.0
11	Hiron Point	50	40	44.6	3.2	3.2
12	Fairway Buoy	50	40	-	22.8	22.8

Source: Field measured and model predicted data; * Predicted noise level is the contribution of vessel only.

b) Prediction of Noise-Project Scenario

747. Two potential locations have been selected for transshipment of coal from mother vessel to lighterage vessel under this project. These are: (i) Fairway Buoy; and (ii) Mazhar Point (Harbaria). At Fairway Buoy, 26 capesize mother vessels have been considered for five months (Nov-Mar) annually. For lightering mother vessel and transshipping coal from Fairway Buoy to the Project site jetty about 208 lighterage vessels have been considered. At Mazhar Point, 117 handysize mother vessels have been considered for seven months (Apr-Oct) annually. For lightering mother vessel and transshipping coal from Mazhar Point to the Project site jetty about 292 lighterage vessels have been considered. Transshipment of coal from mother vessel to the lighterage vessel a self geared floating transfer station (FTS) has been considered in both of the anchorage points. Noise modeling has predicted surface noise which is important for the fauna of the Sundarbans Mangrove forest. Two impact scenarios have been developed based on the changing position of transshipment point and vessel types. In case of cumulative effects of concurrent noise sources, noise level will increase at certain locations when the vessels cross each other or pass side by side.

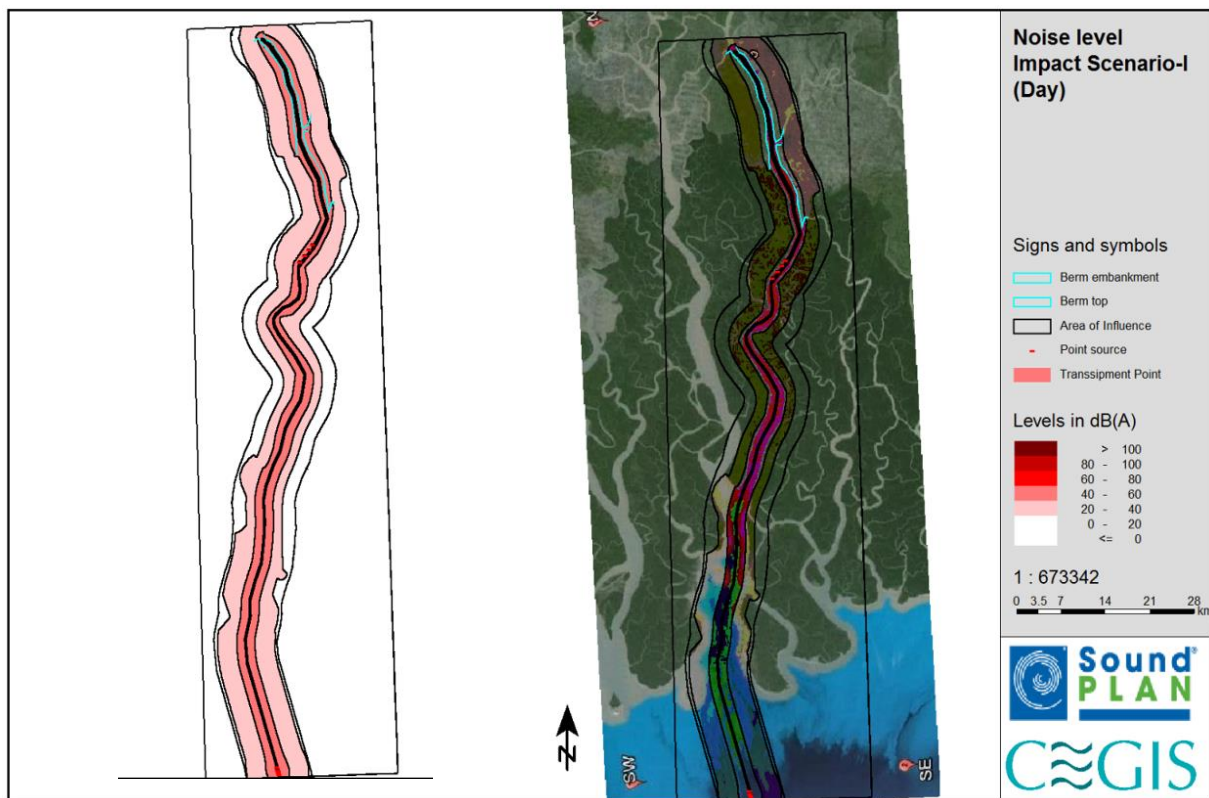
Impact Scenario-I

748. In this scenario, transshipper will unload coal from Capesize vessels to the lighterage at Fairway Buoy. The transshipment point has been considered as a source of noise along with other sources including mother vessel, lighterage vessel and other vessels. High noise generating tug boats or self-propelled lighterage will carry coal to the project site directly. The predicted noise level at the selected receivers are presented in the **Table 9-5** and **Figure 9-3** (day time) and **Figure 9-4** (night time). The increasing vessels and transshipper for coal transportation will increase the ambient noise level at few points which is shown in the Table- 9-5 (Resultant noise level). However, the resultant noise level will be lower than the standard limit of Noise Control Rules, 2006.

Table 9-5: Predicted noise level at selected receivers (Project Case)

No.	Receiver name	Predicted Noise Level (dBA)		Measured Baseline Noise Level (dBA)	Resultant Noise level (dBA)	Noise Control Rule 2006 (dBA)	
		Day	Night			Day	Night
1	NW Corner of the Power Plant Project site	38.5	35.8	44.0	45.0	70	60
2	Power Plant project site	38.7	36.6	47.2	47.7	70	60
3	SW corner of the Power Plant Project site	43.2	41.4	47.1	49.1	70	60
4	Chunkuri-2, Bajua	43.9	42.2	49.4	50.4	55	45
5	Mongla Port area	46	44.2	50.2	51.2	70	60
6	Upper Harbaria Right Bank	35.3	34.6	47.5	47.5	50	40
7	Lower Harbaria Left Bank	37.3	37.1	47.5	47.5	50	40
8	Mazhar Point	35.5	35.1	47.5	47.5	50	40
9	Akram Point	27.2	27.1	44.7	44.7	50	40
10	Alorkol	26	26	44.6	44.6	50	40
11	Hiron Point	18.5	18.5	44.6	44.6	50	40
12	Fairway Buoy	44	44	-	-	50	40

Source: Field measured and model predicted data

**Figure 9-3: Predicted noise level in the selected locations in Day time (Scenario-I)**

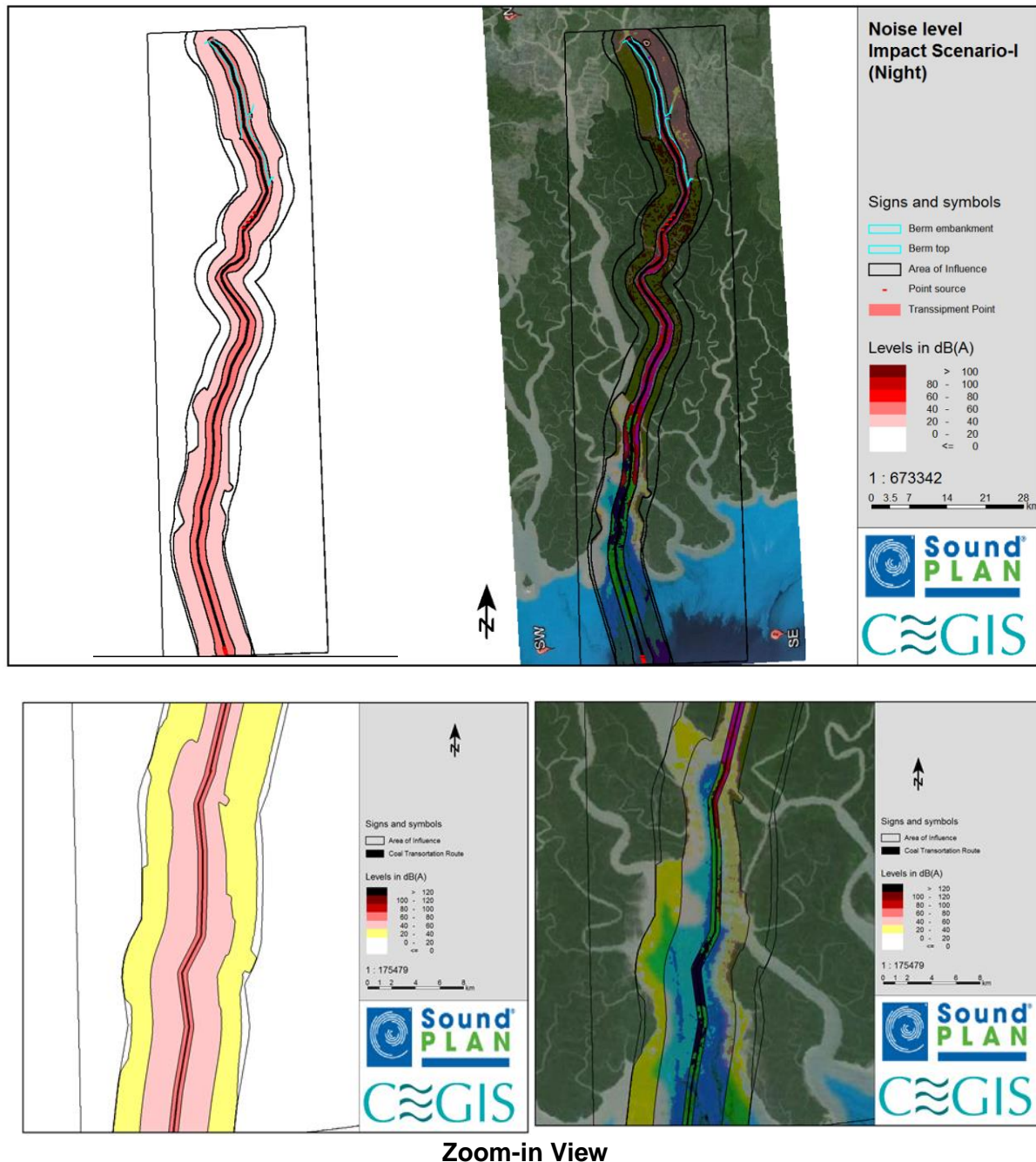


Figure 9-4: Predicted noise level in the selected locations in Night time (Scenario-I)

Impact Scenario – II

749. In this scenario, transhipper will unload coal from Handysize mother vessels to the lighterage at Mazhar Point which is downstream from the Harbaria. The transshipment point has been considered as area source of noise along with the Harbaria Point, and other vessels. Relatively high noise generating tug boats or self-propelled lighterage vessels will carry coal to the plant jetty directly. The predicted noise levels at the selected receivers are well below the measured noise level data presented in the **Table 9-6** and **Figure 9-5** and **Figure 9-6**. The increasing number of coal vessels and transshipper for coal transportation will increase the ambient noise level at few points which is shown in the **Table- 9-6** (Resultant noise level). However, the resultant noise levels are lower than the standard limit of Noise Control Rules, 2006.

Table 9-6: Predicted noise level at selected receivers

No.	Receiver name	Predicted Noise Level (dBA)		Measured Baseline Noise Level (dBA)	Resultant Noise Level (dBA)	Noise Control Rule 2006 (dBA)	
		Day	Night			Day	Night
1	NW Corner of the Power Plant Project site	38.5	35.8	44.0	45.0	70	60
2	Power Plant project site	38.7	36.6	47.2	47.7	70	60
3	SW corner of the Power Plant Project site	43.2	41.4	47.1	48.6	70	60
4	Chunkuri-2, Bajua	43.9	42.2	49.4	50.4	55	45
5	Mongla Port area	46	44.2	50.2	51.2	70	60
6	Upper Harbaria Right Bank	35.3	34.6	47.5	47.5	50	40
7	Lower Harbaria Left Bank	37.3	37.1	47.5	47.5	50	40
8	Mazhar Point (River Bank)	36.8	36.5	47.5	47.5	50	40
9	Akram Point	17.3	15.7	44.7	44.7	50	40
10	Alorkol	13.9	13.9	44.6	44.6	50	40
11	Hiron Point	6.3	6.3	44.6	44.6	50	40
12	Fairway Buoy	27	27	-	-	50	40

Source: All data have been measured within 100 m from the river bank and model predicted data

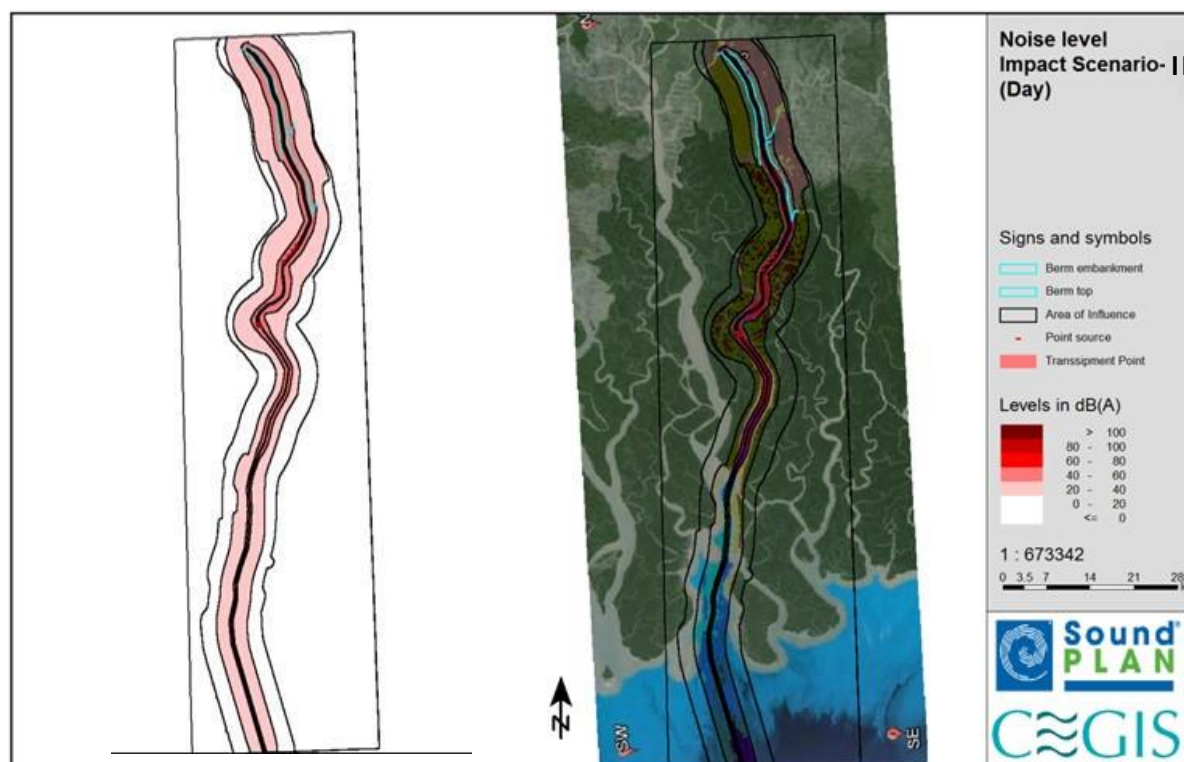


Figure 9-5: Predicted noise level in the selected locations in Day time (Scenario-II)

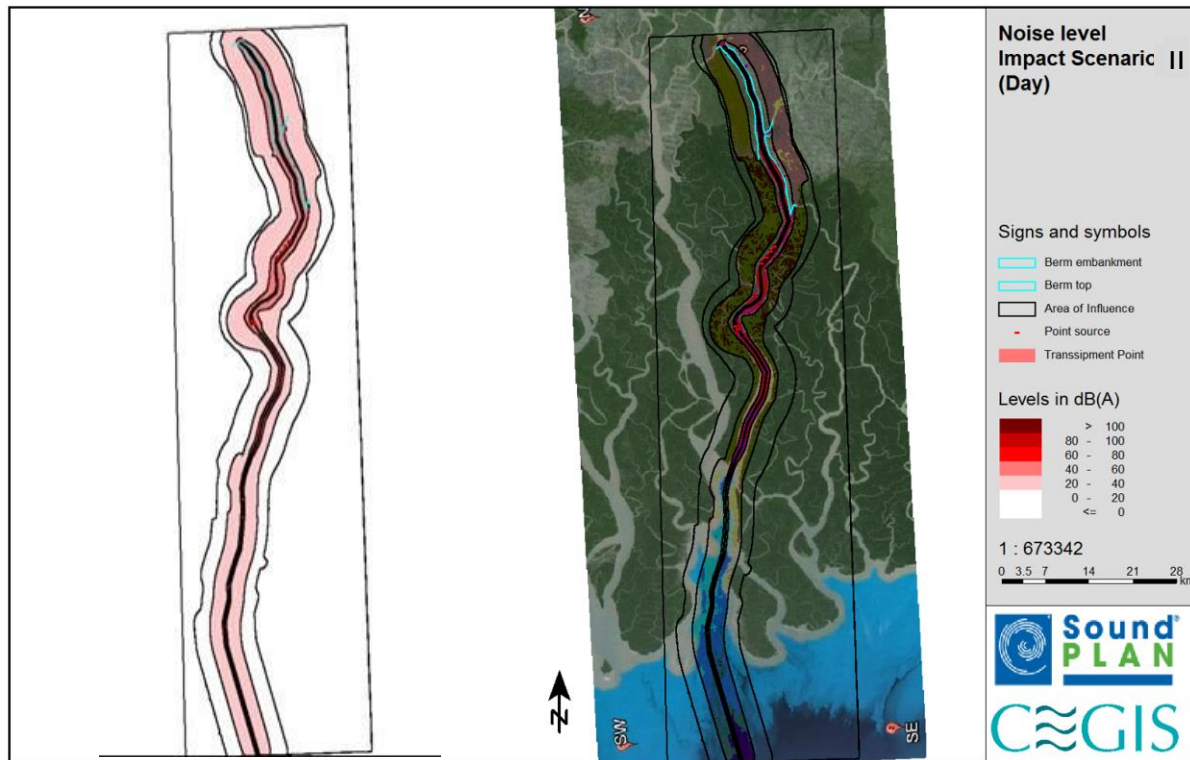


Figure 9-6: Predicted noise level in the selected locations in Night time (Scenario-II)

Mitigation measures are:

- Coal being unloaded from barges will have minimal drop heights
- Coal being unloaded from barges will have minimal drop heights.
- Adhere to transhipper's environmental control measures recommended in this EIA.
- Adherence to a comprehensive equipment maintenance program to maintain equipment, and to maximize efficiency and reliability, which will help limit noise levels associated with the operation.
- System components will be maintained to operate below maximum operating noise levels wherever feasible.
- Maintenance records will be maintained for review by BIFPCL's O/M department.
- Noisy mobile equipment supporting the operation will be removed from service wherever practical and replaced with a less noisy alternative.
- Noise Management plan for ships/barges will be implemented.
- Restrict blowing of whistle within the Sundarbans territory.
- Switch off / throttle down of all equipment when not in use
- For the life of the operation, BIFPCL will evaluate noise levels and onsite activities to identify opportunities for using less noisy equipment and / or making changes to day to day operations that may reduce overall noise levels.

750. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.8 Impact on Ambient Air Quality (including dispersion modeling) (C19)

Objective and Scope of Dispersion Modeling Study

751. The objective of the air quality modeling study is to (i) First assess the baseline condition in the air-shed, (ii) Second, assess the impact on air quality due to project case, which includes emissions from coal transport (including mother vessels, lighter vessels and barges) and Maitree power plant emissions and (iii) Finally, assess the cumulative impact, including future proposed developments in the airshed. USEPA regulatory model CALPUFF is used to predict the effect on ambient air quality for SO₂, NO_x, CO, PM_{2.5} and PM₁₀ emissions. There are many different dispersion models available, but CALPUFF was used because (i) it is designed for long-range analysis, more than 50 kilometers from the source, (ii) it can accurately model both simple and complex terrain, (iii) can model urban and rural areas, and (iv) multiple point, line, area, and volume sources can be modeled. CALPUFF can be used for assessing the impact of emissions 200-300 km from the source. This assessment is done as a part of EIA study for Coal Transportation to meet the compliance requirement of the Government of Bangladesh (GoB) and secure approval of the DoE to implement the project.

Impact on Air quality

a) Pollutants of Concern

752. Coal will be transported using marine vessels (including mother vessels, lighter vessels and barges). Emissions from marine vessels, which use diesel for fuel, are a major concern, especially since they will be traversing through the delicate Sundarbans ecosystem. In addition, the proposed coal-fired Maitree power plant will also be a significant source of emissions in the air-shed. Potential pollutants of concern released from marine vessels and proposed coal-fired power plant are Sulfur Dioxide (SO₂), Nitrogen oxides (NO_x), Particulate Matter (PM_{2.5} and PM₁₀) and Carbon Monoxide (CO). The amount of SO₂ released is dependent on the properties of the fuel, the higher the sulfur content of the fuel, higher the amount of SO₂ will be released. SO₂ emissions are a concern from both marine transport vessels and the proposed coal-fired power plant. High levels of SO₂ can lead to acid rain, which damages crops, forests, and soils, and acidifies lakes and streams. Combustion of diesel can also be a significant source of particulate matter. Particulate matter is created during the incomplete combustion of diesel fuel; its composition often includes hundreds of chemical elements. Coal-fired power plants also tend to release a significant amount of particulate matter in the form of soot and fly ash. The formation of thermal NO_x is dependent on 3 factors during combustion; (i) oxygen concentration, (ii) peak temperature, and (iii) time of exposure at peak temperature. Fuel combustion releases NO_x which is composed of NO and NO₂. NO₂ is of particular concern and is considered as a criteria pollutant. NO₂ is used as the indicator for the larger group of nitrogen oxides (NO_x). In addition to contributing to the formation of ground-level ozone, and fine particle pollution, NO₂ is linked with a number of adverse effects on the respiratory system. Significant health risks are associated with high levels of ambient NO₂, CO and PM_{2.5} concentrations. Emissions from the power plant are estimated for two scenarios (i) Baseline scenario and (ii) project case (which includes emissions from coal transport and the proposed Maitree Coal-fired power plant).

b) Emission of air pollutants

753. The emissions of air pollutants and greenhouse gases have been estimated using USEPA AP-42 and IPCC emission factors. In such estimates, coal transportation systems including mother vessels, lighterage and transhipper have been used and for coal power plant 80% plant factor was used. **Table 9-7** presents the emissions generated from coal transport and the coal power plant.

Table 9-7: Emission rate per year by source

Pollutant	Emissions (tons/yr)		
	Coal Transport	Coal Power Plant	Total Project
NO _x	397	10,351	10,748
SO ₂	1,974	6,502	8,475
CO	105	855	961
PM ₁₀	7	1,386	1,393
PM _{2.5}	6	616	622
Greenhouse Gases			
CO ₂	20,450	6,788,219	6,808,670
CH ₄	11	64	75

c) Air quality modeling input data

754. The latest version of the United States Environmental Protection Agency (USEPA) regulatory model CALPUFF was used to predict and simulate the effects of criteria pollutants from major emission sources in the project area and analyze the effect on ambient air quality for SO₂, NO₂, CO, PM_{2.5} and PM₁₀. Emissions data for point sources like industrial sources in the air-shed were calculated based on plant fuel consumption and emission factors from USEPA AP42. For Maitree STPP, the emissions were calculated considering the emission control measures like Advance LNB, FGD, ESP, etc. Accordingly, emission of SO_x is limited to 200 mg/Nm³ and NO_x-510 mg/Nm³ and PM-50mg/Nm³ (Tender document of Maitree STPP, 2015). This is considered a conservative approach to modeling. To calculate the SO₂ emissions it was assumed that the High Sulphur Diesel (HSD) with a sulphur content of 0.5% of the total mass is used, which is typical in Bangladesh. For emissions from sources that use Heavy Fuel Oil (HFO), 3.5% sulfur content is assumed, which is typically the case in Bangladesh. A Tier-1 and Tier-2 (Ambient Ratio Method) modeling approach was used for NO₂ prediction as per USEPA guidelines. In the Tier-1 approach it is assumed that 100% of the NO_x emissions are converted into NO₂, this approach gives the most conservative results and tends to over predict maximum ground level concentrations. In the tier-2 (ARM) a regional NO₂/NO_x ratio representative of area wide quasi-equilibrium conditions is applied to the model predicted values, this gives more realistic results for maximum ground level NO₂ concentration. NO₂ is the pollutant of concern and is used as an indicator for nitrogen oxides (NO_x) in general.

d) CALMET, CALPUFF and CALPOST Methodology

755. For the dispersion modeling analysis for coal transport, the CALPUFF model suite was used for. CALPUFF is a suite of numerical dispersion models that is composed of CALMET (the metrology processor), CALPUFF, and CALPOST (the post processor). The CALPUFF suite is used to determine the impact of emissions from a source or group of sources, which can be point, line or area. First, three-dimensional meteorological fields were produced by the diagnostic computer model CALMET based on surface and upper air weather data, digital land use data, terrain data, and prognostic meteorological data. The

three-dimensional CALMET meteorological fields were generated using WRF meteorological data and digital terrain and land use data.

756. Then the three-dimensional fields produced by CALMET were used by CALPUFF, which is a three-dimensional, multi-species, non-steady-state Gaussian puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport. Lastly, CALPOST, a statistical processing program, was used to summarize and tabulate the pollutant concentrations calculated by CALPUFF and produce contour diagrams.

Project Modeling Area

757. The CALPUFF dispersion model is comprised of a (i) Meteorological grid, (ii) Computational grid, and (iii) Sampling (receptor) grid as shown in **Figure 9-7**. The Meteorological Grid (shown in blue in the Figure) is 150 km by 150 km with the center point being at Lat: 22.23331 N and Long: 89.5704 E and is the system of grid points at which meteorological parameters such as wind components and mixing heights are defined. The Computational Grid (shown in red) is where the puffs are released and advected, and is either identical to or a subset of the Meteorological Grid, in this case it was chosen to be 140 km by 50 km (7,000 km²), the length was chosen to adequately cover the entire coal transportation route from the Fairway Buoy in the South to 25 km North of the proposed Maitree Coal power plant. The 50 km width was chosen to ensure the emissions impact from marine coal transportation vessels on the Sundarbans forest would be adequately assessed on both sides of the Passur River. A pre-run assessment showed that impacts beyond this range were negligible. Choosing a computational/sampling area that is too big would significantly increase model run-time. The sampling Grid (red x's) defines the set of gridded receptors, which must be placed within the computational grid and meteorological grid. In this case, the sampling grid has the same dimensions as the computational grid.



Figure 9-7: Metrological, Computational and Sampling Grid

758. Figure 9-8 shows the Coal Transportation Route (which runs from the Fairway Buoy to Mazhar Point), the Protocol (India-Bangladesh Friendship Route), the Akram Point to Nalian Route and the location of major point, line and area sources in the air-shed. The area of the Sundarbans Reserve Forest is also indicated, along with the location of Khulna city and Mongla Port.

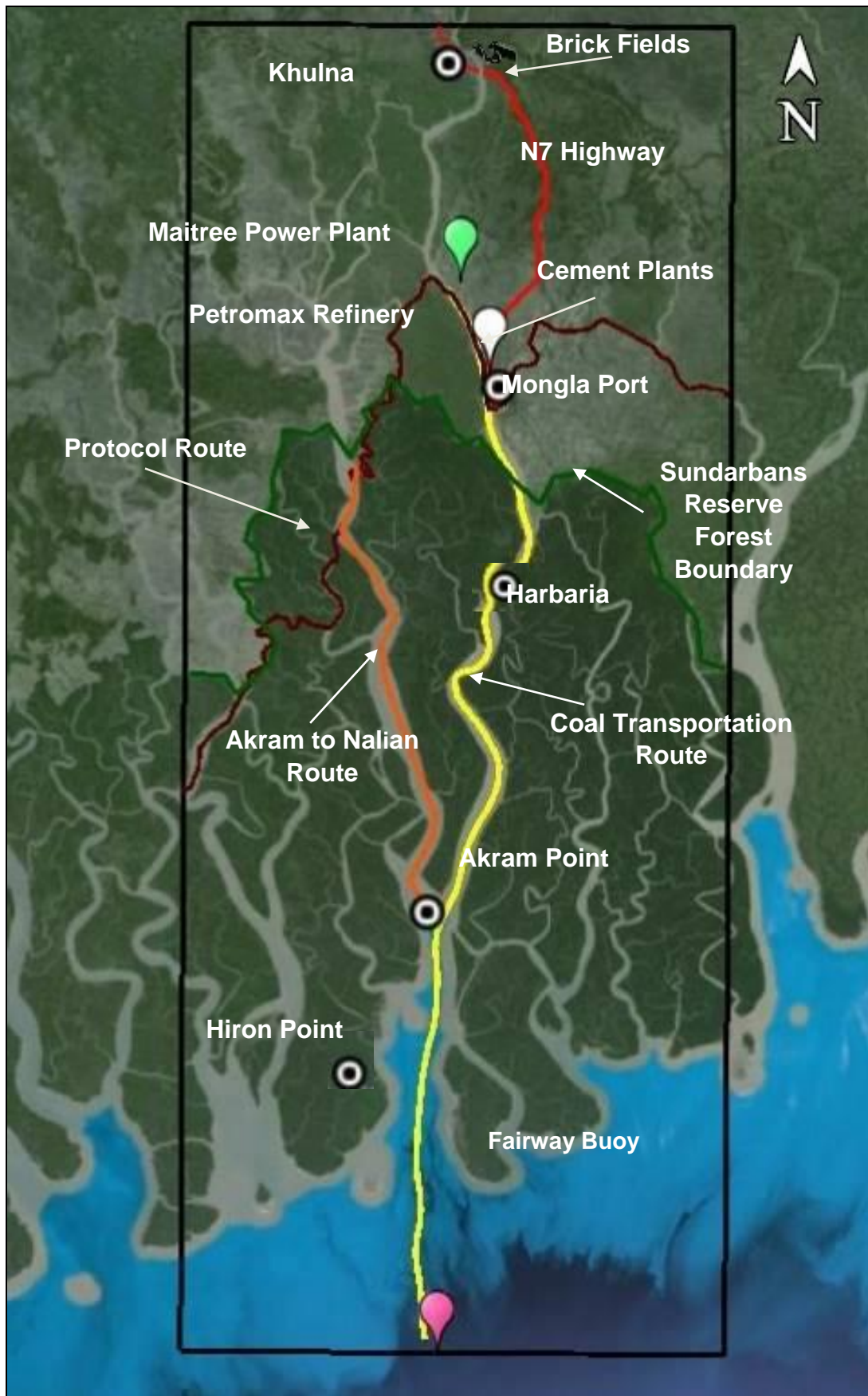


Figure 9-8: Coal Transportation Route and Sources

Emissions Inventory

759. Emission inventories were prepared for all major point, area, and line sources within the airshed. The major point sources for modeling the baseline and project case are as follows:

- Petromax Oil Refinery
- Rupsha Tank Terminal & Refineries
- Maitree Coal Fired-power Plant (1,320 MW)
- Anchored Mother Vessel
- Anchored Trans-shipper

760. During the transshipment of coal, when the coal is being transferred from the mother vessel to lighter vessel, a trans-shipper will be used. The mother vessel and trans-shipper will emit emissions from the running of generators and other auxiliary equipment. For the baseline run, only the Petromax Oil Refinery and Rupsha Tank Terminal & Refineries were included, for the project case, emissions from the proposed Maitree Coal-fired power plant, anchored mother vessel and anchored trans-shipper were also included. For the Maitree Coal-fired power plant it is assumed there is 90% reduction from FGD for SO₂ emissions as per USEPA AP-42, Fifth Edition, Volume 1: Stationary Point and Area Sources. For PM_{2.5} and PM₁₀, ESP controlled emission factor is used and an ash content of 15% as per USEPA AP-42. Table 9-8 shows the major point sources along with input parameters.

Table 9-8: Major Point Source Emissions in the Project Area

Power Plant	Exit Velocity (m/s)	Stack Height (m)	Inner Dia. (m)	Flue Gas Temp. (K)	Emission Rate (g/s)				
					NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀
Petromax Oil Refinery	20	36.6	0.5	771	2.19	0.00	49.69	0.00	0.00
Rupsha Tank Terminal & Refineries Ltd	20	27.4	0.8	771	0.04	0.01	0.00	0.00	0.00
Maitree Power Plant	25	275	7.5	398	328.2	206.1	27.13	19.53	43.95
Anchored Mother Vessel	24	35	1	433	1.04	0.16	0.28	0.02	0.02
Anchored Trans-shipper	24	35	1	433	2.27	0.36	0.60	0.034	0.04

761. Major area source emissions considered in the airshed for the baseline and project case were as follows:

- Brick Fields
- Fugitive Emissions from Mongla Cement Plant
- Fugitive Emissions from Meghna Cement Plant
- Fugitive Emissions from Holcim Cement Plant
- Fugitive Emissions from Five Rings Cement Plant
- Fugitive Emissions during Trans-shipment

762. Brick kilns located in the project area were grouped together and modeled as area sources. Fugitive emissions from transfer of coal from mother vessel to lighter vessel were calculated as per USEPA AP-42 and included in the project case. Fugitive particulate emissions from cement plants were also included in the model. There are no stack

emissions from the cement plants as the clinker is imported from outside Bangladesh, there is only fugitive emissions from the grinding of the Clinker. **Table 9-9** shows the major area sources along with input parameters.

Table 9-9: Major Area Sources in the Study Area

Name	Emission Rate (g/s-m ²)					Source Area (m ²)	Release Height (m)
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀		
Brick Field 1	5.30E-07	1.25E-06	8.31E-07	9.04E-07	2.00E-06	2,913,112	38.1
Brick Field 2	5.25E-07	1.24E-06	8.24E-07	8.96E-07	1.99E-06	2,403,742	38.1
Fugitive (Trans-Shipments)	0	0	0	9.78E-06	6.45E-05	13,000	10
Fugitive (Mongla)	0	0	0	3.5E-04	3.82E-04	7,027.2	2
Fugitive (Meghna)	0	0	0	1.53E-04	1.68E-04	6,154.0	2
Fugitive (Holcim)	0	0	0	3.82E-04	4.18E-04	7,851.1	2
Fugitive (Five Rings)	0	0	0	1.33E-04	1.45E-04	6,154.3	2

763. Major line-area sources of pollution considered in the model are traffic along the major highways and marine vessel traffic in the rivers (including mother vessels, lighter vessels, non-standard vessels, cargo, tourist boats, fishing boats and etc.). The following were modeled:

- Highway N7: 27-30
- Highway N7: 31-34
- Passur River Coal Transportation Route
- Bangladesh-India IWT Protocol Route
- Akram to Nalan Route

764. The types and total quantity of marine vessels were recorded and measured along different sections of the River. Then, the total fuel used was calculated based on the estimated/observed number of marine vessels. Emissions from marine vessels were calculated based on the total estimated fuel used and USEPA AP-42 emission factors. Since different sections of the Passur River had differing amounts and types of marine traffic, it was divided into several line area source segments. **Table 9-10** shows the emission factors for the N7 Highway.

765. **Table 9-11** shows the baseline emission factors along different sections of the Passur River, Protocol Route and Akram to Nalan Route. **Table 9-12** shows the project case emission factors along different sections of the Passur River, Protocol Route and Akram to Nalan Route. Note that for the baseline case 2015 marine vessel traffic data is used and for the project case, 2021 projected marine vessel traffic data is used and includes emissions from additional marine vessels (mother vessels and lighter vessels) required for the proposed Maitree Coal-fired power plant. Emissions were modeled for worst case scenario of Anchorage at Harbaria.

Table 9-10: Major Line-area Sources in the Study Area (Highway Traffic)

Name	Emission Rate (g/s-m ²)					Release Height (m)
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	
N7: 27-30	5.87E-06	1.85E-06	8.22E-05	7.71E-06	1.01E-05	0.5
N7: 31-34	2.10E-06	7.73E-07	2.49E-05	2.82E-06	3.72E-06	0.5

*Calculated based on The RMMS Database, Department of Roads and Highways, Bangladesh.

Table 9-11: Major Line-area Sources in the Study Area (Marine Vessels – Baseline)

Name	Emission Rate (g/s-m ²)					Release Height (m)
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	
Fairway Buoy to Harbaria	1.32E-06	2.08E-07	3.51E-07	1.98E-08	2.36E-08	35
Harbaria to ChandpaiShela	1.13E-06	1.79E-07	3.01E-07	1.70E-08	1.53E-08	15
ChandpaiShela to Katakhal	1.02E-05	1.60E-06	2.70E-06	1.52E-07	1.80E-07	15
Katakhal to Chila Bazar	6.73E-06	1.06E-06	1.79E-06	1.01E-07	1.18E-07	15
Banshtola Bazar to Chila Bazar	1.29E-06	2.04E-07	3.44E-07	1.94E-08	2.32E-08	15
Chila Bazar to Baniashanta Bazar	7.13E-06	1.13E-06	1.89E-06	1.07E-07	1.25E-07	15
Baniashanta Bazar to Mongla Powerhouse	1.12E-05	1.77E-06	2.99E-06	1.68E-07	2.01E-07	15
Mongla Powerhouse to Loudop	4.34E-05	6.85E-06	1.15E-05	6.49E-07	7.77E-07	3
Loudap to Baju Bazar	9.91E-06	1.56E-06	2.63E-06	1.48E-07	1.77E-07	3
Baju Bazar to Khulna	2.19E-06	3.46E-07	5.82E-07	3.28E-08	3.92E-08	3
Protocol Route	3.86E-07	6.09E-08	1.03E-07	5.78E-09	6.91E-09	3
Nalan to Akram	1.26E-06	1.99E-07	3.36E-07	1.89E-08	2.26E-08	3

*Calculated based on data from Mongla port Authority, Khulna Divisional IWT Owners' Group and BIWTA.

Table 9-12: Major Line-area Sources in the Study Area (Marine Vessels – Project Case)

Name	Emission Rate (g/s-m ²)					Release Height (m)
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	
Fairway Buoy to Harbaria	3.95E-06	6.23E-07	1.05E-06	5.91E-08	7.07E-08	35
Harbaria to ChandpaiShela	4.46E-06	7.03E-07	1.18E-06	6.67E-08	5.08E-08	15
ChandpaiShela to Katakhal	1.31E-05	2.06E-06	3.47E-06	1.95E-07	2.23E-07	15
Katakhal to Chila Bazar	9.68E-06	1.53E-06	2.57E-06	1.45E-07	1.57E-07	15
Banshtola Bazar to Chila Bazar	3.06E-06	4.83E-07	8.13E-07	4.58E-08	5.48E-08	15
Chila Bazar to Baniashanta Bazar	9.99E-06	1.58E-06	2.65E-06	1.50E-07	1.65E-07	15
Baniashanta Bazar to Mongla Powerhouse	1.38E-05	2.19E-06	3.68E-06	2.07E-07	2.43E-07	15
Mongla Powerhouse to Loudop	4.60E-05	7.26E-06	1.22E-05	6.88E-07	8.23E-07	3
Loudap to Baju Bazar	1.05E-05	1.66E-06	2.79E-06	1.57E-07	1.88E-07	3
Baju Bazar to Khulna	2.32E-06	3.66E-07	6.17E-07	3.48E-08	4.16E-08	3
Protocol Route	4.88E-07	7.70E-08	1.30E-07	7.31E-09	8.74E-09	3
Nalan to Akram	1.69E-06	2.67E-07	4.49E-07	2.53E-08	3.03E-08	3

*Calculated based on data from Mongla port Authority, Khulna Divisional IWT Owners' Group and BIWTA.

Meteorological Data

766. Pre-processed hourly WRF meteorological data (with resolution of 4 km) from January 1st, 2013 to December 31st, 2015 (for 3 years) was purchased and used for CALMET processing. A monthly summary of the meteorological data is given in **Table 9-13**. It is observed from the table that predominant wind direction towards north/northeast/northwest from the south for eight (8) months (from March to October) and rest of the year (4 months) predominant wind direction towards south/southeast from the north.

Table 9-13: Summary of Meteorological Data Input to CALMET

Month	Wind		Temperature (°C)	
	Max. Speed (m/s)	Predominant Direction	Min	Max
Jan	5.7	SE	11	30
Feb	8.8	SE	13	33
Mar	8.8	NE	18	40
Apr	11.1	NE	23	41
May	11.1	NE	26	38
Jun	8.8	NE	26	40
Jul	8.8	N	25	34
Aug	8.7	N	25	33
Sept	8.0	NE	25	34
Oct	8.7	NW	19	33
Nov	5.7	S	15	31
Dec	5.7	S	11	29

Receptors

767. As discussed previously a uniform sampling grid was used to model the receptors in the model. The 140 km by 50 km model area was divided into a grid with an interval of 4 km, where receptors are located at the center of each grid for plotting of air quality data for the model project area. Important sensitive receptor locations and key receptors along the transporation route were also included in the grid area. The list of sensitive and key receptors, their locations and details are given in **Table 9-14**. A fine grid (250 m x 250 m) is also modeled within 5 km radius of the plant to see micro-environmental impacts of pollutant concentration close to the power plant.

Table 9-14: Location of Sensitive and Key Receptors

No.	Receptor	Coordinates in meter (UTM)		Receptor Characteristics
		X	Y	
1	Khulna	760245.00	2528876.00	Settlement
2	Nearest Tip of the Sundarbans	755323.00	2490640.00	Transition of forest and river
3	Akram Point	760955.9	2435837	Reserve forest
4	Alorkol	762464.6	2411943	Reserve forest
5	Chunkuri Bajua	764200.4	2493851	Reserve forest
6	Hiron Point (WHS)	754732.4	2411566	Reserve forest
7	Lower Harbaria Left Bank	767900.6	2465736	Reserve forest
8	Mazhar Point	763738.2	2457630	Reserve forest
9	Mongla	767337.3	2487948	Industrial area
10	NW Corner of Power Plant Project	761802.2	2501926	-

No.	Receptor	Coordinates in meter (UTM)		Receptor Characteristics
11	SW Corner of the Power Plant	764846.4	2497963	-
12	Upper Harbaria Right Bank	769205.1	2471627	Reserve forest
13	L-1 (Close to Power Plant)	762292.87	2499598.51	Transportation Route
14	L-2 (Close to Mongla Port)	766651.66	2489307.19	Transportation Route
15	L-3 (Close to Harbira)	767756.68	2468098.38	Transportation Route
16	L-4 (Close to Majhar Point)	762386.37	2456781.92	Transportation Route
17	L-5 (South of Akram Point)	761095.06	2431086.34	Transportation Route
18	L-6 (North of Hiron Point)	757516.90	2414425.72	Transportation Route
19	L-7 (At Fairway Buoy)	760966.80	2383684.68	Transportation Route

Air Quality Modeling

768. In this section, the predicted maximum ground level concentration results and contour maps for maximum concentration levels in ambient air are presented for SO₂, NO_x (NO₂), PM_{2.5}, PM₁₀ and CO for both the baseline and project scenario. Measured ambient background concentrations were considered in validation of the predicted modeled results.

c) Background Concentration

769. Background ambient measurements were obtained from the Monitoring Report of environment parameters and implementation of Environmental Management Plan during pre-construction and construction period along with Engineering Activities for site development of Khulna 1,320 MW Coal based Thermal Power Plant Report, (Available since Mar 2014).

770. Validation of ambient air quality measurements made at a location far from major anthropogenic sources at Hiron Point, which is within the UNESCO WHS of the Sundarbans South Wildlife Sanctuary. Eight (8) measurements were made between April 2014 and January 2016 and the average of those values was taken as the background concentration for each pollutant. The ambient background measurements are presented in **Table 9-15**.

Table 9-15: Validation of ambient background concentrations at Hiron Point

Pollutant	Average Background Concentration (µg/m ³)
NO _x	20
NO ₂ *	13
CO	65
PM ₁₀	44
PM _{2.5}	21.5
SO ₂	14

*Estimated based on NO_x concentration using Ambient Ratio

771. The background values for SO₂, PM_{2.5} and PM₁₀ are measured for 8-hour averaging period and thus have to be converted to 24-hr and annual averaging period for compatibility with modeled results. NO₂ is for 8-hour measurement period and has to be converted to 1 hour and average. The CO has to be converted from 8 hour to 1 hour average period. Conversions are done using the power law relationship given below:

$$C_{\text{long}} = C_{\text{short}}(t_{\text{short}}/t_{\text{long}})^P$$

where:

C_{long}= the concentration for the longer averaging time

C_{short}= the concentration for the shorter averaging time

T_{short} = the shorter averaging time (in minutes)

T_{long} = the longer averaging time (in minutes)

p = the power law exponent

772. For ambient air assessments a p value of 0.28 is used. This methodology is deemed to give conservative estimates and thus is deemed appropriate for this case. The converted background concentration values are given in **Table 9-16**. The background ambient concentration values were added to the modeled 1-hr, 8-hr, 24-hr and annual concentration values.

Table 9-16: Converted Background Concentration Values

Pollutant	Concentration ($\mu\text{g}/\text{m}^3$)			
	Ambient Concentration (8-hr averaging period)	Converted Ambient Concentration (24-hr)	Converted Ambient Concentration (1-hr)	Converted Ambient Concentration (Annual)
NO ₂	13	-	23.4	1.8
SO ₂	14	10.29	-	2.0
CO	65	-	118	-
PM _{2.5}	21.5	15.8	-	3.0
PM ₁₀	44	32.3	-	6.2

773. The background PM_{2.5} and PM₁₀ values for 24-hour averaging period are quite high for a remote location in the Sundarbans (Hiron Point), 63% and 65% of the WBG guideline values of 25 and 50 $\mu\text{g}/\text{m}^3$, respectively. It is estimated that a significant portion of the PM_{2.5} concentration in Bangladesh is trans-boundary in nature (secondary pollutants formed from NO_x and SO_x after chemical transformation in the ambient air); predominately from West Bengal and North India.²⁴ The major Indian city of Kolkata is less than 100 km to the west of the project location. Studies show that on average 35% of the PM_{2.5} concentration is trans-boundary in nature and can be as high as 67% depending on the season and direction of the wind⁷.

d) Concentration of Nitrogen Dioxide (NO₂)

774. For NO₂ the maximum ground level concentrations were modeled for 1-hour averaging period and annual averaging period to compare with the national standards (ECR 1997, amended in 2005) and WBG/IFC Guideline Values. For short-term compliance modeling (i.e. 1-hour averaging period), percentiles are used in order to account for unusual meteorological events and avoid overestimation of concentrations, for NO₂ the 99.9th percentile of the max NO₂ value is taken.

775. A Tier-2 approach was used to model the NO₂ concentrations as oppose to a Tier-1 approach. A Tier-1 approach assumes 100% conversion of hourly NO_x emissions into NO₂, which tends to over estimate results. In the Tier-2 (Ambient Ratio Method) approach, the predicted 1-hr maximum ground level concentrations are multiplied an ambient NO₂/NO_x ratio to get more realistic results. The ARM uses the ratio of the average NO₂ and NO_x ambient concentrations measured at a representative site. It uses an ambient equilibrium

²⁴Billah, M., Chatani, S., and Sudo, K. (2009); Application of WRF-CMAQ Modeling System to Study of Urban and Regional Air Pollution in Bangladesh, 8th Annual CMAS Conference, Chapel Hill, NC, October 19-21, 2009.

NO₂/NO_x ratio (annual average) which is calculated based on regional monitoring data.²⁵ Theoretically, equilibrium occurs when the rate of NO₂ formation (from oxidation of NO) equals the rate of dissociation of NO₂ by sunlight²⁶. An ambient equilibrium NO₂/NO_x ratio of 0.65 was used, which is based on data from the Narayanganj CAMS monitoring station of DoE.

776. **Table 9-17** shows the predicted maximum ground concentration of 1-hr and annual averaging values for the baseline and project cases. Both baseline and project case are well below the standards and there is no exceedance of standards due to the implementation of the project (including coal-fired power plant and additional marine vessels required for coal transportation). There is an increase in the maximum 1 hr averaging NO₂ concentration from the baseline to project case. **Table 9-18** gives the predicted maximum ground level concentrations at sensitive and key receptor sites. There is an increase in NO₂ concentration at sensitive receptor sites from baseline to project case; however the results are still well within the National Standards and WBG guidelines.

Table 9-17: Predicted Maximum Concentrations of NO₂ (Baseline & Project Case)

Pollutant	Concentration (µg/m ³)				Coordinates of Max Point (UTM)		Name of Location
	Averaging Time	ECR 1997 (as amended in 2005)	WBG Guidelines	Max Value	East (m)	North (m)	
NO ₂ (baseline)	1-hr	N/A	200	91.3	762,947.0	2,490,901.0	Laudubi, Dacope
	Annual	100	40	5.1	762,947.0	2,526,901.0	Deara, Rupsha
NO ₂ (project case)	1-hr	N/A	200	103.4	762,900.0	2,502,901.0	Kapashdanga, Rampal
	Annual	100	40	6.0	766,900.0	2,486,901.0	Mongla Upazila HQ

Table 9-18: NO₂ maximum GLC at Sensitive and Key Receptors

No.	Receptor	NO ₂ Concentration (µg/m ³)			
		Baseline		Project Case	
		1-hr	Annual	1-hr	Annual
1	Khulna	32.5	1.99	32.78	2.03
2	Nearest Tip of the Sundarbans	29.0	2.2	33.0	2.3
3	Akram Point	26.22	1.95	29.45	2.06
4	Alorkol	25.16	1.89	28.33	2.07
5	Chunkuri Bajua	66.84	3.31	71.13	3.78
6	Hiron Point (World Heritage Site)	24.63	1.85	26.99	1.93
7	Lower Harbaria Left Bank	31.4	2.22	37.15	2.47
8	Mazhar Point	28.36	2.2	28.4	2.04
9	Mongla	90.5	4.9	102.7	5.8
10	NW Corner of Power Plant Project	42.56	2.46	76.31	2.65
11	SW Corner of the Power Plant	49.23	3.29	52.23	3.61
12	Upper Harbaria Right Bank	32.77	2.22	38.3	2.69
13	L-1 (Close to Power Plant)	55.3	3.7	81.75	3.98

²⁵ Journal of the Air and Waste Management Association: The Plume Volume Molar Ratio Method for Determining NO₂/NO_x Ratios in Modeling—Part I: Methodology, 2011.

²⁶ Use of Ambient Ratios to Estimate Impact of NO_x Sources on Annual NO₂ Concentrations. In Proceedings of the 84th Annual Meeting & Exhibition, Air & Waste Management Association, 1991

No.	Receptor	NO ₂ Concentration (µg/m ³)			
		Baseline		Project Case	
14	L-2 (Close to Mongla Port)	91.0	5.0	103.1	5.9
15	L-3 (Close to Harbira)	32.5	2.31	43.83	3.11
16	L-4 (Close to Mazhar Point)	28.07	2.07	28.61	2.04
17	L-5 (South of Akram Point)	27.19	2.09	34.32	2.62
18	L-6 (North of Hiron Point)	27.02	1.91	33.69	2.12
19	L-7 (At Fairway Buoy)	25.84	1.83	31.08	1.9

777. Both the coal transportation and IWT protocol routes run through the study area, the N7 highway is nearby and there is a significant ship traffic at Mongla port as well. There is also a refinery close by and the proposed Maitree coal Power plant will be located at a short distance to the North of this area.

778. **Figure 9-9** and **Figure 9-10** show the 1-hr and annual averaging contour diagrams for the baseline and project case, respectively. From the figures it is seen that the highest predicted maximum ground level concentration areas occur to the north of the Sundarbans Forest Boundary around, in the area around Mongla Port. This area has a high concentration due to the many emission sources in this area, as shown in **Figure 9-8**.

779. As seen from the contour diagrams there are some NO₂ concentration zones within the Sundarbans Forest area, close to the Northern boundary and along the marine vessel routes (especially the Akram Point to Nalian route). However, these concentrations are well within the national standards and WBG Guideline Values.

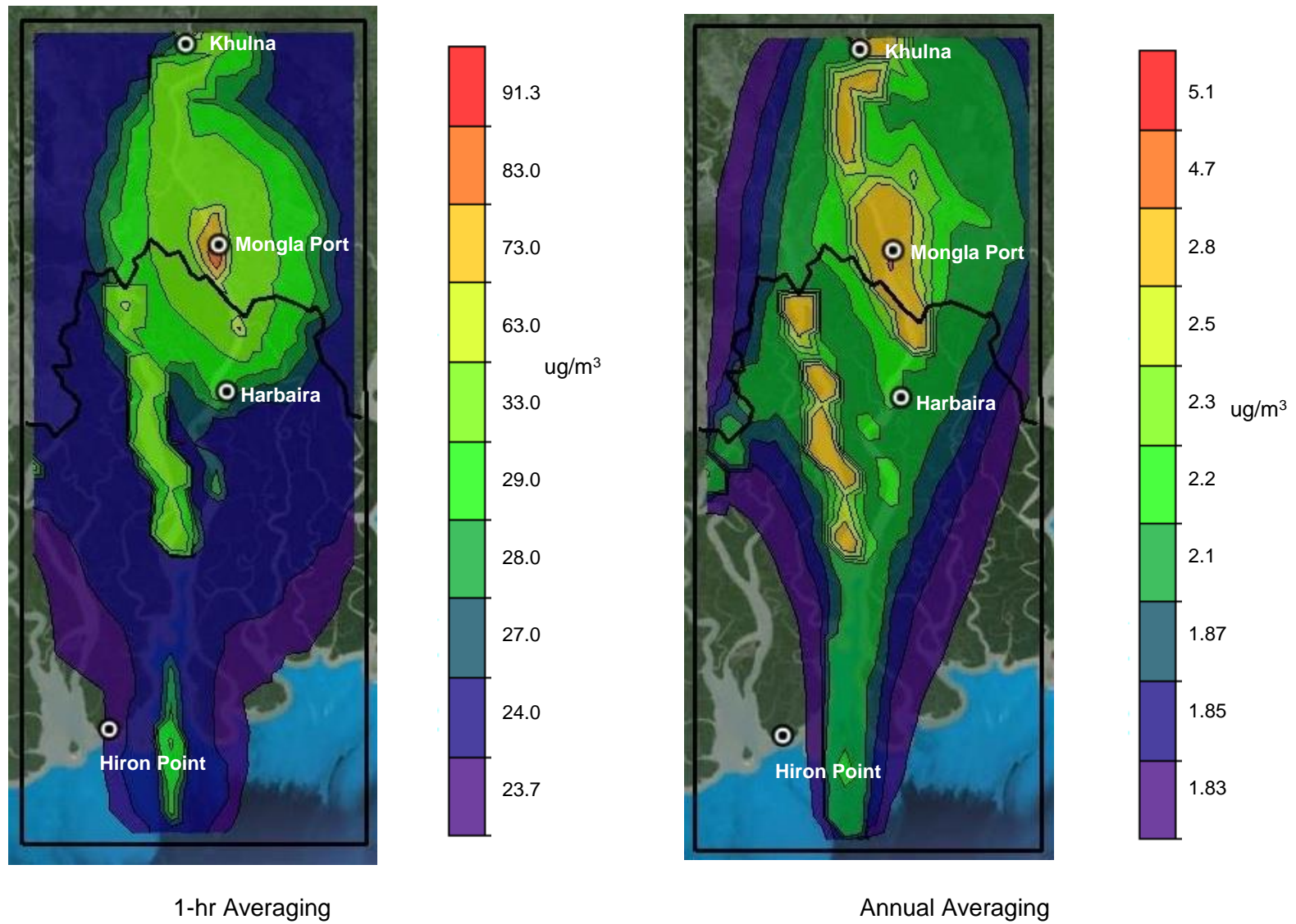


Figure 9-9: Predicted NO₂ Concentration – Baseline

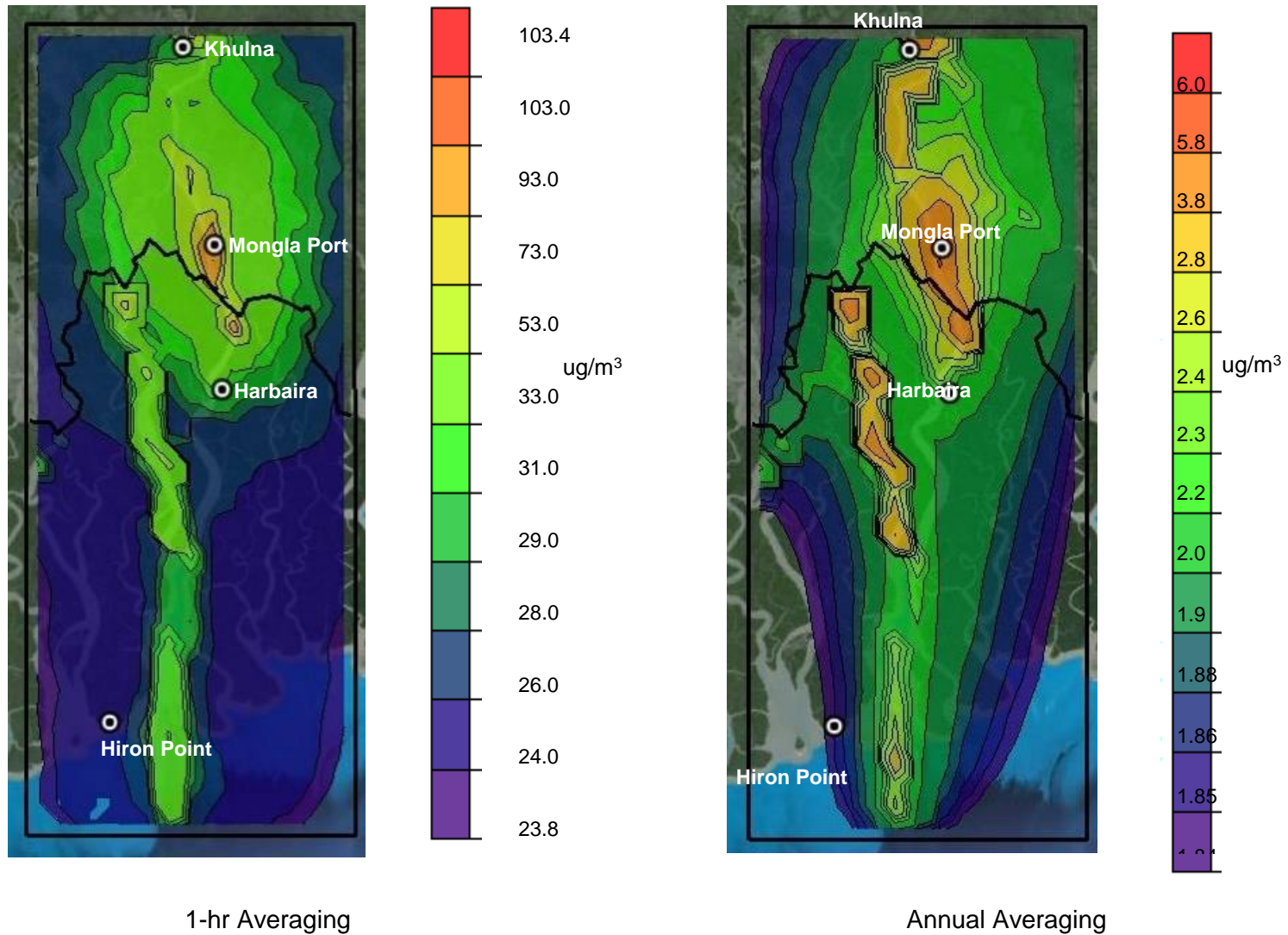


Figure 9-10: Predicted NO₂ Concentration – Project Case

e) Concentration of Carbon Monoxide (CO)

780. For CO the predicted maximum ground level 1-hr and 8-hr averaging values are given in **Table 9-19**, the highest predicted concentration reached for a particular averaging period (1-hr or 8-hr) based on 3 years meteorological data as per the Bangladesh standards. There is no WBG Guidelines for CO. As seen from the table, the CO concentration is very small, a fraction of the standards, therefore is of no concern. There is a negligible increase in maximum CO concentration from baseline to project case.

Table 9-19: Air Quality Modeling – CO (Baseline & Project Case)

Pollutant	Concentration ($\mu\text{g}/\text{m}^3$)				Coordinates of Max Point (UTM)		Name of Location
	Averaging Time	ECR 1997 (as amended in 2005)	WBG Guidelines	Max Value	East (m)	North (m)	
CO (baseline)	1-hr	40,000	N/A	614.1	770,947.0	2,486,901.0	Malgazi, Mongla
	8-hr	10,000	N/A	257.0	762,947.0	2,526,901.0	Deara, Rupsha
CO (project case)	1-hr	40,000	N/A	614.2	770,947.0	2,486,901.0	Malgazi, Mongla
	8-hr	10,000	N/A	258.0	762,947.0	2,526,901.0	Deara, Rupsha

f) Concentration of $\text{PM}_{2.5}$

781. For $\text{PM}_{2.5}$ the predicted maximum ground level 24-hr and annual concentrations are given in **Table 9-20**. Maximum concentration occurred at mongla, which is surrounded by Cement plant. It is suspected that there is a sizable contribution to this from trans-boundary sources. **Table 9-20** shows that the predicted $\text{PM}_{2.5}$ concentrations for baseline and project case are well within the Bangladesh National standards. The predicted concentrations do meet WBG interim target-1 for 24 hour averaging ($75 \mu\text{g}/\text{m}^3$). Interim targets²⁷ are provided for developing countries in recognition of the need for a staged approach to achieving the recommended guidelines. **Table 9-21** gives the predicted concentration at sensitive receptor locations along the project route and close to the power plant. There is a marginal increase in predicted concentration from baseline to project case, the results meet the National Bangladesh Standards and WBG interim targets.

782. All ground level concentration of $\text{PM}_{2.5}$ in the Sundarbans Reserve Forest area are well below Bangladesh National standards and World Bank/IFC guidelines. There are only marginal increases of $\text{PM}_{2.5}$ values due to implementation of Maitree STPP from baseline value.

²⁷ According to EHS Guidelines, IFC, 2007, Interim targets (IT) are provided in recognition of the need for a staged approach to achieving the recommended guidelines (G).

Table 9-20: Predicted maximum concentrations of PM_{2.5} (Baseline and Project Case)

Pollutant	Concentration (µg/m ³)				Coordinates of Max Point (UTM)		Name of Location
	Averaging Time	ECR 1997 (as amended in 2005)	WBG Guidelines/Interim Target	Max Value	East (m)	North (m)	
PM _{2.5} (baseline)	24-hr	65	25 (G)/75 (IT-1)	47.1	766, 947.0	2,494,901.0	Kapalirmet Buridmial, Mongla
	Annual	15	10 (G)	8.6	766, 947.0	2,494,901.0	
PM _{2.5} (project case)	24-hr	65	25 (G)/75 (IT-1)	47.2	766, 947.0	2,494,901.0	
	Annual	15	10 (G)	8.63	766, 947.0	2,494,901.0	

Table 9-21: PM_{2.5} Concentration at Sensitive and Key Receptors

Sl. No.	Receptor	PM _{2.5} Concentration (µg/m ³)			
		Baseline		Project Case	
		24-hr	Annual	24-hr	Annual
1	Khulna	18.66	3.24	18.67	3.25
2	Nearest Tip of the Sundarbans	18.8	3.1	20.8	3.13
3	Akram Point	16.19	3.03	16.28	3.05
4	Alorkol	16.09	3.02	16.13	3.03
5	Chunkuri Bajua	31.8	3.99	31.92	4.03
6	Hiron Point (World Heritage Site)	16.04	3.02	16.13	3.03
7	Lower Harbaria Left Bank	17.3	3.15	17.4	3.18
8	Mazhar Point	16.76	3.09	16.76	3.12
9	Mongla	33.97	4.46	34.02	4.5
10	NW Corner of Power Plant Project	23.52	3.39	23.53	3.41
11	SW Corner of the Power Plant	25.74	5.24	25.8	5.27
12	Upper Harbaria Right Bank	17.38	3.18	17.46	3.21
13	L-1 (Close to Power Plant)	25.44	3.47	25.46	3.48
14	L-2 (Close to Mongla Port)	34.1	4.5	34.15	4.5
15	L-3 (Close to Harbira)	17.27	3.2	17.37	3.2
16	L-4 (Close to Mazhar Point)	16.64	3.08	16.96	3.14
17	L-5 (South of Akram Point)	16.24	3.02	16.32	3.06
	L-6 (North of Hiron Point)	16.08	3.02	16.18	3.03
	L-7 (At Fairway Buoy)	15.9	3.01	15.93	3.01

783. Figure 9-11 and Figure 9-12 show the 24-hr and annual averaging contour diagrams for the baseline and project case, respectively. There is a negligible increase in PM_{2.5} concentration from baseline to project case because the maximum predicted PM_{2.5} concentration occurs near Mongla Port, close to the Cement Plants (major sources of particulate matter). The proposed coal-fired power plant will have ESP technology and a high stack for dispersion (275 m), thus particulate matter emissions from the power plant will not be of concern as the analysis shows (negligible increase from baseline to project case).

784. There is a negligible increase in maximum predicted concentration from baseline to project case, similarly there is a slight increase in predicted PM_{2.5} levels in the Sundarbans above the background level due to project case, as can be seen from the contour diagrams. There is also some localized PM_{2.5} concentration zone south of Harbaria at the anchorage point due to the transshipment of coal. However, this increase is only marginal and the levels are within the Bangladesh national standards and WBG guidelines.

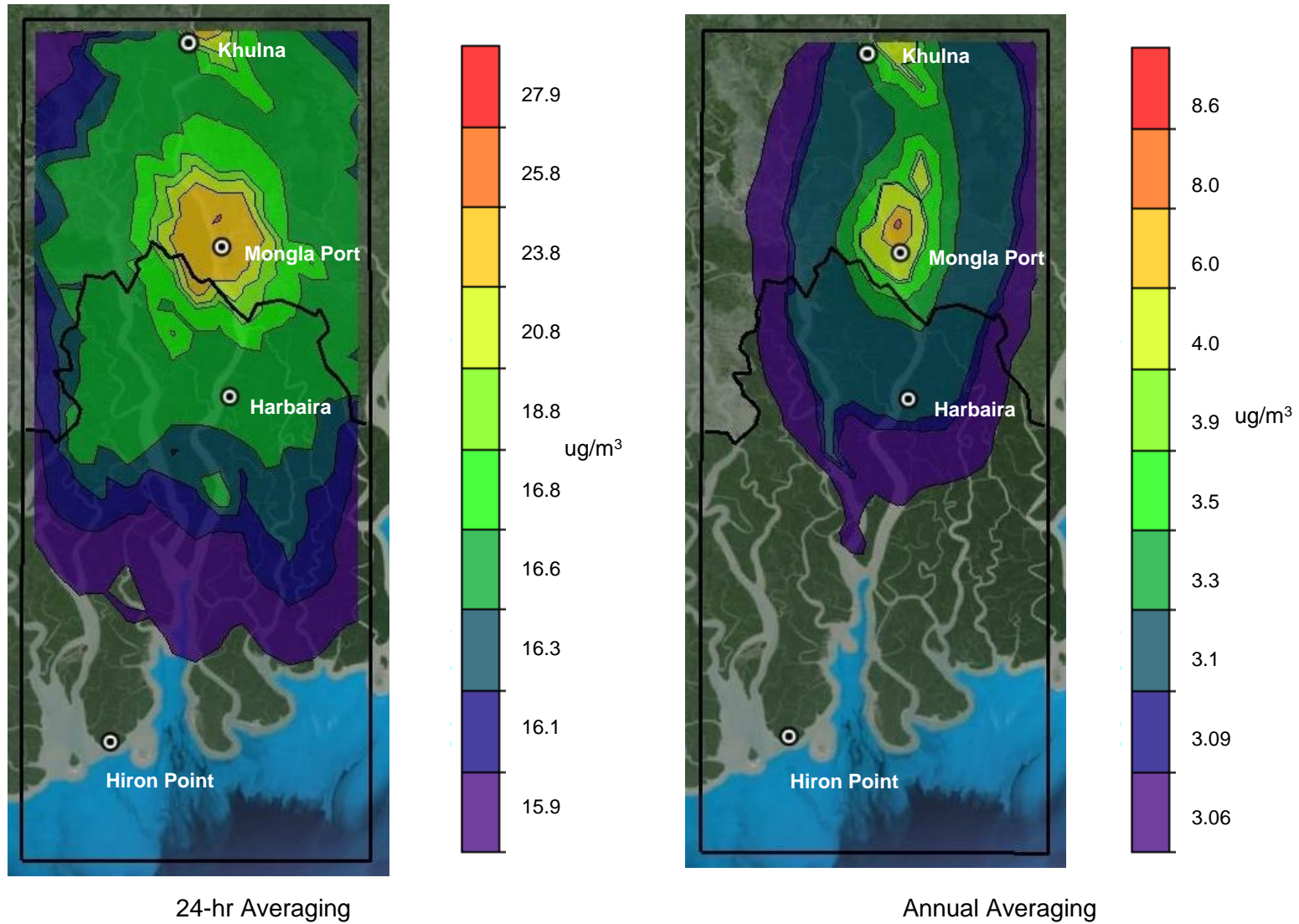


Figure 9-11: Predicted PM_{2.5} Concentration- Baseline Case

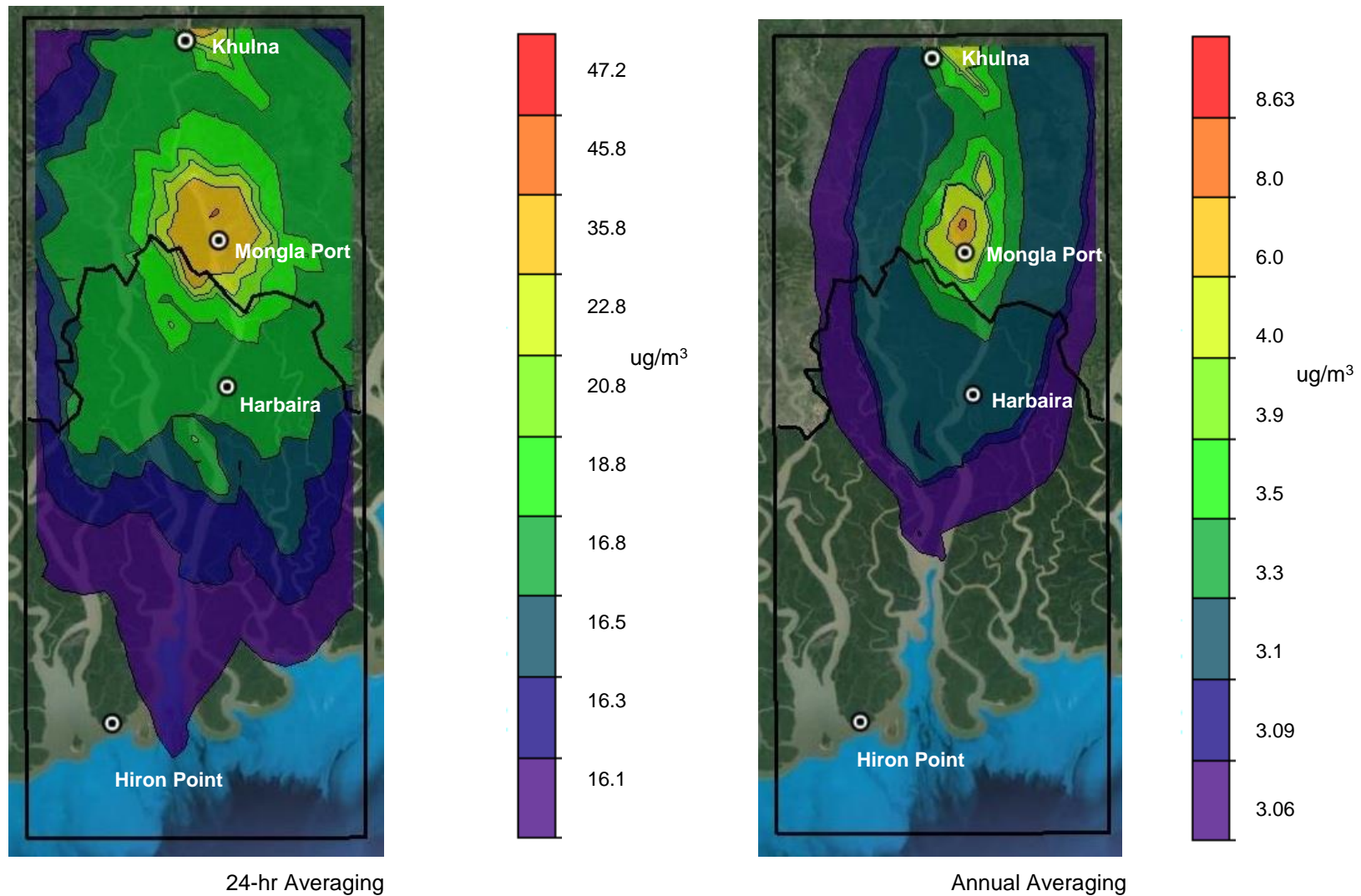


Figure 9-12: Predicted PM_{2.5} Concentration – Project Case

g) Concentration of PM₁₀

785. For PM₁₀ the predicted maximum ground level 24-hr and annual concentrations are given in Table 9-22. Maximum concentration occurred at Mongla, Which is surrounded by Cement Plants.. The table shows that the predicted PM₁₀ concentrations for baseline and project case are well within the National Bangladesh standards. The predicted maximum concentration occurred near Mongla meet WBG interim target -1 for 24 hour averaging (150 µg/m³). Interim targets are provided for developing countries in recognition of the need for a staged approach to achieving the recommended guidelines. Table 9-23 shows the concentration at sensitive receptor locations. There is a marginal increase in predicted concentration from baseline to project case at the sensitive receptor locations; but the predicted results meet the National Bangladesh Standards and WBG interim targets.

786. All ground level concentrations of PM₁₀ in the the Sundarbans Reserve Forest area are well below Bangladesh National standards and World Bank/IFC guidelines. There are only marginal increases of PM values due to implementation of Maitree STPP from baseline value.

Table 9-22: Predicted maximum concentrations of PM₁₀ (Baseline & Project Case)

Pollutant	Concentration (µg/m ³)				Coordinates of Max Point (UTM)		Name of Location
	Averaging Time	ECR 1997 (as amended in 2005)	WBG Guidelines/ Interim Target	Max Value	East (m)	North (m)	
PM ₁₀ (baseline)	24-hr	150	G: 50 IT-1: 150	66.6	766,947.0	2,494,901.0	Kapalirmet Buridmial, Mongla
	Annual	50	20 (G)	12.74	766,947.0	2,526,901.0	
PM ₁₀ (project case)	24-hr	150	G: 50 IT-1: 150	66.7	766,947.0	2,494,901.0	
	Annual	50	G: 20	12.76	766,947.0	2,526,901.0	

Table 9-23: PM₁₀ Concentration at Sensitive and Key Receptors

No.	Receptor	PM ₁₀ Concentration (µg/m ³)			
		Baseline		Project Case	
		24-hr	Annual	24-hr	Annual
1	Khulna	36.94	6.58	36.95	6.6
2	Nearest Tip of the Sundarbans	37.3	6.5	37.5	6.55
3	Akram Point	32.82	6.24	33.08	6.28
4	Alorkol	32.65	6.22	32.82	6.25
5	Chunkuri Bajua	49.79	7.32	50.03	7.4
6	Hiron Point (World Heritage Site)	32.63	6.22	32.85	6.24
7	Lower Harbaria Left Bank	34.04	6.38	34.16	6.46
8	Mazhar Point	33.39	6.31	34.51	6.49
9	Mongla	52.31	7.83	52.35	7.9
10	NW Corner of Power Plant Project	40.77	6.67	40.79	6.71
11	SW Corner of the Power Plant	43.48	8.94	43.61	8.99
12	Upper Harbaria Right Bank	34.14	6.48	34.27	6.48
13	L-1 (Close to Power Plant)	42.91	6.76	42.95	6.79
14	L-2 (Close to Mongla Port)	52.35	7.85	52.5	7.87
15	L-3 (Close to Harbira)	34.13	6.39	34.27	6.48
16	L-4 (Close to Mazhar Point)	33.28	6.3	37.93	6.67
17	L-5 (South of Akram Point)	32.86	6.25	33.09	6.29
18	L-6 (North of Hiron Point)	32.68	6.21	32.9	6.25
19	L-7 (At Fairway Buoy)	32.44	6.21	32.52	6.22

787. Figure 9-13 and Figure 9-14 show the 24-hr and annual averaging contour diagrams for the baseline and project case, respectively. As was the case with PM_{2.5}, there is a negligible increase in PM₁₀ concentration from baseline to project case because the maximum predicted PM₁₀ concentration occurs near Mongla Port, close to the Cement Plants (major sources of particulate matter). The proposed coal-fired power plant will have ESP technology and a high stack for dispersion, thus particulate matter emissions from the power plant will not be of concern as the analysis shows (since there is a negligible increase from baseline to project case).

788. There is a negligible increase in maximum predicted concentration from baseline to project case, similarly there is marginal increase in predicted PM₁₀ levels in the Sundarbans above the background level due to project case, as can be seen from the contour diagrams. There is some localized PM₁₀ concentration zone south of Harbaria at the anchorage point due to the transshipment of coal. However, these levels are well within the Bangladesh National Standards and WBG guidelines.

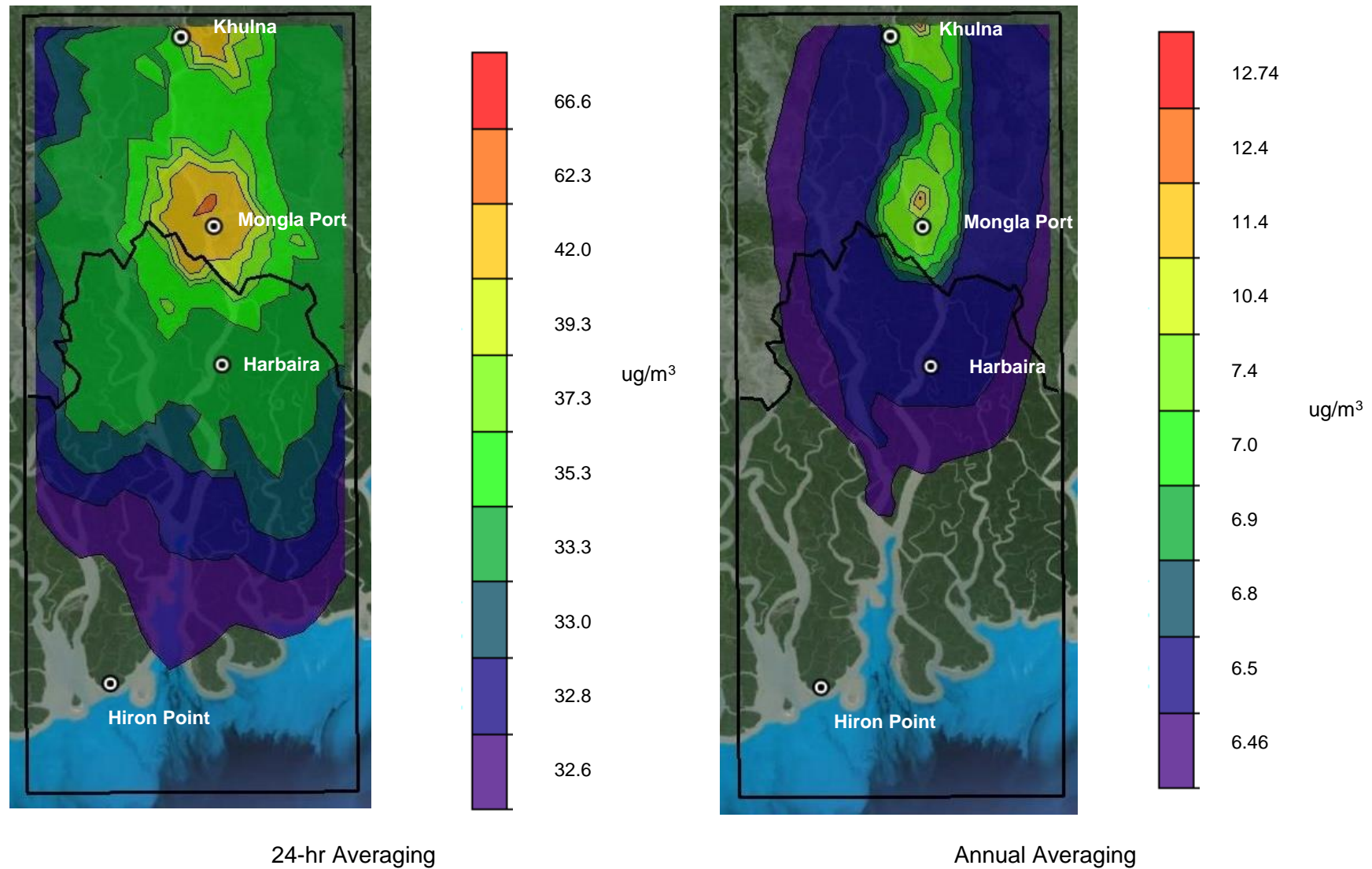


Figure 9-13: Predicted PM10 Concentration – Baseline Case

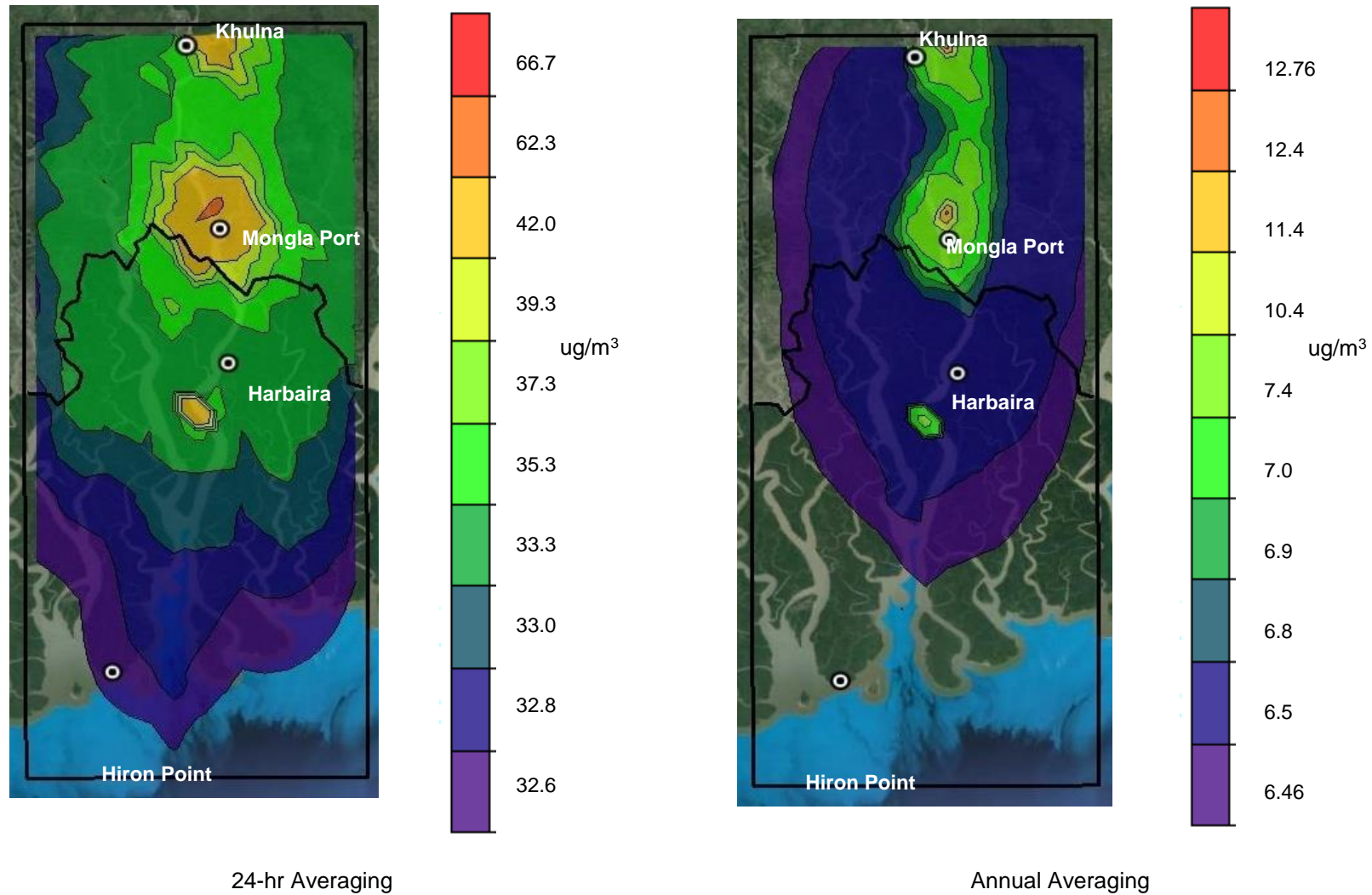


Figure 9-14: Predicted PM10 Concentration – Project Case

h) Concentration of SO₂

789. For SO₂ the predicted maximum ground level 24-hr and annual concentrations are given in Table 9-24. The table shows that the predicted SO₂ concentrations for baseline and project case are well below the Bangladesh National standards and WBG Interim Target-1 (125 µg/m). The maximum SO₂ concentration occurred near Rupsa, where brick kiln are widespread. It is suspected that there is a sizable contribution to this from trans-boundary sources. As discussed previously, interim targets are provided for developing countries in recognition of the need for a staged approach to achieving the recommended guidelines. Table 9-25 shows the predicted concentration at sensitive and key receptor locations for baseline and project case. The predicted concentration at both the baseline and project case meets the National standards and WBG guidelines.

790. All predicted round level concentration of SO₂ in the Sundarbans Reserve Forest area are well below Bangladesh National standards and World Bank/IFC guidelines. There are only negligible increases of SO₂ value due to implementation of Maitree STPP from baseline value.

Table 9-24: Predicted maximum concentrations of SO₂ (Baseline & Project Case)

Pollutant	Concentration (µg/m ³)				Coordinates of Max Point (UTM)		Name of Location
	Averaging Time	ECR 1997 (as amended in 2005)	WBG Guidelines/ Interim Target	Max Value	East (m)	North (m)	
SO ₂ (baseline)	24-hr	365	G: 20 IT-1: 125	24.0	766,947.0	2,526,901.0	Sreefaltala, Rupsha
	Annual	80	-	6.0	766,947.0	2,526,901.0	
SO ₂ (project case)	24-hr	365	G: 20 IT-1: 125	24.1	766,947.0	2,526,901.0	
	Annual	80	-	6.07	766,947.0	2,526,901.0	

Table 9-25: SO₂ Concentration at Sensitive and Key Receptors

No.	Receptor	SO ₂ Concentration (µg/m ³)			
		Baseline		Project Case	
		24-hr	Annual	24-hr	Annual
1	Khulna	11.93	2.16	11.94	2.22
2	Nearest Tip of the Sundarbans	10.8	2.1	13.3	2.2
3	Akram Point	10.48	2.04	11.15	2.12
4	Alorkol	10.39	2.03	10.98	2.1
5	Chunkuri Bajua	12.36	2.41	16.89	2.82
6	Hiron Point (World Heritage Site)	10.39	2.01	10.93	2.07
7	Lower Harbaria Left Bank	10.82	2.12	12	2.28
8	Mazhar Point	10.68	2.11	11.42	2.15
9	Mongla	14.28	2.82	15.62	3.21
10	NW Corner of Power Plant Project	11.34	2.2	19.71	2.36
11	SW Corner of the Power Plant	11.81	2.55	14.72	2.81

No.	Receptor	SO ₂ Concentration (µg/m ³)			
		Baseline		Project Case	
12	Upper Harbaria Right Bank	10.86	2.12	11.86	2.35
13	L-1 (Close to Power Plant)	12.01	2.52	15.71	2.7
14	L-2 (Close to Mongla Port)	14.29	2.84	15.64	3.22
15	L-3 (Close to Harbira)	10.98	2.14	12.29	2.45
16	L-4 (Close to Mazhar Point)	10.68	2.08	11.41	2.14
17	L-5 (South of Akram Point)	10.55	2.08	11.47	2.25
18	L-6 (North of Hiron Point)	10.43	2.02	11.02	2.12
19	L-7 (At Fairway Buoy)	10.36	2.01	10.61	2.04

791. Figure 9-15 and Figure 9-16 show the 24-hr and annual averaging contour diagrams for the baseline and project case, respectively. As was the case with particulate matter there is a negligible increase in SO₂ concentration from baseline to project case because the maximum predicted SO₂ concentration occurs near Khulna, close to the brick fields. The proposed coal-fired power plant will have FGD technology and a stack of 275 m, thus SO₂ emissions from the power plant will not be of concern as the analysis shows (negligible increase from baseline to project case).

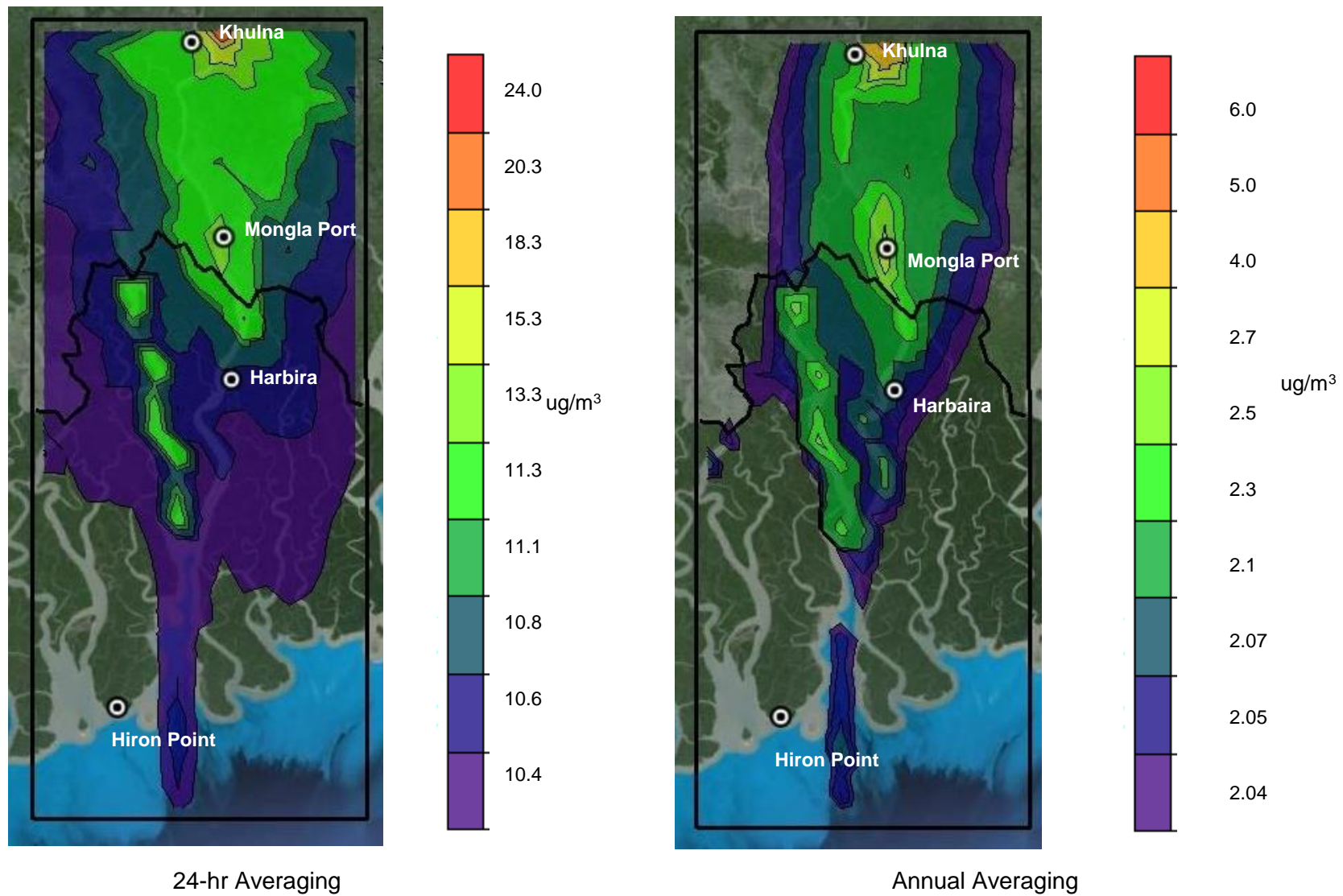


Figure 9-15: Predicted SO_2 concentration - Baseline

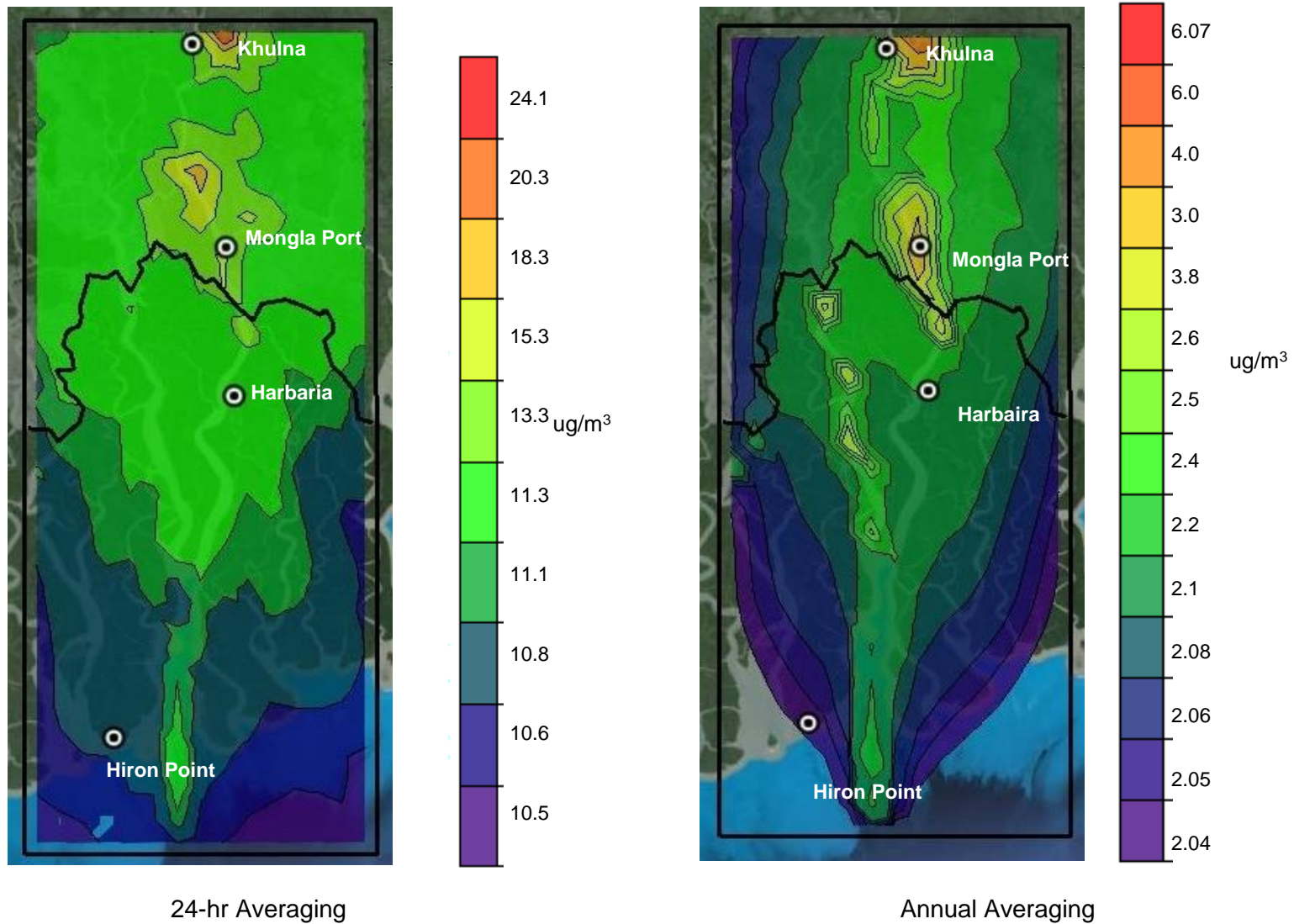


Figure 9-16: Predicted SO_2 Concentration – Project Case

Mitigation measures are:

- Air Quality modeling assessment for project case shows ambient air quality within the National Ambient Air Quality Standards.
- Implementation of Air Quality Management Plan.
- All vessels will comply with applicable international and national standards, e.g., IMO conventions, MARPOL, HNS Convention, etc.

792. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.9 Accumulation of Fugitive Coal Dust and Spills in River Environment (C20)

793. Accumulation of fugitive coal dust and coal spills in river environment (bed material) during lighterage loading and unloading and transshipper mooring would be negligible due to use of environment friendly transshipper (Chapter 4). However, the concentration of coal dust in water and surroundings has to be monitored routinely and based on the monitoring report, mitigation measures are to be taken, if required. This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- Accumulation of coal dust in the transshipment point of coal will be periodically monitored. Based on the findings, mitigation measures (if required) will be carried out.
- Add water mist to wet the coal to prevent dusting.
- Specific design and material handling procedures will be used to minimize the loss of coal in the marine environment.
- Maintenance of facilities, including daily cleaning, is proposed to reduce the build-up of dust that could become a source of sediment during rain events.

Residual Impact: After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.10 Impact of Fugitive Coal dust and Spills on Water Quality and Benthos (C21)

794. Impact on water quality and benthos, particularly at Harbaira, from fugitive coal dust during lighterage loading and unloading, transshipper mooring and lighterage transport. The benthos, (organisms dwelling on the river bottom) may be affected due to the disturbance of the bottom caused by deposition of fugitive coal particles (Johnson and Bustin, 2006). Johnson and Bustin (2006) also found that a high concentration of coal dust oxidizes and reduces oxygen available for benthos. Coal oxidation could also produce anoxic conditions which would be detrimental to the benthos, this would only occur in close proximity (hundreds of meters) to the fugitive coal sources (Johnson and Bustin, 2006). Coal dust can also block the gills of fish, if the concentration is high enough. However, the Passur being a tidal river, the deposition is expected to be insignificant thus resultant effect would be marginal. The concentration of coal dust in water and surroundings has to be monitored routinely and based on the monitoring report, mitigation measures are to be taken, if required. This impact is characterized as 'Moderate Adverse', as given in Table 9-1.

Mitigation measures are:

- Use recommended dust control measures for loading coal. Specific design and material handling procedures will be used to minimize the loss of coal in the marine environment during handling and transport activities.
- Water/mist system used to spray coal during the unloading process.
- Cover coal stack yard except for entry/exit points.
- Grabs in floating transfer station (transshipper) will be equipped with dust cover plates.
- The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is expected to control dust throughout the transportation chain.
- Maintenance of facilities, including daily cleaning, is proposed to reduce the build-up of dust that could become a source of sediment during rain events.
- Minimize drop heights when using cranes.
- Implement Air Quality Management Plan.
- Results of air quality monitoring and enforcement actions should be disclosed through appropriate method and means.

795. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.11 Impact of Coal dust on Surrounding Environment and Mangroves (C22)

796. There may be impact from coal dust and fugitive dust emissions from coal unloading and loading on surrounding environment and Sundarabans if environment friendly transshipper is not used. It is expected that 208 lighterages will be loaded and run between Fairway Buoy anchorage point and power plant jetty during five (5) months period and about 292 lighterages between Mazhar Point and the proposed power plant jetty during 7 months period. Fugitive coal dust may not coat mangrove leaves and reduce photosynthesis if environment friendly transshipper is used. However, the concentration of coal dust on mangrove leaves and surroundings plants has to be monitored routinely and based on the monitoring report, mitigation measures are to be taken, if required. This impact is characterized as 'Moderate Adverse', as given in **Table 9-1**.

Mitigation measures are:

- As a secondary dust mitigation measure, water mist will be sprayed on the lighterage vessels in a controlled manner, as deemed necessary by the operations superintendent or the Environmental Coordinator.
- The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is expected to control dust throughout the transportation chain.

- Covered lighterage (class vessel) has been included in project design.
- Grabs in floating transfer station (transshipper) will be equipped with dust cover plates.
- Implement EMP Sub-plan 2: Biodiversity Management Plan
- Implement Water Quality Management Plan (coal dust mitigation measures).
- Results of water quality monitoring, sediment monitoring and enforcement actions should be disclosed through appropriate method and means.

797. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.12 Impact of Coal dust from Transshipment and Transfer Processes on Human Health (C23)

798. There may be an impact from coal dust and fugitive dust emissions from transfer processes and transshipping on the health of operation staffs. There are no other human settlements nearby. The trans-shipper will have 2 cranes of with average loading capacity of 900 t/h each. An unloading rate of 20,000 t/d can be achieved from mother vessel by using this type of facility. Two stacker/reclaimers for stacking the coal from ship and reclaiming of coal from the stackyard to the bunkers will also be used. This impact is characterized as 'Moderate Adverse', as given in **Table 9-1**.

Mitigation measures are:

- Use recommended dust control measures for loading and unloading coal.
- Water/mist system used to spray coal during the unloading and transfer processes.
- Cover coal stack yard except for entry/exit points.
- Grabs in floating transfer station (transshipper) will be equipped with dust cover plates.
- The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is expected to control dust throughout the transportation chain.
- Minimize drop heights when using cranes and curved chutes at transfer points.
- Use enclosed conveyor system equipped with water and chemical agent spraying nozzles.
- Use of mechanical profiling of coal in conveyors to limit exposure to air flow.
- Mandatory use of appropriate PPEs for all operation staffs.
- Implement Air Quality Management Plan.
- Results of air quality monitoring and enforcement actions should be disclosed through appropriate method and means.

799. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.13 Discharge of Contaminants from Spills can realase PAH's into Aquatic Environemnt (C25)

800. There can be a severe impact on marine environment from discharge of contaminants through spills; discharge of coal to water bodies may realase Polycyclic aromatic hydrocarbons (PAH's) into aquatic environment. Polycyclic aromatic hydrocarbons (PAHs) are aromatic compounds containing two or more fused arenes structures. High PAH concentrations in sediments are linked with abnormalities (such as liver neoplasms) in fish that tend to dwell near sediments²⁸. Also, high PAH concentrations may pose a risk to aquatic organisms and potentially also to human consumers of fish and shellfish²⁹. This impact has been listed as 'Moderate Adverse', as in Table 9-1.

Mitigation measures are:

- Implementation of management plans to mitigate effects of discharge from spills.
- Numerous studies concluded that PAHs are not bioavailable because of the source of PAH in the sediments was from pitch globules and coal particles to which the PAHs were tightly bound.
- The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is expected to control dust and spills throughout the transportation chain.
- Periodical monitoring of deposition of coal and coal dust on the river/channel bed at transshipment area (especially focusing on PAHs). In case of noticeable coal dust deposition, they will be removed for safe disposal on land and mitigation measures be suggested accordingly.

801. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.14 Risk of Spontaneous Coal Combustion during Transport (C27)

802. There may be a risk of fire from spontaneous combustion, oxygen depletion, and corrosion of metal from coal during barge and vessel transport. Coals may emit methane, a flammable gas. A methane/air mixture containing between 5% and 16% methane constitutes an explosive atmosphere which can be ignited by sparks or naked flame, e.g., electrical or frictional sparks, a match or lighted cigarette. Methane is lighter than air and may, therefore, accumulate in the upper region of the cargo space or other enclosed spaces. If the cargo space boundaries are not tight, methane can seep through into spaces adjacent to the cargo

²⁸ Malins, D.C., McCain, B.B., Landahl, J.T., Myer, M.S., Krahn, M.M., Brown, D.W., Chan, S. and Roubal, W.T. 1988. Neoplastic and other diseases in fish in relation to toxic chemicals: an overview. *Aquatic Toxicology*, 11, 43-67

²⁹ MPMMG (Marine Pollution Monitoring Management Group). 1998. National Monitoring Programme Survey of the Quality of UK Coastal waters. Marine Pollution Monitoring Management Group, Aberdeen, ISBN 0 9532838 36

space. Coals may be subject to oxidation, leading to depletion of oxygen and an increase in carbon dioxide or carbon monoxide concentrations in the cargo space. Carbon monoxide is an odourless gas, slightly lighter than air, and has flammable limits in air of 12% to 75% by volume. It is toxic by inhalation with an affinity for blood haemoglobin over 200 times that of oxygen. Some coals may heat spontaneously and the spontaneous heating may lead to spontaneous combustion in the cargo space. Flammable and toxic gases, including carbon monoxide, may be produced. These impacts have been listed as 'Moderate Adverse', as in Table 9-1.

Mitigation measures are:

- Transport coal following IMSBC Code in Cargo B, coal can create flammable atmospheres, may heat spontaneously and may deplete the oxygen concentration.
- When the ship master is concerned that the cargo is showing any signs of self-heating or spontaneous combustion, such as an increase in the concentration of methane or carbon monoxide or an increase in temperature, the following actions shall be taken:
- Consult with the ship's agent at the loading port. The Company's designated person ashore shall be advised immediately.
- Check the seal of the cargo space and re-seal the cargo space, as necessary.
- Do not enter the cargo space and do not open the hatches, unless the master considers access is necessary for the safety of the ship or safety of life. When any ship's personnel have entered into a cargo space, re-seal the cargo space immediately after the personnel vacate the cargo space. Increase the frequency of monitoring the gas composition, and temperature when practicable, of the cargo.

803. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.15 Risk of Oil Spill from Coal Vessel and Oil Tanker Collision (C28)

804. There is a risk of oil spill in the River due to collision between coal vessel and oil tanker which both use the route. This impact has been listed as 'Moderate Adverse', in Table 9-1.

Mitigation measures are:

- Precautionary measures will be taken by the Ship Masters to follow IMO procedures to operate the vessels.
- All coal vessels will be operated under the supervision of the MPA designated pilot.
- Implement emergency response plan recommended under this EIA for the MPA.
- Prevent the spread of oil spills and ensure the safety of onboard crew members
- Report oil spills to the proposed Mongla Port ERG immediately and ask for assistance

- ERG will involve local authorities (MPA, Navy, Coast Guard) in stopping oil spills as per the emergency response plan.

805. **Residual Impact:** After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.16 Risk of Coal Vessel Sinking (C29)

806. There is always a severe risk of coal vessel sinking due to structural or mechanical failure and spilling oil and fuel into the River. This impact has been listed as 'Moderate Adverse', as in Table 9-1.

Mitigation measures are:

- Avoid barge operation in such a high wind speed as suggested in the IMO rules and regulations.
- Transport coal following IMSBC Code in Cargo B.
- Spill Response Containment plan to be implemented in case of accident.
- The vessel route in the Passur River is considered sheltered and no significant wave height is anticipated.
- Qualitative risk assessment shows minimal risk of sinking if coal transportation follows IMSBC Code in Cargo B.

Residual Impact: After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.17 Risk of Collision, Grounding Due to Low Visibility (C30)

807. There may be a risk of collision and grounding during low visibility and fog conditions, which are especially prevalent in the humid environment of the Sundarbans. This impact has been listed as 'Moderate Adverse', as in Table 9-1.

Mitigation measures are:

- Night operations will as far as follow appropriate lighting and piloting arrangement.
- Navigation assistance through VHF communication based on radar information to adverse weather condition, restricted visibility, changes in pilot services, or any other dangerous situation for the vessel.

Residual Impact: After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.8.18 Risk of Collision, Grounding Due to Tidal Conditions (C31)

808. The water level of the Passur River rises from April to August and then recedes up to January. The highest water level observed at Hiron Point was 4.58 m, in the year 2009 and the lowest was -0.12 m in 2010. On average, the tidal variation of Hiron point is about 2 m. Daily minimum water level increases by 0.5 m during the monsoon. There is a risk of collision and grounding during due to tidal conditions. This impact has been listed as Moderate adverse in Table 9-1.

Mitigation measures are:

- Bathymetric survey of the transportation route to be carried out routinely by MPA.
- Use of appropriate navigation assistance through VHF communication based on radar information to counter adverse weather condition, restricted visibility or any other dangerous situation for the vessel.
- Coal barges are to be compartmentalized to reduce the potential severity of the impacts.

Residual Impact: After the implementation of above mitigation measures the impact will reduce to 'Minimal'.

9.9 Critical Habitat Assessment**9.9.1 Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources**

809. The Performance Standard (PS)- 6 aims at protecting and conserving biodiversity, maintaining ecosystem services, the variety of life in all its forms, including genetic, species and ecosystem diversity and its ability to change and evolve, is fundamental to sustainable development. The objectives of this PS are to:

- i. protect and conserve biodiversity;
- ii. maintain the benefits from ecosystem services; and
- iii. Promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.

810. The components of biodiversity, as defined in the *Convention on Biological Diversity*, include ecosystems and habitats, species and communities, and genes and genomes, all of which have social, economic, cultural and scientific importance. This PS addresses how clients can avoid or mitigate threats to biodiversity arising from their operations as well as incorporate sustainable management of renewable natural resources¹.

811. PS- 6 recognises that protecting and conserving biodiversity—the variety of life in all its forms, including genetic, species and ecosystem diversity—and its ability to change and evolve, is fundamental to sustainable development. It reflects the objectives of the *Convention on Biological Diversity* to conserve biological diversity and promote use of renewable natural resources in a sustainable manner. For the purposes of implementation of this PS, habitats are divided into modified, natural and critical. Critical habitats are a subset of modified or natural habitats. For the protection and conservation of biodiversity, the mitigation hierarchy includes biodiversity offsets, which may be considered only after appropriate avoidance, minimization, and restoration measures have been applied. A biodiversity offset should be designed and implemented to achieve measurable conservation outcomes that can reasonably be expected to result in no net loss and preferably a net gain of biodiversity; however, a net gain is required in critical habitats. The design of a biodiversity offset must adhere to the “like-for-like or better” principle and must be carried out.

9.9.2 Habitat Survey

- Identification of different habitat types (forest/vegetation types) of the Project study area and provide information on forest types, species composition, terrain and topographical features. This will then allow for the identification of natural and modified habitat for a critical habitat assessment.
- Provide a biodiversity action plan to improve the habitat quality of the project area to enhance the overall biological diversity (Flora and Fauna).

9.9.3 Critical Habitat Assessment

812. In order to obtain an understanding of habitats and their species composition occurring in the study area, to assess possible triggers of critical habitat as defined in IFC's Performance Standard (PS) 6 on Biodiversity Conservation and Sustainable Management of Living Natural Resources (IFC, 2012a) and the associated guidance note (IFC, 2012b), the baseline data on habitats and species described was assessed as described in the following sections. Species listed in **Table 9-26** are considered for possible triggers of critical habitats.

Table 9-26: Possible Species triggers for Critical Habitat

Sl. No.	Common name	Scientific name	Class	IUCN Global Status	IUCN Local Status 2016
1	Swamp Francolin	<i>Francolinus gularis</i>	Aves	VU	RE
2	White Rumped Vulture	<i>Gyps bengalensis</i>	Aves	EN	CR
3	Pallas's fishing eagle	<i>Haliaeetus leucoryphus</i>	Aves	VU	EN
4	Greater adjutant stork	<i>Leptoptilos dubius</i>	Aves	EN	RE
5	Lesser adjutant stork	<i>Leptoptilos javanicus</i>	Aves	VU	VU
6	Indian Skimmer	<i>Rynchops albicollis</i>	Aves	VU	CR
7	Black Billed Tern	<i>Sterna acuticauda</i>	Aves	EN	CR
8	Green frog	<i>Euphlyctis hexadactylus</i>	Amphibia	NE	LC
9	Asian Small-clawed Otter	<i>Aonyx cinerea</i>	Mammalia	VU	EN
10	Fishing cat	<i>Prionailurus viverrinus</i>	Mammalia	EN	EN
11	Smooth-coated otter	<i>Lutrogale perspicillata</i>	Mammalia	VU	CR
12	Rhesus macaque	<i>Macaca mulatta</i>	Mammalia	LC	VU
13	Barking deer	<i>Muntiacus muntjak</i>	Mammalia	LC	EN
14	Royal Bengal Tiger	<i>Panthera tigris</i>	Mammalia	EN	CR
15	Ganges river Dolphin	<i>Platanista gangetica</i>	Mammalia	EN	VU
16	Irrawaddy Dolphin	<i>Orcaella brevirostris</i>	Mammalia	VU	NT
17	Bengal Fox	<i>Vulpes bengalensis</i>	Mammalia	LC	VU
18	Asiatic Softshell turtle	<i>Chitra indica</i>	Reptilia	EN	CR
19	River terrapin	<i>Batagur baska</i>	Reptilia	NE	CR
20	Leatherback Sea turtle/Huskbill	<i>Dermochelys coriacea</i>	Reptilia	CR	CR
21	Black pond turtle	<i>Geoclemys hamiltonii</i>	Reptilia	VU	EN
22	Olive ridley turtle	<i>Lepidochelys olivacea</i>	Reptilia	VU	VU
23	Three-keeled land Tortoise	<i>Melanochelys tricarinata</i>	Reptilia	VU	VU
24	Yellow Turtle	<i>Melanochelys petersi</i>	Reptilia	VU	NT
25	King cobra	<i>Ophiophagus hannah</i>	Reptilia	VU	VU
26	Rock Python	<i>Python molurus</i>	Reptilia	VU	DD
27	Ganges softshell turtle	<i>Nilssonina gangetica</i>	Reptilia	VU	EN
28	Ring lizard	<i>Varanus salvator</i>	Reptilia	LC	VU
29	Estuarine crocodile	<i>Crocodylus porosus</i>	Reptilia	LC	EN

Table 9-27: Habitat Identification as per IFC 2012 PS 6

Land Use Class.	Attributes	Habitat Type (IFC PS6, 2012)	Rationale
Natural Mangrove Forest SRF	Major plant species are <i>Heritiera fomes</i> , <i>Excoecaria agallocha</i> , <i>Nypa fruticans</i> , <i>Sonneratia apetala</i> , <i>Xylocarpus mekongensis</i> , <i>Avicennia spp</i> , <i>Amoora cucullata</i> , <i>Bruguiera gymnorrhiza</i> , <i>Hibiscus tiliaceous</i> , <i>Ceriops decandra</i> , <i>Phoenix paludosa</i> , etc. Of which, <i>Heritiera fomes</i> is the EN species according to IUCN Red List Version 2016-1.	NATURAL	All the plant species existing in this forest are grown naturally on intertidal area and they depend on tidal influences for their life cycle.
World Heritage Site (WHS)	There are three wildlife sanctuaries in the Sundarbans, out of which the Sundarbans South Wildlife Sanctuary extends over an area of 36,970 hectares (91,400 acres) is existed inside the study area and the outer boundary of the WHS is 1.5 to 2.75 km away from the route. The dominant floral species are <i>Heritiera fomes</i> , <i>Excoecaria agallocha</i> , <i>Ceriops decandra</i> and <i>Sonneratia apetala</i> . Major faunal species are <i>Panthera tigris</i> , rhesus macaque <i>Macaca mulatta</i> , Indian spotted deer <i>Cervus axis</i> , Smooth-coated otter <i>Lutrogale perspicillata</i> , Estuarine crocodile <i>Crocodylus porosus</i> are common. Aquatic mammals include the Ganges river dolphin <i>Platanista gangetica</i> (EN), Indo-Pacific hump-backed dolphin <i>Sousa chinensis</i> , Irrawaddy dolphin <i>Orcaella brevirostris</i> (VU) and finless porpoise <i>Neophocaena phocaenoides</i> (VU) (Mukherjee, 1975) are also found. Of which <i>Lutrogale perspicillata</i> (CR), <i>Macaca mulatta</i> (VU), <i>Panthera tigris</i> (CR), <i>Platanista gangetica</i> (VU), <i>Lepidochelys olivacea</i> (VU), <i>Lepidochelys olivacea</i> (VU), <i>Crocodylus porosus</i> (VU) are listed in IUCN Redlist.	NATURAL	All the plant species existing in this forest are grown naturally on intertidal area and they depend on tidal influences for their life cycle. The wildlife is also breed naturally inside the forest and water areas of this critical habitat.
Wildlife Sanctuaries/Dolphin Sanctuaries	Two dolphin sanctuaries, i.e., Dhangmari and Chandpai Wildlife Sanctuaries extend over 900 ha of river area of Dhangmari and Shela river that are existed beside the route. The major concern species of this habitat is <i>Platanista gangetica</i> and Irrawaddy dolphin <i>Orcaella brevirostris</i> . Of which, the Ganges river dolphin is "Vulnerable" and the Irrawaddy dolphin	NATURAL	The concern wildlife breed naturally in river water areas of this critical location.

Land Use Class.	Attributes	Habitat Type (IFC PS6, 2012)	Rationale
	is “Near Threatened” according to IUCN Redlist of Bangladesh and “Endangered” and “Vulnerable” respectively according to IUCN Global Redlist.		
River Levees Habitat (Includes bankline lands).	River levees are intertidal area which mainly vegetated with saline tolerant grasses and scatter distribution of some mangrove plant species like <i>Sonneratia apetala</i> and <i>Acanthus ilicifolius</i> .	MODIFIED	As most species recorded were natural grasses and mangroves, so the habitat could be considered natural. But, there are several human interventions like industrial establishment and aquaculture along the river levees causing degradation and perhaps modification of habitats mostly in the ECA area. Because of these impacts the habitat is considered modified.
Passur River	Includes entire natural area encompassing the water of the river.	NATURAL	The river is confined within natural banks and habitats, with no manmade alteration such as concrete banks etc.
ECA	The area exists along the 10 km buffer zone of the Sundarbans Reserve Forest and Landuse of this zone is primly for settlement/homesteads, rice monoculture and shrimp farming. Dominated species are <i>Albiziasaman</i> , <i>Cocos nucifera</i> , <i>Phoenix sylvestris</i> , <i>Mangifera indica</i> , <i>Syzygium cumunii</i> , <i>Psidium guajava</i> , <i>Ricinus cummunis</i> , <i>Ziziphus mauritiana</i> , <i>Carica papaya</i> , <i>Lanneacoramandelica</i> , <i>Sweiteniamahagoni</i> , <i>Musa spp</i> , and <i>Ficus hispida</i> . As per IUCN (2016v 1), <i>Sweitenia mahagoni</i> is Endangered (EN).	MODIFIED	All trees planted are for domestic use and no parts of the homestead plantations have succeeded into natural forest. The EN species, <i>Swietenia mahagoni</i> introduced.

813. Rationale to defining the habitats on above table (Table 9-28), Natural Mangrove forest/the Sundarbans Reserve Forest (SRF) and the Passur River can be considered as “NATURAL” habitat and River bankline and 10 km south buffer area of SRF considered as “MODIFIED” habitats within the study area. In addition, The World Heritage Site and the Sundarbans South Wildlife Sanctuary also fall under the “Natural Mangrove Forest” of “NATURAL” habitat type.

Screening of Potential Critical Habitat

IFC PS 6 identifies critical habitats as areas with high biodiversity value, including

- i. Habitat of significant importance to Critically Endangered and/or Endangered (1) species;
- ii. Habitat of significant importance to endemic and/or restricted range species;
- iii. Habitat supporting globally significant concentrations of migratory species and/or congregatory species;
- iv. Highly threatened and/or unique ecosystems; and/or
- v. Areas associated with key evolutionary processes.

814. PS6 Guidance Notes (GN6) (IFC2012b) is shown in Table 9-28 for defining the criteria for critical habitats.

Table 9-28: Critical Habitat Criteria

Criteria	Tier 1 ⁽¹⁾	Tier 2 ⁽¹⁾
Criteria 1: Critically Endangered (CR)/ Endangered (EN) Species	a) Habitat required to sustain ≥ 10 percent of the global population of an IUCN Red-listed CR or EN species where there are known, regular occurrences of the species and where that habitat could be considered a discrete management unit for that species.	a) Habitat that supports the regular occurrence of a single individual of an IUCN Red-listed CR species and/or habitat containing regionally-important concentrations of an IUCN Redlisted EN species where that habitat could be considered a discrete management unit for that species.
	b) Habitat with known, regular occurrences of CR or EN species where that habitat is one of 10 or fewer discrete management sites globally for that species.	b) Habitat of significant importance to CR or EN species that are wide ranging and/or whose population distribution is not well understood and where the loss of such a habitat could potentially impact the long-term survivability of the species. c) As appropriate, habitat containing nationally/regionally important concentrations of an EN, CR or equivalent national/regional listing.
Criterion 2: Endemic and Restricted range Species	a) An endemic species is defined as one that has ≥ 95 percent of its global range inside the country or region of analysis.	a) Habitat known to sustain ≥ 1 percent but < 95 percent of the global population of an endemic or restricted-range species where that habitat could be considered a discrete management unit for that species, where adequate data are available and/or based on expert judgment.

Criteria	Tier 1 ⁽¹⁾	Tier 2 ⁽¹⁾
Criterion 3: Migratory and Congregatory Species	a) Habitat known to sustain, on acyclical or otherwise regular basis, ≥ 95 percent of the global population of a migratory or congregatory species at any point of the species' life-cycle where that habitat could be considered a discrete management unit for that species.	a) Habitat known to sustain, on a cyclical or otherwise regular basis, ≥ 1 percent but < 95 percent of the global population of a migratory or congregatory species at any point of the species' life-cycle and where that habitat could be considered a discrete management unit for that species, where adequate data are available and/or based on expert judgment. b) For birds, habitat that meets BirdLife International's Criterion A4 for congregations and/or Ramsar Criteria 5 or 6 for Identifying Wetlands of international Importance. c) For species with large but clumped distributions, a provisional threshold is set at ≥ 5 percent of the global population for both terrestrial and marine species. d) Source sites that contribute ≥ 1 percent of the global population of recruits.
Criterion 4: Highly Threatened and/or Unique Ecosystems	No Tiered system is prescribed a) that are at risk of significantly decreasing in area or quality; b) with a small spatial extent; and/or c) Containing unique assemblages of species including assemblages or concentrations of biome-restricted species. Highly threatened or unique ecosystems are defined by a combination of factors which may include long term trend, rarity, ecological condition, and threat	
Criterion 5: Key Evolutionary Processes	The criteria is defined by a) Isolated areas (e.g., islands, mountaintops, lakes) are associated with populations that are phylogenetically distinct. b) Areas of high endemism often contain flora and/or fauna with unique evolutionary histories (note overlap with Criterion 2, endemic and restricted-range species). c) Landscapes with high spatial heterogeneity are a driving force in speciation as species are naturally selected on their ability to adapt and diversify. d) Environmental gradients, also known as ecotones, produce transitional habitat which has been associated with the process of speciation and high species and genetic diversity. e) Edaphic interfaces are specific juxtapositions of soil types (e.g., serpentine outcrops, limestone and gypsum deposits), which have led to the formation of unique plant communities characterized by both rarity and endemism. f) Connectivity between habitats (e.g., biological corridors) ensures species migration and gene flow, which is especially important in fragmented habitats and for the conservation of meta populations. This also includes biological corridors across altitudinal and climatic gradients and from "crest to coast." g) Sites of demonstrated importance to climate change adaptation for either species or ecosystems are also included within this criterion.	

Note (1) No tier system is in place for Criteria 4 and Criteria 5.

815. The IFC PS-6 also suggests that, "In areas of critical habitat, the client will not implement any project activities unless all of the following are demonstrated:

- No other viable alternatives within the region exist for development of the project on modified or natural habitats that are critical;
- The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values;
- The project does not lead to a net reduction in the global and/or national/regional population of any Critically Endangered or Endangered species over a reasonable period of time; and

- A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program.”

816. Table 9-30 provides the species that were recorded in the area either through direct observations or from secondary literatures or through consultations with local communities. The screening for potential critical habitat species has been carried out against Criteria 1 to 3 which are

- Habitat of significant importance to Critically Endangered (CR) and/or Endangered (EN) species;
- Habitat of significant importance to endemic and/or restricted-range species;
- Habitat supporting globally significant concentrations of migratory species and/or congregatory species

817. This assessment has been done based on conservational significance of both global and local status as per IUCN Red List, 2015. The Sundarban Reserve Forest performs all the above criteria. With respect to Criteria 4 and 5:

- Highly threatened and/or unique ecosystems
- Areas associated with key evolutionary processes

818. The baseline assessment has not identified any highly threatened ecosystems. But Natural habitats within the Sundarbans Reserve Forest are unique worldwide for having its diverse flora and faunal communities.

Table 9-29: Project Area Critical Habitat Screening Assessment – Criteria 1 and 2 Critically Endangered or Endangered Species and Endemic and/or Restricted-range species

Species Name	Common Name	Criteria 1: CR or EN Species (Global/Local)	Criteria 2: Endemic or Restricted Range	Species Criteria 3 Migratory / Congregatory	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
Mammals <i>Platanista gangetica</i>	Ganges River Dolphin (South Asian River Dolphin)	EN/VU	-	-	-	Yes	<p>Criteria 1 Tier 2e</p> <p>The presence of species was confirmed by regular sightings inside the Passur River and its tributaries. In addition, boundaries of two Dolphin Sanctuaries (i.e. Dhangmari and Shela Gang) have been falls within the study area (proposed transportation route). Local fishermen, FD officials confirm its presence frequently whole of the year; It is under threat from the accidental catch in the gill nets of local fishers. There is very rare evidence of accident death due to collision with river crafts/mother vessel</p>	<p>The species is present in the Ganges river dolphin is primarily found in the Ganges and Brahmaputra Rivers and their tributaries in Bangladesh, India and Nepal and all the major rivers in Bangladesh. A total of world population of 4000-5000 is estimated. About 225 individuals in the Sundarbans (about 7% calves) (Smith et al. 2006), 125 in Karnaphuli, Sangu River system (Smith et al. 2001).</p> <p>Ref:</p> <p>1) Smith, B.D., Ahmed, B., Edrize, M. and Braulik, G. 2001. Status of the Ganges river dolphin or shushuk <i>Platanista gangetica</i> in Kaptai Lake and the southern rivers of Bangladesh, Oryx 35(1): 61-72.</p> <p>2) Smith, B.D., Braulik, G., Strindberg, S., Ahmed, B. and Mansur, R. 2006. Abundance of Irrawaddy dolphins (<i>Orcaella brevirostris</i>) and Ganges river dolphins (<i>Platanista gangeticagangetica</i>) estimated using concurrent counts from</p>

Species Name	Common Name	Criteria 1: CR or EN Species (Global/Local)	Criteria 2: Endemic or Restricted Range	Species Criteria 3 Migratory / Congregatory	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
								independent teams in waterways of the Sundarbans mangrove forest in Bangladesh, Marine Mammal Science 22 (3): 527-547.
<i>Panthera tigris</i>	Royal Bengal Tiger	CR/CR	-	-	-	Yes	<p>Criteria 1 Tier 2e</p> <p>Presence of this species along the study area have been confirmed by observing pugmarks in forest floor surround the Passur River and through consultation with BFD officials, local people and fishermen. But their actual population is not known for this study area. However, according to Tiger Status Report of Bangladesh Sundarbans 2015, tiger sign was Moderate (south bank of Shela River near Chandpai) to low (World Heritage Site, Hiron Point) along the study area.</p> <p>The population of <i>Panthera tigris</i> in the Sundarbans appears to have stabilized since 1990s. Various estimates indicated the Tiger numbers</p>	<p>This mammal is native to Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Russian Federation, Thailand and Vietnam. It is possibly extinct in Korea (DPR) and extinct in Afghanistan, Iran, Kazakhstan, Kyrgyzstan, Pakistan, Singapore, Tajikistan, Turkey, Turkmenistan and Uzbekistan (Tilson and Seal 1987).</p> <p>Only viable population is in the Sundarbans in the southwest of Bangladesh, but tigers are rarely sighted in the bordering areas of the Chittagong Hill Tracts (particularly in Kassalong Reserved Forest and Sangu Wildlife Sanctuary) and very rarely in the bordering areas of Greater Sylhet (particularly Patharia Hill Reserved Forest) straying from the neighbouring forests in India.</p> <p>Ref. Reza, A.H.M.A. and Khan, (s), initials]. 2015. <i>Panthera tigris</i>. In:</p>

Species Name	Common Name	Criteria 1: CR or EN Species (Global/Local)	Criteria 2: Endemic or Restricted Range	Species Criteria 3 Migratory / Congregatory	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							between 106 and 500(Ahmad et al. 2009, Khan 2011, 2014, Bangladesh Forest Department 2015 in litt.).	IUCN Bangladesh. Red List of Bangladesh Volume 2: Mammals. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh. p. 74.
<i>Lutrogale perspicillata</i>	Smooth-coated otter	VU/CR	-	-	-	Yes	Criteria 1 Tier 2e Occurrence of this species along the study area has been confirmed by physical observation during field visits in SRF and through consultation with BFD officials, local people and fishermen. But their actual population is not known for this study area. However, according to Tiger Status Report of Bangladesh Sundarbans 2015, Otter sign intensity was high at internal khals and creeks of Chandpai and Karamjal area, moderate in Mazhar Point and low at World Heritage Site in Hiron Point and its surrounding area along the study area.	It is native to Bangladesh, Bhutan, Brunei Darussalam, Cambodia, China, India, Indonesia, Iraq, Lao PDR, Malaysia, Myanmar, Nepal, Pakistan, Thailand and Viet Nam (de Silva et al. 2015). The species is restricted to the hilly areas of the northeast and southeast and the coastal districts when its largest population possibly still thrives in the Sundarbans Mangrove forest in the southwest corner of the country (Feeroz et al. 2011ab, Khan 1982, 2015).

Species Name	Common Name	Criteria 1: CR or EN Species (Global/Local)	Criteria 2: Endemic or Restricted Range	Species Criteria 3 Migratory / Congregatory	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
Reptiles <i>Batagur baska</i>	River Terrapin	CR/CR	-	-	-	Yes	Criteria1 Tier 2e This turtle species was reported from Passur river tributaries by the local fishermen and found in local market at Mongla (Whitaker 1983). According to turtle survey along Chandpai, Sarankhola and Khulna Ranges conducted by Rashid and Moll in 1990, no Batagur nesting site was confirmed. The Turtle Survival Alliance (TSA) team recently found an adult female from a homestead pond near SRF at Phultala Village in Batiaghata Upazila, what may be the last known wild population of this Critically Endangered species.	The species is considered as Critically Endangered in Bangladesh and India because the subpopulations are all very small and declining. There are no recent data and it is therefore presumed to be Extinct in Myanmar, Vietnam and Singapore.
<i>Crocodylus porosus</i>	Estuarine crocodile	LC/EN	-	-	-	-	Criteria1 Tier 2e This species is restricted to the Sundarbans with a small population of 100-150 mature individuals (Khan 1982, Rashid 2012). Occurrence of this species	This species occurs in Australia, Bangladesh, Brunei Darussalam, Cambodia, China, India, Indonesia, Malaysia, Micronesia, Myanmar, Nauru, Palau, Papua New Guinea, Philippines, Singapore, Solomon Islands, Sri Lanka, Thailand, Vanuatu and Vietnam (Crocodile Specialist Group 1996). It is

Species Name	Common Name	Criteria 1: CR or EN Species (Global/Local)	Criteria 2: Endemic or Restricted Range	Species Criteria 3 Migratory / Congregatory	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							<p>along the study area has been confirmed by physical observation during field visits in SRF and through consultation with BFD officials, local people and fishermen.</p> <p>According to Tiger Status Report of Bangladesh Sundarbans 2015, estuarine crocodile sign intensity was high in connected khals and tributaries/distributaries of Chandpai and Karamjal area, moderate in Akram Point and record low at World Heritage Site in Hiron Point and its surrounding area along the study area.</p> <p>Ref. 1) Khan M.A.R. 1982c. Present status and distribution of the crocodiles and gharial of Bangladesh. Crocodiles. Proceedings of the 5th Working Meeting of the Crocodile Specialist Group, IUCN. 229-236.</p> <p>2) Rashid, S.M.A. 2012. Crocodiles and turtles of the</p>	found in only some rivers of the Sundarbans and mangrove forests of Bangladesh (Khan 1982a, 2015).

Species Name	Common Name	Criteria 1: CR or EN Species (Global/Local)	Criteria 2: Endemic or Restricted Range	Species Criteria 3 Migratory / Congregatory	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							Sundarbans. Rediscovering the Sundarbans, pp. 116 – 122.	
<i>Dermochelys coriacea</i>	Leatherback Sea turtle	VU/EN	-	-	-	Yes	Criteria1 Tier 2e No individual of this species are not confirmed along the study area.	This turtle is found in the offshore of the Bay of Bengal from the Sundarbans in the west to the Saint Martin's Island in the east (Khan 1982, 1987). So far live specimens have been caught in fishinggears in and around the Sonadia Island, Maheshkhali Islandthe Cox's Bazar in Bakkhali Channeland Estuary under theCox's Bazar district (Islam 2002, http://www.seaturtlebd.org/Leatherback.html) Ref. 1) Islam, M.Z. 2002. Marine Turtle Nesting at St. Martin's Island, Bangladesh. Marine Turtle Newsletter. 96: 19-21.
<i>Heliopais personatus</i>	Masked Finfoot	EN/EN	-	-	-	-	Inside the study area, status of this species is unknown due to unavailability of literature or even sightings physically by the field team. According to a study by G. NEUMANN-DENZAU, E. FAHRNI MANSUR and R. MANSURin 2004 at South-eastern portions (surround 60	This species is thinly distributed from north-east India, Myanmar, Thailand, Cambodia, Laos and Vietnam to Peninsular Malaysia, Sumatra and Java, Indonesia. (http://www.rufford.org/rsg/projects/sayam_chowdhury) In Bangladesh this bird is only recorded from the Sundarbans, the mangrove

Species Name	Common Name	Criteria 1: CR or EN Species (Global/Local)	Criteria 2: Endemic or Restricted Range	Species Criteria 3 Migratory / Congregatory	Critical Habitat Tier 1	Critical Habitat Tier 2	Rationale	Information
							sqm of Katka Kachikhali area) and 19 nests was found.	forest in the Ganges-Meghna-Brahmaputra delta (Hussain and Acharya 1994, Khan2003, 2005, Gani 2005). This species is sedentary and seen alone, or in pairs toforage by walking in mudflat or swimming in shallow water.It feeds on mudskippers, small fishes, aquatic insects, mollusks and others invertebrates. It builds nests amongst thick bush or on horizontal mangrove tree branches about two metres above the ground (Islam and Chakma 2008, Khan 2008, 2015).
Flora <i>Heritiera fomes</i>	Sundaree	EN (according to IUCN Redlist Version 2016-1)	-	-	-	-	The species is present all over the SRF along the study area including WHS in Hiron Point.	<i>Heritiera fomes</i> is native to coastal regions of the Indo-Pacific, its range extending from the east coast of India through Bangladesh and Malaysia to Myanmar and Thailand. (Vanden Berghe, Edward (2014). "Heritiera fomes Buch.-Ham.". World Register of Marine Species. Retrieved 2015-02-22.) In Bangladesh, this species is occurred in mainly the Sundarbans Reserve Forest and other mangrove patches in coastal area.

Assessment of Impacts of Project Activities on Habitats and Species within the Study Area

819. As part of the Critical Habitat Assessment and in order for appropriate mitigation to be applied, a high level impact assessment has been completed whereby the impacts of the proposed project activities were assessed against habitats and species identified in the study area. The assessment has been completed using ERM standard impact assessment criteria as outlined in Table 9-30 and Table 9.31. Focus has been placed on species identified through the critical habitat assessment as potential trigger species.

Table 9-30: Habitat-Impact Assessment Criteria

Habitat Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
		Effect is within the normal range of natural variation	Affects only a small area of habitat, such that there is no loss of viability / function of the habitat	Affects part of the habitat, but does not threaten the long-term viability / function of the habitat.	Affects the entire habitat, or a significant proportion of it, and the long-term viability / function of the habitat is threatened
Negligible Low	Habitats with negligible interest for biodiversity. Low Habitats with no, or only a local designation / recognition, habitats of significance for species listed as of Least Concern (LC) on IUCN Red List of Threatened Species, habitats which are common and widespread within the region, or with low conservation interest based on expert opinion.	Not significant	Not significant	Not significant	Not significant
		Not significant	Not significant	Minor	Moderate
Medium	Habitats within nationally designated or recognised areas, habitats of significant importance to globally Vulnerable (VU) Near Threatened (NT), or Data Deficient (DD) species, habitats of significant importance for nationally restricted range species, habitats supporting nationally significant concentrations of migratory species and / or congregator species, and low value habitats used by species of medium value.	Not significant	Minor	Moderate	Major
High	Habitats within internationally designated or recognised areas; habitats of significant importance to globally	Not significant	Moderate	Major	Critical

Habitat Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
	Critically Endangered (CR) or Endangered (EN) species, habitats of significant importance to endemic and/or globally restricted-range species, habitats supporting globally significant concentrations of migratory species and / or congregatory species, highly threatened and/or unique ecosystems, areas associated with key evolutionary species, and low or medium value habitats used by high value species.				

Table 9-31: Species-Impact Assessment Criteria

Habitat Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
		Effect is within the normal range of variation for the population of the species.	Effect does not cause a substantial change in the population of the species, or other species dependent on it.	Effect causes a substantial change in abundance and / or reduction in distribution of a population over one, or more generations, but does not threaten the long term viability / function of that population, or any population dependent on it.	Affects entire population, or a significant part of it causing a substantial decline in abundance and / or change in and recovery of the population (or another dependent on it) is not possible either at all, or within several generations due to natural recruitment (reproduction, immigration from
Negligible	Negligible Species with no specific value or importance attached to them.	Not significant	Not significant	Not significant	Not significant
Low	Negligible Species with no specific value or importance attached to them.	Not significant	Not significant	Minor	Moderate
Medium	Species on IUCN Red List as VU, NT, or DD, species protected under	Not significant	Minor	Moderate	Major

Habitat Sensitivity/ Value		Magnitude of Effect on Baseline Habitats			
		Negligible	Small	Medium	Large
	national legislation, nationally restricted range species, nationally important numbers of migratory, or congregatory species, species not meeting criteria for high value, and species vital to the survival of a medium value species.				
High	Species on IUCN Red List as CR, or EN. Species having a globally restricted range (i.e. plants endemic to a site, or found globally at fewer than 10 sites, fauna having a distribution range (or globally breeding range for bird species) less than 50,000 km ²), internationally important numbers of migratory, or congregatory species, key evolutionary species, and species vital to the survival of a high value species.	Not significant	Moderate	Major	Critical

820. A description of the specific habitat values within the project site and surrounding areas within the study area which are of relevance to each species of conservational significance is provided in Table 9-32. ECA and river levees are not included in the assessment as they are negligible interest for biodiversity conservation as determined by the baseline assessment. Presence of threatened species in Natural Mangrove Forest SRF and the Passur River has been identified. Hence, these two habitats are ultimately considered for the assessment.

Table 9-32: Habitat Impact Assessment

Habitat Description	Associated Species	Impact Description	Sensitivity	Magnitude of Effect	Significance
Natural Mangrove Forest	<i>Panthera tigris</i> , <i>Lutrogale perspicillata</i> , <i>Heliopais personatus</i> , <i>Heritiera fomes</i> etc	<ul style="list-style-type: none"> • Movement of large number of vessels and transshipment operation may cause disturbance to forest animals in WHS as well as surrounded forest due to noise and light beaming • Emission of dust during coal transportation is suspected to fall on floral leaves surround the transshipment area as well as on SRF vegetation 	Presence of Endangered species was observed and reported in SRF within the study area- HIGH	The proposed transshipment point is close to the existing overseas ship berthing area of MPA and the wildlife inside the SRF is already habituated/disturbing to noise and beaming. Additional noise and beaming due to coal transportation will MINOR effects to the SRF wildlife which may be MINIMIZED to abide necessary rules and regulations. So, the Effect is also likely to be MINOR. Environment friendly transhipper and transshipment process will arrest dust emission, hence the effect is also NEGLIGIBLE regarding this case.	MINOR
Passur River	<i>Platanista gangetica</i> , <i>Orcaella brevirostris</i> , <i>Batagur baska</i> (Captive breeding at Karamjal beside the Passur Channel on the bank of the tributary)	<ul style="list-style-type: none"> • Increasing maritime traffic may pose threat to these animals and the ecology of the project site such as: vessels collide with freshwater dolphins resulting in injuries • Coal vessels may cause erosion of the river bank due to their high wave if speed limit is not maintained. • Pollution from ships may degrade habitats and reduce fish and crustacean production and recruitment • Erosion caused by 	Presence of Endangered species was observed and reported in Passur River systems inside the SRF within the study area- HIGH	Water contamination due to accidental Hydrocarbon spillage and leaks is likely to be Moderate due to tidal actions. Effect is also likely to be temporary- MEDIUM	MODERATE

Habitat Description	Associated Species	Impact Description	Sensitivity	Magnitude of Effect	Significance
		vessel waves results sedimentation in the deep pools where freshwater dolphins congregate for feeding and rest Accidental hydrocarbon spillage may pollute river water and caused a to aquatic animals of river area.			
World Heritage Site (WHS)	<i>Lutrogale perspicillata</i> (CR), <i>Macaca mulatta</i> (VU), <i>Panthera tigris</i> (CR), <i>Platanista gangetica</i> (VU), <i>Orcaella brevirostris</i> (NT), <i>Lepidochelys olivacea</i> (VU) and <i>Crocodylus porosus</i> (VU)	<ul style="list-style-type: none"> • Movement of large number of vessels and transshipment operation may cause disturbance to forest animals in WHS as well as surrounded forest due to noise and light beaming • Accidental discharge of coal particles and hydrocarbon spillage may pollute river water and caused a severe threats to aquatic animals of this protected area 	Presence of Endangered species was observed and reported in WHS inside the SRF within the study area -HIGH	The proposed route is far away (2.0-2.5 km.) from the forest boundary and the effects from noise and beaming is negligible. Effect is also likely to be NEGLIGIBLE. Water contamination from accidental coal and Hydrocarbon spillage and leaks is likely to be low due to large volume of water flowing in the foreshore areas/estuaries. Effect is also likely to be temporary- SMALL.	NOT SIGNIFICANT
Wildlife Sanctuaries/Dolphin Sanctuaries	<i>Platanista gangetica</i> (VU), <i>Orcaella brevirostris</i> (NT)	<ul style="list-style-type: none"> • Accidental discharge of coal particles and hydrocarbon spillage may pollute river water and caused a serious threats to concern animals of this protected area 	species was observed and reported in river area within the study area- HIGH	Water contamination from accidental coal and Hydrocarbon spillage and leaks is likely to be low due to large volume of water flowing in the sanctuaries as well as distributary river area of the proposed route river Passur. Effect is also likely to be temporary- SMALL	MINOR

Table 9-33: Species - Impact Assessment

Species	Impact Description	Sensitivity	Magnitude of Effect	Significance
Fauna species Mammals <i>Platanista Gangetica</i> (Ganges River Dolphin/ South Asian River Dolphin), The IUCN Red List Species: VU A2acd ver 3.1	This species has been observed along all the reaches of Passur River and its tributaries from Akram Point to Chalna Bazar that overlapping the study area. Abundance of this aquatic mammal is high at river confluence points and inside the connected tributaries of Passur river like Shela Gang and Dhangmari Khal. This species is already threatened by fishnets Lubricants from vessels may affect their habitats due to deterioration of water quality which is less suspected likelihood inside the study area. But there is no evidence of accidental death or injury with mechanical propeller in this study area.	HIGH: It is listed as 'ENDANGERED' as per IUCN Global Red List for Threatened Species and "VULNERABLE" as per IUCN Species Redlist of Bangladesh. International trade is prohibited by the listing of the South Asian river dolphin on Appendix I of the Convention on International Trade in Endangered Species (CITES). The species is listed on Appendix I and Appendix II of the Convention on the Conservation of Migratory Species of Wild Animals (CMS).	MINOR	MINOR
<i>Batagur baska</i> (River Terrapin) The IUCN Redlist Species, Version 2015.1	The project activities will not directly impact this reptile. But, deterioration of water quality due to accidental discharge of bilge water and excess noise from vessels may hamper regular activities of this species. There is a captive breeding centre of this species at Karamjal which is about 200m away from the Passur Channel.	HIGH: It is considered as Critically Endangered in Bangladesh and India because the sub-populations are all very small and declining. and Sch. III of Bangladesh Wildlife Prevention order, 1973	NEGLIGIBLE	NEGLIGIBLE
<i>Pantheratigris</i> (Royal Bengal Tiger) The IUCN Redlist Species, CR A1bcd ver 3.1	Emission of excess noise and beaming of light by coal carrying vessels may disturb this animal at the proposed anchorage location in Mazhar Point. According to baseline study, existing noise level measured 47.5 and 44.6 within 100m area from the riverbank inside SRF at Mazhar Point and WHS Hiron Point respectively. The noise levels would not exceed significantly in future which have been predicted by the Noise Modelling (Detail in Noise Modelling Section in this Report: Chapter 9). So, it may be said that the noise from the coal carrying vessels will not disturb this animal. Proper controlling of light beaming will also minimize the disturbance to them.	HIGH: It is listed as 'Critically Endangered' as per IUCN red list for Threatened Species. International trade is prohibited by the listing of the Royal Bengal Tiger on Appendix I of the Convention on International Trade in Endangered Species (CITES).	SMALL	MINOR
<i>Lutrogale perspicillata</i>	The project activities will not directly impact on this aquatic	HIGH: It is listed as 'Vulnerable' as	SMALL	MINOR

Species	Impact Description	Sensitivity	Magnitude of Effect	Significance
(Smooth-coated otter) The IUCN Redlist Species, CR A2acd ver 3.1	mammal as their habitat is mainly within the canals, creeks inside SRF. But, deterioration of water quality due to accidental discharge of coal particles and excess noise from navigational vessels may hamper their regular activities. The proposed transportation route alignment passed generally along the middle portion of the Passur River. So, the impact is unlikely.	per IUCN Global Red List for Threatened Species. International trade is prohibited by the listing of this animal on Appendix II of the Convention on International Trade in Endangered Species (CITES).		
<i>Crocodylus porosus</i> (<i>Estuarine crocodile</i>) The IUCN Redlist Species EN D ver 3.1	This reptile is sensitive to noise and water quality. The project activities will not directly impact on this aquatic animal because their sightings are limited in internal distributaries of the Passur River. If the water quality deteriorate due to accidental discharge of bilge water and excess noise from navigational vessels may disturb their regular activities.	HIGH: It is listed as 'Endangered' as per IUCN Global Red List for Threatened Species. International trade is prohibited by the listing of this animal on Appendix I of the Convention on International Trade in Endangered Species (CITES).	SMALL	MINOR
<i>Heliopais personatus</i> (Masked Finfoot) The IUCN Redlist Species EN B1ab(iii) ver 3.1	Masked Finfoot is threatened by habitat destruction and hunting for human consumption all over its range (BirdLife International 2001). Inside the study area, status of this species is unknown due to unavailability of literature or even sightings physically by the field team. So the impact is unlikely.	HIGH: It is listed as 'Endangered' as per IUCN Global Red List for Threatened Species.	SMALL	NEGLIGIBLE

Floral Species

Species	Impact Description	Sensitivity	Magnitude of Effect	Significance
<i>Heritiera fomes</i> (Sundari Tree) The IUCN Redlist Species Endangered A2cde ver 3.1 Ref: http://www.iucnredlist.org/details/178815/0 >.Downloaded on 20 Sep 2016.	Impact on this tree is unlikely due to the project activities though the coal will be transhipped by environment friendly transshipper which will prevent dusting and spillage of coal. So, there is very insignificant release of dust and coal spillage from the ship which may fall on floral leaves surround the transhipped areas.	HIGH is listed as 'ENDANGERED' as per IUCN Global Red List for Threatened Species	NEGLIGIBLE	NOT SIGNIFICANT

9.9.4 Preliminary Critical Habitat Assessment

821. Criteria 1: Four Mammals *Panthera tigris*, *Lutrogale perspicillata*, *Platanista gangetica*, *Orcaella brevirostris*, One bird *Heliopais personatus*, two reptiles *Batagur baska* and *Crocodylus porosus* were screened for potential critical habitat triggering against Criteria 1 and 2. It was assessed that criteria 3, 4 and 5 were not relevant for the screening process.

9.9.5 Inference of Critical Habitat Assessment

822. The assessment concludes that the threatened plant species *Heritiera fomes* may not be impacted by the project activities and therefore do not result in triggering of critical habitat. The *Platanista Gangetica* (Ganges River Dolphin) and the *Orcaella brevirostris* (Irrawaddy dolphin) have been considered as possible candidate for the critical river habitat due to underwater noise and collision with coal carrying vessel propeller. Due to their abundance at the confluences and inside the distributaries of the Passur River, the impact on these dolphin species has low likelihood.

823. Recently, the presence of Critically Endangered turtle species (i.e. River Terrapin) in the wild is absent and the captive breeding centre of this species is about 200 m away from the Passur channel. Hence, the project activities will have no direct impact on this reptile in captivity.

824. Sensitivity of noise and beaming is high to the Royal Bengal Tiger. There would be no exceedances of noise due to movement of coal carrying vessels inside the forest from the base situation (Detail in Noise Modelling Section in this Report: Chapter 9). Beacuase, the model result shows that noise generated from the ships/vessels would be decayed within distance of 500 m to 1 km from the source while wildlife habitat is 2-2.5 km away from that source. There is an anticipated disturbance to this animal from light beaming of coal transportation vessels. This would be possible to control by taking some measures like limiting unnecessary beaming from the ships, using of controlled beaming, etc. On the other hand there is no confirmed record of crossing the Passur River by this mammal along the proposed route alignment. So, it may be said that the project activities may not hamper their regular movement and activities.

825. Sighting of estuarine crocodile is limited mainly in distributaries of the Passur River. So, the movement of coal transportation vessels would not affect their habitats. But, deterioration of water quality due to accidental discharge of bilge water, and sudden noise (whistle) from navigational vessels may hamper their regular activities to some extent. This issue is also applicable for the Critically Endangered Smooth Coated Otter and other animals having conservation significance.

826. The presence of Masked Finfoot and nesting area is not confirmed inside the study area. However, in case of presence of masked finfoot only sudden excessive noise from the whistle may cause disturbance to this avifauna.

827. Above discussion, about the natural habitats within the SRF and the Passur River are assessed as being of high significance due to the presence of the mentioned endangered species with the magnitude of impacts to the habitat considered small due to very limited chance of contamination from the Project activities along with other types of disturbances, their limited spatial extent and inability to affect habitat function or viability. The threats to the species are also considered small as the impacts are unlikely to cause a change in the

species population or populations of other species dependent on it. Critical habitats are therefore not triggered for the dolphin species, tigers, masked finfoot, etc. or their habitats.

9.9.6 Mitigation

828. Mitigation measures for habitat are suggested in Table 9-34 and for species are suggested in Table 9-35. The mitigation methods recommended attempt to reduce impacts of project activities. They do not necessarily reduce impacts already of activities existing within the study area prior to commencement of the project e.g. impacts from river vessels used for fishing or other river based activities and unconnected with the project activities or background sources of pollution within the Passur River.

Table 9-34: Habitat wise mitigation measures

Significance Ranking	Mitigation Hierarchy	Mitigation (Description)	Mitigation Area
The Sundarbans Reserve Forest (Natural Mangrove Forest)	Minimisation	Habitat conservation measures by supporting surveillance, monitoring systems of Forest Department at proposed transportation route Adopt wildlife conservation regulations to the mariners, labours and local fishermen for minimize negative effect of the project activities Aware and engaged local communities, relevant NGO,s for wildlife conservation Foster existing wildlife breeding project in SRF	Parts of the SRF inside the study area
World Heritage Site (WHS)	Minimisation	Habitat conservation measures by supporting surveillance, monitoring systems of Forest Department at proposed transportation route Adopt wildlife conservation regulations and IMO regulations to the mariners, labours and local fishermen for minimize negative effect of the project activities	Parts of the WHS inside the study area
Wildlife Sanctuaries/Dolphin Sanctuaries	Minimisation	Habitat conservation measures by supporting surveillance, monitoring systems of Forest Department at proposed transportation route Adopt wildlife conservation regulations and IMO regulations to the mariners, labours and local fishermen for minimize negative effect of the project activities Aware and engaged local communities, related NGOs for dolphin conservation.	Parts of the sanctuaries inside the study area
The Passur River	Minimisation	Movement of water vessel will be limited through a fixed alignment to avoid disturbance of aquatic mammals Restrict whistling, beaming and spillage inside reserve forest area Limiting speed of coal transportation vessels inside the SRF	The Passur River area inside the SRF

Table 9-35: Species -Mitigation Measures

Species	Significance Ranking	Mitigation (Description)
Mammals: <i>Platanista Gangetica</i> (Ganges River Dolphin) and <i>Orcaella brevirostris</i> (Irrawaddy dolphin), <i>Pantheratigris</i> (Royal Bengal Tiger), <i>Lutrogale perspicillata</i> (Smooth-coated otter) Reptiles: <i>Crocodylus orosus</i> (Estuarine crocodile)	Moderate	<p>Concerned authorities will properly enforce rules and ensure no malpractice like discharge of ballast water, bilge water, oily water discharge, waste and wastewater shall take place within the territory of Bangladesh.</p> <p>Develop capacity of Forest Department for proper surveillance. Vessel movement should be through a designated route of the MPA by following fixed alignment of the river and keep safe distance for vessel movement from the alignment of two dolphin sanctuaries inside Passur river. Ensure dry residues and/or the wash water that contains residues from an HME discharged at adequate port reception facilities. Limit vessel speed while passing inside the Sundarbans and inland river. Use Bow thrusts for all coal carrying vessels.</p> <p>Give special care during passing near two dolphin sanctuaries. Aware local fishers, community leaders and handling labours and related workers. Keeps liaison with WSC, Forest Department to join patrolling in Passur River. Give financial facilitation to Crocodile and turtle breeding project at Karamjal of Forest Department as part of their CSR.</p> <p>Carry out routine monitoring of the dolphin movement so that their movement is not obstructed by vessels.</p> <p>Prepare and submit monthly monitoring report mentioning occurrence of dolphin accident/poaching and taken mitigation measures.</p>

10 Cumulative Impacts

10.1 Introduction

829. Cumulative impacts are changes to the environment that are caused by an action in combination with other past, present and future human actions (Canadian Environmental Assessment Agency, 1999). Cumulative effects occur as interactions: between actions, between actions and the environment and between components of the environment. The study considers three major areas of concern for cumulative study. These are described below:

10.2 Cumulative Impacts on Air Quality

830. The cumulative impact of all major emission sources in the air-shed is assessed in this section. To assess the foreseeable future condition and account for an increase in pollution from brick fields, and increase in road and marine vessel traffic, projected data for 2030 is used for modeling. It is noted that there will an EPZ in the Mongla Port area. But no detail of the type and size of those industries could be gathered. However it is anticipated that there would not be air industries over there. The emissions and input parameters for brick fields, road and vessel traffic is given respectively in **Table 10-1**, **Table 10-2** and **Table 10-3**.

Table 10-1: Major Area Sources in the Project Area (2030)

Name	Emission Rate (g/s-m ²)					Source Area (m ²)	Release Height (m)
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀		
Brick Field 1	1.14E-06	2.69E-06	1.79E-06	1.95E-06	4.33E-06	2,913,112	38.1
Brick Field 2	1.13E-06	2.67E-06	1.78E-06	1.94E-06	4.29E-06	2,403,742	38.1

1) Calculated based on The RMMS Database, Department of Roads and Highways, Bangladesh.

2) Projected data calculated using 5.28% growth rate (Abdullah, M.N. and Shamsher, R. Traffic Congestion in Bangladesh- Causes and Solutions: A study of Chittagong Metropolitan City. Asian Business Review, Volume 2, Number 1/2013)

Table 10-2: Major Line-area Sources in the Project Area (Highway Traffic- 2030)

Name	Emission Rate (g/s-m ²)					Release Height (m)
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	
N7: 27-30	5.79E-06	2.12E-06	6.84E-05	7.77E-06	5.79E-06	0.5
N7: 31-34	1.61E-05	5.09E-06	2.26E-04	2.12E-05	1.61E-05	0.5

2) Projected data calculated based on Padma Multipurpose Bridge Design Project Traffic Study, BBA, 2009.

Table 10-3: Major Line-area Sources in the Project Area (Marine Vessels – Project Case-2030)

Name	Emission Rate (g/s-m ²)					Release Height (m)
	NO _x	SO ₂	CO	PM _{2.5}	PM ₁₀	
Fairway Buoy to Harbaria	9.91E-06	1.56E-06	2.63E-06	1.48E-07	1.78E-07	35
Harbaria to ChandpaiShela	7.61E-06	1.20E-06	2.02E-06	1.14E-07	1.36E-07	15
ChandpaiShela to Katakali	1.09E-05	1.73E-06	2.91E-06	1.64E-07	5.70E-08	15

Name	Emission Rate (g/s-m2)					Release Height (m)
	NOx	SO2	CO	PM2.5	PM10	
Katakhali to Chila Bazar	1.61E-05	2.54E-06	4.27E-06	2.41E-07	2.34E-07	15
Banshtola Bazar to Chila Bazar	1.35E-05	2.14E-06	3.59E-06	2.03E-07	1.66E-07	15
Chila Bazar to Baniashanta Bazar	3.12E-06	4.93E-07	8.30E-07	4.68E-08	5.59E-08	15
Baniashanta Bazar to Mongla Powerhouse	1.34E-05	2.11E-06	3.56E-06	2.01E-07	1.74E-07	15
Mongla Powerhouse to Loudop	1.54E-05	2.43E-06	4.09E-06	2.31E-07	2.54E-07	3
Loudap to Bajju Bazar	4.82E-05	7.60E-06	1.28E-05	7.21E-07	8.62E-07	3
Baju Bazar to Khulna	1.10E-05	1.74E-06	2.92E-06	1.65E-07	1.97E-07	3
Protocol Route	2.43E-06	3.84E-07	6.46E-07	3.64E-08	4.35E-08	3
Nalan to Akram	6.01E-07	9.48E-08	1.60E-07	8.99E-09	1.08E-08	3

*Projected data calculated based on data from Mongla port Authority, Khulna Divisional IWT Owners' Group and BIWTA.

Concentration of Nitrogen Dioxide (NO₂)

831. Table 10-4 shows the predicted maximum ground level 1-hr and annual averaging values for the cumulative case. The predicted values are within the National Bangladesh standards and WBG guidelines. There is an increase of about 2.16 µg/m³ in the maximum annual averaging NO₂ concentration from the project to cumulative case. However, the values are still within the standards. The predicted concentration at sensitive receptor locations is given in Table 10-5, which shows an increase in concentrations from project to cumulative case, however the values are within the National Standards and WBG Guidelines.

Table 10-4: Predicted Maximum Concentrations of NO₂ (Cumulative Case)

Pollutant	Concentration (µg/m ³)				Coordinates of Max Point (UTM)		Name of Location
	Averaging Time	ECR 1997 (as amended in 2005)	WBG Guidelines	Max Value	East (m)	North (m)	
NO ₂ (cumulative Case)	1-hr	N/A	200	124.4	766, 947.0	2, 486,901	Mongla Upazila HQ
	Annual	100	40	8.16	769,205.0	2,471, 627	Mora Passur Khal

Table 10-5: NO₂ Concentration at Sensitive and Key Receptors

Sl. No.	Receptor	NO ₂ Concentration (µg/m ³)			
		Project Case		Cumulative	
		1-hr	Annual	1-hr	Annual
1	Khulna	32.78	2.03	47.11	2.18
2	Nearest Tip of the Sundarbans	33.0	2.3	33.4	2.4
3	Akram Point	29.45	2.06	46.64	2.81
4	Alorkol	28.33	2.07	35.55	2.54
5	Chunkuri Bajua	71.13	3.78	124.0	5.5
6	Hiron Point	26.99	1.93	31.72	2.08
7	Lower Harbaria Left Bank	37.15	2.47	41.15	2.59
8	Mazhar Point	28.4	2.04	29.32	2.2
9	Mongla	102.7	5.8	106.3	5.8
10	NW Corner of Power Plant Project	76.31	2.65	81.06	3.67
11	SW Corner of the Power Plant	52.23	3.61	75.08	4.54
12	Upper Harbaria Right Bank	38.3	2.69	60.57	4.0
13	L-1 (Close to Power Plant)	81.75	3.98	88.4	4.01

Sl. No.	Receptor	NO ₂ Concentration (µg/m ³)			
		Project Case		Cumulative	
14	L-2 (Close to Mongla Port)	103.1	5.9	105.7	6.0
15	L-3 (Close to Harbira)	43.83	3.11	57.3	3.61
16	L-4 (Close to Mazhar Point)	28.61	2.04	29.1	2.14
17	L-5 (South of Akram Point)	34.32	2.62	41.47	3.0
18	L-6 (North of Hiron Point)	33.69	2.12	48.8	3.4
19	L-7 (At Fairway Buoy)	31.08	1.9	32.08	2.0

832. **Figure 10-1** shows contour diagrams for the cumulative case for 1-hr and annual averaging time, respectively. Similar to the project case, the high concentration areas are located close to Mongla Port. As seen from the contour diagrams there are some NO₂ concentration zones within the Sundarbans Forest area, close to the Northern boundary and along the marine vessel routes (especially the Akram to Nalian route). However, these concentrations are well within the national Standards and WBG Guidelines.

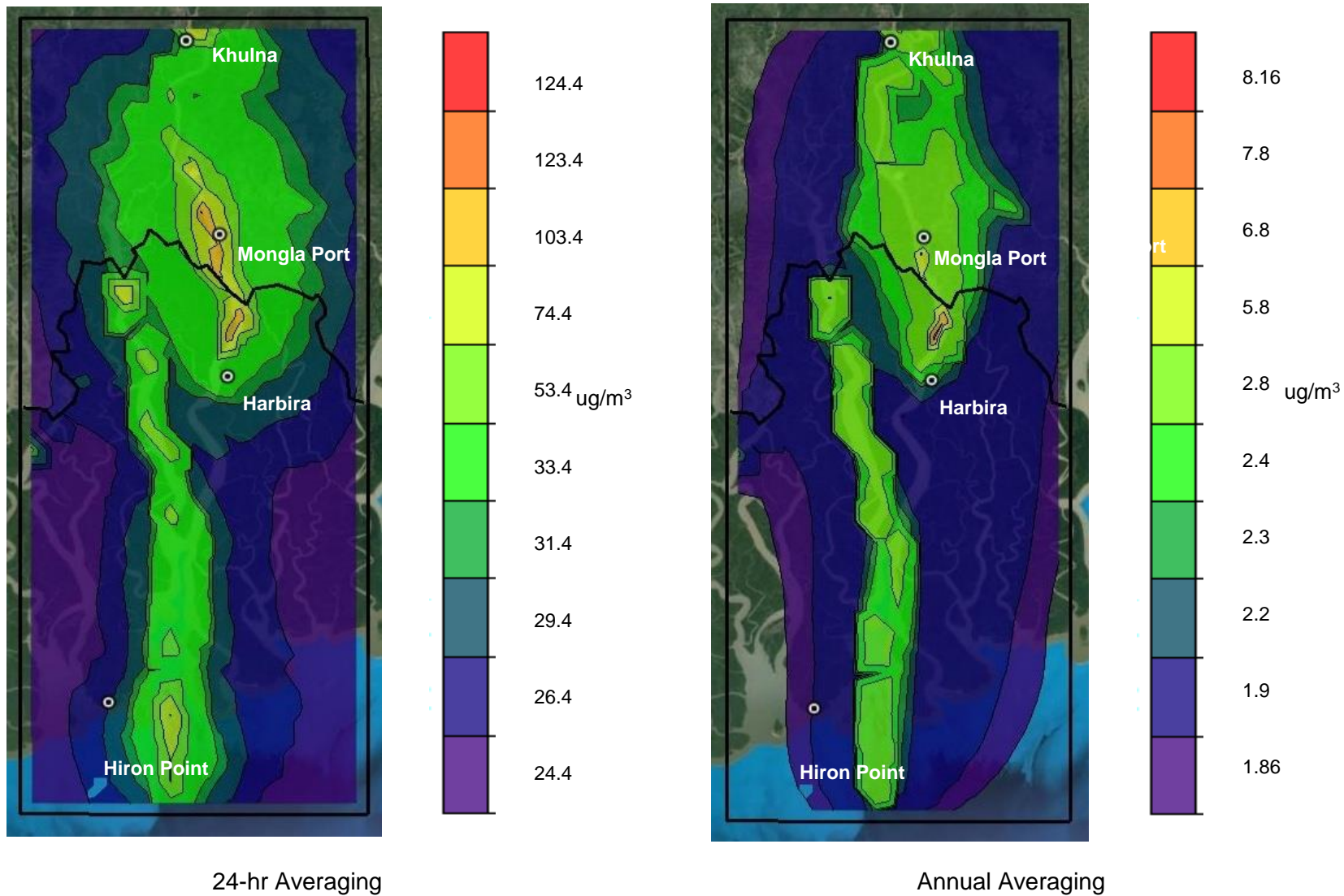


Figure 10-1: Predicted NO_2 Concentration – Cumulative Case

Concentration of PM_{2.5}

833. Table 10-6 shows the predicted maximum ground level 24-hr and annual concentrations for PM_{2.5}. As can be seen from the table, there is an increase in maximum predicted levels for 24-hr and annual averaging from the project case to the cumulative case. The maximum predicted concentrations are within the Bangladesh National standards and the predicted 24-hr average concentration meets WBG interim target-1 (75 µg/m³). Table 10-7 gives the predicted concentration at sensitive receptor locations, there is a marginal increase from the project case to the cumulative case.

Table 10-6: Predicted maximum concentrations of PM_{2.5} (Cumulative Case)

Pollutant	Concentration (µg/m ³)				Coordinates of Max Point (UTM)		Name of Location
	Averaging Time	ECR 1997 (as amended in 2005)	WBG Guidelines	Max Value	East (m)	North (m)	
PM _{2.5} (cumulative Case)	24-hr	65	G: 25 IT-1: 75	55.7	762,947.0	2,526,901.0	Deara, Rupsha
	Annual	15	G: 10 IT-1: 35	9.62	766,947.0	2,526,901.0	

Table 10-7: PM_{2.5} Concentration at Sensitive and Key Receptors

Sl. No.	Receptor	PM _{2.5} Concentration (µg/m ³)			
		Project Case		Cumulative	
		24-hr	Annual	24-hr	Annual
1	Khulna	18.67	3.25	24.16	3.67
2	Nearest Tip of the Sundarbans	20.8	3.13	20.85	3.17
3	Akram Point	16.28	3.05	16.49	3.08
4	Alorkol	16.13	3.03	16.28	3.05
5	Chunkuri Bajua	31.92	4.03	53.8	5.8
6	Hiron Point	16.13	3.03	16.28	3.04
7	Lower Harbaria Left Bank	17.4	3.18	17.65	3.21
8	Mazhar Point	16.76	3.12	17.12	3.29
9	Mongla	34.02	4.5	52.3	5.61
10	NW Corner of Power Plant Project	23.53	3.41	24.08	3.5
11	SW Corner of the Power Plant	25.8	5.27	30.55	5.31
12	Upper Harbaria Right Bank	17.46	3.21	18.82	3.4
13	L-1 (Close to Power Plant)	25.46	3.48	31.8	3.8
14	L-2 (Close to Mongla Port)	34.15	4.5	52.1	5.22
15	L-3 (Close to Harbira)	17.37	3.2	17.71	3.24
16	L-4 (Close to Majhar Point)	16.96	3.14	17.1	3.2
17	L-5 (South of Akram)	16.32	3.06	16.49	3.08
18	L-6 (North of Hiron Point)	16.18	3.03	16.4	3.05
19	L-7 (At Fairway Buoy)	15.93	3.01	15.99	3.02

834. Figure 10-2 shows the contour diagrams, there is a marginal increase in predicted concentrations in the Sundarbans from the project case, however it is well within the ambient air quality standards. As with the project case, the maximum predicted PM_{2.5} concentration in the air-shed occurs near Khulna, close to the brick fields (major sources of particulate matter) and Highway N7. Mongla port is also another high concentration area due to the significant marine vessel traffic in the area.

835. However, all cumulative Ground Level Concentrations (GLC) of PM_{2.5} in the Sundarbans Reserve Forest area for 24 hours averaging and as well as annual averaging period are well within the Bangladesh National Standards and WBG Guidelines.

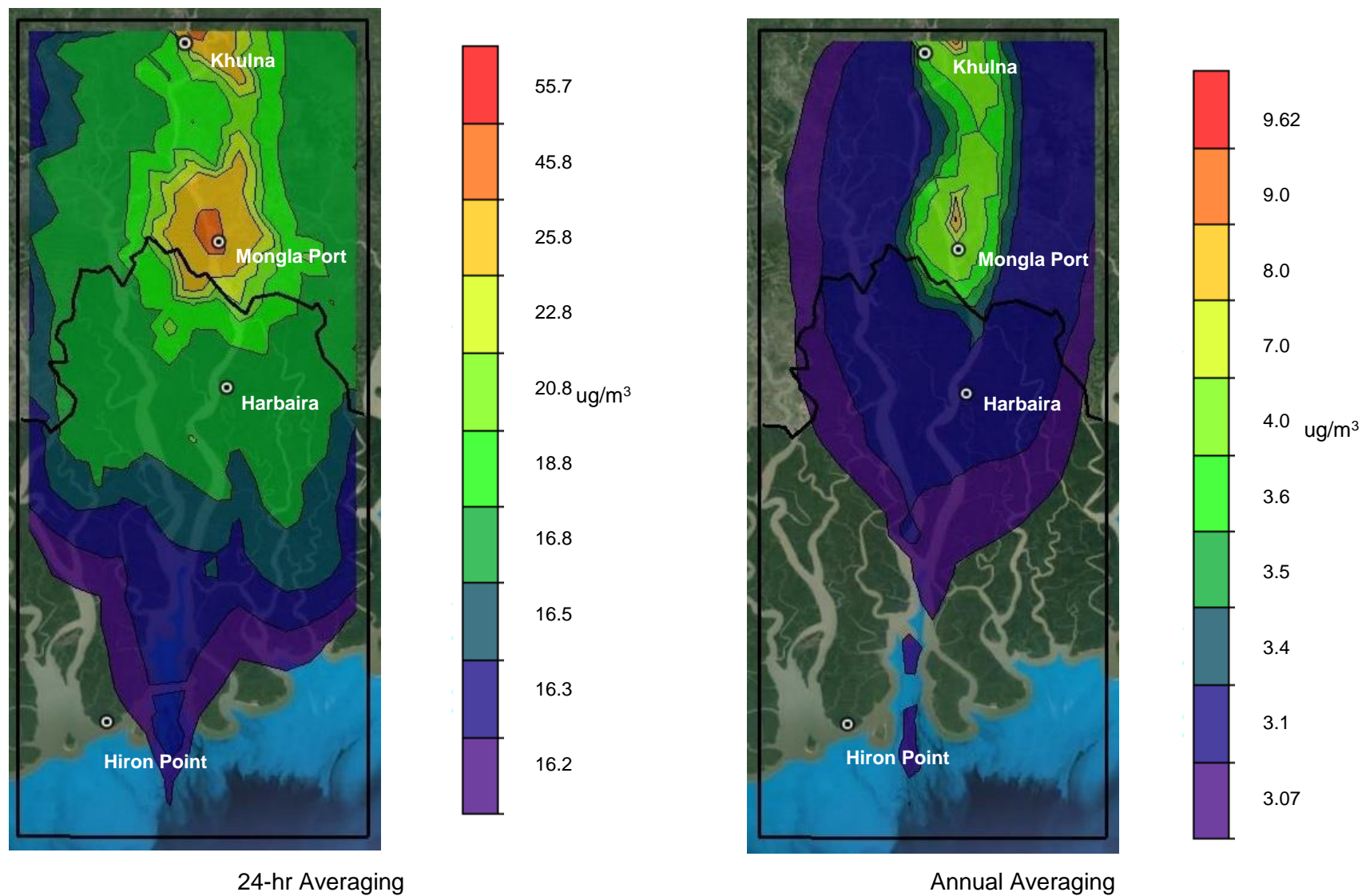


Figure 10-2: Predicted $PM_{2.5}$ Concentration – Cumulative Case

Concentration of PM₁₀

836. Table 10-8 shows the predicted maximum ground level 24-hr and annual concentrations for PM₁₀. As can be seen from the table, there is a marginal increase in maximum predicted levels for 24-hr and annual averaging from the project case to the cumulative case. The predicted concentrations are still within the Bangladesh National standards and the predicted 24-hr average concentration meets WBG interim target-1 for 24-hr averaging (150 µg/m³) and interim target-1 for annual averaging (70 µg/m³).

837. Figure 10-3 shows the contour diagrams, as with the project case, the maximum predicted PM_{2.5} concentration in the airshed occurs near Khulna, close to the brick fields (major sources of particulate matter) and National Highway, N7. There is also a high concentration area around Mongla port due to marine vessel traffic. Table 10-9 shows the predicted concentration at sensitive receptor locations, there is an increase from the project case to the cumulative case.

838. However, all cumulative Ground Level Concentrations (GLC) of PM₁₀ in the Sundarbans Reserve Forest area for 24 hours averaging and as well as annual averaging period are well within the Bangladesh National Standards and WBG Guidelines.

Table 10-8: Predicted maximum concentrations of PM₁₀ (Cumulative Case)

Pollutant	Concentration (µg/m ³)				Coordinates of Max Point (UTM)		Name of Location
	Averaging Time	ECR 1997 (as amended in 2005)	WBG Guidelines	Max Value	East (m)	North (m)	
PM ₁₀ (cumulative Case)	24-hr	150	G: 50 IT-1: 150	85.8	766,947.0	2,494,901.0	Kapalirmet Buridmial
	Annual	50	G: 20 IT-1: 70	20.4	766,947.0	2,526,901.0	Sreefaltala, Rupsha

Table 10-9: PM₁₀ Concentration at Sensitive and Key Receptors

Sl. No.	Receptor	PM ₁₀ Concentration (µg/m ³)			
		Project Case		Cumulative	
		24-hr	Annual	24-hr	Annual
1	Khulna	36.95	6.6	45.24	7.23
2	Nearest Tip of the Sundarbans	37.5	6.55	37.9	6.59
3	Akram Point	33.08	6.28	33.42	6.32
4	Alorkol	32.82	6.25	33.07	6.28
5	Chunkuri Bajua	50.03	7.4	74.0	9.37
6	Hiron Point	32.85	6.24	33.12	6.27
7	Lower Harbaria Left Bank	34.16	6.46	34.77	6.50
8	Mazhar Point	34.51	6.49	39.17	6.9
9	Mongla	52.35	7.9	73.24	9.61
10	NW Corner of Power Plant Project	40.79	6.71	41.62	6.89
11	SW Corner of the Power Plant	43.61	8.99	48.6	9.01
12	Upper Harbaria Right Bank	34.27	6.48	35.7	6.61

Sl. No.	Receptor	PM10 Concentration ($\mu\text{g}/\text{m}^3$)			
		Project Case		Cumulative	
13	L-1 (Close to Power Plant)	42.95	6.79	52.1	7.7
14	L-2 (Close to Mongla Port)	52.5	7.87	77.3	9.3
15	L-3 (Close to Harbira)	34.27	6.48	34.8	6.52
16	L-4 (Close to Majhar Point)	37.93	6.67	53.3	6.71
17	L-5 (South of Akram)	33.09	6.29	33.4	6.32
18	L-6 (North of Hiron Point)	32.9	6.25	33.13	6.3
19	L-7 (At Fairway Buoy)	32.52	6.22	32.64	6.23

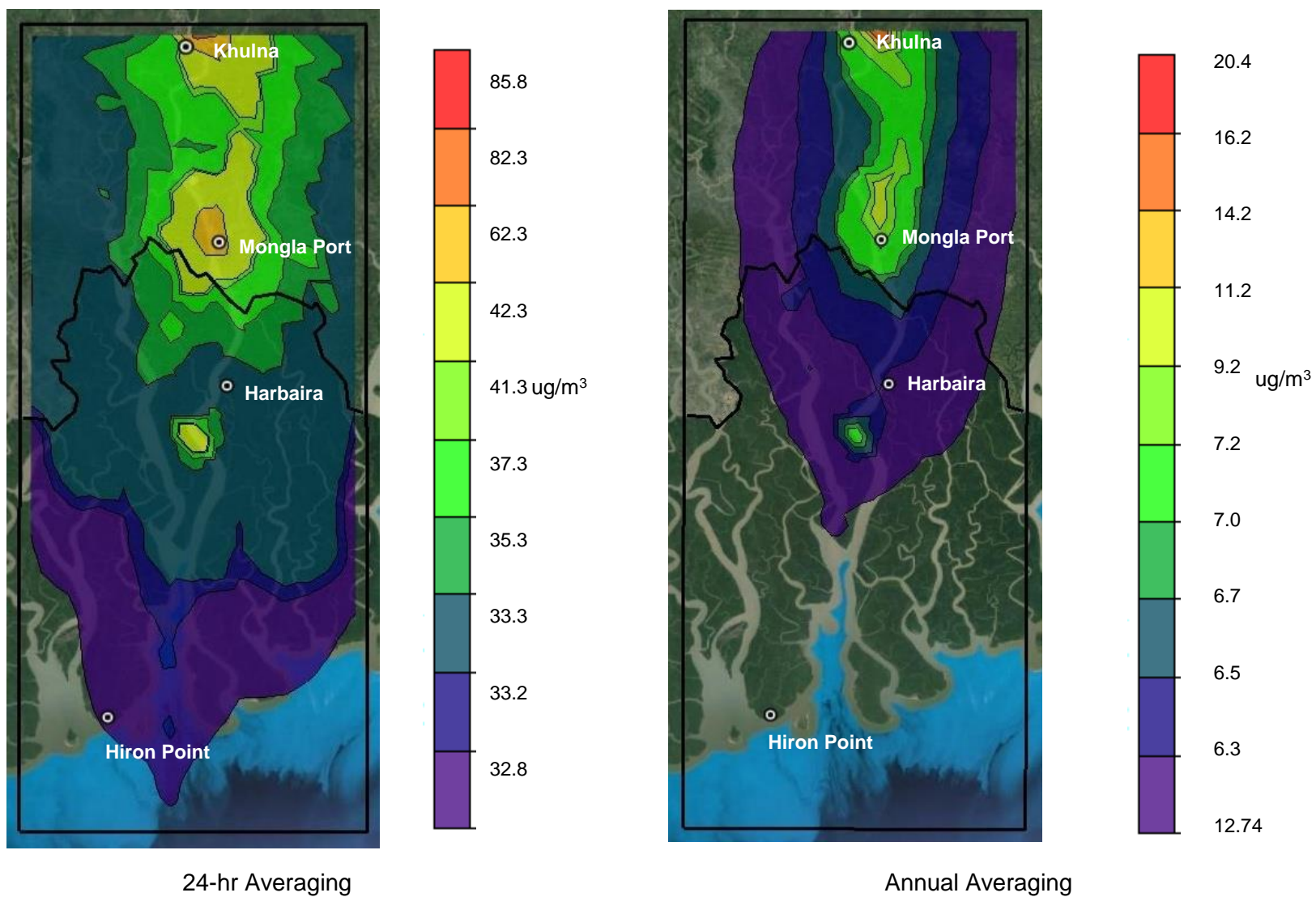


Figure 10-3: Predicted PM_{10} Concentration – Cumulative Case

Concentration of SO₂

839. For SO₂ the predicted maximum ground level 24-hr and annual concentrations are given in Table 10-10. The table shows that the maximum predicted SO₂ concentrations for the cumulative case are well within the Bangladesh Ambient Air Quality Standards and the predicted 24-hr averaging value is within interim target-1 (125 µg/m³). There is a negligible increase in 24-hr predicted concentrations from the project case to cumulative case except Upper Harbaria Point and there is also an increase in overall annual concentrations. Table 10-11 gives the predicted concentration at sensitive receptor locations, there is a marginal increase in predicted concentrations from the from the project case. The predicted results at the sensitive receptor locations meet the National Bangladesh Standards and WBG guidelines.

Table 10-10: Predicted maximum concentrations of SO₂ (Cumulative Case)

Pollutant	Concentration (µg/m ³)				Coordinates of Max Point (UTM)		Name of Location
	Averaging Time	ECR 1997 (as amended in 2005)	WBG Guidelines	Max Value	East (km)	North (km)	
SO ₂ (cumulative Case)	24-hr	365	G: 20 IT-1: 125	39.8	762,947.0	2,494,901.0	Dacope
	Annual	80	-	10.6	766,947.0	2,526,901.0	Sreefaltala, Rupsha

Table 10-11: SO₂ Concentration at Sensitive and Key Receptors

Sl. No.	Receptor	SO ₂ Concentration (µg/m ³)			
		Project Case		Cumulative	
		24-hr	Annual	24-hr	Annual
1	Khulna	11.94	2.22	14.1	2.39
2	Nearest Tip of the Sundarbans	13.3	2.2	13.52	2.3
3	Akram Point	11.15	2.12	12.0	2.3
4	Alorkol	10.98	2.1	11.18	2.22
5	Chunkuri Bajua	16.89	2.82	17.1	3.27
6	Hiron Point	10.93	2.07	11.03	2.11
7	Lower Harbaria Left Bank	12	2.28	12.34	2.32
8	Mazhar Point	11.42	2.15	11.54	2.2
9	Mongla	15.62	3.21	16.6	3.41
10	NW Corner of Power Plant Project	19.71	2.36	19.82	2.68
11	SW Corner of the Power Plant	14.72	2.81	15.74	2.96
12	Upper Harbaria Right Bank	11.86	2.35	15.64	3.69
13	L-1 (Close to Power Plant)	15.71	2.7	16.25	2.87
14	L-2 (Close to Mongla Port)	15.64	3.22	17.1	3.7
15	L-3 (Close to Harbira)	12.29	2.45	12.87	2.67
16	L-4 (Close to Majhar Point)	11.41	2.14	11.56	2.18
17	L-5 (South of Akram)	11.47	2.25	11.57	2.35
18	L-6 (North of Hiron Point)	11.02	2.12	12.59	2.42
19	L-7 (At Fairway Buoy)	10.61	2.04	10.67	2.06

840. Figure 10-4 shows the 24-hr and annual averaging contour diagrams for the cumulative case. There is an increase in SO₂ concentration from project to cumulative case. The high concentration area occurs near Khulna, close to the brick fields (major sources of SO₂).

841. However, all cumulative Ground Level Concentrations (GLC) of SO₂ in the Sundarbans Reserve Forest area for 24 hours averaging and as well as annual averaging period are well within the Bangladesh National Standards and WBG Guidelines.

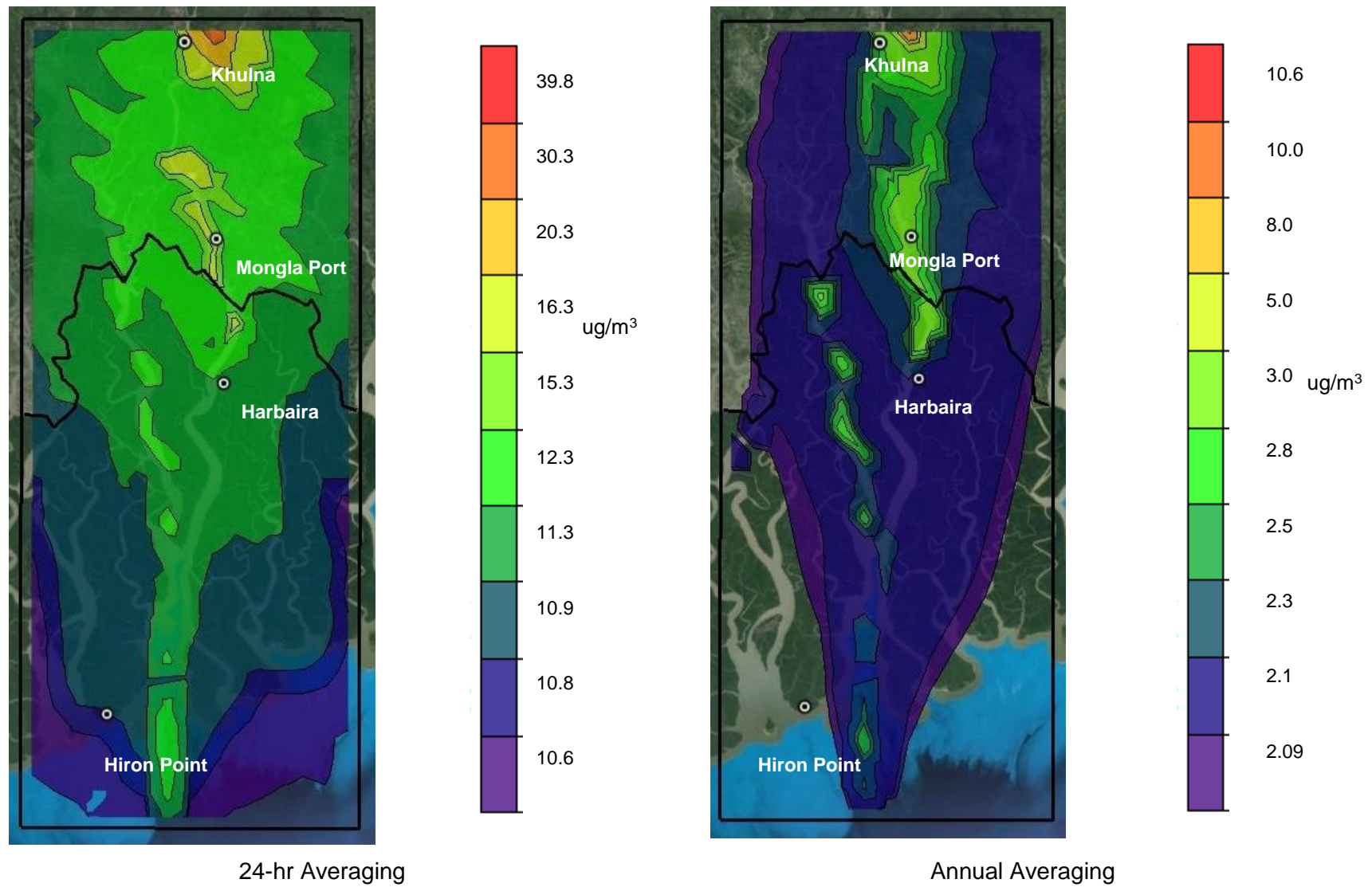


Figure 10-4: Predicted SO_2 Concentration – Cumulative Case

10.2.1 Cumulative Impacts on Aquatic Habitat

Baseline Condition

842. Aquatic ecosystems of the project influenced area are affected by Increasing river traffic and industrial developments on the Passur River banks and adjoining areas. Industrial effluent discharge, discharge from inland water transport and urban sanitary sewage are degrading water quality of the river and affecting habitats of aquatic species like fishes, dolphins and other crustaceans. Saline Brackish water shrimp farming is another major cause for severe deterioration of aquatic habitat quality of inland water area. Moreover, increase in noise level from inland water transport also negatively impacting on the dolphin movement.

843. SRF is the largest mangrove forest of the world and also an important wetland designated by RAMSAR Convention. Rivers and creeks of this forest support large number of Ganges River Dolphin (*Platanista gangetica*) and Irrawaddy Dolphin (*Orcaella brevirostris*) and about 196 other species. Overharvesting and illegal catching of fish caused diversity and population loss of fishes. Fishing nets are also a major threat of entanglement to dolphins for and hinder their smooth movement in the Passur River.

Probable Cumulative Effects on Aquatic Habitat

844. Existing air emissions, emission from proposed Maitree power plant, coal transportation through the Passur River, future growth in inland water transport, and future planned industrial development will further degrade biodiversity of the Sundarbans. High concentration of fugitive coal dust can block the gills of fish, thereby suffocating them, and diminish the prey available for dolphins and other aquatic predators.

845. Existing and projected enhanced inland water transport through Passur River may increase the potential of collision and injury of dolphins. Coal dust during transshipment and spillage of oils and lubricants from inland water vessels, industrial effluent discharge in Passur River will pose threat to aquatic species. The Critically Endangered Estuarine Crocodile, River Terrapin abundance is high at Karamjal, can also be negatively impacted by the deteriorated water quality.

846. Transshipment activities of different materials and goods at in the Harbaria Anchorage have been carrying out for long time. Transshipment of coal at the Mazhar Point, which is about 12 km downstream of the Harbaria Anchorage, construction of Power Plant jetty and unloading at plant jetty, may affect the habitats of aquatic species in the Passur River. Any further development in the area and additional associated activities along the inland waterway will further may deteriorate the habitat quality. This EIA has made a recommendation to conduct an additional study to assess the future activities in the Sundarbans area which may be a part of the Strategic Environmental Assessment (SEA) to be conducted by Government of Bangladesh. The scope of work of this study is included in Annex 10-1 for this additional study.

10.2.2 Cumulative Impacts on Biodiversity of the Sundarbans

Baseline Condition

847. Major threats to biodiversity in the Sundarbans Reserve Forest (SRF) have come mainly from the growing human population, and consequently, overexploitation of both timber and fauna, and conversion of the cleared land to agriculture and aquaculture. Industrial development, human habitation, infrastructural development, landuse change and salinity intrusion along the Passur River bank have severely affected the terrestrial ecosystems of the area. Right bank of the Passur River from Chalna to Jaimonirgol have already developed different types of industries. Of which, especially huge amount of fugitive dust generated from cement factories. Besides, transshipment of clinker from mother vessels to lighterage at Harbaria also generates fugitive dust, which will have impact on SRF. Stack emissions from inland water transport is another source of emissions of suspended particulate matter in the airshed. Change of landuse due to brackish water shrimp cultivation threatens permanent damage to the terrestrial and aquatic life forms. Salinity intrusions in the mainland due to shrimp cultivation and climate change are leading to agricultural loss of the local farmers

848. The Sundarbans Reserve Forest possesses unique resource of floral and faunal diversity. Natural calamities, such as cyclones have always posed threats on the Sundarbans and along with saline water intrusion and siltation, remain potential threats to the attributes of the Sundarbans. Cyclones and tidal waves cause some damage to the forest along the sea-land interface and have previously caused occasional considerable mortality among some species of fauna such as the spotted deer. Over exploitation of timber resources and fauna, illegal hunting and trapping, and agricultural encroachment have been threatening the Sundarbans and its overall integrity.

Probable Cumulative Effects on Biodiversity

849. The proposed Maitree Power Plant and other future development, will lead to increased number of inland water vessel movement, emission of coal dust during coal transportation, emission of particulates from power plant is expected to accumulate on floral leaves surrounding the plant area as well as on SRF vegetation. Ongoing trend of industrial development will increase motorized vehicle movement in land area and inland water transport in the river will cause cumulative effects in the airshed. Cumulative air quality dispersion modeling analysis indicates that all criteria pollutants are expected to be lower than the NAAQS and WBG at the nearest sensitive receptors. The predicted maximum concentrations meet 24 hour averaging WBG interim target-1 for SO₂ (125 µg/m³) and target-3 for PM_{2.5} (37.5 µg/m³) and PM₁₀: 50 µg/m³). Interim targets are provided for developing countries in recognition of the need for a staged approach to achieving the recommended guidelines. Increase in suspended particles accumulate on floral leaves prevent normal physiological activities like photosynthesis and transpiration. The wildlife of SRF is unique all over the world are sensitive to noise, human disturbance and light beams. Enhanced future river traffic for transportation of coal, industrial raw materials, and inland goods may further impact wildlife and floral habitats to some extent. It is expected that Strategic Environmental Impact Assessment (SEIA) of the area may be conducted among others, to assess the optimum movement of marine vessel through the MPA route so that the wildlife is not fallen under stressed condition.

11 Environmental Management Plan

11.1 Introduction

850. The Environmental Management Plan (EMP) includes several plans for implementing mitigation and enhancement measures, disaster management, spill response, hazardous materials management, emergency response, dust management, occupational health and safety, and Environmental Code of Practices. Generally, the impacts, which are minor or moderate, are to be mitigated by adopting Environmental Code of Practices (ECP) and Contractor's good practices during project implementation. On the other hand, impacts and risks which are critical or major will be mitigated or prevented by adopting mitigation measures discussed in Chapter 8 and 9 along with specific plans discussed in this Chapter.

11.2 Objectives of EMP

851. The basic objective of the EMP is to manage adverse impacts of project constructions and operation in a way, which minimizes the impacts on the Sundarbans, the natural environment and people of the Project area. The specific objectives of the EMP are to:

- Facilitate the implementation of the mitigation and enhancement measures identified during the present EIA to comply with regulatory requirements discussed earlier in the document.
- Maximize potential project benefits and control negative impacts.
- Draw responsibilities for project proponent, contractors, coal suppliers including shipping agents, consultants, and other members of the Project team for the environmental management of the Project; and
- Maintain essential ecological process, preserving biodiversity and wildlife, where possible restoring and compensating degraded or fragmented natural resources, and livelihood improvement that rely on the Sundarbans.
- Make stakeholders aware about implications of the project activities, satiate their concerns and roles and responsibilities of respective quarters.
- Foster and facilitate informed decision making process
- Ensure sustainable development.

852. The EMP will be managed through a number of tasks and activities. One purpose of the EMP is to record the procedure and methodology for management of mitigation and enhancement measures identified for each negative and positive impacts of the Project, respectively. The management plan will clearly delineate the responsibility of various participants and stakeholders involved in planning, implementation, and operation of the Project.

11.3 Project Description

853. There are five major components of the Coal Transportation. These are: (i) Mother Vessel; (ii) Transshipper; (iii) Lighterage/Smaller Barge; (iv) Unloading at Plant Jetty, and (v) Coal transfer to Coal Stack Yard. Details of the project components are given in Chapter 3 and Chapter 4.

- Various Categories of mitigation measures

854. The EMP includes various categories of mitigation measures and plans: (i) general and non-site-specific measures in the form of environmental codes of practices (ECPs) presented in **Annex 11-1** to address general construction and operation matters identified as moderate and minor in significance prior to mitigation in Table 9-1; (ii) project specific and to the extent possible, site-specific mitigation measures discussed in Chapter 9 and summarized in Table 9-1; (iii) Hazardous Materials Management and Spill Response Plan, and (iv) Construction Environmental Action Plan (CEAP) with site-specific and contract-specific management plans to be prepared by the contractor, which include pollution prevention, occupational health, safety and environment, and emergency response.

11.4 Inclusion of EMP in Contract Documents

855. In order to make the Coal Suppliers, Contractors, and Shipping Agents fully aware of the implications of the EMP and responsible for ensuring compliance, technical specifications in the tender documents will include compliance with mitigation measures proposed in the EIA as well as WBG's General Environmental Health and Safety Guidelines and IMO Conventions. The Contractor must be made accountable through contract documents for the obligations regarding the environmental and social components of the project.

11.5 Institutional Arrangements

856. The existing organogram of BIFPCL and the proposed organizational structure under Project Management for the implementation of the EMP is presented in Figure 11-1.

11.5.1 BIFPCL Project Management Control and Commercial

857. BIFPCL is the project proponent. The Project Management Control and Commercial (PMCC) established under the Managing Director of the BIFPCL will monitor and coordinate all project implementation activities. PMCC would be responsible for all aspects of Project implementation including the recruitment of Owner's Engineer and EPC Contractors, and overseeing the implementation of EMP and Chief Financial Officer (CFO) for financial management, Chief Procurement Officer (CPO) for procurement of coal and limestone and Chief Human Resources Officer (CHRO) for recruitment of staff. In addition, there are project units under the supervision of Project Head to conduct fuel management (including coal and limestone coordination, barging and logistics), contracts and materials, operation and maintenance (including chemical laboratories), technical services (including environment, ash utilization, and safety), site finance, and site human resources.

11.5.2 Environmental, Health and Safety Unit, BIFPCL

858. It is proposed to create an Environmental, health and Safety Unit (EHSU) under PMCC during implementation and under technical services group during O/M, consisting of the following staffs:

- Manager, Environmental, Health and Safety Unit
- Environmental Specialist,
- Occupational, Health, and Safety Specialist,
- Emergency Coordinator,
- Field Supervisor (Environment),and
- Occupational, Health, and Safety Supervisor

859. The responsibilities of the EHSU are: (i) supervising, facilitating and coordinating implementation of environmental management plans including ERP; (ii) ensuring that contractors follow DOE regulations, World Bank Group General EHS Guidelines and OHS Guidelines, and other requirements mentioned in the EMP; (iii) identifying any issues of non-compliance and report these; (iv) suggesting mechanisms to link contractor performance in relation to the EMP to the timing of financial payments, incentives or penalties; (v) coordinate various stakeholders during disasters and emergency events, and (vi) interacting with stakeholders for their concerns about the construction activities. The EHSU can be part of technical services as permanent basis after the completion of the Project.

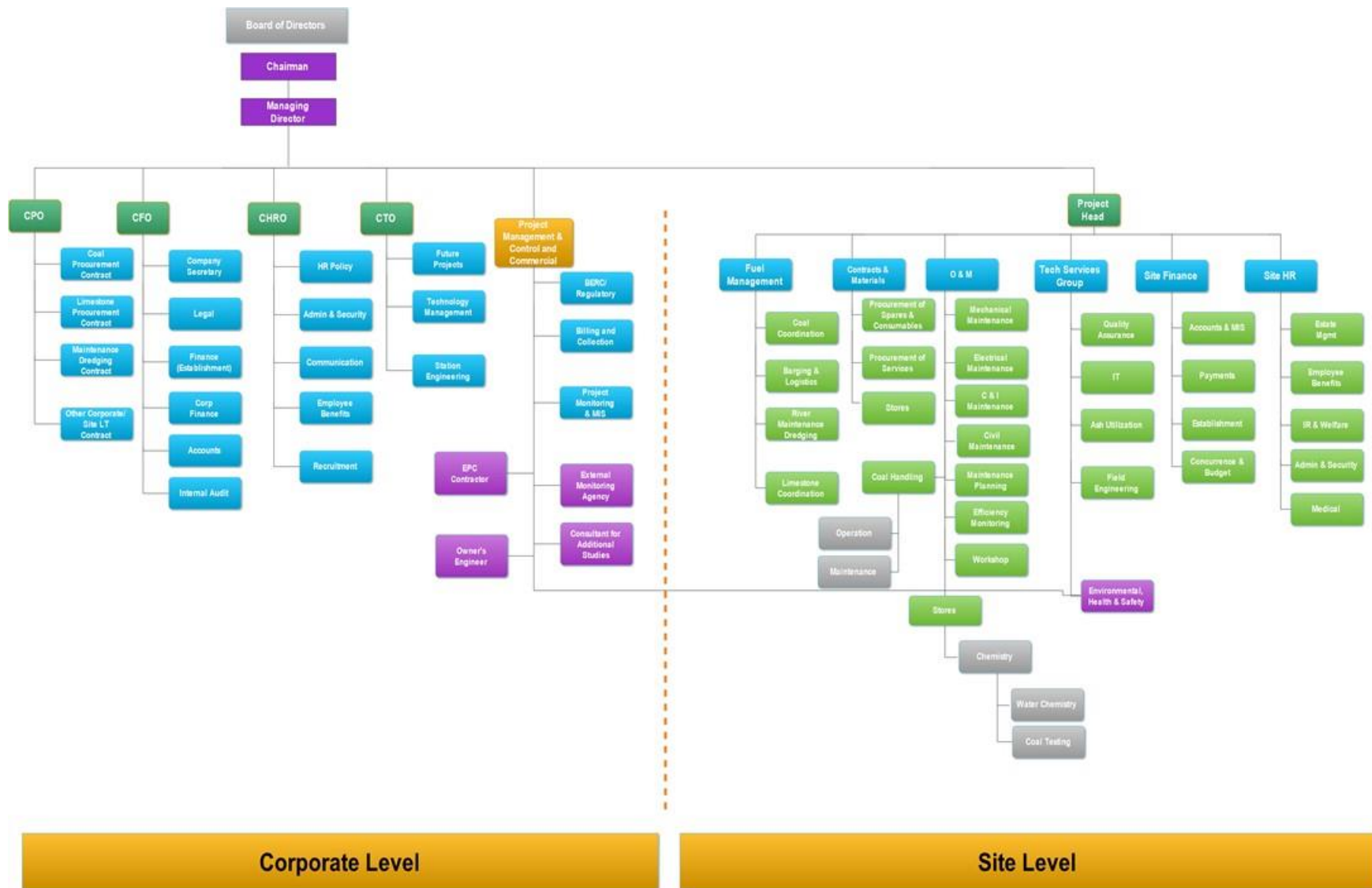


Figure 11-1: Proposed Institutional Structure for Implementation of EMP

11.5.3 Owner's Engineer

860. BIFPCL has appointed an Owner's Engineer (OE) for preparing specification for the Plant as well as supervision of EPC contractor's work.

11.5.4 Independent Monitoring Agency

861. Presently, in compliance with the terms of EIA approval letter, accorded by the Department of Environment (DoE), Govt of Bangladesh on 5th August, 2013 and the environmental and social safeguarding rules of Bangladesh, BIFPCL has appointed an independent agency for carrying out tow-tier comprehensive monitoring activities, such as compliance monitoring and environmental (physical and biological) monitoring including social parameters. The independent agency has been appointed for monitoring the implementation of environmental management plan (EMP) during pre-construction/design phase and implementation/construction phases.

862. The study covers quarterly monitoring of different environmental and social parameters, and implementation of EMP during design and implementation phases. The monitoring locations were selected based on physical activities, wind direction, sensitive receptors, etc and were finalised with the consultation of DoE, Department of Fisheries (DoF), MPA and Forest Department (FD). The same Independent Monitoring shall continue up to operation phase.

11.5.5 EPC Contractors

863. Contractors are also required to appoint the following environmental staff for the implementation of EMP in the field, particularly the mitigation measures.

- Environmental coordinator
- Ecologist (specifically to deal with the impacts on biodiversity)
- Occupational Health and Safety Officer
- Community Liaison Officer
- Human Resources Officer

864. The contractor will develop various plans directed towards health, safety, the environment and social issues, and get them approved by the Owner's Engineer. The contractor will also be responsible for communicating with and training of its staff in the environmental, health and safety aspects before the commencement of the physical works on site. The construction contract will have appropriate clauses to bind the contractor for the above obligations.

11.5.6 Mongla Port Authority

865. Mongla Port Authority (MPA) is under the administrative control of the Ministry of Shipping (MOS). The Chairman is the Chief Executive of the Port Authority. There is a Board comprising of the Chairman and 3 Members, covering Engineering and Development, Finance, and Harbor and Marine. The Board formulates the policies for operations, administration, finance and development of the port. There are 12 Departments which undertake the responsibilities of running and managing the port's activities. The structure of the port has remained unchanged since the days of Chalna Port Authority.

866. Based on the approved establishment strength by the Government, the port manning comprises 2,800 Officers and Staffs. At present, the manpower strength consists of 113 Officers and 1,264 Staffs (total of 1,377 personnel) at work in the port. This is about 49% of the approved establishment strength. The port operates a 3 shift system round the clock.

867. There is no designated emergency management department or section in MPA to ensure the effective management of response forces and resources in preparing for and responding to situations including natural disasters, national security emergencies, and technological incidents. There are medical, security and fire sections under Director Admin and Conservancy Section under Harbor Master. An institutional reform and capacity building will be needed to manage ongoing and future disaster risks and emergencies. This reform and capacity building is pre-requisite for the MPA to allow coal transportation and enhanced traffic movement in the MPA designated route along the Passur River. The reform must be consistent with the Emergency Preparedness and Response Plan presented in **Annex 11-4**.

11.6 Grievance Redress Mechanism

868. Grievances are actual or perceived problems that might give grounds for complaints. As a general policy, PMCC, Technical Services and EHSU will work proactively towards preventing grievances through the implementation of impact mitigation measures and community liaison activities that anticipate and address potential issues before they become grievances. Minor issues will be resolved by the Contractor in consultation with Owner's Engineer.

869. The project will establish a grievance redress mechanism (GRM) for addressing grievances and complaints received from the project-affected persons. The claims and complaints will need to be brought to the attention of the local grievance redress committee (LGRC). They will then forward grievances to the higher levels of authorities as desired. The Grievance Redress Mechanism is shown in **Figure 11-2**.

870. The fundamental objective of GRM will be to resolve any project-related grievances locally in consultation with the aggrieved party to facilitate smooth implementation of the environmental management plans. Another important objective is to democratize the development process at the local level and to establish accountability to the affected people.

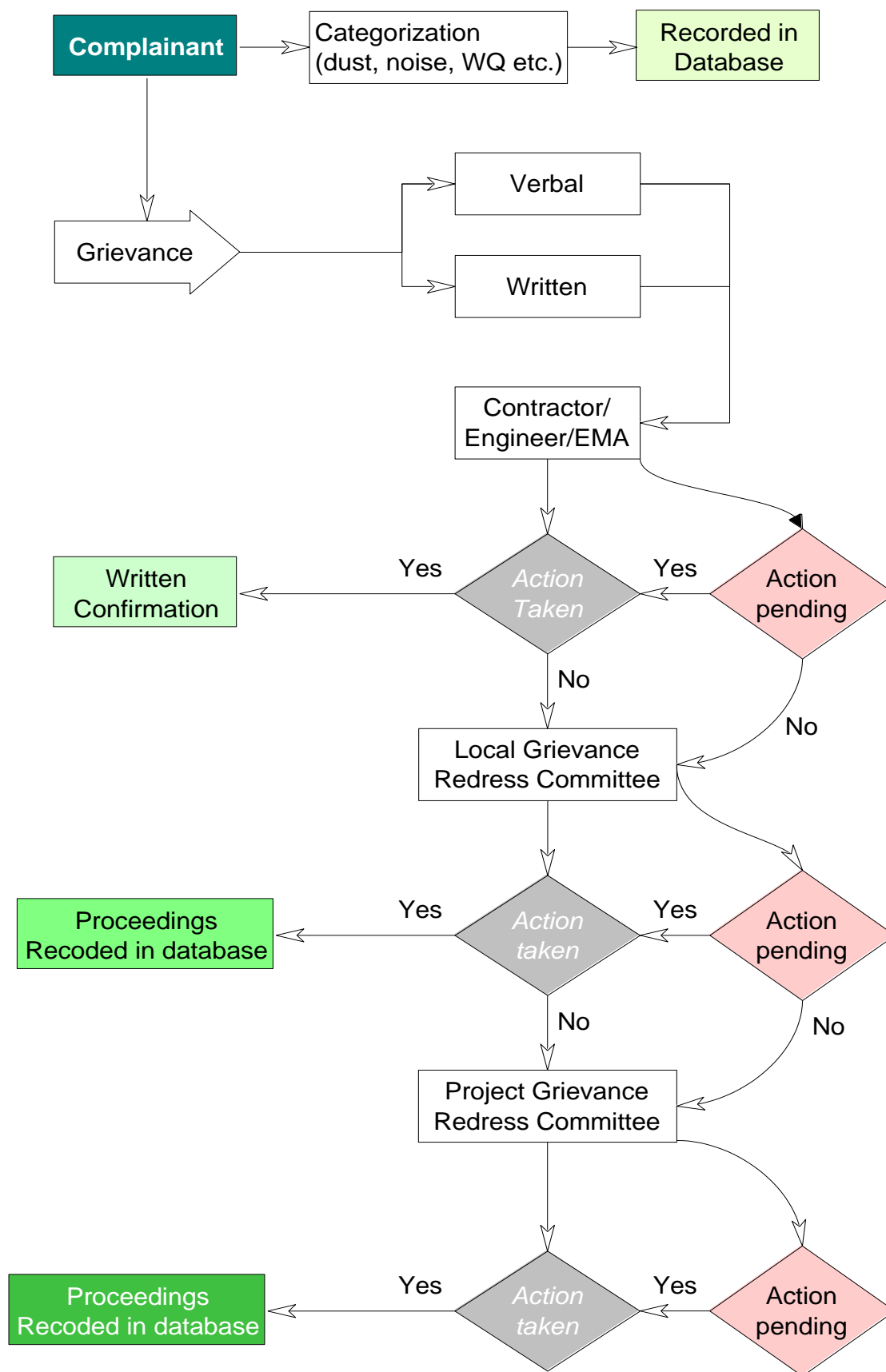


Figure 11-2: Grievance Redress Mechanism

871. Under the GRM, two grievance redress committees (GRCs) will be formed: local grievance redress committee (LGRC); and project grievance redress committee (PGRC). Most of the grievances would be resolved at LGRC within 7 days of receipt of complaint, while a few might be forwarded to PGRC, which will take two weeks to resolve the complaint. These GRCs are described below.

11.6.1 Local Grievance Redress Committee

The following LGRC composition has been proposed for the project:

- EHSU, BIFPCL: Convener
- Community Representative(s)³⁰: Members
- Contractors Representative: Member

872. LGRC meetings will be held in the convener's office in the Project impact area or other location(s) as agreed by the Committee members. If needed, LGRC members may undertake field visits to verify and review the issues, including mistakes related to temporary disturbance due to construction works, unauthorized disposal of solid and hazardous wastes, noise and vibration due to the use of heavy equipment, access restrictions, etc.

11.6.2 Project Grievance Redress Committee

873. The grievances that are not resolved at the LGRC will be forwarded to the PGRC. The PGRC will be empowered to take a decision, which would be binding on BIFPCL but it will require approval of the Managing Director for implementation of the decision. The Site Incharge will head the PGRC. The composition of the PGRC will be as follows:

- Site Incharge: Chair Person
- EHSU, BIFPCL: Member Secretary
- Representative of Local Community/Project Affected Persons: Member (nominated by Managing Director with the help of IMA).

874. The Secretary of PGRC with the help of Environmental Specialist of BIFPCL will provide necessary knowledge and information regarding relevant project policies and agreements with development partner. The provision of PGRC will further establish fairness and transparency in the resolution of grievances of the project-affected persons. In case of technical nature of environmental issues, or any legal matters, Environmental Specialist of BIFPCL will advise the PGRC. In specific cases, external legal and or technical advice may also be sought, if required.

11.7 Environmental Code of Practices

875. A set of environmental code of practice (ECPs) has been prepared for various environmental and social management aspects: ECP 1: Waste Management; ECP 2: Fuels and Hazardous Goods Management; ECP 3: Water Resources Management; ECP 4: Drainage Management; ECP 5: Soil Quality Management; ECP 6: Erosion and Sediment Control; ECP 7: Protection of Flora; ECP 8: Protection of Fauna; ECP 9: Protection of Fisheries; ECP 10: Traffic Management (Road and Inland); ECP 11: Construction Camp Management; ECP 12: Cultural and Religious Issues; ECP 13: Workers Health and Safety,

³⁰ This may be, for example, any community member representing project affected persons and one woman.

and ECP 14: Construction and Operation Phase Security. The Contractors will be contractually obligated to comply with these ECPs, presented in **Annex 11-1**.

11.8 Environmental Management Plans during Implementation

11.8.1 Site Preparation

876. The site preparation would require base stripping and clearance of shrubs and bushes. The contractor will prepare a site preparation plan on the basis of ECP 4, ECP 5, ECP 6, ECP 8, ECP 9, and ECP 13 to ensure safeguarding of environment. This plan must be submitted to OE for review and approval.

11.8.2 Implementation/Construction Environmental Management Plans

877. The following are some of the plans proposed in this EMP to guide the Contractor to prepare a Construction Environmental Action Plan (CEAP) and Site Specific Environmental Management Plan (SEMP). The Contractor will expand the plan to address site specific measures with layouts, action plans, drawings, etc. and get them approved by the project authority before mobilization to the project site.

Surface Water Quality and Sediment Control Plan

878. Potential effects on surface water quality are generally expected during works in and around jetty construction. The following mitigation measures will be implemented during construction in this area:

- Catch basin protection will be installed prior to construction in the jetty working areas and adjacent to truck routes supporting construction at the jetty site, if required.
- Excavation discharge will be directed to in-ground pits specifically created to manage turbid excavation waters. These pits will be excavated prior to other works beginning onsite.
- Excavation waters will not be discharged to storm water mains or direct to the Passur River.
- Daily site cleaning will be conducted to prevent a build-up of dust that could become a source of sediment during rain events. Similarly, site cleaning will be conducted as needed during the wet season to prevent mud tracking.
- Potentially restricting selected excavation works during inclement weather.
- Inactive soil stockpiles will be located away from catch basins and will be securely covered to prevent wind losses on dry days and rains-plash erosion of wet days.

879. There will be some encroachment into the riparian zone of the Passur River for the construction of jetty and bank protection works. During construction mitigation measures will be implemented to protect water quality (e.g., erosion and sediment controls, hazardous materials management) and to avoid damage to non-target vegetation in the riparian zone. Equipment storage and maintenance, fueling and other activities will not be permitted within 15 m of the channel. Machine access will also be restricted in the riparian zone to the extent feasible.

Environmental Monitoring Plan

880. The existing independent environmental monitor who has been conducting the independent monitoring for the Maitree Power Plant will visit the site quarterly during implementation of the plant jetty to evaluate the effectiveness of mitigation measures. A water quality sampling program will be conducted in support of the excavation discharge program. It is proposed to collect groundwater from excavation areas and discharge it into separate in-ground infiltration pits. Excavation discharge water quality will be monitored for the following parameters:

- pH (in situ)
- dissolved metals (analytical)
- conductivity (in situ)
- total dissolved solids (in situ)

881. Environmental monitoring will also be conducted during pile installation at Berth construction. Environmental monitoring activities and associated data will be summarized in a post construction monitoring report to be submitted to the BIFPCL and DoE.

Hazardous Materials Management and Spill Response Plan

882. The Hazardous Materials Management and Spill Response Plan (HMMSRP) provide guidance on managing potentially hazardous materials. This includes chemicals used during construction, and wastes generated as a result of construction. Spills of hazardous materials have the potential to affect soil, water and sediment quality. Hazardous wastes are prohibited from routine landfill disposal. Examples of hazardous materials that are most likely to be associated with the project construction include: gasoline and diesel fuel, hydraulic fluids, solvents and waste oils.

Hazardous Materials Management Strategies

883. Effective hazardous materials management strategies include:

- Preparing inventories of chemicals that will be used, or have the potential to be used onsite. Inventories should include anticipated volumes and types of materials and MSDS.
- Providing storage and general guidelines for use of hazardous materials.
- Conducting an overview assessment of risks associated with spills of known hazardous materials used in working areas. This requires the contractor to evaluate the potential hazards of working with specific chemicals, in association with a particular task, in a particular area.
- Developing and posting spill prevention plans. Such plans would include guidelines for daily use and overnight fuel storage, as well as designated waste storage areas for oils, solvents, concrete and other potentially hazardous products. These plans also include guidelines for managing suspect or known contaminated materials
- Developing and posting spill preparedness and response plans for chemicals in use onsite. These plans should include, at a minimum, information on appropriate spill response equipment, communications and response plans.

Storage and Use of Hazardous Materials

884. Where feasible and applicable, EPC Contractors should follow these general guidelines for storage and use of hazardous materials in construction areas:

- Outdoor storage will be secured when unmanned, and storage of hazardous or potentially hazardous materials will ideally be arranged so that stored products are away from vegetated areas and there is ≥ 6 m between stored products, uncontrolled grasses or weeds, and fuel dispensers.
- Storage areas and containers will be regularly inspected for leaks, poor condition, inadequate seals and other problems that may result in the spill or release of a hazardous substance.
- Personnel will read and follow the directions for all products, and have easy access to MSDS for all hazardous material onsite.
- Products will be stored in their original containers and their labels maintained in good condition, labels should be protected with transparent tape as necessary.
- As needed and where safe to do so, a correctly sized funnel will be used to transfer hazardous materials from one container to another.
- Personnel will avoid mixing chemicals unless specified by the manufacturer, and will use chemicals as specified on labels, in well ventilated areas.
- Corrosives will be stored away from flammables.
- Re-useable or recycled lubricants will be used where possible or appropriate to machinery and equipment.

Spill Prevention

885. Spill prevention strategies for the project will include the following:

- Daily inspections of machinery for leaks, cracked hoses and other conditions that may result in spills. Contractors will ensure external equipment surfaces are free of oil, diesel and other potential contaminants prior to use.
- Routine inspections of storage areas and containers for leaks, poor condition, improper seals and other problems that may result in the release of a hazardous substance.
- Storage of daily use fuels, lubricants and other chemicals over impermeable areas and / or in lined, leak proof containers.
- Temporary covers will be used as needed to prevent rainfall from pooling in daily use storage containers.
- Daily use chemicals will be stored onsite in a locked container or will be taken offsite at the end of each day.
- Fuelling and equipment maintenance will be undertaken ≥ 30 m away from all permanent drainages.
- Written procedures for the proper use and storage of chemicals will be provided consistent with the potential risks associated with each chemical, anticipated frequency of use and any special handling requirements.

Spill Preparedness

886. Written spill response procedures and communications protocols will be posted at conspicuous locations onsite. Personnel will know the locations of the spill kits in each working area and be trained in their use. Spill kits will be appropriate to the types of hazardous materials and anticipated spills onsite. Contractors will be expected to develop and post a list of contacts and emergency numbers for managing and responding to spills.

887. Machine operators will have onboard spill kits and one (1) larger spill kit will also be available at each working area. At a minimum we recommend larger spill kits may contain the followings:

- (50) absorbent pads
- (4) booms
- (1) bag granular absorbent
- (4) disposal bags
- (1) stop leak plug
- personal protective equipment
- (1) roll duct tape
- flagging and tarps
- up to 80 empty sand bags
- instructions and list of contents

888. Spill kits will be restocked after use. Fire extinguishers, pointed and/or broad shovels, nylon rope (100 m) and recovery / storage drums should also be available for use onsite. Finally, keep between 250 ml and 1 Liter of commercial, dry or pre-mixed bentonite clay onsite to plug holes in leaking containers during spill response.

Spill Response

889. Contractors will develop and post spill response plans prior to construction. These plans will include but not be limited to the following procedures:

- Confirm the safety of all personnel and secure the area (as needed)
- Eliminate ignition sources
- Identify spilled product, associated hazards and clean up requirements (refer to MSDS if uncertain)
- Contact site supervisor
- Determine if the spill can be contained and cleaned up by onsite staff. Spills that cannot be managed by onsite personnel should be directed to the fire department as required.
- Stop the flow of spilled materials if safe to do so.
- Contain spilled materials if safe to do so.

- Clean up and dispose of spilled product and used response materials consistent with the Environmental Conservation Act, Hazardous Waste Regulation.
- Notify the DOE and the local administration in the event of a reportable spill, as defined by the Spill Reporting Regulation of the Environmental Conservation Act.
- Spills of flammable Class 3 Liquids like gasoline or fuel oil ≥ 100 liter in volume are reportable.
- Investigate causes of the spill and identify required changes to hazardous materials management strategies and spill response plans.
- Complete spill reporting forms ensuring the following information is provided:
 - Name of the person(s) reporting the spill
 - Witnesses of the spill
 - Date, time and location of the spill
 - Source of spill
 - Type and estimated volume of product
 - Nature of the receiving environment (soil, water)
 - Spill response measures
 - Estimated volume recovered
 - Impact of the spill on terrestrial and / or aquatic resources
 - Required remediation (if any)
 - Measures take to prevent similar spills in future
 - Agencies made aware of the spill (as needed)

Air Quality Management Plan

890. The following mitigation measures to prevent air quality impacts are recommended:
- On-road low sulfur diesel fuel will be used in all equipment capable of using such fuel
 - Diesel particulate filters should be used on all construction equipment capable of supporting their use.
 - Covered vehicles are required when transporting bulk fine materials to the project area
 - Paved areas need to be cleaned on a routine basis to prevent the accumulation and mobilization of dust. Speed limits will also be implemented to reduce dust mobilization
 - Site-specific worker education programs will be developed to address:
 - Idling reduction (automatic anti-idling shut-off where feasible).
 - Operation of equipment at optimum rated loads.
 - Routine equipment inspection and maintenance.
 - Daily inspections to identify dust and equipment exhaust issues.

- Use newer model equipment and vehicles.
- Compliance with the DoE Emission Standards for vehicles.
- Ongoing assessments of the potential for dust generation and combustion emissions. Steps will be taken to minimize dust and combustion emissions as needed.
- Visual assessments of dust and exhaust emissions will be completed on an ongoing basis during work and / or while machinery is operating.
- Use of water trucks to control dust as needed.
- Establishing speed limits to control dust mobilization.

891. Given the mitigation measures proposed above, the need for air quality monitoring during construction is not anticipated at this time. However, should dust monitoring for example, become a requirement, sampling will be consistent with standard methods used in Bangladesh and approved by DOE.

Noise Management Plan

892. Examples of noise mitigation measures that may be implemented during construction include but are not necessarily limited to the following:

- Developing a construction noise awareness training program for all personnel addressing site specific and generic construction noise issues, potentially sensitive noise receptors, relevant national noise standards and performance criteria.
- Preparing and submitting a list of equipment, prior to construction, to evaluate potential noise impacts. Noise ratings for selected machines are provided in **Table 11-1**.
- Limiting construction hours between 06:00 hours and 21:00 hours.

Table 11-1: Examples of noise ratings and equipment age

Equipment	Noise levels dBA (measured at 15 m from source)		Equipment	Noise levels dBA (measured at 15 m from source)	
	New equipment	Old equipment (>5 yrs old)		New equipment	Old equipment (>5 yrs old)
Compressor	73	76-80	Grader	72-75	85-90
Backhoe	75-80	83-88	Jackhammer	75-80	85-90
Concrete Mixer	75	85-87	Loader	80-85	92-95
Concrete Pump	75	82-85	Paver	80-85	95-101
Concrete Saw	90	n/a	Rock Drill	80-85	95-98
Concrete Vibrator	75	76-80	Roller	80	88-90
Crane	75	85-90	Scraper	78-83	96-98
Bulldozer	75	83-88	Tractor	75	85-90
Dump Truck	84	85-88	Trencher	83-88	n/a
Excavator	83	85-87	Vibratory Rollers	95	n/a

Source: Gilchrist A, Allouche E. N., and Cowan, D. (2003). *Prediction and mitigation of construction noise in an urban environment*.

- Selecting less noisy machinery, vehicles and equipment for use onsite wherever possible. Newer equipment, and/or equipment with noise suppression features like exhaust silencers on air tools should be evaluated for use onsite.
- Equipment should be kept in good order, emphasizing lubrication, replacement of worn parts and the condition of exhaust systems. Diesel and gas powered equipment should be routinely inspected and equipped with higher quality mufflers where possible.
- Locating noisy equipment (e.g., portable generators) away from sensitive noise receptors, such as construction personnel or nearby shoreline areas frequented by birds.
- If needed, fit equipment with residential-rated mufflers and/or silencers for night-time work
- Muffling back up beepers where safe and feasible to do so.
- Shutting off equipment that is not in use and operating equipment at the minimum speeds permitting effective operation, with hood and shields closed.
- Enforcing speed limits to reduce vehicle noise. This will also help to reduce dust mobilization.
- Installing temporary noise barriers as needed. If noise barriers are necessary, they should be located as close as possible to the source of the noise and made from solid materials and ideally lined with absorbing materials.

Pile Driving Plan

893. Pile installation will be consistent with the Best Management Practices for Pile Driving³¹ and Related Operations. Standard mitigation measures that will be implemented, if driven pile is used, onsite include:

- Conferring with fisheries department (and other agencies with jurisdiction) to determine the preferred timing and methods of the pile driving program
- For driving steel pipe piles that are >16 inch in diameter, using a diesel hammer, air hammer, or similar powered hammer equipment, department of fisheries prefers that pile driving occur outside of the April-July sensitive period to avoid fish breeding and spawning season.
- Maintaining equipment in good condition to prevent leaks or spills of potentially hazardous materials like hydraulic fluid, diesel, gasoline and other petroleum products.
- Recovering waste or any miscellaneous unused materials for disposal in an appropriately designed facility or placed in storage.
- Maintaining emergency spill equipment available working near or on the water.

³¹ Note: Pile Driving Contractors will be required to prepare a detailed Pile Driving Plan for submission to BIFPCL and other agencies for review and comment. This plan will outline pile driving methodologies, timing and mitigation measures in the context of site specific conditions and constraints.

- Positioning water borne equipment in a manner that will minimize damage to fish habitat. Where possible, alternative methods will be used (e.g., anchors instead of spuds)
- Fish exclusion devices may be installed in the water column around the pile driving area to prevent fish access. The need for exclusion will be determined on the basis of installation timing, mitigation measures, the success of mitigation measures in the field etc.
- Bubble curtains (with frames acceptable to department of fisheries) over the wetted length of the pile may be required to mitigate impacts on aquatic life.

Drinking Water Supply and Sanitation Plan

894. A Separate water supply and sanitation provisions might be needed for the temporary facilities, labor camp and workshops, in order not to cause shortages and/or contamination. A Plan will be prepared by the Contractor for drinking water and sanitation. The Plan will be submitted to the BIFPCL for review and approval before contractor mobilization.

11.8.3 Communication Plan

895. A communication plan has been prepared and presented in **Table 11-2**. While carrying out the communication plan modifications of process and planning may be done as per the projects requirement.

Table 11-2: Communication Plan Adopted for the Project

Stakeholder	Information/ Message	Communication Means	Timing/Frequency	Responsibility
PAPs	Project awareness (general project information, etc.)	Consultations	Scoping session in the preparation of Draft EIA	EIA Consultant, supervised by Project Management Control and Commercial Unit (PMCC)- BIFPCL
	Project findings (environmental and social concerns)	Disclosures: DoE through presentation; public through BIFPCL website and formal consultations	Immediately after preparation of Draft EIA	EIA Consultant, supervised by PMCC
	Employment opportunities	The Company, BIFPCL's own service rules: for new recruitment at AE/AM position informed public by TV, mobile network, radio, newspaper (English / Bangla); for others, BIFPCL's internal system.	6-7 weeks before recruitment / job opening	BIFPCL
	Implementation of Coal Transportation	Consultations & announcement	At the start of coal shipping, transshipment and unloading at plant	IMA, supervised by BIFPCL, MPA

Stakeholder	Information/ Message	Communication Means	Timing/Frequency	Responsibility
			jetty	
General population (Local)	Skilled and unskilled labour employment opportunities	Poster, local daily newspaper, in-person communication	3 to 4 weeks before recruitment	BIFPCL
Emergency Response Group	Incidents of hazards	Formally institute the group and delineate contact point & MoU with MPA, DC, local Fire Service, Forest Department, local Police, Coast Guard, Bangladesh Navy, and National Disaster Management. Communicate incident through VHF, cell phone, and other means of communication	Immediately when any incident is detected	Master Mariner, Harbor Master, MPA, Shift Engineer (BIFPCL)
Emergency Response Team	Incident of disasters (coal and oil spill, collision, ship sinking)	VHF, cell phone, and other mobile communication	Immediately when any incident is detected	Master Mariner, MPA Harbor Master, Shift Engineer (BIFPCL)
Police Station	Incidents of disasters and security issues	Telephone, cell phone	Immediately when any incident is detected	Shift Engineer (BIFPCL)

11.9 Operational Environmental Management Plans

896. With reference to the possible significant environmental impacts and risks during operation stage identified in Chapter 8 and Chapter 9, impact specific Environmental Management Plans have been prepared to address those impacts. The operational management plans will be finalized upon completion of detailed design and consultation. At a minimum however, the following management plans will be implemented during operations:

- Air quality management plan
- Safety Measures of Coal Transportation
- Runoff collection and treatment plan
- Wastewater Management
- Emergency response plan
- Lighting plan
- Noise management plan

11.9.1 Air Quality Management

897. An Air Quality Dispersion Modelling Assessment was completed for the project using USEPA Regulatory Model CALPUFF and addressed potential emissions sources associated with the coal transportation, coal fired power generation plant, water transports and road

traffic in the airshed, and other point and area sources. Air quality parameters were evaluated in the context of the Department of Environment's Ambient Air Quality Standards (AAQS) and World Bank Group Guideline Values; which were developed to protect public health and the environment. The sensitive receptors were identified and considered in the assessment and ground level concentrations in each receptor locations are predicted using the CALPUFF. The assessment also conducted to predict maximum ground level concentrations for each criteria pollutant. The modeling exercise was conducted for three scenarios, baseline condition, project condition, and future development condition in the airshed.

898. The modelling results indicated the air quality parameters of interest during operations are expected to be lower than the National AAQS at the nearest sensitive receptors. It is expected that a significant portion of the PM_{2.5} concentration in Bangladesh is trans-boundary in nature (secondary pollutants formed from NO_x and SO_x after chemical transformation in the ambient air); predominately from West Bengal and North India³². The major Indian city of Kolkata is less than 100 km to the west of the project location. Studies show that on average 35% of the PM_{2.5} concentration is trans-boundary in nature and can be as high as 67% depending on the season and direction of the wind. Some potential for localized NO₂ emissions above the AAQS were identified in Protocol Routes and N7 Highway. However, as indicated above, the predicted NO₂ levels were below the AAQS at the sensitive receptor.

899. Air quality monitoring programs and mitigation measures will be required at the maximum ground level concentration locations, plant jetty and operating area close to Harbaria anchorages (Mazhar Point). Key components of the plan are outlined in the monitoring plan presented in Table 12- in Chapter 12.

Weather Monitoring

900. Real time and forecasted weather data will be used to plan coal offloading activities. At a minimum, an anemometer for measuring wind speed (including gusts) and direction in the vicinity of the coal stackyard will be installed. Forecasted weather will also be used to plan activities like site cleaning, equipment maintenance, temporary coal stockpiling (volumes and pile face configuration).

Air Quality Monitoring

901. BIFPCL will install Ambient Air Quality Monitoring stations along with meteorological stations. The locations will be finalized based on the air quality modeling assessments at the maximum ground level concentration. DOE standards for PM_{2.5} and PM₁₀ are 65 µg/m³ and 150 µg/m³ over 24 hours, respectively. Available limits³³ for coal dust exposure are as follows:

- Coal dust - Bituminous, Respirable - 0.9 mg/m³
- Coal dust - Anthracite, Respirable, - 0.4 mg/m³

³² Billah, M., Chatani, S., and Sudo, K. (2009); Application of WRF-CMAQ Modeling System to Study of Urban and Regional Air Pollution in Bangladesh, 8th Annual CMAS Conference, Chapel Hill, NC, October 19-21, 2009

³³ Worksafe BC, OHS Regulation, Guidelines Part 5, Table of exposure limits.

902. Dust monitoring data will be used to evaluate the need for site cleaning or maintenance, temporary work stoppages, or identify procedural revisions to limit dust generation and / or mobilization.

Dust Mitigation Measures

903. Dust management will emphasize strategies to limit dust generation, followed by ongoing monitoring and site cleaning / maintenance. These strategies will include but may not be limited to the following:

- Using meteorological and dust monitoring data to plan and / or suspend activities onsite.
- Appropriate precautions will be taken to protect machinery and accommodation spaces from the dust of the cargo. Bilge wells of the cargo spaces shall be protected from ingress of the cargo. Due consideration will be paid to protect equipment from the dust of the cargo. Persons, who may be exposed to the dust of the cargo, shall wear protective clothing, goggles or other equivalent dust eye-protection and dust filter masks, as necessary.
- Enclosed conveyors are to be used to transport coal to stockpiles and are routinely monitored and cleaned to minimise dust.
- During coal receipt, the moisture content of coal being unloaded will be measured and monitored to ensure it remains above its dust extinction moisture level. If recorded coal moisture content levels are lower than required, unloading should be halted. No further activity on that specific cargo takes place until suitable remedial measures are enacted.
- Enclosing the coal stackyard with natural barriers and applying a directed spray to the coal while they are unloading in the stackyard.
- Empty cargo will be sprayed a second time in the transshipment point and jetty area before leaving to prevent dust mobilization associated with the movement of empty cargo.
- Sufficient sprinklers will be installed on overhead gantries and stackers and wetting down of stockpile surfaces is undertaken when an increased risk of dust is evident as a result of forecast high winds or other adverse conditions.
- Water carts will be employed as a backup measure, to assist in dust prevention and management, as required.
- Weather will be consistently monitored and works will be planned around windy conditions (i.e., limit potentially dusty work activities during periods of high winds).
- Site operations will be proactively managed in a way that reduces dust (i.e., bulldozer movements are minimized and traffic movement in the stockpile areas will be managed).
- Routine site cleaning in and around the coal stackyard, conveyor systems, transfer points, berth and surrounding paved areas.

11.9.2 Safety Measures of Coal Transportation

904. The IMSBC Code requires vessels carrying coal to carry gas detectors, and that their crews are trained in their use. The gas detector should first be checked in a gas-free area,

before entering enclosed spaces or taking hold measurements. Most gas detectors are fitted with electro-catalytic sensors to detect flammable gases and are capable of operating reliably in atmospheres with more than 15% oxygen.

905. The IMSBC Code requires Shippers to provide cargo details including moisture content, sulfur content, particle size, and information on whether the cargo is liable to emit methane, self-heat, or both. The IMSBC Code requires that the Vessel has the following:

- An instrument capable of measuring oxygen, carbon monoxide and methane
- Gas sampling ports on all holds
- A means of measuring the pH values of bilge water samples

906. Further, the Code recommends that the vessel has a means of measuring cargo temperature, both during loading and the voyage, such as an infra-red heat detector.

907. The IMSBC code states that coal should not be loaded if its temperature exceeds 55°C. After loading, and unless advised otherwise, the holds should be ventilated for the first 24 hours or until the methane concentration is acceptably low, i.e., below 20% LEL.

908. Once the cargo has been loaded and hatch covers closed, evidence of self-heating can easily be checked by monitoring carbon monoxide levels. The atmosphere in each hold will be monitored daily. If the cargo is being ventilated to remove methane, then ventilation will be stopped at least four hours prior to sampling. According to the IMSBC Code, carbon monoxide levels above 50 ppm, or a steady rise of the cargo's temperature over three consecutive days, indicate that self-heating is taking place, and the Master should contact Owners and the Shipper. As coal is a good insulator, hot spots within the bulk of the cargo can still go undetected, even if the crew takes bilge well temperature readings or surface temperature measurements.

- Prior to departure, and during the voyage, the Master should also ensure that:
- The cargo is trimmed flat to reduce its surface area
- Gas monitoring equipment on board is well maintained and calibrated in accordance with the manufacturer's instructions
- All enclosed spaces adjacent to the holds are regularly monitored and adequately ventilated
- No one should enter confined spaces without first confirming that it is safe to do so
- If the cargo behaves differently from that specified in the cargo declaration, the Master should report this to the Shipper, his Technical Managers and insurance company.

909. If there is a fire or self-heating has progressed to an advanced state, the Vessel should:

- Close all ventilation to the holds
- Commence boundary cooling of the affected holds and consider heading towards the nearest port as a refuge
- The insurance company should be notified without delay as an emergency response may need to be triggered including the attendance of an expert

- Ensure all spaces adjacent to the holds are checked prior to entry and that no one enters confined spaces without confirming that it is safe to do so
- Provide Owners and the insurance company with all temperature and gas monitoring records for the voyage

11.9.3 Run-off Management Plan

910. In addition to the storm water management and fire suppression infrastructure described in Sections 4.4 and 4.6 (e.g., sumps, containment tanks, oil/water interceptor, sprinkling towers, stockpile containment berm) the runoff management plan will include the re-use of treated water for dust suppression.

Water Treatment

911. During dry periods, water used onsite would be treated and re-directed back into the system. During wet periods, excess water would require treatment and periodic offsite discharge. At a minimum, water treatment programs would emphasize pH adjustment and solids removal (potentially requiring flocculation, detention and settling prior to offsite discharge). The scope of supplies and services of water treatment systems is given in **Annex 11-5** and details of treatment systems have been provided in the Contract Document of EPC Contractor.

912. A pH adjustment system would likely be required for runoff with a pH of <6.5 (low range of Approved Water Quality Guideline for pH for the protection of aquatic life). This can be addressed through injections of buffering agents as part of the treatment process. For solids removal, a flocculant like Chitosan is proposed, which can remove suspended sediment, phosphorus, metals, PAH and other organics. A finishing sand filter may be required as the final step in the treatment system for treating larger volumes of water. The chemicals and infrastructures associated with water treatment onsite will be finalized in consultation with the BIFPCL and EPC Contractor as the management plans for the site evolve.

913. Sand filters have a backwash phase in a closed loop system to flush particulates from the sands. Treated water can be directed back into the system for re-use, or discharged offsite during high flow.

Water Quality Monitoring

914. At a minimum, the monitoring program will emphasize in situ measurements of pH, temperature, turbidity / TSS, specific conductivity, TDS, dissolved oxygen (DO) and oxidation reduction potential (ORP). These data will be compiled and maintained by operations personnel to evaluate site and system performance.

11.9.4 Emergency Response Plans

Potential emergencies of environmental concern include fires from the spontaneous combustion of coals, coal leachate may corrode ship walls and bottom, spills or uncontrolled releases to the aquatic environment during barge loading, coal barge may collide / crash with other ships/barges and tidal surge / tsunami / cyclone may cause capsizing of vessels. Emergency Response Plan has been delineated at **Annex 11-4**.

Spontaneous Combustion during Loading at Load Port

915. Following precautions should be taken during loading at load port of coal:

- Prior to loading, the shipper, or their appointed agent as per IMO Convention, shall provide in writing to the master, the characteristics of the cargo and the recommended safe handling procedures for loading and transport of the cargo. As a minimum, the cargo's contract specifications for moisture content, sulfur content and size shall be stated.
- This cargo shall be stored for seven (7) days prior to loading. This substantially reduces the risk of spontaneous combustion in subsequent transport, storage and handling.
- Before loading this cargo, the master shall ensure the following:
- Weather deck enclosures to the cargo space have been inspected to ensure their integrity. Such closures are closed and sealed;
- All electrical cables and components situated in cargo spaces and adjacent spaces are free from defects. Such cables and electrical components are safe to be used in a flammable and/or dusty atmosphere or positively isolated;
- Smoking and the use of naked flames shall not be permitted in the cargo areas and adjacent spaces and appropriate warning notices shall be posted in conspicuous places. Burning, cutting, chipping, welding or other sources of ignition shall not be permitted in the vicinity of cargo spaces or in other adjacent spaces;
- Individual cargo spaces shall be loaded without interruption, where possible. Hot spots may develop in a cargo space that has been kept open for more than six days (or less in weather over 30°C);
- Prior to departure, the master shall be satisfied that the surface of the material has been trimmed reasonable level to the boundaries of the cargo space to avoid the formation of gas pockets and to prevent air from permeating the body of the briquettes. Casing leading receives the necessary cooperation from the loading terminal; and
- Individual cargo spaces shall be closed and sealed as soon as practicable after the cargo has been loaded into each cargo space.

Spontaneous Combustion during Carriage

916. Following precautions should be taken while transportation of coal as per IMO Convention:

- It is recommended to install thermometer (0 to 100°C) in each compartment of the vessel to monitor temperature during voyage. The cargo spaces shall not be ventilated during voyage.
- As far as practicable, any gases which may be emitted from the cargo shall not be allowed to accumulate in adjacent enclosed spaces, such as store-rooms, carpenter's shop, passage ways, tunnels, etc. Such spaces shall be adequately ventilated and regularly monitored for methane, oxygen and carbon monoxide.

- The atmosphere in the space above the cargo in each cargo space shall be regularly monitored for the concentrations of methane, oxygen and carbon monoxide.
- The frequency of the monitoring shall be determined based upon the information provided by the shipper and the information obtained through the analysis of the atmosphere in the cargo space. The monitoring shall be conducted at least daily and as close as practical to the same time of day. The results of monitoring shall be recorded. The shipper may request more frequent monitoring, particularly if there is evidence of significant self-heating during the voyage.

917. The following issues shall be taken into consideration as per IMO Convention:

- The oxygen level in the sealed cargo space will fall from an initial 21% over a period of days to stabilize at levels of the order of 6 to 15%. If the oxygen level does not fall below 20%, or rapidly increases after an initial fall, it is possible that the cargo space is inadequately sealed and is at risk of spontaneous combustion.
- Carbon monoxide levels will build up to concentrations which fluctuate in the 200 to 2000 parts per million (ppm) ranges in a safe, well-sealed cargo space. A rapid increase of approximately 1000 ppm in carbon monoxide levels in this cargo over a 24-hour period is a possible indicator of spontaneous combustion, particularly if accompanied by an increase in methane levels.
- The methane composition in briquette cargo is normally low, less than 5 ppm and does not constitute a hazard. However, a sudden and continuing rise in methane levels, to concentrations above 10 ppm, is an indicator of the occurrence of spontaneous combustion in the hold.
- The temperature in this cargo in a well-sealed cargo space normally remains at 5 to 10°C above sea water temperature, the increase being due to normal diurnal breathing of small quantities of air into the cargo space. Checking of the cargo space seals to minimize air leakage is essential. A rapid increase in temperature of approximately 20°C over 24 hours is evidence of spontaneous combustion.
- Regular hold bilge testing shall be systematically carried out. If the pH monitoring indicates that a corrosion risk exists, the master shall ensure that all bilges are kept dry during the voyage in order to avoid possible accumulation of acids on tank tops and in the bilge system.
- When the behaviour of the cargo during the voyage differs from that specified in the cargo information, the master shall report such differences to the shipper. Such reports will enable the shipper to maintain records on the behaviour of this cargo, so that the information being provided to the master can be reviewed in the light of the transport experience.
- When the master is concerned that the cargo is showing any signs of self-heating or spontaneous combustion, such as an increase in the concentration of methane or carbon monoxide or an increase in temperature, as described above, the following actions shall be taken:
 - Consult with the ship's agent at the loading port. The Company's designated person ashore shall be advised immediately.
 - Check the seal of the cargo space and re-seal the cargo space, as necessary.

- Do not enter the cargo space and do not open the hatches, unless the master considers access is necessary for the safety of the ship or safety of life. When any ship's personnel has entered into a cargo space, re-seal the cargo space immediately after the personnel vacate the cargo space. Increase the frequency of monitoring the gas composition, and temperature when practicable, of the cargo.
- Send the following information, as soon as possible, to the ship's owner or agent at the loading port to obtain expert advice:
 - the number of cargo spaces involved;
 - monitoring results of the carbon monoxide, methane and oxygen concentrations;
 - if available, temperature of the cargo, location and method used to obtain results;
 - the time the gas analyses were taken (monitoring routine);
 - the quantity of the cargo in the cargo space(s) involved;
 - the description of the cargo as per the shipper's declaration, and any special precautions indicated on the declaration;
 - the date of loading, and Estimated Time of Arrival (ETA) at the intended discharge port and transshipment point (which shall be specified); and
 - any other comments or observations the master may consider relevant.

918. Combustion mitigation measures will include but not be limited to the following:

- Fire suppression system.
- Training onsite personnel in required site maintenance procedures and early detection of spontaneous combustion (e.g., observations of steam, localized white smoke).
- Ongoing weather and dust monitoring, visual inspections of operating systems and surrounding areas and routine site cleaning and equipment maintenance at all parts of the operation to limit the build-up of loose coal.
- Restricting the residence time of stockpiled coal onsite and treating with a sealant, for example, as described above to limit air movement into and inside of the pile.
- Routine visual inspections of the stockpile will be conducted and in some cases, (e.g., depending on weather conditions and the length of time the pile remains onsite), pile moisture and temperature readings may need to be taken. BIFPCL will be equipped to measure moisture and temperature as needed and monitoring data will be compiled and maintained onsite.

919. Spontaneous combustion events are not expected in the transhipper, given the short time frame coals will be stockpiled onsite. However, in the event spontaneous combustion occurs, response measures may include but not be limited to the following (where practical and safe to implement):

- Isolating the zone of combustion
- Digging out the affected area and moving the coal to a location where it can be spread out for cooling, saturated with water or compacted and covered with an inert material

Spontaneous Combustion during Unloading

920. Prior to, and during, unloading:

- The cargo space shall be kept closed until just before the commencement of unloading of that space. The cargo may be sprayed with a fine water spray to reduce dust.
- Personnel shall not enter the cargo space without having tested the atmosphere above the cargo. The personnel entering into a cargo space in which the atmosphere contains oxygen levels below 21% shall wear self-contained breathing apparatus. Carbon dioxide and carbon monoxide gas levels shall also be tested prior to entry into the cargo spaces. The recommended Threshold Limit Value (TLV) for carbon monoxide is 50 ppm.
- During unloading, attention shall be paid to the cargo for signs of hot spots (i.e., steaming). If a hot spot is detected, the area shall be sprayed with fine water spray and the hot spot shall be removed immediately to prevent spreading. The hot spot cargo shall be spread out on the wharf away from the remainder of the cargo.
- Prior to suspending the unloading of cargo for more than eight hours, the hatch covers and all other ventilation for the cargo space shall be closed.
- After unloading of the cargo, the bilge wells and the scuppers of the cargo spaces shall be checked and any blockage in the bilge wells and the scuppers shall be removed.

Coal Spill Prevention and Response

921. Spill prevention will be addressed throughout the operation, through routine inspections and maintenance of the grabs, conveyors, hoppers, and transfer boom. Additionally, the entire off loading operation will be manned from the time mother and lighterage vessels arrive onsite and unloading operation begins in the transshipment point (to the time the loaded barges leave the anchorage) and in the jetty (to the time coal is transferred to the coal stackyard). Prior to the mother vessel and lighterage arriving onsite, personnel will ensure all parts of the system (transhipper and unloader including emergency response systems) are functioning as intended. Prior to barge loading, personnel will confirm the barges are empty of debris, in good condition, and are properly closed. As part of the barging contract³⁴, BIFPCL will require shipper submits maintenance and training records.

922. A spill of un-burned coal could impact water quality through elevated turbidity (increasing suspended particles in the water). Coal particles may also settle on the riverbed and become a component of the sediments.

923. The physical effects of coal can be consistent with those of suspended (and settled) sediments including: abrasion, smothering, clogging of respiratory and feeding organs, changes to sediment composition and reduced availability of light (Ahrens and Morrissey,

³⁴ Note: Barge Loading Master Plans will be developed by the operators and submitted to BIFPCL for review and comment. Additionally, barges will be double walled in compliance with IMSBC Code, Cargo B.

2005)³⁵. The potential chemical effects of coal are variable, with some authors considering unburned coal to be largely inert. Ahrens and Morrissey, (2005) noted potential toxic effects of selected components of coal are less evident than physical effects and are dependent on coal composition. They further noted the bioavailability of selected components in coal in many cases appears to be very low.

924. The bioavailability of the various components is important to characterizing potential effects. The bioavailability of trace elements and PAHs is dependent on a variety of factors, including coal composition, ambient conditions (pH, dissolved organic matter), sediment composition (particle size distribution) and sediment chemistry (pH, cations, oxides, sulfides, % carbon). Under more neutral pH conditions in the Passur River leaching of selected metals like cadmium, copper, lead and zinc would be less of a concern.

925. In the event of a spill to the Passur River during vessel unloading and loading, the following mitigation measures will be implemented:

- Operations will stop and the Director of Operation and Maintenance (DOM), site superintendent, transhipper and unloading shed operator, and the MPA will be informed of the spill.
- Personnel will make an estimate of the volume released and in consultation with DOM determine if the material can be effectively recovered. This will depend on a variety of factors including but not limited to tide level and volume released.
- In the event of a larger spill at the transshipment point and at berth, occurring for example if a grab or barge door fails during filling, onsite personnel in consultation with the DOM and the plant authority will determine if a suction dredger or similar needs to be mobilized to the spill site for recovery.
- Post spill (and clean up) water and sediment sampling would be conducted onsite and in adjacent areas to determine the potential effects of the spill and ensure clean-up is completed consistent with the applicable provincial and federal guidelines and regulatory framework.

Ship Collision and Oil Spill Prevention and Response

926. In case of collision between coal vessel and oil tankers along the route sustainable oil spill prevention and response will be required as it has significant impact on the aquatic ecosystem of the Sundarbans and coastal environment. In case of accidental oil spills the following factors will be considered in determining appropriate response:

- size of the spill
- type of material that is spilled
- location of the spill
- exposure/damage potential of vulnerable receptors (biodiversity, human and environmental) and property
- willingness and ability of the shipper to respond

³⁵ Ahrens, J. and Morrissey, D. (2005) *Biological Effects of Unburnt Coal in the Marine Environment. Oceanography and Marine Biology: An Annual Review*, 2005, 43, 69-122, R. N. Gibson, R. J. A. Atkinson, and J. D. M. Gordon, Editors, Taylor & Francis.

- cost of spill clean-up and containment compared to the effectiveness expected and the damage reduction anticipated
- availability of responding agencies capabilities
- media/political interest

927. In case of moderate to major oil spills the following measures can be taken:

- Prevent the spread of oil spills and ensure the safety of onboard crew members
- Report oil spills to the proposed Mongla Port ERG immediately and ask for assistance
- ERG will involve local authorities (navy, coast guard) in stopping oil spills as per the emergency response plan

928. Common mechanical recovery approaches of oil spill response include:

- Booms for containment of oil
- Skimmers/sweepers for recovery of oil
- Pumps
- Oil / water separators
- Temporary storage
- Vessel for towing of booms and operation of recovery units

929. In case of deploying boom, two to three vessels can be involved. However, the effectiveness of the boom in accumulating oil would be dependent on the wave condition, tow speed, boom configuration and oil properties. Some of the common techniques/tools of manually removing the oil spills are:

- Manual sorbent application
- Manual removal of oiled materials (hand, shovel, rakes)
- Manual cutting of vegetation
- Low pressure flushing at ambient temperature
- Vacuum trucks
- Warm water / low pressure washing
- High pressure flushing
- Manual scraping
- Beach cleaners

930. Moreover, bioremediation, dispersant, sorbent etc. methods are commonly used for managing oil spills. However, considering the sensitivity of the location, it is not suggested to use any of these techniques in the river area. However, these methods can be used only till Fairway Buoy. In case of any oil spill incident in the transportation route after Fairway Buoy, only mechanical recovery approach should be used. **Annex 11-4** presents an emergency response plan.

931. A National Oil Spill Contingency Plan (NOSCP) has been formulated as the country has seen multiple cases of spillage situation which prompts the country and the region to

setup a detailed framework and guidelines for all agencies, organization and stakeholders concerned that must be active in responding to spillage events and combatting marine pollution, leading in remedial action and prevention in the long-term under the guidance of MPA. The preparation of a National Oil Spill Contingency Plan is, therefore, necessary to identify the national capabilities and resources in order to establish an organizational structure to combat marine pollution so that focal points and lead agencies are identified and guided effectively.

Ship Collision and Rescue of Sunken Ship

932. In the event of a ship collision where vessels has been damaged and at the verge of sinking, the following actions should be taken:

- Inform Ship Master immediately and inform him of the current status. Once he has taken charge, follow his instruction.
- If Ship Master is not available on the bridge, inform engine room and stop the engine (The decision to stop the engine would depend on the severity of the accident and immediate action to be taken).
- Immediately send distress signal to nearby ships/naval vessel via radio. If radio communication is not possible, use other means of communication (e.g., lighting a flare etc.).
- Record important data related to ship collision (e.g., time of collision, information of vessel that was collided with, extent of the damage sustained, any crew members missing etc.)
- Ensure safety of crew members. All crew members should wear their life jackets during such incidents. In case of collisions leading to the ship being sunk, guide them to the nearest safety points/life boats.
- Based on the extent of damage sustained, take immediate actions. If any tank or tanks appeared to have suffered damage and ingress of water is confirmed, necessary arrangements should be taken to pump out the water. If the pumps are not effective and cannot contain the ingress of water the whole compartment should be sealed in order to prevent other compartments from being flooded. In case of minimal impact, the engine room should be checked for damage or any oil leakages.
- Check for any oil spills. In case of apparent oil spills, follow instructions presented in section 110.
- Reach the nearest port/naval post/coast guard office if possible and alert them of the situation.
- Emergency response plan presented in **Annex 11-4** provides further details on the salvage of sunken ship.

933. It should be noted that the above mentioned guideline should not be taken as a steadfast guideline. In an emergency scenario, one's knowledge, seamanship and personal competence comes into play in handling the situation and in saving lives.

Cyclone and Storm-surge

934. A cyclone is a low-pressure system which develops in the tropics and is sufficiently intense to produce sustained gale force winds of at least 63 km/h. If the sustained wind reaches hurricane force of at least 118 km/h the system is defined as a severe tropical cyclone. There is a high potential of cyclone and heavy storm-surge in the Project corridor. Mongla Port Authority has Cycle Disaster Preparedness Plan (1991), which provides action to be taken and by whom for signal number 3 to 10 with cycle Alert numbers 1 to 4. Alert number 4 is announced after the storm warning Signal No. 8, 9 or 10 (Great Danger) have been hoisted. These signals indicate that the port will experience severe weather from a storm of great intensity and exhaustive precautionary measures must be taken at once by all concerned.

935. Meteorological data for signal no. 8, 9 and 10:

- Cyclone, Severe Cyclone, wind velocity 70 Knots or over North of 21° & East of 88° moving over Mongla.
- Speed of advance 20 Knots.
- Storm surge warning

936. MPA's Cyclone Disaster Preparedness Plan provided details on the actions to be taken for all 4 alerts. It is recommended that an ERT sub-committee for cyclone comprising of all Heads of the Department/Cell of Mongla Port Authority is formed when Alert No. 4 is hoisted and a cycle hits in the MPA's area of jurisdiction. The Harbor Master will act as Convener of the sub-committee. Convener will immediately convene a meeting of the sub-committee and apprise the committee members of the latest situation and the imminent danger, if any. The committee will discuss and finalize details of various actions to be taken as per the plan to face the situation. Detail action plans for each type of alert is provided in Annex 11-3 and Annex 11-4 provides details on the preparedness and response of cyclone and storm-surge emergencies and Annex 11-5 provides comprehensive emergency responses to be taken up by the MPA.

11.9.5 Lighting Plans

937. No new mast lighting is anticipated. Direct lighting in the mother vessel, along the conveyors, transhipper, barge loader, jetty, and inside of the unloading shed of the berth will be required for safe operations. Any additional lighting required to operate the offloading facility will be consistent with the World Bank Group's Occupational Health and Safety Guidelines, Part 2.3, Illumination, and selected, installed and operated with consideration of the following mitigation measures

- Minimizing nighttime activity (to the extent practical)
- Using light on an 'as and when needed' basis
- Directing light toward the ground on working areas
- Reducing the height of lighting to the extent possible
- Minimizing the number of lights required through strategic spacing
- Eliminating upward directed lighting
- Using fittings on lamps to direct and confine the spread of light

- Ensuring lights are in good condition at all times
- To the extent possible given security and safety requirements, using lights with appropriate wavelengths to avoid attraction and disorientation by birds.
- Shutting off lights when they are not needed.

11.9.6 Noise Management Plan

Baseline and Forecasted Traffic

938. MPA handles inbound and outgoing cargo including general goods, containers and vehicles. Frozen food, shipped in refrigerated containers are the bulk of the cargo operation due to large number of food processing factories located in Khulna. Numbers of vessels those take the MPA's designated route or the routes around it are described in Section 7.7: Vessel Traffic in Mongla Port and Channels in detail.

939. Vessels accessing the project area and equipment in regular use as part of the operation include:

- Break-bulk and Containerized Vessels
- Tug boats to assist vessel berthing
- Container stackers
- Front end loaders
- Skid steers
- Conveyor systems
- Lifting cranes
- Container gantry cranes
- Hydraulic barge ramp

Operations

Vessel Traffic

940. Noise generated from mother vessels are typically 75-85 dBA, from lighterage 85-95 dBA, and transhipper 110-118 dBA.

Unloading facility

941. The coal conveyor systems will be electric at the plant jetty, with anticipated conveyor noise levels up to 91 decibels (dB). This level of noise is in the range of normal conversation at a distance of 3 feet / 0.914m. Front end loaders will primarily be needed to establish and / or maintain stockpiles, which will be onsite only if there is an interruption in the barge loading systems. Stockpiling more than four days at a given time is not anticipated. Front end loaders for periodic stockpile creation and maintenance will not generate noise levels significantly that may affect the surrounding environment. The berm surrounding the stockpile will also help mitigate noise / sound travel resulting from activity in this area.

942. Barge loading at transshipment point will be using floating transfer station with internal generator and engines, cranes with grab, hopper, and conveyor with a radial stacker and lifting arm, and self-propelled lighterage vessels. Noise levels generated from

transhipper and lighterage vessel operation are expected to be 110-118 dBA and 85-95 dBA, respectively. Given the material is loose, light weight particulate matter (coal dust) with a low drop height, noise associated with barge loading will be limited.

943. Based on the noise modeling result presented in Section 8.9.2, it is envisaged that noise generated from the project activities will comply with Noise Rules of 2006. Adherence to a comprehensive equipment maintenance program to maintain equipment, and to maximize efficiency and reliability, which will help limit noise levels associated with the operation. System components will be maintained to operate below maximum operating noise levels wherever feasible. Maintenance records will be maintained for review by BIFPCL's O/M department. Noisy mobile equipment supporting the operation will be removed from service wherever practical and replaced with a less noisy alternative.

944. For the life of the operation, BIFPCL will evaluate noise levels and onsite activities to identify opportunities for using less noisy equipment and / or making changes to day to day operations that may reduce overall noise levels. Weather monitoring conducted at the site (e.g., wind speed and direction) may be helpful in determining when it may be necessary to suspend potentially noisy activities associated with the operation.

11.9.7 Waste and water pollution management

Management of waste and effluents

945. Waste products that are being generated by shipping can affect the marine environment in case they are not handled properly. An example of irresponsible handling of waste products is the disposing of garbage or contaminated bilge water in the sea and inland water. To facilitate and promote safe and environmental friendly disposing of waste products from vessels, waste reception facilities need to be established at transshipment point and plant jetty. It is obligatory for ships to discard their waste products at the clearing port designated waste reception facilities. The availability of waste collection points in the port is the result of MARPOL, Annex 5, revised in July 2011 which entered into force on 1 January 2013 to minimize environmental damage to the marine ecosystem caused by waste products from sea ships.

946. Under Annex 5, all ships are obliged to pay a fee for waste disposal whether they do or do not make use of the waste reception facilities, the amount of this fee is dependent on the engine size. In exchange the ship is allowed to dispose garbage (Household garbage, plastic, small chemical) free of charge (dependent of engine size). If more garbage is handed in the ship owner will be charged for the additional costs.

947. For oil waste products the system is also based on indirectly financing. A ship pays a fee on every port call and receives a subsidy upon the disposal of oil. In both cases the system promotes (frequent) disposal of garbage and oil at waste reception facilities for further processing and thereby discourages the illegal dumping of waste and effluents at sea and Inland water.

948. As to make sure the ships hand in their waste and effluents all ships have to notify the port authority on the waste on board (substance, quantity) and their capacity for waste storage. Ships are only exempted from their duty of obligatory disposal if they still have enough remaining capacity for waste storage.

Management of Ballast Water

949. Ships make use of ballast water to control their balance and buoyancy. The intake and release of ballast water can occur at locations that have completely different ecosystems. By the intake and release of ballast water, species alien to the surroundings can be released, some of the species thrive in their new surroundings and become so-called invasive species. Such species can have a severe impact on the ecosystem they are released in.

950. To minimize the risk of ballast water, the ballast water can for example be treated with chemical substances or be filtered. To regulate the use of ballast water to prevent the introduction of alien species, the IMO proposed a new convention in 2004 to regulate the intake and disposal of ballast water. This convention is not yet in force, as not enough countries have yet ratified it. At the moment, around 15% of the world tonnage is covered meaning countries those transport cargoes about 15% of the total has ratified; however, ratification of 35% of the world tonnage of cargo is needed for enforcement (IMO, 2009).

951. The convention describes ballast water exchange standards and ballast water performance standards. Depending on the ballast water tank size and the year of construction, different dates have been set for meeting the ballast water performance standard. The convention describes where and when ballast water discharging is allowed to take place. The different programs describe how the ballast water exchange has to be conducted from a number of pumping cycles to a number of organisms still present in the ballast water.

Prevention of Oil Spills

952. In case of oil spills occur, the Port Authority will try to keep the environmental damage to a minimum. An example of how spill prevention is to through the Bunker checklist. Ships engaged in tanking procedures have to adhere to a number of precautionary measures to reduce the risk to a minimum, controlled by the port master. This Bunker checklist describes the necessary precautionary actions to be taken prior to bunkering.

953. Precautionary measures will be taken by the Ship Masters to follow IMO procedures to operate the vessels. **Annex 11-4** presents emergency response plan, which provides a framework on major emergencies including oil spill prevention and response procedures.

11.10 EMP to Address Cumulative Impacts

954. Three EMP Subplans were prepared to address cumulative impacts, to direct environmental management procedures and the implementation of prescribed mitigation and enhancement measures during the implementation and operational phases of the Project. The following sub-plans have been developed and presented in Sections 11.10.1 and 11.10.2:

11.10.1 Air Quality Management

EMP-Subplan 1: Air Quality Management Plan					
Objective	<ul style="list-style-type: none"> Minimize the risk to public health and biodiversity of the Sundarbans from coal dust and air emissions from various sources. Reduce the risk of degraded airshed due to planned and future development Promotes excellent visibility Addresses issues of global warming and climate change Enhances economic development Prevent future deterioration and work towards continuous improvement of air quality 				
Performance criteria	<ul style="list-style-type: none"> Limited air quality impacts including dust, vehicle and equipment emissions from construction, spoil haulage and spoil stockpiling. Reduced air quality impacts including coal dust, inland water transport vessels and transhipper emissions during transshipment, carriage, loading/unloading operation and coal conveyance, stacking and stockpiling. Ambient Air Quality complying with ECR 1997 (as amended in 2005). No significant deterioration in biodiversity of the Sundarbans and UNESCO WHS. 				
Targets	<ul style="list-style-type: none"> Minimize disturbance on wildlife of both aquatic and the Sundarbans reserve forest, Minimize impact on biodiversity of the Sundarbans, Zero community complaints regarding degraded air quality. 				
Impact/Issue	Mitigation/ Enhancement Measures/ Actions	Responsibility for implementation	Responsibility for Supervision	Timing	Monitoring
Dust and air pollution from the construction activities and quarry areas	<ul style="list-style-type: none"> All dust generating locations shall be kept wet with water sprinkling. Fugitive dust emissions will be minimized by appropriate methods such as spraying water/mist on material where required and appropriate. Development of water supply system for controlling dust from the quarry area; Continuous air monitoring will be carried out near the sensitive receptors to ensure they do not exceed ambient air quality standards. 	EPC Contractor	EHSU (BIFPCL)	Implementation	Quarterly air quality monitoring at nearby sensitive receptors
Coal spillage and dust can degrade biodiversity, water quality and riverbed materials in	<ul style="list-style-type: none"> EIA has recommended to reduce transshipment points from two to one to minimize operation within the Sundarbans. Duly designed larger hoppers in FTS will facilitate the operation of the crane driver. 	Ship and Transhipper Master	EHSU (BIFPCL)	Operation	Quarterly monitoring at transshipment point by IMA

EMP-Subplan 1: Air Quality Management Plan					
transshipment point	<p>Hoppers are provided with anti-spillage plates so that the cargo spillage, if any, is collected inside the hoppers instead of falling into the sea/ river.</p> <ul style="list-style-type: none"> • Grabs in FTS equipped with dust cover plates. • Closed conveyor belts and the loading boom are covered to avoid windborne dust and are kept clean by means of scrapers. • High-efficiency internal combustion engines of the auxiliary diesel generators of FTS are of high fuel efficiency type, thus minimizing emissions. 				
Prevention of Air Pollution from Ships and vessels	<ul style="list-style-type: none"> • MARPOL Annex VI Prevention of Air Pollution from Ships (entered into force 19 May 2005) sets limits on sulfur oxide and nitrogen oxide emissions from ship exhausts and prohibits deliberate emissions of ozone depleting substances; designated emission control areas set more stringent standards for SOx, NOx, and particulate matter. A chapter adopted in 2011 covers mandatory technical and operational energy efficiency measures aimed at reducing greenhouse gas emissions from ships. 	Ship Master	EHSU (BIFPCL)	Operation	Quarterly monitoring at transshipment point by IMA
Coal spillage and dust in plant jetty and conveyance to coal stackyard	<ul style="list-style-type: none"> • Enclosed conveyors to transport coal to stockpiles. • Applying water spray at transfer points between conveyor systems and to loaded barges prior to transport plant jetty. 	Operation Staff, BIFPCL	EHSU (BIFPCL)	Operation	Quarterly monitoring at plant jetty by IMA
Coal dust at stackyard	<ul style="list-style-type: none"> • Sufficient sprinklers will be installed on overhead gantries and stackers and wetting down of stockpile surfaces is undertaken when an increased risk of dust is evident as a result of forecasted high winds or other adverse conditions. • Enclosing the coal stackyard with natural 	Operation Staff, BIFPCL	EHSU (BIFPCL)	Operation	Quarterly monitoring at plant jetty by IMA

EMP-Subplan 1: Air Quality Management Plan					
	<p>barriers and applying a directed spray to the coal while they are unloading in the stackyard.</p> <ul style="list-style-type: none"> Weather will be consistently monitored and works will be planned around windy conditions (i.e., limit potentially dusty work activities during periods of high winds). Site operations will be proactively managed in a way that reduces dust (i.e., bulldozer movements are minimized and traffic movement in the stockpile areas will be managed). 				
Emission of NO ₂ due to enhanced vessel movement, road traffic along Dhaka-Mongla Highway, power plant and other point sources operation	<ul style="list-style-type: none"> Design of Maitree power plant has considered low-NO_x burner. Coordinate with DOE to make sure that they approve EIA and issue clearance certificate only when all future project in the airshed consider low-NO_x burner. This EIA has considered ambient air quality monitoring station to monitor air quality at the maximum ground level concentration points. During quarterly monitoring and auditing, IMA will verify plant records to confirm whether low-NO_x burner was operational during last quarter. 	DoE, Operation Staff, BIFPCL	EHSU (BIFPCL)	Operation	Quarterly monitoring at plant jetty by IMA
Emission of SO ₂ due to enhanced vessel movement, diesel vehicles along Dhaka-Khulna Highway, power plant and other point sources operation	<ul style="list-style-type: none"> Design of Maitree power plant has considered flue-gas desulfurization (FGD) unit. Coordinate with DoE to make sure that they approve EIA and issue clearance certificate only when all future projects in the airshed consider FGD. This EIA has considered two ambient air quality monitoring stations to monitor air quality at the maximum ground level concentration points based on the 	DOE, Operation Staff, BIFPCL	EHSU (BIFPCL)	Operation	Quarterly monitoring at plant jetty and at the plant by IMA

EMP-Subplan 1: Air Quality Management Plan					
	dispersion modelling output.				
	<ul style="list-style-type: none"> During quarterly monitoring and auditing, IMA will verify plant records to confirm whether FGD was operational during previous quarter. 				
Auditing	<ul style="list-style-type: none"> An Independent Monitoring Agency (IMA) will audit and monitor on a regular basis the implementation of air quality management measures in the airshed including the coal transportation route. Continuous monitoring of ambient air quality and meteorological parameters Monitor the implementation measures intended to air and dust emission 				
Guidelines, Standards and Legislation	<ul style="list-style-type: none"> Environmental Conservation Act, 1995 (amended in 2010) The Environment Conservation Rules, 1997 (amended in 2005) WBG Environment, health and Safety Guidelines, 2008. International Convention for the Prevention of Pollution from Ships (MARPOL), Adoption: 1973 (Convention), 1978 (1978 Protocol), Annex VI Prevention of Air Pollution from Ships (entered into force 19 May 2005) 				
Potential Concern	Corrective Action				Responsibility
Possible habitat degradation due to emission from enhanced inland water transport, coal vessel movement, and coal dust and spills during transshipment in Harbaria (Mazhar Point)	<ul style="list-style-type: none"> Transhipper has been chosen with strict environmental controls to minimize coal dust and coal spillage All coal vessels will comply with the requirements of applicable MARPOL Annex VI Prevention of Air Pollution from Ships Adaptive Management Approach would be adopted based on the routine monitoring reports for facilitating dolphin habitat conservation Create awareness and engage local communities, related NGO's for wildlife conservation Strengthen existing wildlife breeding projects in the Sundarbans Reserve Forest Monitor concentration of coal dust in water and its surroundings. Take appropriate measures for mitigate impacts, if any. 				All stakeholders
Impact of NOx and SO2 in the ambient air quality	<ul style="list-style-type: none"> Take corrective action in response to complaints about diminished air quality at properties adjacent to construction sites as a consequence of construction works or operation of construction vehicles. Applying water spray at transfer points between conveyor systems and to loaded barges prior to transport to plant jetty. Take corrective action in response to the independent monitoring and auditing of plant operation, coal transshipment and carriage. 				All stakeholders
Reporting	Monthly Ambient Air Quality Monitoring Report – 2nd week of every month Quarterly Auditing and Monitoring Report – Quarterly Report Yearly Auditing and Monitoring Report – Annual Report				

11.10.2 Biodiversity Management Plan

EMP-Subplan 2: Biodiversity Management Plan					
Objective	<ul style="list-style-type: none"> Establish mitigation measures where species of conservation significance, critical habitats, and, special biodiversity areas, are located within the proposed transportation route over the year. Set suitable parameters for monitoring during coal handling, trans-shipment and vessel movement. Develop buffer zones within the proposed transportation route, to support/protect nursing grounds of dolphin, tiger, crocodile, deer and various species of fishes Implement appropriate mitigation measures for the protection of flora and fauna during coal transshipment activities and at the transshipment area. Monitor key species during coal handling, trans-shipment and vessel movement. Train and create awareness among the coal handling workers and the targeted groups in the communities regarding the protection of plants and wildlife with international and national conservation significance. 				
Performance criteria	<ul style="list-style-type: none"> Increase in number of species of conservation significance, no deterioration in their habitats, and designated biodiversity areas. No significant change in the status of key species at trans-shipment area and along the transportation route. Enhanced capacity of Forest Department at related area and improved performance in delivering the tasks The project supported activities to supplement management plan of other organization and improvement in biodiversity conservation of the Sundarbans Training on awareness among the mariners, related labors and workers, and the local communities regarding the protection of plants and wildlife with international and national conservation significance are delivered and number of people trained. 				
Targets	<ul style="list-style-type: none"> Reduced disturbance on wildlife of both aquatic and the Sundarbans reserve forest Reduction in number of poaching, Reduction in number of species killed due to entanglement by fish nets, Minimize number of accident/collision among aquatic mammals and water vessels Increase in the area of critical habitats of species of conservation significance, Increased number of people trained in biodiversity management. 				
Impact/Issue	Mitigation/ Enhancement Measures/ Actions	Responsibility for implementation	Responsibility for Supervision	Timing	Monitoring
<ul style="list-style-type: none"> Waste disposal from ship can affect Ganges River Dolphin, which is vulnerable 	<ul style="list-style-type: none"> Responsible authorities will properly enforce rules and regulations of MPA and applicable MARPOL in the management of bilge and ballast water, oily water discharge, waste and waste water. 	<ul style="list-style-type: none"> Forest Department Overseas Mariners 	<ul style="list-style-type: none"> Mongla Port Authority Wildlife Management and Nature 	Entire Project life	Independent Monitoring Agency (IMA) recruited by BIFPCL. Monitor that dolphin habitats

EMP-Subplan 2: Biodiversity Management Plan					
<p>aquatic mammal that roam inside the Passur River upto Akram Point throughout the year.</p> <ul style="list-style-type: none"> This species are under threats from trapping by local fishnets and injured by propeller of mechanized boats, fishing nets and other water vessels Vessel movement can affect the breeding process of dolphin during dolphin breeding period. Abundance of dolphin is high at river confluences specially at two sanctuaries at Dhangmari and mouth of Shela River Enhanced movement of inland vessel will deteriorate habitat condition of this 	<ul style="list-style-type: none"> Adaptive Management Approach would be adopted based on the routine monitoring reports. Develop capacity of Forest Department for proper surveillance. Vessel movement will be controlled through the designated route of the river. Vessel operators should keep safe from the known habitat of the two dolphin sanctuaries inside Passur River Ensure dry residues and/or the wash water that contains residues from an HME discharged at adequate port reception facilities. Limit vessel speed while passing inside the Sundarbans and Inland River as prescribed by the MPA. Use Bow thrusters for all coal carrying vessels and operate them in dolphin and fishing grounds to avoid other nets and boats during fishing operations, and manoeuvring in extremely tight quarters. Take special precautions while passing close to dolphin sanctuaries. Restrict fishing and take programs to improve feedstock of dolphins in the sanctuaries. Create awareness among local fishers, community leaders and coal handling workers and others about the importance of dolphin. Keep liaison with WSC and Forest Department for joint patrolling in Passur 	<ul style="list-style-type: none"> Workers of inland vessels and coal trans-shipper 	<p>Conservation Division, Forest Department</p> <ul style="list-style-type: none"> District Environmental Officer 		<p>are not obstructed by navigation vessels.</p> <p>Monitor any case of entanglement and injuries due to collision.</p> <p>Prepare and submit quarterly monitoring report indicating occurrence of dolphin injuries/entanglements and improvement in feedstock</p>

EMP-Subplan 2: Biodiversity Management Plan					
mammal	<p>River</p> <ul style="list-style-type: none"> Additional study for the preparation of detailed management plans for dolphin conservation in Chandpai/Shela and Dhangmari sanctuaries can be undertaken by the concerned authority like FD or DoE where Proponent may provide in-kind or monetary support. 				
<ul style="list-style-type: none"> Estuarine crocodile (<i>Crocodylus porosus</i>) is critically endangered reptiles under threats due to habitat disturbances by human disturbance, they occurs in canal creeks or rivers inside the Sundarbans Reserve Forest and their abundance is high at Karamjal site at the bank of Passur River Increased movement of inland vessels and deterioration of 	<ul style="list-style-type: none"> Responsible authorities will properly enforce applicable rules and regulations of MPA and MARPOL in the management of bilge and ballast water, oily water discharge, waste and waste water. May provide financial or in-kind support through the Project to Crocodile breeding project at Karamjal of Forest Department 	<ul style="list-style-type: none"> Forest Department Overseas Mariners Researcher of Crocodile Breeding Project 	<ul style="list-style-type: none"> Wildlife Management and Nature Conservation Division, Forest Department External Monitoring Agency 	Entire Project life	Prepare and submit half yearly monitoring report during November and March stating breeding success and nests sited and mitigation measures taken during the breeding season

EMP-Subplan 2: Biodiversity Management Plan					
water quality may degrade the suitability of crocodile habitat					
<ul style="list-style-type: none"> Population of river terrapin (<i>Batagur baska</i>), a Critically Endangered turtle has been significantly reduced due to illegal hunting and disturbance in grazing area by human intervention Their nesting season is December to March Major occurrences of this turtle is at Karamjal area and recently a breeding project is initiated in Koromjol 	<ul style="list-style-type: none"> Ensure strict surveillance against illegal hunting and support Forest Department in their surveillance activities. Restrict tourist movement close to terrapin habitat. May provide financial or in-kind support through the Project to Turtle breeding project at Karamjal of Forest Department 	<ul style="list-style-type: none"> Forest Department 	<ul style="list-style-type: none"> Wildlife Management and Nature Conservation Division, Forest Department External Monitoring Agency 	Entire Project life	Prepare and submit half yearly monitoring report during December and March stating breeding success and nests sited and mitigation measures taken during the breeding season
Royal Bengal Tiger (<i>Panthera tigris</i>) is flagship wildlife of the Sundarbans which is globally endangered and is under threat due to illegal hunting, noise from water	<ul style="list-style-type: none"> Ensure strict surveillance against illegal hunting and support Forest Department in their surveillance activities. Restrict tourist movement close to high encounters of tiger Keep safe distance from the forest edge for vessel movement through Passur River Monitor cross-river movement of tigers and 	<ul style="list-style-type: none"> Forest Department Master Mariners Tiger Team 	<ul style="list-style-type: none"> Wildlife Management and Nature Conservation Division, Forest Department Mongla Port Authority 	Entire Project life	Prepare and submit half yearly monitoring report regarding cross-river movement of tiger and incidence of illegal hunting

EMP-Subplan 2: Biodiversity Management Plan					
vessels, interception of tiger's cross-river movement with ships, and scarcity of prey.	<ul style="list-style-type: none"> slow the speed Use silencer of all mechanized water vessels 		<ul style="list-style-type: none"> External Monitoring Agency 		
Spotted Deer (<i>Axis axis</i>), which occurs all over the Sundarbans reserve forest and depend on tree leaves and grasses, is very sensitive to noise and currently under threat due to illegal poaching. Potential impact on wildlife through food chain, as fugitive dust from coal may be accumulated in the leaves of trees, especially at the transshipment point	<ul style="list-style-type: none"> Ensure strict surveillance against illegal hunting and support Forest Department their surveillance activities. Limit blowing whistle inside the reserve forest Limit unnecessary beaming inside the Sundarbans Maintain standard noise level for all ships and inland water vessel Limit dust emissions using equipment design change and dust management practices. 	<ul style="list-style-type: none"> Forest Department Master Mariners District Environmental Officer 	<ul style="list-style-type: none"> Forest Department Mongla Port Authority External Monitoring Agency 	Entire Project life	Prepare and submit yearly monitoring Report including occurrence rate, incidence of illegal hunting and mitigation measures taken during the coal handling though chance of accumulation of dust in leaves close to the transshipment point is very low, monitoring of the same is required.
Auditing	<ul style="list-style-type: none"> In liaison with the Forest Department, DOE, Mongla Port Authority, IUCN, Wildlife Conservation Society (WCS), environmental groups and consultant monitor on a regular basis the implementation of biodiversity conservation measures along the proposed transportation route Monitor abundance of flagship species Monitor the implementation measures intended to reduce noise level, dust emission, unnecessary beaming and illegal poaching 				
Guidelines, Standards and Legislation	<ul style="list-style-type: none"> Wildlife (Protection and Safety) Act- 2012- Environmental Conservation Act, 1995 (amended in 2010) The Environment Conservation Rules, 1997 (amended in 2005) Bangladesh Biological Diversity Act (2012) 				

EMP-Subplan 2: Biodiversity Management Plan		
Potential Concern	Corrective Action	Responsibility
Possible habitat degradation due to enhanced inland water transport	<ul style="list-style-type: none"> Supporting surveillance, monitoring systems and financial aid to Forest Department and engaging an external monitoring agency to monitor the status of various parameters along the transportation route for facilitating dolphin habitat conservation, Adaptive Management Approach would be adopted based on the routine monitoring reports. Adopt wildlife conservation regulations to the mariners, labours and local fishermen to minimize negative impact of the project activities Create awareness and engage local communities, related NGO's for wildlife conservation Strengthen existing wildlife breeding projects in the Sundarbans Reserve Forest 	All stakeholders
The impact on critical riverine habitat, nesting, breeding, and spawning grounds.	<ul style="list-style-type: none"> Movement of water vessel will be limited through the designated route to avoid disturbance of aquatic mammals Restrict blow of whistles, beaming and spillage inside reserve forest area Limiting speed of coal transportation vessels inside the Sundarbans Reserve Forest to 4 Knot 	All stakeholders
Reporting	<ul style="list-style-type: none"> Capacity (training) Building Plan – 1stMonth Baseline Monitoring Survey Report – Quarterly Half yearly Monitoring Report on Dolphins Half Yearly Monitoring Report on Tiger, Crocodiles and Turtles Yearly Monitoring Report on Spotted Deer 	

11.11 Mitigation Plan

955. The mitigation plan presented in **Table 11-3** is organized around various project activities and includes various actions identified under the mitigation measures discussed in Chapter 9, define responsibilities for implementation as well as supervision of each action, and also indicate the timing of these actions. Should any changes to the Project design or methods of construction and operation take place, post this assessment stage, the impacts and mitigation measures discussed may need to be revised to reflect such changes to allow the environmental and social implications of these changes to be addressed.

Table 11-3: Mitigation Plan

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
A. FEASIBILITY AND DESIGN PHASE				
A1. The Sundarbans Ecosystem	Adverse impacts on the Sundarbans ecosystem due to improper selection of coal logistics (i.e., transportation route, and anchorage point and trans-shipper).	<ul style="list-style-type: none">Findings of alternative analysis reveal that the designated route of the Mongla Port Authority (MPA) along the Passur River is the best feasible route, which will have less environmental impacts compared to other alternatives. Other routes require significant dredging, longer distance, and smaller vessels with more traffic.Anchorage points were selected by the MPA based on river draft and other relevant factors. The study also considers the selected anchorage points (Mazhar Point in in the Sundarbans) in view of avoidance of close-proximity of World Heritage Site and in accordance with national guidelines to entail minimal disturbance to the Sundarbans ecosystem.EIA study has recommended to reduce transshipment points from two to one to minimize impacts in Sundarbans.EIA study has revealed that Harbaria/Mazhar point will be used for transshipment of coal due to its present draft and closeness to the power plant jetty site. However, in course of time, new or alternate transshipment point may be designated by the MPA considering draft and other factors of that time. At present, Harbaria is being used as transshipment point for Mongla Port. Additionally, Fairway Buoy will also be used during the fair weather as a transshipment point.Preparation of the plans and required institutional set up for their implementation to minimize impacts in the Sundarbans.<ul style="list-style-type: none">Construction Environmental Action Plan (CEAP)/Social and Environmental Management Plan (SEMP) andEmergency Response Plan (ERP) system and	Coal logistics and EIA Consultant	Forest Department, MPA, EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		<ul style="list-style-type: none"> Grievance Redressal Mechanism (GRM). 		
Aquatic Species A2. Gangetic Dolphin and Threatened Irrawaddy Dolphin	Dolphins, including vulnerable Gangetic dolphin (<i>Platanista gangetica</i>) and near threatened Irrawaddy dolphin (<i>Orcaella brevirostris</i>) can be impacted by an improper route selection.	<ul style="list-style-type: none"> Route selection was finalized with the intention of avoiding dolphin sanctuary in Shela and Dangmari. Primary survey on dolphin abundance was conducted in both Chandpai and Dangmari sanctuaries. Research on dolphins conservation may be promoted as a part of Corporate Social Responsibility (CSR) as measures beyond compliance. Almost for the last 60 years, ships have been sailing through the MPA's designated route. So far, no noticeable incident of death of dolphin due to collision with vessels have been reported. Additionally, dolphin abundance has been studied and found that dolphins are mostly congregated in the tributaries of the Passur for preying facilities. Fishing nets induced casualty of dolphins is dominant factor in this area. Collision of dolphin with the vessel in the Passur Channel is rare. As the passur Channel has long been used for navigation of vessels, dolphin has been habituated with movement of vessels. 	Coal logistics and EIA Consultant	Forest Department, MPA, EHSU-BIFPCL
A3. Aquatic Species, including Critically endangered Batagur turtle, Leather back sea turtle and endangered small clawed otter	Aquatic species, such as the critically endangered Batagur turtle (<i>Batagur baska</i>) lives inside the Sundarbans but travels to sandy banks crossing substantial distance (50-60 km) during breeding period (Dec-Mar). The leather back sea turtle (<i>Dermochelys coriacea</i>) lives in the sea but comes to sandy beach during breeding. The endangered small clawed otter (<i>Aonyx cinerea</i>) generally predate in the creeks and can be	<ul style="list-style-type: none"> Batagur turtle is generally available in the Karamjal canal, which is inside the Sundarbans and falls on the Passur River. There is also a captive breeding area of Batagur turtle. The route is about 500 m away from the confluence of Karamjal canal and the Passur River. Research on Batagur turtle, small clawed otter, etc. conservation may be promoted as a part of Corporate Social Responsibility (CSR) as measures beyond compliance. Almost for the last 60 years, ships have been sailing through the MPA's designated route. So far, no noticeable incident of death of Batagur turtle due to collision with vessels have been reported. Proper management of bilge water of the lighterage should be carried out for avoiding contamination of water. 	-	-

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
	impacted by an improper route selection.			
A4. Fish and Shrimp farming	Improper selection of coal logistics (i.e., transportation route, anchorage point and trans-shipper) may lead to loss of fish and shrimp, on which many people depend on for their livelihoods.	<ul style="list-style-type: none"> • MPA designated route was selected for coal transportation. • For mooring large vessels inside the Sundarbans there are two potential anchorage points, i.e., Akram Point and Mazhar Point or other area to be selected by the MPA in future. According to MPA, similar draft and almost similar size vessels will be able to anchor both in the Akram Point and in the Mazhar Point. Considering these issues, EIA study envisages that Mazhar Point is more suitable at the moment than the Akram Point because it is closer to the Project site jetty and more distant from the World Heritage Site (WHS). • No fishing and catching of shrimp post larvae (PL) is allowed in the transportation route of the MPA. • Due to frequent movement of vessel illegal fishing and catching of PL will be discouraged as such, fish production will be increased in the wild. If regular monitoring demonstrates disruption of habitat due to coal transportation vessel and corresponding decline of shrimp and fish production, necessary measures need to be undertaken for restoration of habitat and also to address the alternative livelihood opportunities of the affected fisher's community. 	Coal logistics and EIA Consultant	Forest and Fishing Departments, MPA
A5. Conventions and Codes	Suppliers/shippers of coal are obliged to comply with International Convention for the Prevention of Pollution from Ships to prevent pollution of the marine environment and International Maritime Solid Bulk Cargoes (IMSBC) Code, which has the objective of ensuring safe transport of solid bulk cargoes including	<ul style="list-style-type: none"> • Shippers will be responsible for assessing and declaring whether cargoes are harmful to the marine environment (HME) using specific environmental classification criteria. • Shippers will maintain updated documents in compliance with the requirements of applicable MARPOL and the IMSBC Code with respect to coal cargoes. • Maintain documents with a comprehensive review of the properties of coal, like GCV, moisture, ash, sulphur content, etc. • Maintenance of environment friendly operation of vessel with low noise, low air emission, and ante-oil spillage 	Shippers	MPA, CPO/BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
	coal.	technology.		
B. IMPLEMENTATION PHASE				
Social Impacts				
Employment opportunities B1. Economic activities	Generation of employment.	<ul style="list-style-type: none"> In employing workforces in different Project activities during construction, it is suggested to involve largely the local people particularly the Project-affected Persons (PAPs) directly or indirectly. 	EPC Contractor	BIFPCL
B2. Economic activities	Increased economic activity.	<ul style="list-style-type: none"> New market for local produces, more sales and services and revenue generation during dredging activity and jetty construction. As a result of the influx of a workforce, there shall be a higher demand for locally produced food, goods and services benefiting local farmers, producers, traders including small shops within project area and thereby reduce dependency of locals on the Sundarbans for their livelihoods. Due to increased transportation of materials and goods through MPA's maritime route and its jurisdiction, revenue of the MPA will be increased substantially. The Proponent should provide temporary/ permanent market place facilities and the EPC Contractor or the Labour Contractor will facilitate the access of the workforce to shopping in that market place. 	EPC Contractor	BIFPCL
B3. Accidental risks	Risk of accidents and unsafe working conditions for workforce.	<ul style="list-style-type: none"> Occupational Health and Safety Plan (OHSP) to be implemented. Ensure the use of Personal Protective Equipment (PPE). Emergency Preparedness Plan (EPP) to be implemented. Observance of mock drill on OHSP & EPP at regular interval. Contractor should follow relevant IFC Performance Standard (PS) like PS-2 on Labor and Working Conditions; PS-3 on Resource Efficiency and Pollution Prevention and PS-4 on Community Health, Safety, and Security. Safety training for all workers should be ensured prior starting work. 	EPC Contractor	MPA, EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		<ul style="list-style-type: none"> Kitchen waste should be dumped in defined bins by category and sent to the landfill. 		
B4. Security risks	Security risks for workers and project staffs, especially from pirates and bandits who are known to roam the area and carry-out kidnappings for ransoms.	<ul style="list-style-type: none"> Continued consultations with the local leaders and local community representatives on security matters. Keep close liaison with the Law Enforcement Authorities (for pirates, the scope will be under the jurisdiction of regulatory authorities, e.g. coast guards, MPA and Police). Ensure the presence of armed and trained security guards at the work sites and camps. Issuance of identity cards to workers and checking them properly when enter into the workplace. Access to the camps and accommodation facilities must be controlled through gated entrances and entrance and exit logs with security personnel shall be maintained at each entrance. Preparation and implementation of the contractor's Communication Plan to engage local elected representatives and community. Every labour camp should have lockers for safe keeping of money, stuffs and belongings for labour. Implement ECP 14: Construction and Operation Phase Security. 	Coast Guard, Navy, EPC Contractor	EHSU-BIFPCL/MPA
B5. Risk to assets	Inadequate construction site security poses a significant risk to assets, construction materials and property. Theft/vandalism of assets, materials and property would increase construction costs and cause delays in project completion.	<ul style="list-style-type: none"> Ensure security at the work sites and camps. Employ night watchman significant on-site storage or when the area necessitates. Ensure there is proper fencing around construction site perimeter. Pre-employment screening investigations should be used to verify the applicants relating to their employment, education and criminal history background. Issuance of identity cards to workers Implement ECP 14: Construction and Operation Phase Security 	EPC Contractor	EHSU-BIFPCL
B6. Cultural conflicts	Possible cultural conflicts between communities and	<ul style="list-style-type: none"> Conduct awareness campaign and develop Code of Conduct for workers on local cultural affairs. 	EPC Contractor	EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
	workers.	<ul style="list-style-type: none"> • Develop and function the grievance redressal mechanism along with formation of grievance redress committee. • Develop and implement disclosure system and strong community participation plan. 		
B7. HIV/AIDS/STI risks	Risks of HIV/AIDS and STI due to the flow of migrant workers.	<ul style="list-style-type: none"> • Awareness creation on HIV/AIDS infection and diseases through a well-designed campaign implementation plan targeting all risk-prone groups. • The awareness programme will be conducted by EPC contractor at the time of induction training and periodic update on HIV/AIDS shall also be shared as and when received from the Govt agencies or NGOs. Hand Leaflet and posters/ banners in using Bangla/ English shall be issued. • Empowering women as much as possible through employment in the construction and other official work as eligible. • Unskilled and semi-skilled workers should be engaged from the affected communities so that they can be close proximity of their families and reduce the risk of mixing with other genders. 	EPC Contractor	EHSU-BIFPCL
B8. Local facilities	Increased pressures on local facilities (i.e., mosques, health care facilities) due to in-flux of migrant labors/workers.	<ul style="list-style-type: none"> • Construction contractors will provide all required facilities for workers; provide maintenance and repairing of damages of existing infrastructure facilities, if any due to project activities to minimize pressure on local social facilities. • Community engagement plan will be prepared by the EPC Contractor as part of the CEAP and made functional for bringing cultural and communal harmony between the community and the workers. 	EPC Contractor	EHSU-BIFPCL
B9. Risk from hazardous chemicals	Health and safety risk of the community due to the existence of a construction site(s) and the storage and use of hazardous chemicals.	<ul style="list-style-type: none"> • The Contractor shall follow WBGEHS guidelines and PS-4 on Community Health, Safety, and Security. • Exposed stockpiles of materials will be covered with tarpaulin or impervious sheets before a rainstorm occur. • Disposal of hazardous materials following environment friendly manner. 	MPA, EPC Contractor	MPA,EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		<ul style="list-style-type: none"> During construction phase the contractor site camps should be properly managed and should maintain proper housekeeping. 		
B10. Change in land use	Temporary land requisition by the contractor during construction activities may bring change in existing land use.	<ul style="list-style-type: none"> The Contractor will seek permission for a parcel of rasied land from the Proponent for conducting temporary construction activities for avoiding further disturbances to environmental components. In case of permission required for river front activities, the Proponent will seek permission from the competent authority in accordance with the law of the land. Greenery should be developed in the open space allocated for labour camp. Site closing, decommissioning and proper site remediation works. 	EPC Contractor	EHSU-BIFPCL
B11. Risk from increased traffic	Safety hazards due to increased traffic especially for children and elderly people.	<ul style="list-style-type: none"> ECP 10: Traffic Management Plan including community friendly traffic schedule for addressing general access to be implemented. Most of the construction materials will be transported using inland water transport. Safety and security actions and procedures to protect local community during construction phase. 	EPC Contractor	EHSU-BIFPCL/MPA
B12. Consumptive water requirement	Impact on water resources particularly on ground water from Construction Labour Camp	<ul style="list-style-type: none"> Considering the poor quality of surface water and low availability of ground water, it is suggested to avoid extraction of ground water for non-potable and other uses in the labour camp instead it is recommended to continue with Reverse Osmosis (RO) Plant throughout the Project period. Effective and efficient use of water should be ensured. Reuse of water with due treatment in suitable water use area. Sludge collection sump should be built. 	EPC Contractor	EHSU-BIFPCL
B13. Sewage/solid waste management facilities	Impact on surrounding environment and community	<ul style="list-style-type: none"> The tentatively required dimension of sewage/organic solid waste tank should be 25 m³ (L-4mXW-2.75mXH-2.25m) for capacitating the 41-55 metric tons of organic solid waste in three years. 	EPC Contractor	EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		<ul style="list-style-type: none"> • The tank should be septic tank for better absorption of liquid by the soil. • Maintain hygienic condition of the water closet (WC) for the next person's use. • Dismantling of septic should be done with proper care and release gases arrested in the tank carefully for avoiding casualty. • Proper sanitation will be maintained according to environmental standards. 		
Environmental Impacts				
B14. Air Pollution	Emissions of dust and air pollution will be generated from operation of construction equipment and vehicles, material transport, and site clearance.	<ul style="list-style-type: none"> • Water the soil surface and any non-asphalted roads, especially in the dry season. • Water the soil before starting excavation. • The storage and handling of spoil, subsoil, topsoil and materials will be carefully managed to minimize the risk of wind-blown material and dust. • Cover hauling vehicles carrying dusty materials moving outside the construction site. • Fit vehicles with appropriate exhaust systems and emission control devices. • Implement Air Quality Management Plan. • Use wind fencing in construction areas that are frequently subjected to high winds. • Reduce activities that create fugitive dust during windy conditions. 	EPC Contractor	MPA/ EHSU-BIFPCL
B15. Increased Use of Lights	Increased lighting during construction will impact the surrounding wildlife and birds.	<ul style="list-style-type: none"> • Minimize night-time construction activity (where practical). • Use light on an "as and when needed" basis. • Direct lighting toward the ground on working areas, reducing the height of lighting to the extent possible and minimizing the number of lights required through strategic placement. • Use fittings on lamps to direct light and confine the spread of light. • Follow lighting plans. • Halogen bulb/light can be used for its longevity, higher 	EPC Contractor	EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		efficiency, money saving, etc. • Avoid mercury vapour lamp.		
B16. Fuel and Chemical Spillage	Contamination of soil and surface water due to the accidental spills and leakage of fuels and chemicals.	• Contractor will prepare and implement Pollution Prevention Plan as part of the CEAP. • Implement ECP 2: Fuels and Hazardous Goods Management. • Contractor to confine the contaminants immediately after such accidental spillage. • Contractor to collect contaminated soils and washouts containing petroleum products treat and dispose them in environment friendly manner. • All areas intended for storage of hazardous materials to be quarantined and provided with adequate facilities to combat emergency situations complying all the applicable statutory stipulation.	EPC Contractor	MPA EHSU-BIFPCL
B17. Solid Waste and Effluent	Indiscriminate and unplanned disposal of solid and liquid waste may affect local environment adversely.	• Implement ECP 1 Waste Management. • Siting of fuel and hazardous material storage sites, including refuelling facilities, batching plants and construction yards are to be located inside the flood embankments. • Hazardous waste will be disposed of following environment friendly manner by designated contractors. • Good housekeeping will be adopted to reduce generation of construction wastes and the potential water pollution.	EPC Contractor	EHSU-BIFPCL
B18. Aquatic Wildlife and Fisheries Habitat	Impact on river habitats by sediment flow (i.e., general habitat and passage of dolphins, fishes and other animals) from construction activities, including clearance of a shabby patch of river bank vegetation.	• Control of sediment flow from the construction activities • Silt curtains along river training works and/or other industry good practice management controls will be used to restrict the spread of sediment released during construction of Terminal/Jetty/Materials Offloading Facility earthen causeway. • Minimize and restrict clearing of river slope and river bank vegetation as much as possible. • Implement ECP 8 Protection of Fauna for species with conservation significance especially endangered and near threatened.	EPC Contractor	MPA/FD/EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
B19. Pile driving activities	Most of the piles will be cast in-situ type. So, overpressure from piling activities will be remote. In case of pre-cast pile driving activities following concern may arise: Overpressure from pile driving activities will harm riverine animals, including dolphins inhabited in the confluence of the Moidhara and the Passur Rivers, which is about 2 km downstream of the jetty construction site.	In case of pre-cast pile driving activities following measures will be applicable: <ul style="list-style-type: none"> • Pile driving will be completed using Best Management Practices for Pile Driving and related Operations. • Conferring with appropriate organizations to determine the preferred timing and methods of the pile driving. 	EPC Contractor	EHSU-BIFPCL
B20. Underwater Noise Level	Most of the piles will be cast in-situ type. So, underwater noise from piling activities will be remote. In case of pre-cast pile driving activities following concern may arise: Noise from in-water construction along with pile driving generates intense underwater sound pressure waves that will adversely affect riverine organisms including vocalization and behavior of fish, dolphins and other animals concentrated in the confluence of the Moidhara and the Passur Rivers, which is about 2 km downstream of the jetty construction site.	In case of pre-cast pile driving activities following measures will be applicable: <ul style="list-style-type: none"> • Use of vibratory hammers instead of impact hammers. • Monitoring of underwater noise levels and use of underwater air bubble curtains, metal or fabric sleeves to surround the piles to reduce noise levels if required. • A large bubble curtain consists of a hose with drilled holes, supplied with compressed air. The hose is placed on the river bed and the air escaping from the holes forms the bubble screen. [Single bubble curtain reduce noise by: 12 dB (SEL), 14 dB (peak); Double bubble curtain by 17 dB (SEL), 21 dB (Peak)]. • Hydro Sound Damper consists of fishing nets with small balloon filled with gas and foam - tuned to resonant frequencies fixed to it. It can be applied in different ways. [Hydro Sound Damper reduce noise by 4 - 14 dB (SEL)] • Setting up cofferdam which consists of a rigid steel tube surrounding the pile. Once the pile is stabbed into the cofferdam, the water is pumped out. [Cofferdam up to 22 dB (SEL) and 18 dB (Peak)]. • Conduct pile driving during low tides in intertidal and shallow subtidal areas. 	EPC Contractor	EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		<ul style="list-style-type: none"> • Implement seasonal restrictions when necessary to avoid construction-related impacts to habitat during species' critical life history stages (e.g., spawning and egg development periods). • Reduce sound pressure impacts during pile installation by using wood or concrete piles, rather than hollow steel piles which produce intense, sharp spikes of sound that are more damaging to fish and dolphins having air cavities. • Underwater noise during piling activities could be carried out with a hydrophone sensor which is normally placed in a water column at least 1 metre deep, with the sensor located at a depth of 0.5 metre above bottom of the water column. 'Reference sound levels from pile driving normally are reported at a fixed distance of 10 meters'. 		
B21. Collision with Dolphin	Risk of dolphin collision with construction vessels in River.	<ul style="list-style-type: none"> • Restrict the motor boat speeds as per MPA rules (MPA Traffic Guidelines). • Restrict boat movement within safe distance around the construction site if river width permits. Avoid areas where Dolphins are known to congregate at the confluence of Moidara and Passur River, which is 2.0 km away from the jetty site. 	EPC Contractor	MPA/FD/EHSU-BIFPCL
Terminal, Jetty, Conveyor System and Coal Stackyard B22. Clearing of natural vegetation	Clearing of natural vegetation and trees during construction activities of jetty in project areas.	<ul style="list-style-type: none"> • Vegetation clearance shall be limited to the extent required for execution of works. • Contractor will follow ECPs 7 and 8 on Protection of Flora and Fauna while tree felling. • Include environmental management and awareness as part of training for employees during construction. 	EPC Contractor	EHSU-BIFPCL
B23. Loss of faunal habitat	Loss of faunal habitat at locations of construction works, camp, staff quarters and on access/haul routes due to the felling of trees.	<ul style="list-style-type: none"> • Minimize construction or civil works in the shabby patch of plants where birds take shelter. • Use of existing access road. • Implement ECP 8 Protection of Fauna for species with conservation significance especially endangered and near threatened. • Plantation of native trees for restoring the lost habitats of birds and other wildlife. 	EPC Contractor	FD/EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		<ul style="list-style-type: none"> MoU has already been signed with Forest Department for plantation of 0.2-0.3 million native tree species under Greenbelt Development Programme. 		
B24. Impact on top soil	Earthworks will impact the fertile top soils that are enriched with nutrients required for plant growth	<ul style="list-style-type: none"> Strip the top soil to a depth of 35 cm and store in stockpiles of height not exceeding 2m. Remove unwanted materials from top soil like grass, roots of trees and others. Spread the topsoil to maintain the physico-chemical and biological activity of the soil. The stored top soil will be utilized for covering all disturbed area and along the proposed plantation sites. Contractor will prepare Top Soil Management plan as part of the CEAP/SEMP. 	EPC Contractor	EHSU-BIFPCL
B25. Terrestrial invertebrates	Excavation works will impact on the loss of habitats especially the terrestrial invertebrates that live in the ground.	<ul style="list-style-type: none"> Avoid construction during effective rainy days in the monsoon. Minimize digging of trenches and vegetation clearance to minimum required level. 	EPC Contractor	EHSU-BIFPCL
B26. Increased traffic congestion	Increased Traffic on local roads will affect access to the trading centre and, houses close to the road, deteriorate safety (especially the school children), spillage of fuels and chemicals, and damage to infrastructures and properties due to vibration	<ul style="list-style-type: none"> Contractor will implement traffic management plan to ensure uninterrupted traffic movement during construction. Restrict truck deliveries, where practicable, to day time working hours. Restrict the transport of oversize loads. Use covered trucks to avoid spreading of dust. Ensure proper maintenance of vehicles and roads. Enforce on-site speed limit, especially close to the sensitive receptors, schools, health centres, etc. Implement ECP 10: Traffic Management Inspect structures within the close proximity of construction site for damages. 	EPC Contractor	EHSU-BIFPCL
B27. Noise and vibration from operation	Operation of heavy equipment and construction vehicle movements will cause noise and vibration affecting workers and the nearby	<ul style="list-style-type: none"> Construction activities near settlements will be limited to day time mostly. High noise producing equipment will be provided with mufflers or acoustic hood/enclosures. Install acoustic enclosures around generators and install 	EPC Contractor	EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
	community. Most of the construction materials and plant equipment will be transported using water vessels.	temporary noise control barriers where appropriate to reduce noise levels. <ul style="list-style-type: none"> • Fit high efficiency mufflers to appropriate construction equipment. • Notify affected communities in advance regarding major noisy operation. • Implement Noise Management Plan 		
B28. Temporary breeding pools	Loss of temporary breeding pools and pans due to refilling of such pools by construction soil or gravel while constructing the jetty and coal stackyard.	<ul style="list-style-type: none"> • Schedule trench construction during dry season to reduce impact since the amphibian populations will be low during non-breeding season • Fence off the trenches with nets to prevent amphibians falling into the trap. • Implement ECP 8 Protection of Fauna for species with conservation significance especially endangered and near threatened. 	EPC Contractor	EHSU-BIFPCL
B29. Borrow and quarry activities	Impact of borrow materials and quarry activities.	<ul style="list-style-type: none"> • Borrow/quarry areas will be developed close to the project area for extraction of earth material and aggregates for river protection works. • No private lands or agriculture lands will be used for borrowing. • Minimize volume of borrow material by using dredged material generated from the associated component of the project. • Control dust and air pollution by application of watering. • Photographs recorded of each borrow area showing pre-construction baseline for comparison with after rehabilitation. 	EPC Contractor	EHSU-BIFPCL
B30. Archeological assets	Damage to unidentified archaeological asset(s) during quarry activities for trenching of civil structure and river protection works.	<ul style="list-style-type: none"> • In case of any artefact or site of archaeological, cultural, historical, or religious significance are discovered during construction activities, the works will be stopped in that area, and the appropriate department will be informed. • Contractor will develop a procedure for management of 'Chance Finds'. THE ANTIQUITIES ACT, 1968 of Bangladesh (Draft ANTIQUITIES ACT, 2015) and IFC's PS 8- Cultural Heritage will be followed by the Contractor. 	EPC Contractor	EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
C. OPERATION AND MAINTENANCE PHASE				
Social Impacts				
C1. Employment Opportunities	Generation of employment.	<ul style="list-style-type: none">• Employment for local workers and technicians, local unskilled labors during operation of the coal transportation and handling.• New employment opportunities in shipping and related businesses.• Due to availability of quality and uninterrupted electric supply, lots of industries will be developed in Khulna area, which will create a huge employment opportunities and economic activities.	BIFPCL	IMA
C2. Economic activities	Increased economic activity.	<ul style="list-style-type: none">• At present about 4.5 million tons of materials and goods area being handled by MPA per year. During operation of this project, MPA would handle more than 4.5 million tons of materials and goods for this project only. As such, MPA would be able to generate a substantial amount of income from this project.• Establishment of new private businesses and commercial enterprises in shipping and at the anchorage points. Increase in local business opportunities due to shipping.	BIFPCL	IMA
C3. Fishery productivity	Increased movement of vessel may cause disturbance to post larvae (PL) catching which in turn will facilitate wild shrimp production, mixing of oxygen into water and increase in dissolved oxygen.	<ul style="list-style-type: none">• Since catching of fish and post larvae will be discouraged during operation of the project, as such, the production of shrpm and fish will increase in the area. If regular monitoring demonstrates decline of shrimp and fish production, necessary measures need to be undertaken to address the alternative livelihood opportunities of the affected fisher's community.• Shrimp post larvae catching dependent livelihood will be restored in different phases of power plant construction and operation and also in the industries to be developed in the EPZ, Mongla.• Government should bring the post larvae catchers into the social safety net program.	BIFPCL	IMA
C4. Social disturbance	Social disturbance due to poor expectation of the project.	<ul style="list-style-type: none">• Make formal arrangement for continued communication and engagement with local stakeholders, in the form of a community engagement cell.	BIFPCL	IMA

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		<ul style="list-style-type: none"> An independent monitoring team will conduct regular monitoring of various socio-environmental parameters. Disclosure of monitoring results with appropriate methods. Ensure consistent communication with local communities, national stakeholders even if they are opponents of the Project. 		
C5. Increase in coal vessel traffic	Coal would be transported in a covered vessel through the MPA designated route, which is 1.5 to 2.75 km away from the outer periphery of the World Heritage Site. As such, no significant/quantifiable impact is apprehended on the WHS due to transportation of coal.	<ul style="list-style-type: none"> -Shipping vessel would follow applicable MPA and IMO conventions when transporting coal. Monitor and review of shipping impacts on a regular basis and work with stakeholders to help minimize impacts on protected areas. Periodic audits for the compliance of IMO regulation of coal vessels. 	IMA	MPA/EHSU-BIFPCL /FD
C6. Fish and Shrimp growth	Increase in shipping induced pollution by water quality deterioration, may impact fish and shrimp growth, on which livelihood of local communities depend on.	<ul style="list-style-type: none"> Monitor and review of potential impacts of vessel movement on a regular basis and work with stakeholders to help minimize impacts. Aware fisherman about the coal vessel movement and potential collision with vessels and consequences. Ensure vigilance and monitoring of pollution due to vessel movement. All vessels should comply with the applicable MARPOL and IMSBC conventions. 	IMA	EHSU-BIFPCL/MPA
C7. The Sundarbans and world heritage site ecosystem	Increase in shipping, coal transshipment, and coal transport can increase collision induced risk and subsequent spillage, which can affect the functionality of the Sundarbans ecosystem and affect the growth of forestry products (such as timber, honey, medicinal plants, Golpata and etc.) on	<ul style="list-style-type: none"> Review of potential impacts of vessel movement on a regular basis and work with stakeholders to help minimize impacts. Review and update the Sundarbans Forest Management Plan to mitigate potential impacts on livelihood. Implement Emergency Response plan. A framework of the ERP is developed in the EMP for the MPA to develop a comprehensive ERP with appropriate resources, management structure, and effective communication in order to manage any emergency events associated with coal transportation. 	IMA	MPA/FD/EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
	which livelihood of local people depend on.	<ul style="list-style-type: none"> • There should be commitment of MPA and adequate budgetary provision to implement ERP with due diligence. • There should be commitment of the Forest Department (FD) and adequate budgetary provision to implement the prescribed EMP with due diligence. 		
Environmental Impacts				
Coal Transport and Transfer Operations C8. Complying with MARPOL and IMSBC codes	Proper documentation of suppliers/ shippers of coal complying with applicable MARPOL and IMSBC Code	<ul style="list-style-type: none"> • Verify compliance documents of applicable MARPOL and IMSBC Code during cargo clearance from the Mongla Port Authority. • Verify documents indicating properties of coal, like GCV, moisture, ash, sulphur content etc. • Monitor whether liquid residues of coal vessel discharge into the marine environment. • Ensure dry residues and/or the wash water that contains residues from an HME discharged at adequate port reception facilities of the MPA. 	Shippers	CPO/MPA/ BIFPCL
C9. Noise level	Generation of noise from vessels and trans-shipper will negatively affect surrounding environment and wildlife, including resident and migratory birds. Sudden and periodic noises may affect animals behaviorally and physiologically. In extreme cases, loss of hearing through inner ear damage has been observed in laboratory mammals. Furthermore, high levels of noise for fairly short durations have produced significant effects on sexual function, blood chemistry, auditory function and susceptibility to seizures.	<ul style="list-style-type: none"> • Coal being unloaded from barges will have minimal drop heights. • Adhere to trans-shipper's environmental control measures recommended in this EIA. • Adherence to a comprehensive equipment maintenance program to maintain equipment, and to maximize efficiency and reliability, which will help limit noise levels associated with the operation. • System components will be maintained to operate below maximum operating noise levels wherever feasible. • Maintenance records will be maintained for review by IMA, BIFPCL's O/M and EHSU. • Noisy mobile equipment supporting the operation will be removed from service wherever practical and replaced with a less noisy alternative. • Noise Management plan for ships/barges will be implemented. • Restrict blowing of whistle within the Sundarbans territory. • Switch off / throttle down of all equipment when not in use 	Ship Master	IMA, EHSU- BIFPCL/ /MPA/

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
	Neural and hormonal processes may be stressed. Since acoustic signals play a major role in survival, viable behavior and population dynamics may be disturbed if communication is obscured by background noise. ³⁶	<ul style="list-style-type: none"> For the life of the operation, BIFPCL will evaluate noise levels and onsite activities to identify opportunities for using less noisy equipment and / or making changes to day to day operations that may reduce overall noise levels. 		
C10. Increased lighting	Increased lighting from ships/barges and etc. will impact the surrounding wildlife, including resident and migratory birds, the Masked Finfoot, Spoon Billed Sandpiper, White Rumped Vulture, Slender-billed Vulture, White-headed Duck and Greater Spotted Eagle are considered to be endangered.	<ul style="list-style-type: none"> Minimize night-time activity (where practical). Use light on an “as and when needed” basis. Eliminate upward directed light. Use fittings on lamps to direct light and confine the spread of light. Ensure lights are in good condition at all times. Adoption of EMP Sub-plan 2: Biodiversity Management Plan. 	Ship Master	MPA/ IMA, Forest Department, EHSU- BIFPCL
C11. Ship wastes	Contamination risk from effluents (residue of ballast water, bilge water, oil, lubricant, garbage, domestic waste, food and kitchen waste, coal leachate, sewage, etc.) from ships.	<ul style="list-style-type: none"> Strictly follow MARPOL Convention, as applicable Annex V on the Prevention of Pollution by Garbage from Ships, the IMO introduced new classification criteria to enable identification of substances harmful to the marine environment (HME). Coal transportation shall be carried out using existing navigational route of the MPA. Responsible authorities will properly enforce rules and regulations of MPA and applicable MARPOL in the management of bilge and ballast water, oily water discharge, waste and waste water. MPA should ensure adequate port waste (solid and liquid) 	Ship Master	IMA, /MPA/ EHSU-BIFPCL

³⁶Glover, T. O., Hinkley, M. E., and Riley, H. L. (1970); Unit Train Transportation of Coal: Technology and Description of Mine Representative Operations, US Bureau of Mines, Information Circular, 8444, pp. 109.

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		<p>reception facilities.</p> <ul style="list-style-type: none"> Results of monitoring and enforcement should be disclosed through appropriate method and means. 		
C12. Pollution from ships	Pollution from ships can degrade aquatic habitats and reduce fish and crustacean production and recruitment. There will be risk to aquatic species, including endangered estuarine/coastal animals such as Batagur turtle and otter.	<ul style="list-style-type: none"> Ensure dry residues and/or the wash water that contains residues from an HME discharged at adequate port reception facilities (that has to be ensured by the MPA). A facility to be developed in the MPA designated area for receiving the bilge for lighterage that will be calling at the plant jetty. Follow applicable MARPOL Convention for all shipping activities, which is the main International convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. Responsible authorities will properly enforce rules and regulations of MPA and applicable MARPOL in the management of bilge and ballast water, oily water discharge, waste and waste water. They will be discharged at adequate port reception facilities. Use of class lighterage vessels for transporting coal from the anchorage points to the jetty. Implement EMP Sub-plan 2: Biodiversity Management Plan Impact of vessel movement on water, mangrove forest, riverine species, etc. are being monitored and is suggested to continue the monitoring activities till the end of the power plant project life. Based on the monitoring report, appropriate measures should be taken for mitigating impacts, if any. 	Ship Master	IMA, MPA, MoEF/ EHSU/ BIFPCL
C13. Threat to aquatic mammals and other species	Enhanced maritime traffic will have impact on dolphins, fish, and crustaceans such as: vessels colliding with freshwater dolphins resulting in injuries.	<ul style="list-style-type: none"> Implement EMP Sub-plan 2: Biodiversity Management Plan. Vessel movement should be through a fixed alignment of the river (optimization of the lane and dimension of the fairways) designated by the MPA. Encourage the use of bow thrusters for all coal vessels or use pingers for repelling aquatic animals. 	Ship Master	MPA/IMA, FD, EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
C14. Threat to Local river Traffic	Enhanced maritime traffic (presence of barges and associated vessels) may pose a risk to local river traffic.	<ul style="list-style-type: none"> • Provide navigation aids for the barges and associated vessels. • Provide proper navigational lighting. • Check all navigational lights routinely to ensure that they are working properly. 	Ship Master	MPA
C15. Erosion due to coal vessel movement	Movement of bulk carriers and class lighterage carrying coal and limestone may generate wave on sea and inland water that might cause erosion along seashore and riverbank, including more than 1 km from route. It might also increase the rate of erosion at existing erosion prone areas.	<ul style="list-style-type: none"> • Erosion along the banks of the Passur River to be monitored routinely by the concerned authorities like the MPA, etc. • In general, restriction on vessel speed limits risk of erosion. Vessel speed in the route of the Mongla Port is guided by the MPA. 	Ship Master	IMA, MPA/EHSU-BIFPCL
C16. Sedimentation from erosion	Erosion caused by vessel wakes results in excessive sedimentation in the deep pools where freshwater dolphins congregate for feeding and as refuge areas.	<ul style="list-style-type: none"> • Maintain speed limit of vessel sailing through the MPA route. • Take special precaution and maintain safe distance while passing close to the dolphin sanctuaries. • Erosion on both sides of the MPA route to be monitored routinely and accordingly measures to be taken. 	Ship Master	IMA/ MPA/ FD, EHSU- BIFPCL
C17. Invasion of alien species	The transportation of imported coal may risk of invasion of alien species. Alien species might come through ballast water, hull-fouling, and by contact of vessel body, these species may compete with native species and therefore threaten biodiversity of the Sundarbans and their abundance.	<ul style="list-style-type: none"> • Quarantine inspection should be conducted. • Responsible authorities will regularly inspect shipping and barging activities to detect introduced species early. • Standard operational practice, including IMO Conventions and ECR 1997 shall be followed by the transportation agency. • Prevent the introduction of species, especially from ballast water and hull-fouling. • The outcome of disclosure of inspection of vessels and enforcement records should be made through appropriate method and means. 	Ship Master	IMA, MPA/ EHSU-BIFPCL
C18. Vessel movement and the	Movement of coal and limestone vessels and	<ul style="list-style-type: none"> • Ensure enforcement of ECA, 1995 (as amended in 2010) and ECR, 1997 (as amended in 2005), Forest Protection 	Ship Master	MPA/IMA, Forest

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
Sundarbans ecosystem	transshipment process may have impacts on the surrounding the Sundarbans Ecosystem (including, terrestrial wildlife, aquatic fauna and nearby World Heritage Site of UNESCO at South Sanctuary).	<p>Act, and other rules, regulation and treaties for conserving the Sundarbans and Ecologically Critical Area (ECA).</p> <ul style="list-style-type: none"> • Coal will be transported in covered class vessels. • Every kind of discharge from ship should follow applicable MARPOL Convention. • Restrict outside lighting of the water vessel during navigation across the Sundarbans. • Restrict the beaming of searchlight on Forest area/Sea Shores/Protected Beach/Protected Areas • Use low beam of searchlight during navigation across the Sundarbans/Bird Colony. • Restrict blowing of whistle within the Sundarbans • Introduce speed limitation for vessels in the Sundarbans • Anchorage of water vessel only in designated sites. • Implement Biodiversity Management Plan. • Results of monitoring and enforcement should be disclosed through appropriate method and means. 		Department, EHSU-BIFPCL
C19. Fuel combustion and emission	Impact of air emissions from vessels and transshiper on ambient air quality	<ul style="list-style-type: none"> • Air Quality modeling assessment for project case shows ambient air quality within the National Ambient Air Quality Standards. • Implementation of Air Quality Management Plan. • All vessels will comply with international and national standards, e.g., IMO conventions, applicable MARPOL, Hazardous and Noxious Substances (HNS), etc. 	Ship Master, BIFPCL	MPA/IMA, EHSU-BIFPCL
C20. Accumulation of dust on riverbed	Accumulation of fugitive coal dust and coal spills on riverbed during loading and unloading by transshipper at the mooring area.	<ul style="list-style-type: none"> • Accumulation of coal dust in the transshipment point of coal will be periodically monitored. Based on the findings, mitigation measures (if required) will be carried out. • Add water mist to wet the coal to prevent dusting. • Specific design and material handling procedures will be used to minimize the loss of coal in the marine environment. • Maintenance of facilities, including daily cleaning, is proposed to reduce the build-up of dust that could become a source of sediment during rain events. 	Ship Master	MPA/IMA, EHSU-BIFPCL
C21. Water Quality	Impact of fugitive coal dust	<ul style="list-style-type: none"> • Use recommended dust control measures for loading coal. 	Ship Master	MPA/IMA,

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
and Benthos	and coal spills on river water quality, particularly at Mazhar Point and plant jetty during lighterage load-out and load-in, transshipper mooring, and lighterage transport. Johnson and Bustin (2006) found that high concentration of coal dust oxidize and reduce dissolved oxygen available for benthos.	<p>Specific design and material handling procedures will be used to minimize the loss of coal in the marine environment during handling and transport activities.</p> <ul style="list-style-type: none"> • Water/mist system used to spray coal during the unloading process. • Cover all receiving stackyard except for entry/exit points. • Grabs in floating transfer station (transshipper) will be equipped with dust cover plates. • The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is expected to control dust throughout the transportation chain. • Maintenance of facilities, including daily cleaning, is proposed to reduce the build-up of dust that could become a source of sediment during rain events. • Minimize drop heights when using cranes. • Implement Air Quality Management Plan. • Results of air quality monitoring and enforcement actions should be disclosed through appropriate method and means. 		EHSU-BIFPCL
C22. Biodiversity of the Sundarbans	Impact of coal dust emissions from unloading and loading and lighterage transport on biodiversity of the Sundarbans. Fugitive coal dust can coat mangrove leaves and reduce photosynthesis in Sundarabans located more	<ul style="list-style-type: none"> • As a secondary dust mitigation measure, water mist may be sprayed on the lighterage vessels in a controlled manner (i.e., approximately five minutes every 30 minutes), as deemed necessary by the operations superintendent or the Environmental Coordinator. • The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling 	Ship Master	MPA/IMA, EHSUBIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
	than 1km from the source. Study conducted by Naidoo and Naidoo (2005) ³⁷ found that coal dust from the Richards Bay coal terminal in South Africa harms local mangrove trees and related ecosystems by impairing the ability of the trees to photosynthesis. The study found that coal dust on the undersurface of leaves is not removed by wind, rain, or even physical washing. The undersurface of the leaves, as well as the rough surfaces of twigs, branches and trunk, tend to accumulate dust and appear black.	<p>at coal transfer and handling areas, is expected to control dust throughout the transportation chain.</p> <ul style="list-style-type: none"> • Covered lighterage (class vessel) has been included in project design. • Grabs in floating transfer station (transshipper) will be equipped with dust cover plates. • Implement EMP Subplan 2: Biodiversity Management Plan • Implement water Quality Management Plan (coal dust mitigation measures). • Results of water quality monitoring, sediment monitoring and enforcement actions should be disclosed through appropriate method and means. 		
C23. Human Health	Impact of fugitive coal dust from transshipment and transfer processes on human health (operation staffs) as there is no settlements closeby.	<ul style="list-style-type: none"> • Use recommended dust control measures for loading and unloading coal. • Water/mist system used to spray coal during the unloading and transfer processes. • Cover all receiving pits/stckyard except for entry/exit points. • Grabs in floating transfer station (transshipper) will be equipped with dust cover plates. • The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is expected to control dust throughout the transportation chain. 	Ship Master	IMA, EHSU/BIFPCL

³⁷ Naidoo, G and Naidoo, Y (2005) Coal dust pollution effects on wetland tree species in Richards Bay, South Africa, Wetlands Ecology and Management, Springer, 13: 509–515.

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		<ul style="list-style-type: none"> Minimize drop heights when using cranes and curved chutes at transfer points. Use enclosed conveyor system equipped with water spraying nozzles. Mandatory use of appropriate PPEs for all operation staffs. Implement Air Quality Management Plan. Results of air quality monitoring and enforcement actions should be disclosed through appropriate method and means. 		
C24. Coal dust and fugitive emission	Spreading of coal dust and dispersion of fugitive dust from coal storage may affect surrounding environment.	<ul style="list-style-type: none"> There will be fully covered coal storage except for entry/exit points.. Use recommended dust control measures for loading coal Water/mist system used to spray coal during the unloading process. Cover all receiving pits/stackyard except for entry/exit points. Minimize drop heights and curved chutes at transfer points. Plant vegetation around storage area to prevent wind from dispersing fugitive dust emissions. 	O & M/ BIFPCL	MPA/IMA and EHSU
C25. Discharged contaminants	Discharge of contaminants through spills; discharge of coal to water bodies will release Polycyclic Aromatic Hydrocarbons (PAH's) into aquatic environment.	<ul style="list-style-type: none"> Implementation of management plans to mitigate effects of discharge from spills. Numerous studies concluded that PAHs are not bioavailable because of the source of PAH in the sediments was from pitch globules and coal particles to which the PAHs were tightly bound. The use of dust suppressants, in combination with proposed dust mitigation measures including but not limited to: covered dumping shed and conveyors, ongoing site cleaning and system maintenance, misting and sprinkling at coal transfer and handling areas, is expected to control dust and spills throughout the transportation chain. Periodical monitoring of deposition of coal and coal dust on the river/channel bed at transshipment area. In case of noticeable coal dust deposition, they will be removed for safe disposal on land. 	Shippers	MPA, O & M/ EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
C26. Coal drainage runoff	Coal contaminated drainage run-off from coal storage will release PAH's into aquatic environment.	<ul style="list-style-type: none"> Separately collect coal drainage wastewater (including leachate, collected water, and exposed water) in a gravity driven settlement pond and implement ECP 1: Waste Management and Run-off and collection and treatment to mitigate and to reduce the impacts of run-off into nearby waterways prior to it being recycled or discharged the same. 	O & M/ BIFPCL	IMA and EHSU-BIFPCL
C27. Fire due to spontaneous combustion	Risk of fire from spontaneous combustion, oxygen depletion, and corrosion of metal from coal during barge and vessel transport.	<ul style="list-style-type: none"> Transport coal following IMSBC Code in Cargo B, coal can create flammable atmospheres, may heat spontaneously, may deplete the oxygen concentration and may corrode metal structures. When the master is concerned that the cargo is showing any signs of self-heating or spontaneous combustion, such as an increase in the concentration of methane or carbon monoxide or an increase in temperature, the following actions shall be taken: <ul style="list-style-type: none"> Consult with the ship's agent at the loading port. The Company's designated person ashore shall be advised immediately. Check the seal of the cargo space and re-seal the cargo space, as necessary. Do not enter the cargo space and do not open the hatches, unless the master considers access is necessary for the safety of the ship or safety of life. When any ship's personnel have entered into a cargo space, re-seal the cargo space immediately after the personnel vacate the cargo space. Increase the frequency of monitoring the gas composition, and temperature when practicable, of the cargo. 	Ship Master	MPA, IMA, EHSU-BIFPCL
C28. Oil spill due to collision of barges/oil tankers	Risk of oil spill due to the collision between coal vessel and oil tanker	<ul style="list-style-type: none"> Precautionary measures will be taken by the Ship Masters to follow IMO procedures to operate the vessels. Use of piloting will reduce the risk of collision to minimim. All coal vessels will be operated under the supervision of the MPA designated pilot. Implement emergency response plan recommended under this EIA for the MPA. 	Ship Master	MPA, IMA, EHSU-BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
		<ul style="list-style-type: none"> Prevent the spread of oil spills and ensure the safety of onboard crew members Report oil spills to the proposed Mongla Port ERG immediately and ask for assistance ERG will involve local authorities (MPA, Navy, Coast Guard) in stopping oil spills as per the emergency response plan 		
C29. Coal vessel sinking	Risk of coal vessel sinking due to structural or mechanical failure and spilling oil and fuel into River.	<ul style="list-style-type: none"> Avoid barge operation in such a high wind speed as suggested in the IMO rules and regulations. Transport coal following IMSBC Code in Cargo B, Spill Response Containment plan to be implemented in case of accident. The vessel route in the Passur River is considered sheltered and no significant wave height is anticipated. Qualitative risk assessment shows minimal risk of sinking if coal transportation follow IMSBC Code in Cargo B. 	Shippers	MPA, O & M/ BIFPCL
C30. Collision and grounding risk (low visibility and fog condition)	Risk of Collision, grounding, impact during low visibility and fog conditions.	<ul style="list-style-type: none"> Night operations will follow lighting and personnel (pilot) requirements. Navigation assistance through VHF communication based on radar information to adverse weather condition, restricted visibility, changes in pilot services, or any other dangerous situation for the vessel. Appropriate equipment to be selected in accordance with specific weather conditions and vessel load characteristics. 	Shippers	MPA, O & M/ BIFPCL
C31. Collision and grounding risk (tidal condition)	Risk of collision and grounding due to tidal conditions.	<ul style="list-style-type: none"> Bathymetric survey of the transportation route to be carried out routinely by MPA. Use of appropriate navigation assistance through VHF communication based on radar information to counter adverse weather condition, restricted visibility or any other dangerous situation for the vessel. Coal barges are to be compartmentalized to reduce the potential severity of the impacts. 	MPA	MPA, O & M/ BIFPCL
C32. Risk of fire	Risk of fire from spontaneous combustion of coal at	<ul style="list-style-type: none"> Stakeholder should be aware of incubation time to Spontaneous combustion. 	O&M/ BIFPCL	MPA, IMA and EHSU/BIFPCL

VECs/Issues	Environmental Impacts	Mitigation/Enhancement Measures	Institutional Responsibilities	
			Implementation	Supervision
	stackyard.	<ul style="list-style-type: none"> • Implement a Fire Safety Plan and train all employees in regards to this plan. • Smoke detection and monitoring (as an indicator for the potential for fire). • Periodic spray of water to minimize spontaneous combustion at coal stackyard. • Emergency Response Plan (ERP) and Fire hazard management plan will be in place to handle such emergent situation.. 		
C33. Risk of fire	Risk of fire from spontaneous combustion of coal during conveyor transport.	<ul style="list-style-type: none"> • Implement a Fire Safety Plan and train all employees in regards to this plan. • Regular scheduled checks and maintenance of process area equipment (i.e., conveyor system). • No open flame/ignition source/hot work is permitted in the process areas without following proper procedural controls. • Emergency Response Plan (ERP) and Fire hazard management plan will be in place to handle such emergent situation. 	O&M/ BIFPCL	IMA and EHSU/BIFPCL
D. ASSOCIATED COMPONENTS (CAPITAL AND MAINTENANCE DREDGING)				
<p>Two separate EIA studies, i.e., one for the river reach from Mongla Port to the Project site and another for Outer Bar (not related to Maïtree STPP) for dredging have been conducted by the MPA and duly approved by DoE. They have identified the dredged spoil disposal area. Prior to the mobilization of dredging Contractors, MPA will ensure dredged spoil disposal sites those are identified in the mentioned studies whether for beneficial use or permanent land filling, in consultation with public representatives and concerned land owners. MPA should ensure all mitigation measures during all phases of dredging based on the approved EIA studies. They should prepare site-specific Dredged Material Management Plan with proper containment compartment and drainage provision. Notification to communities and river users prior to initiation of dredging. Erection of buoys in the area to alert river vessels passing the dredging site. The MPA and the Dredging contractor would be responsible for complying all the EMP measures prescribed in the approved EIAs for dredging.</p>				

11.12 Budget for EMP

956. The cost of implementing the EMP is about USD 8.03 million including monitoring cost of USD 2.02 million based on 2016 market price. Details of EMP and associated costs are given in **Table 11-4**.

Table 11-4: Estimated cost of EMP

No	Item	Unit	Amount (USD)	Remarks
	Continuous Ambient Air Quality Monitoring Station	LS	-	Included in EPC Contract
	Noise attenuation measures	LS	-	
	Continuous Stack Emission Monitoring System		-	
	Micro Weather Station LS	LS	-	
	EHS Staffs of Contractor Contractor's HIV/AIDs Management	LS	-	
	Environmental Control in Transhipper	-	-	Deemed to be included in Coal Supply Contract
	Environment Management Plan a) Air Quality Management Plan b) Biodiversity Management of Sundarbans c) Emergency Preparedness and Response Plan		- 279,500 5,723,450	Included in EPC Contract
	Institutional Arrangements			
	a) Independent Monitoring (4 years of Construction)	LS	900,000	-
	b) Independent Monitoring (5 years of Operation)	LS	1,125,000	-
Total=			8,027,950	-

12 Environmental Monitoring Plan

12.1 Introduction

957. A two-tier monitoring program has been proposed comprising compliance monitoring and independent monitoring, as the key elements of the EIA. The main purpose of this monitoring program is to ensure that the various tasks detailed in the environmental management plan (EMP), particularly the mitigation measures are implemented in an effective manner, and also to evaluate Project's impacts and risks on the key environment and social parameters. Various types of monitoring are presented in the following sections and the locations of monitoring are presented in **Figure 12-1** and **Figure 12-2** for physical parameters and biological issues respectively.

12.2 Compliance Monitoring

958. Compliance monitoring is a very important aspect of environmental management to safeguard the protection of environment. The compliance monitoring plan is presented in **Table 12-1**. The monitoring will comprise surveillance to check whether the contractor is meeting the provisions of the contract during implementation and BIFPCL during the operation of the Project including the responsible agencies for monitoring implementation and supervision.

959. For monitoring of physico-chemical parameters, locations close to the baseline sampling points are suggested. The Proponent/Contractor will be responsible for carrying out, or contracting to an approved third party, the monitoring of all the parameters as required frequency as shown in the following table by his own cost during the implementation phase. The measurement values are to be compared with the WBG's General EHS Guidelines, where relevant standards are specified, or the national standards (Environmental Conservation Rules, 1997, successive amendments or Draft Environmental Conservation Rules, 2017 and Noise Control Rules, 2006), WBG's General EHS guidelines where applicable.

12.3 Independent Monitoring

960. In compliance with the terms of EIA approval letter, BIFPCL has appointed an independent agency for carrying out tow-tier comprehensive monitoring activities, such as compliance monitoring and environmental (physical and biological) monitoring including social parameters. The independent agency has been appointed for monitoring the implementation of environmental management plan (EMP) during pre-construction/design phase and implementation/construction phases.

961. The study covers quarterly monitoring of different environmental and social parameters, and implementation of EMP during design and implementation phases. The monitoring locations were selected based on physical activities, wind direction, sensitive receptors, etc and were finalised with the consultation of DoE, Department of Fisheries (DoF), MPA and Forest Department (FD). The scope of independent monitoring covers the following activities:

- Monitoring implementation of EMP and environmental compliance;
- Monitoring of ambient air quality, noise level and water quality;

- Monitoring of cropping pattern and soil quality;
- Monitoring of fisheries resources covering fish habitats, biodiversity, migration and production;
- Monitoring of ecosystem and biodiversity;
- Monitoring of the Sundarbans Forest Health; and
- Monitoring of socio-economic condition and livelihoods.

962. Accordingly, 12 such Quarterly Monitoring Reports have been submitted to concerned departments including DoE, Bangladesh. The scope of work of the Independent Monitoring Agency (IMA) is presented in **Annex 12-1**. The abovementioned independent monitoring mission shall continue up to operation phase.

12.4 Regulatory Monitoring

963. The Forest Department and the Department of Environment will have to play important roles separately to monitor the health and biodiversity of the Sundarbans ecosystem over the years. The Forest Department has been monitoring the Sundarbans forest routinely with their own perspective. In order to capture any changes of the ecosystems, the Forest Department will rationally fix the monitoring locations and select the indicators considering the potentially of impacts for coal transportation, transshipment and other activities in the Passur Channel. Baseline monitoring, compliance monitoring and impact monitoring are to be conducted for understanding the impacts of mentioned activities on the ecosystem, biodiversity, bio-physical elements, animals' behavior etc. routinely by the Forest Department. The monitoring results will be analyzed for decision making to protect the integrity of the Sundarbans ecosystem. Similarly, the Department of Environment as a regulatory agency voluntarily can check water quality, air quality, noise level, etc. at different sensitive receptor's locations for observing the changes of the ambient environment due to the operation of power plant and associated coal transportation and transshipment activities. In this regard, the monitoring locations and indicators may be shifted over the times depending on the previous monitoring results. Most of the relevant indicators are already mentioned in the monitoring matrix presented in **Table 12-1**. Moreover, it is suggested that an Independent Monitoring Committee comprising representatives from relevant stakeholders may be formed by the Ministry of Environment and Forest (MoEF) to review and scrutinize the quarterly monitoring reports prepared by Independent Monitoring Agency.

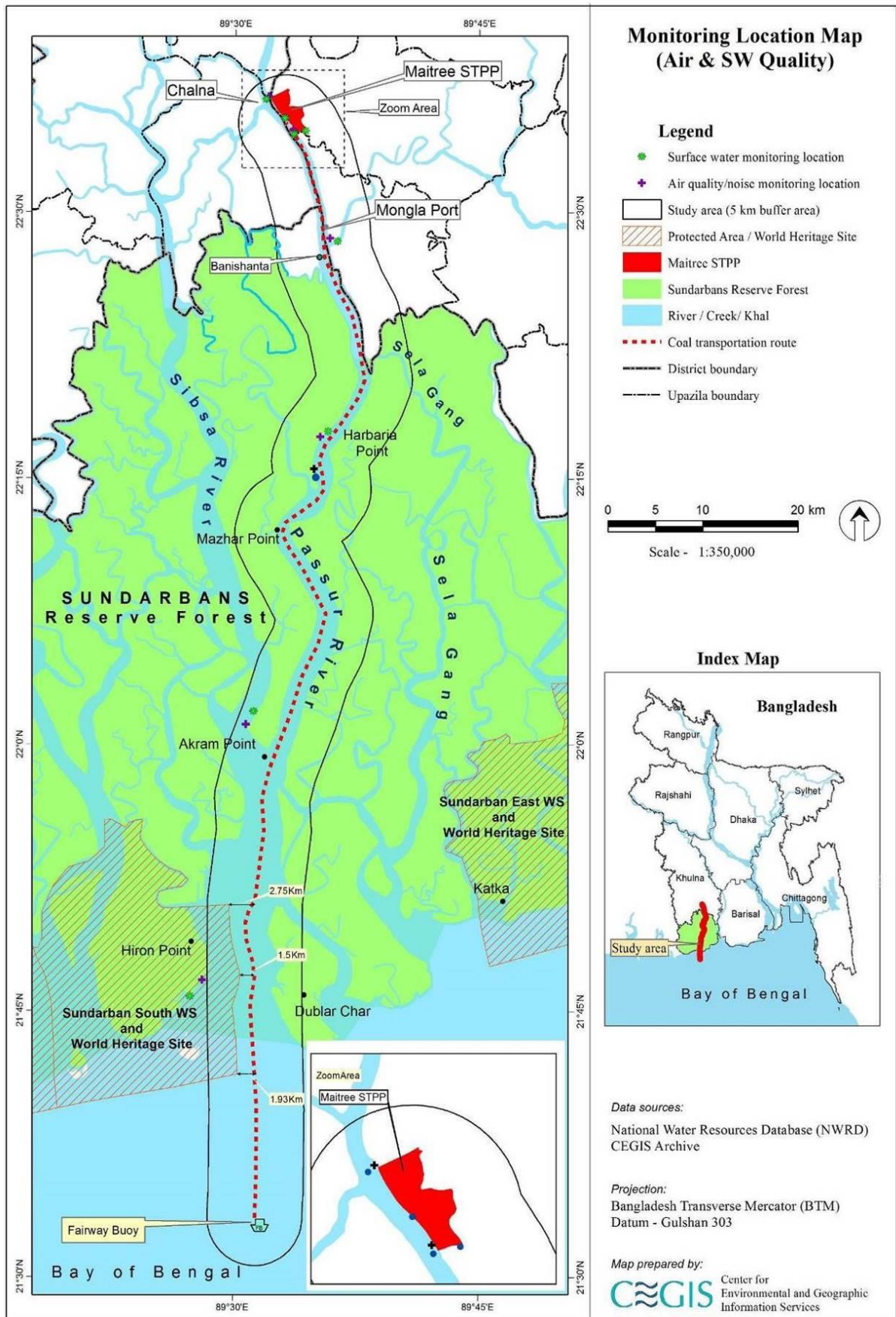


Figure 12-1: Locations of physical parameters monitoring

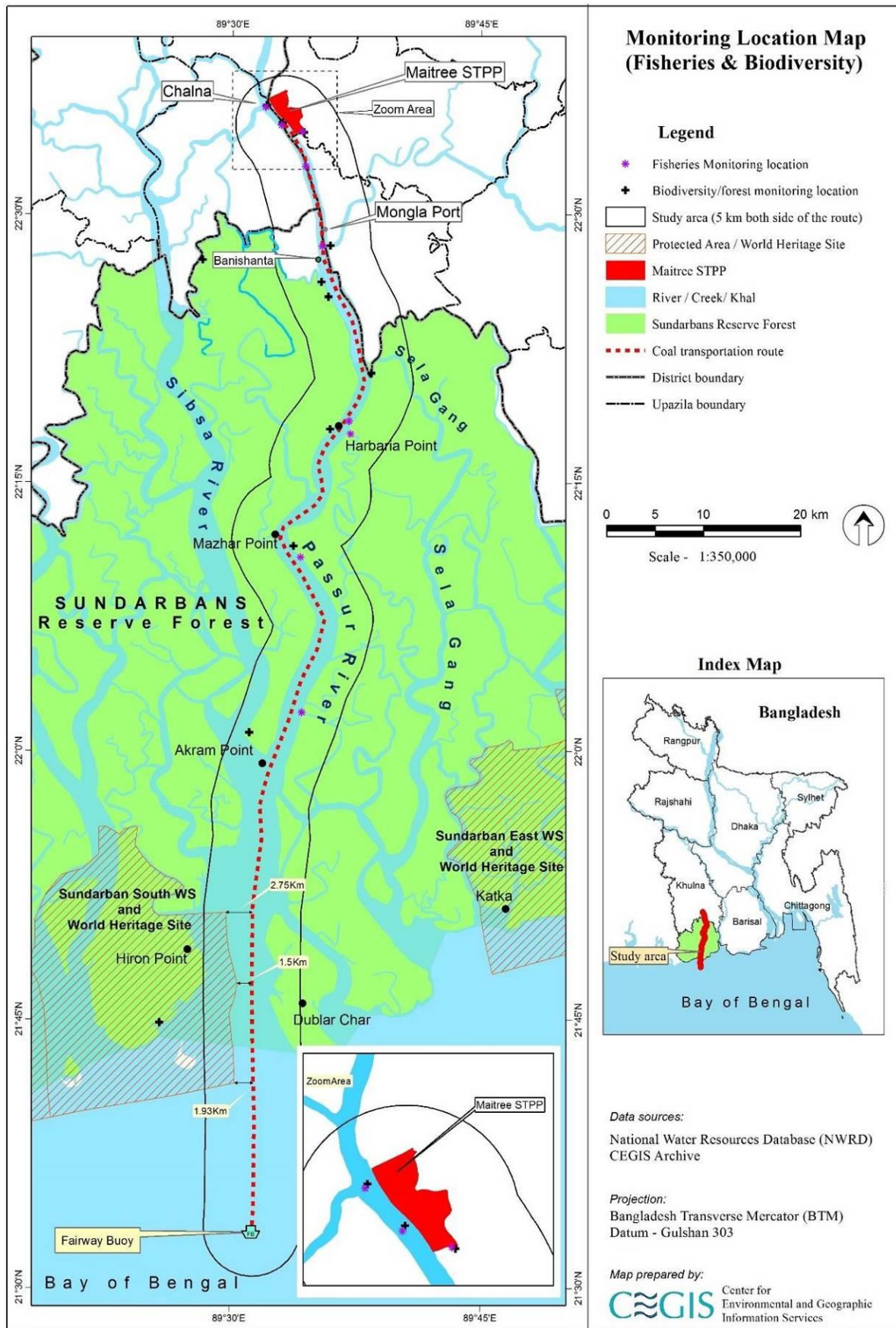


Figure 12-2: Locations of biological issues monitoring

Table 12-1: Environmental Compliance Monitoring Plan

Sl. No.	Components of EHS Monitoring	Indicator/Parameter	Locations	Frequency	Methods/Tools/ Techniques	Implemented by	
						Monitoring	Supervision
Environmental Monitoring during Implementation Phase							
1	Noise	Noise Level	South-west corner of the Jetty North-west corner of the Jetty [Monitoring Points which were being monitored under the environmental monitoring of the Maitree Power Plant should be continued up to the operation phase]	Quarterly	Field measurement using portable Noise Level Meter (ANSI II, USEPA approved)	EPC Contractor	IMA, EHSU (BIFPCL)
2	Waste Generation and Management	Quantity of Waste Generation: Domestic Waste (kg/project staff) Construction Waste (kg)	Labor Camps Project Office Rest house Construction sites	Quarterly	Field assessment using checklist, weight balance, waste separation equipment, etc.	EPC Contractor	IMA, EHSU (BIFPCL)
3	Water Quality	As per DoE's required water quality parameters	Middle of Passur River at about 100m up and down stream of the construction site. [Monitoring Points which were being monitored under the environmental	Quarterly	Field Sampling and Analysis in Accredited Lab	EPC Contractor	IMA, EHSU (BIFPCL)

Sl. No.	Components of EHS Monitoring	Indicator/Parameter	Locations	Frequency	Methods/Tools/ Techniques	Implemented by	
						Monitoring	Supervision
			monitoring of the Maitree Power Plant should be continued up to the operation phase]				
4	Changes in Tidal Behavior	Tide level (m), Tide range and lag period	Mongla port jetty	Half Yearly	Secondary data from MPA	EPC Contractor	IMA, EHSU (BIFPCL)
5	Traffic Management	Vehicular composition, traffic volume	Inside Plant including approach road	Quarterly	Traffic count survey (for vehicular composition and traffic volume) Manual observation (for vehicular speed)	EPC Contractor	IMA, EHSU (BIFPCL)
6	Vessel Movement	No. of vessel ,type of vessel and speed	Plant Jetty	Half Yearly	Field Data Collection	EPC Contractor	IMA, EHSU (BIFPCL)
7	Dolphin occurrence of river systems	Dolphin occurrence Migration route and activities	Maidara river Passur River near project Jetty Site	Quarterly	Visual survey, Transect Survey by boat and Fishers	EPC Contractor	IMA, EHSU (BIFPCL)
8	Employment Opportunity	No. of local people involved in Project jetty construction related activities	Jetty Site	Quarterly	Interview of labors and Contractor	EPC Contractor	IMA, EHSU (BIFPCL)
9	Health and Safety	Occurrence of respiratory diseases Number of accident/ near misses/incident in jetty related activities	a. Kaigar Daskati, Kapasdanga, Rajnagar and Bara Durgapur village Project jetty site	Half Yearly	Household survey and FGD; Interview of labor/personnel involved in project jetty related activities.	EPC Contractor	IMA, EHSU (BIFPCL)

Sl. No.	Components of EHS Monitoring	Indicator/Parameter	Locations	Frequency	Methods/Tools/ Techniques	Implemented by	
						Monitoring	Supervision
10	Implementation of EMP	Compliance and Independent Monitoring	<ul style="list-style-type: none"> Construction sites Labor sheds 	Quarterly	Inspection and Evaluation Interview Document/Evidence review/Checklist filling/Auditing	EHSU (BIFPCL)	IMA
Environmental Monitoring During Operation Phase							
Physical Environment							
1	Climate and meteorology	Temperature, Rainfall, Humidity, Evaporation, Sun shine hour, wind speed, wind direction	Maitree Power Plant Site	Continuous	Installation of microclimatic station along with CAMS	EHSU/ BIFPCL	IMA
2	Ambient Air Quality	SPM, PM ₁₀ , PM _{2.5} , SO ₂ , NO ₂ , CO	Location of maximum ground level concentration based on the dispersion modeling output	Continuous	Continuous Air Monitoring Station	EHSU/ BIFPCL	IMA
3	Ambient Air Quality (SO ₂ concentration)	Limestone data, FGD energy use	Flue-gas desulfurization unit at scrubber	Quarterly	Record of limestone import and use	IMA	EHSU (BIFPCL)
4	Water Quality: Surface Water	DO, BOD, COD, As, Hg, Pb, pH, Salinity, Hardness, PAH, ³⁸ NO ₃ ⁻ , PO ₄ ³⁻ , TDS, Temperature, Oil &	1. Project jetty site on Passur River at 100m up and downstream 2. Mazhar Point at	Quarterly	Field sampling and Lab analysis State of Art Technology	IMA	EHSU (BIFPCL)

³⁸Only in Harbaria and plant jetty

Sl. No.	Components of EHS Monitoring	Indicator/Parameter	Locations	Frequency	Methods/Tools/ Techniques	Implemented by	
						Monitoring	Supervision
		Grease, NO ₃ , SO ₄ , PO ₄	Harbaria (Anchorage Point) 3. Sibsa river at Akram point 4. Passur river at Hiron point				
5	Water Quality: River water	Suspended Solids and Turbidity	1. Project jetty site on Passur River at 100m up and downstream 2. Mazhar Point	Quarterly at 50 cm, 4 m from the surface and 50 cm from the riverbed	Field sampling and Lab analysis State of Art Technology	IMA	EHSU (BIFPCL)
6	River Water	Water level and current	1. 1 km downstream of Transshipment point and plant jetty	Quarterly, before ship passage and 1 minute after ship passage, every 2 minutes for 30 minutes and every fifteen minutes for 2.5 hrs	Field observation and current meter	IMA	EHSU (BIFPCL)
7	Coal dust	Dust	1. Bed sediments close to jetty 2. Bed sediments at transshipment point of Mazhar Point	Quarterly	Visual and Surface-Deposition Weight	IMA	EHSU (BIFPCL)
8	Ambient Noise	Day time (6:00 – 21:00) and Night time (21:00 – 6:00) LAeq, L10, L90	1. Jetty vicinity on the North 2. Harbaria, Mazhar Point	Quarterly	Three measurements during day time and one measurement during night time, 15	IMA	EHSU (BIFPCL)

Sl. No.	Components of EHS Monitoring	Indicator/Parameter	Locations	Frequency	Methods/Tools/ Techniques	Implemented by	
						Monitoring	Supervision
			(Anchorage Area) 3. The Sundarbans, close to Mazhar Point 4. South Wildlife Sanctuary-Hiron Point		min of measurement each time.		
9	Sediment quality monitoring	Suspended sediment load, PSD, PAH, As, Hg, Pb	1. Jetty site 2. Trans-shipment point (Mazhar Point)	Quarterly	Grab sampling	IMA	EHSU (BIFPCL)
10	Cargo air and bilge water	O ₂ , CO, CH ₄ , temperature, pH	Cargo Space	Continuous	Continuous	Ship Master	Shipper
11	Erosion and Accretion	Bank line Shifting Char Formation Change in river planform	Plant Jetty	Yearly	Image Analysis using RS/ GIS tools (once in a year) Ground Truthing through field observation	IMA	EHSU (BIFPCL)
12	Plant Health	Dust on Leaves	1. Project site at Jetty location 2. Trans-shipment point (Mazhar Point) 3. South Wildlife Sanctuary at Hiron Point	Quarterly	Leaf sampling	IMA	EHSU (BIFPCL)
13	Status of fostering activities to the	Abundance and growth	Karamjal Turtle and crocodile	Yearly	Discussion with related project officials	IMA	EHSU (BIFPCL)

Sl. No.	Components of EHS Monitoring	Indicator/Parameter	Locations	Frequency	Methods/Tools/ Techniques	Implemented by	
						Monitoring	Supervision
	crocodile and turtle project at Karamjal		breeding farms		and document review		
14	Status of forest surveillance	Number of illegal logger and poacher caught	Along the transportation route of SRF	Continuous	Periodic patrolling	Forest Department	IMA EHSU (BIFPCL)
15	Status of habitat condition	Habitat condition and Fish richness	Transshipment Point in Passur River	Yearly	Discussion with nearer Forest Beat Office/Camp officials and Catch Assessment Survey (CAS)	IMA	EHSU (BIFPCL)
16	Dolphin occurrence	Population abundance &	1. Dhangmari 2. Shela River 3. Mazhar Point (Anchorage Point) 4. Project Jetty 5. Confluence of Passur and Maidara River	Half Yearly	Opportunistic Survey through Boat Transect	IMA	EHSU (BIFPCL)
17	Benthos and plankton	Species composition & population	Plant Jetty site in Passur river Mazhar Point(Anchorage Point)	Half Yearly	Water column and sediment sampling using grab	IMA	EHSU (BIFPCL)
18	Occupational Health and Safety	Records of incidents and accidents	Jetty Trans-shipper Lighterage	Quarterly	Review of accident and incident reports	IMA	EHSU (BIFPCL)

12.5 Implementation of Environmental Monitoring Plan

12.5.1 Responsible Agency

964. PMCC during construction and technical services group of BIFPCL during operation will implement environmental monitoring program. During implementation phase, the Environmental Compliance Monitoring will be conducted by the Contractor(s) supervised by the EHSU of BIFPCL. Independent Monitoring Agency (IMA) retained by BIFPCL will conduct monitoring during entire implementation period and five years of operation. The EHSU will supervise the monitoring program during both implementation and operation phases.

12.6 Performance Indicators

965. For evaluating the performance of the environmental management and monitoring plan, performance indicators are identified for efficient and timely implementation of measures/actions proposed in the EMP. The indicators are defined both for construction and operation phases. IMA will be responsible for compiling the information on these indicators during implementation and during operation and report to BIFPCL.

966. Performance indicators for each environmental issue have been specified in **Table 12-1** and **Table 12-2**. To measure the overall environmental performance of the Project, an additional list of performance indicators is provided below:

- Number of inspections carried out by EHSU per month;
- Number of non-compliances observed by EHSU;
- Continuous period of non-compliance;
- Number of grievances received;
- Number of grievances resolved;
- Number of occupational health and safety related accidents/incidents;
- Timely reporting of documents (as defined in EMP and monitoring plan);
- Availability of environmental health and safety specialists in EHSU;
- Availability of environmental health and safety specialists in EHSU;
- Availability of environmental health and safety specialists in EPC contractors; and
- Number of trainings imparted to stakeholders/other capacity building initiatives.

12.7 Reporting and Feedback Mechanism

967. The monitoring activities will require proper documentation. In case of Independent Monitor, the monitoring results and relevant documents should be properly reported to the project implementation authority. The project authority will submit the report to the Department of Environment, DoF and to the Financer (if any).

968. During implementation phase, the environmental specialist of EHSU will be engaged in monthly discussion meeting with the Contractor(s) for giving necessary feedback. The EHSU may arrange a discussion meeting quarterly with the financer regarding the environmental compliance.

969. During the operation phase, the IMA will carry out the monitoring activities and keep all the records and results of monitoring with proper documentation and will produce quarterly/annual reports on Environmental Monitoring and submit to BIFPCL. BIFPCL then submit all reports to DoE which is a condition of renewing the Site Clearance Certificate and may submit to the financier for post-completion monitoring and evaluation of the Project.

970. During operation, the EHSU will give necessary feedback instantly to the person in concern. The EHSU will arrange a monthly meeting to disclose the results of environmental monitoring to the concerned personnel.

12.8 Budget for Environmental Monitoring

971. The cost of implementing the monitoring is about USD 2.02 million based on 2016 market price. Details of monitoring costs are given in **Table 12-2**.

Table 12-2: Estimated cost of Monitoring

Sl. No.	Items		Amount (USD)
1	Environmental Monitoring		
	1.1	Compliance monitoring during Jetty Construction (In-built in EPC Contract)	Nil
	1.2	Independent Monitoring (4 years of Construction)	900,000
	1.3	Independent Monitoring (5 years of Operation)	1,125,000
	Total=		2,025,000

13 Public Consultation and Information Disclosure

13.1 Background

972. The Environment Impact Assessment (EIA) process included public participation, consultation and focus group discussions to assist the proponent for achieving public acceptance about the Project. Public consultation is a regulatory process by which the public's input on matters affecting the community is involved and their suggestions solicited. Public consultation is preferred for the EIA study of any development Project according to the DoE Guidelines of Environmental Assessments, 1997. The following are the operational framework for the consultations:

- Free, prior and informed consultation with affected people and project relevant agencies (GOs & NGOs) from the very beginning of the project and throughout implementation period.
- Public consultation in local language (Bengali) so that it can be easily understandable to all the participants.
- Community engagement free of external manipulation, interference, or coercion, and intimidation, and conducted on the basis of timely, relevant, understandable and accessible information.
- A mitigation and contingency plan to receive and facilitate resolution of the affected communities' concerns.

13.2 Regulatory Requirements

13.2.1 Bangladesh Guidelines

973. The EIA guideline formulated by DoE in 1997 (Chapter 2) stated that since the general public is the ultimate recipient of the economic benefit and environmental damages, an EIA study should involve the public as part of decision making process development. To achieve effective public participation, it is necessary to communication with as many people as possible, as early as possible and through as many different ways as possible. This requires pre-planning, resources, identification of target groups and several of techniques for effective communication.

Techniques of Consultation

- Radio and television
- News releases
- News latter
- Advertisement
- Sample polls
- Lobbying
- Workshops
- Public meeting
- Public hearing
- Information van and
- Citizen advisory committee

13.3 Objective of the consultations

974. Public participations through consultations have been ensured during EIA study. The main objective of the consultations was to build awareness about the project within the affected community. During the detailed design phase, four types of consultation meetings were conducted with the following objectives:

- to make the public aware about the Project;
- to ensure that the public was participated in the decision-making process and raised the issues that would affect them;

- to identify the widest range of potential issues due to implementation of the Project and to identify probable solution to resolve those;
- to ensure that government departments were notified and consulted in design and mitigation process; and
- to ensure a broad range of perceptions were considered in decision-making about the transportation route.

13.4 Consultation Methodology

13.4.1 Consultation Approach

975. Participatory approach was followed for identifying the stakeholders for conducting consultations. The study team consulted the project proponent (BIFPCL) for understanding the project brief and identifying the potential stakeholders. Therefore, the key stakeholders include occupational groups, such as the Sundarbans dependent livelihood groups like honey collector (Mawali), wood collector (Bawali), *Go! Pata* collector (Thatching), fishermen (Jele), traders, boatmen, etc. along with farmers, elite persons, etc. whose activities are likely to be impacted due to the implementation of the proposed project. Furthermore, local population, LGIs, interested groups (Ship Owners Association, etc.), and BIFPCL, MPA, FD, DoE, DoF officials were considered as the potential stakeholders and were also consulted at this EIA stage.

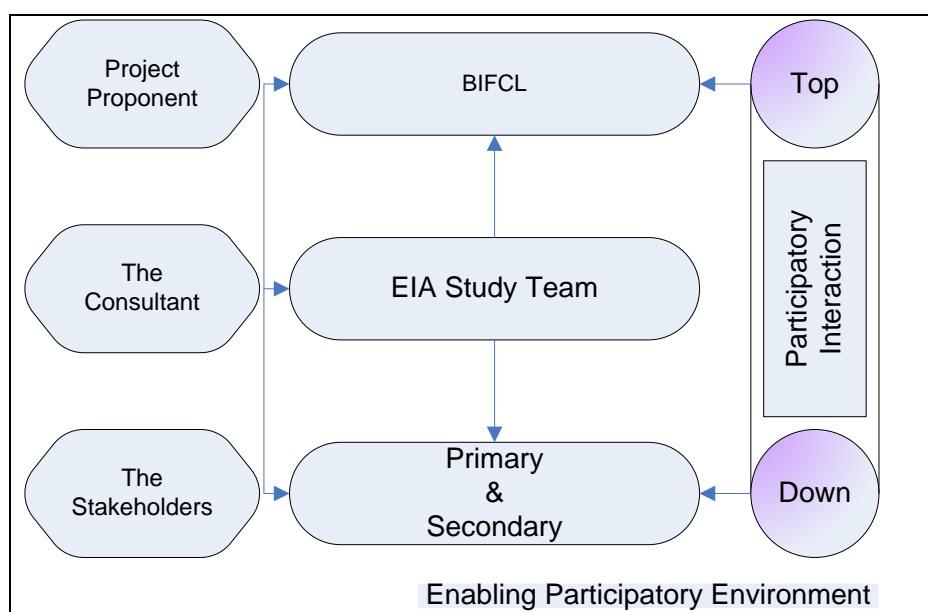


Figure 13-1: Public Consultation Process

976. Consultations and public participations have been conducted during the project preparation since January, 2016. Awareness about the project within the affected community is well established. During the detailed design phase, three tiered consultation meetings were conducted with the following objectives:

- **Informal consultation:** A number of occupational groups and other relevant stakeholders were consulted informally. These consultations were made on spot when the team visited the coal transportation route. This was actually done to create awareness among the masses and to share project related information to

them and eventually obtain support from the local communities to conduct baseline environmental, ecological, fisheries, and socio-economic surveys. No formal questionnaire were used rather people were consulted by the individual team member in terms of specific sectors i.e. water resources, agriculture, fishery, bio diversity and socio-economic sectors etc.

- **Expert Consultation/ Key Informant Interview (KII):** Experts were consulted through individual and group meetings, selected individuals and organizations with professional knowledge of EIA processes. The meetings were conducted at a very early stage (Scoping Stage) of the EA with the objective to identify people to be consulted, to brief stakeholders about the project components, and to discuss potential environmental and social impacts of the Project. The outcomes of those consultations were used to identify valued environmental components, stakeholders for public consultation and institutional strengthening of BIFPCL to implement the EMP.
- **Focus Group Discussions (FGDs):** FGDs were conducted at various stages with the affected communities, women groups, local traders, fishers, village and group village headmen and construction material suppliers. The purpose was to discuss specific issues, such as coal transportation route, trans-shipment issue, Bird population, coal quality, oil spillage and dust, water traffic management, availability of local labors, safety and security issue for labor, livelihood restoration, community involvement and sustainable environmental management. The outcome of those discussions was used to prioritize impacts and risks, and to structure the EMP.

13.4.2 Stakeholder identification

977. Stakeholders include all those who affect and are being affected by policies, decisions or actions within a particular system. Stakeholders can be groups of people, organizations, institutions and sometimes even individuals. Stakeholders can be divided into primary and secondary stakeholder categories.

978. **Primary stakeholders** are people who would be directly benefited or impacted by the proposed project. In this context, people who used this transportation route for living their livelihood or other domestic purposes were considered as the primary stakeholders.

979. **Secondary stakeholders** pertains to those who may not be directly affected but have interests that could contribute to the study, play a role in implementation at some stage, or affect decision making on Project aspects. In this project local elite persons, people who are living at the close vicinity, occupational groups, government departments and line agencies fall under this category.

13.5 Consultation Outcomes

13.5.1 Informal consultations

980. The findings of informal discussions, Focus Group Discussions (FGDs) and formal Public Consultation Meetings (PCMs) are presented in the following table.

Table 13-1: Outcome of public consultations

Sectors	Comments/Suggestions/ Concerns	Action Points
Water Resource	<ul style="list-style-type: none"> • Surface water contamination may be occurred by coal spillage and coal dust. • Bilge water can contaminate river water if discharge without treatment. • Increased movement of vessel may accelerate the river bank erosion. • Wrecked vessel should remove from the route for clearing the route and decreasing susceptibility of vessel sink. • Navigational aids should be sufficient for safe movement of vessel. 	<ul style="list-style-type: none"> • BIFPCL will use Floating Transfer Station (FTS)/Trans-shipper which is characterized by modern, efficient and tends to zero spillage of coal and dispersion of dust during unloading of coal from mother vessel to lighterage/FTS and unloading of coal at plant jetty. • The bilge water containment facilities will be developed in the plant area or MPA designated area for the lighterage vessel. • MPA will regulate speed of the vessel to prevent excessive wave to control erosion. • BIFPCL's vessel should maintain regulation of MPA and IMO on Speed, speed and beaming of light. • MPA can procure salvage vessel of adequate capacity (e.g., 20,000 ton) or go for MoU with the private or outside country agency having required salvage facilities. • MPA will install adequate navigational aids like buoy, light house, etc.
Fisheries resources	<ul style="list-style-type: none"> • Increase of vessels along the Passur River may cause disturbance to fishing. • Accidental oil and coal spillage may contaminate water; through bioaccumulation and bio-magnification enter into the human body. • Disposal of oil mixed water from the ship may cause deterioration to local habitat. 	<ul style="list-style-type: none"> • MPA and FD jointly should demarcate fishing safe zone along the Passur and sketch out to the fishermen during taking fishing pass from the Forest Beat/Range offices. • Fixing of gear type with dimension should be done with the joint effort of MPA, DoF and FD and inform the fishing community. • Fishermen are encouraged to fishing in the rivers/canals/ creeks connected with the Passur River where FD can play important role. • The capacity of MPA on emergency preparedness for combating oil spillage related issues should be increased in different ways like procuring oil sweeping vessel, boomer, etc. along with doing MoU with other private or neighbouring country company having such facilities. • The bilge water containment facilities will be developed in the plant area or MPA designated area for the lighterage vessel.
Land resources	<ul style="list-style-type: none"> • Frequent movement of large vessel for coal transportation of Rampal power plant might cause shoreline/bank line erosion due to generated wave from vessel. 	<ul style="list-style-type: none"> • MPA will regulate speed of the vessel to prevent excessive wave to control erosion. • BIFPCL's vessel should maintain regulation of MPA and IMO on Speed, speed and beaming of light.

Sectors	Comments/Suggestions/ Concerns	Action Points
	<ul style="list-style-type: none"> • Soil contamination can occur through the use of toxic materials by the transport industry. 	<ul style="list-style-type: none"> • BIFCL to engage an independent monitor/auditor to look after the vessel movement issue for check and balance. And also BIFPCL can advice the ship/vessel contractor to maintain the IMO/other rules and regulations for environmental health and safety issue where applicable. • BIFCL will make soil quality checking through SRDI/BCSIR/or other reputed organization periodically for knowing about the soil contamination.
Ecological resources	<ul style="list-style-type: none"> • Increase of river traffic may adversely affect dolphin movement, vocalization for identifying others echolocation and also can cause injury by propellers, etc. • Waste disposal from ship and accidental spills may severely deteriorate river habitat quality of the Passur River. • Wave action from vessels may cause disturbance to estuarine crocodile and river terrapin. • Wildlife inside forest may be frightened for excess beaming and whistling from ships. • Under water noise may disturb the habitat condition for biodiversity and their predation movement. 	<ul style="list-style-type: none"> • BIFPCL in coordination with MPA will take necessary steps to maintain vessel speeds, restrict spills and limiting beaming and whistling. IMO rules and regulations are advisable to follow where applicable. • MPA will increase their capacity in coping up with the emergency situation. As such, it will procure oil sweeping vessel for removing oil from water, for salvaging sunk vessel/or removing wreck a salvage vessel of capacity about 20,000 ton can be procured or MPA can do MoU with the neighbouring country(ies) agency who have required facilities. • BIFPCL's vessel should maintain regulation of MPA on Speed, speed and beaming of light. • Close coordination with Forest Department to enhance biodiversity conservation programme and financial support to strengthen surveillance systems along the route of interest. • Almost for the last 60 years, ships have been sailing through the MPA's designated route. So far, no quantifiable impact has been noticed. • The Govt./BIFPCL is suggested to conduct under water noise study for understanding the effect of vessel generated noise on local biodiversity.
Socio-economic	<ul style="list-style-type: none"> • The livelihood groups dependent on the Sundarbans (e.g. Bawali, Mawali, Fisher, wood collector, fuel wood collector, etc.) might be unaffected from coal transportation and handling. Fishers of the Sundarbans may notice disturbance in fishing activities e.g. damage of fishing nets, etc due to 	<ul style="list-style-type: none"> • Special care needs to be taken to avoid and damage to fishing nets. The relevant authorities (MPA, BIWTA, etc) should properly mark navigational route. The vessel should strictly follow the navigational route. No fishing net is supposed to be laid on the navigational channel.

Sectors	Comments/Suggestions/ Concerns	Action Points
	<p>navigation activities.</p> <ul style="list-style-type: none"> • Coals transportation and handling related works will create water pollution due to oil spillage, coal spillage and other malpractice like waste discharge, discharge of ballast and bilge water, etc. Thus, polluted water may create different water borne diseases within the nearside locality of coal transportation route. 	<ul style="list-style-type: none"> • According to IMO conventions and ECR 1997, contamination to water body is prohibited. Hence, if the responsible authorities enforce these regulations properly, water pollution due to shipping and barging activities would be minimal.

13.6 Expert/Institution Consultation

981. Expert consultations were conducted in different relevant Government and Non-government organizations both in local and national level. The interviewed experts who have specialized knowledge in wildlife, river ecology and biodiversity, fisherie, hydrology, morphology, forest, marine safety, environment issues etc. These experts are reputed persons and are responsible for reviewing the EIA report and making decisions on the EIA Approval in order to issue Clearance Certificate with Terms and Conditions. The information related to the Project were shared and obtained their feedback on valued environmental components that should be considered in the EA process. During the consultations, the discussions were held on the draft Project Description and the probable potential environmental and social impacts. The consultations offered to collect adequate information from primary and available secondary sources on environmental and social parameters. These consultations also suggested to conducted public consultations and disclosure with potential stakeholders. In addition, the regulatory requirements for environmental approval, and the public consultations were discussed in detail in Chapter 2. Table 13-2 presents list of experts and institutions consulted and their opinion on different aspects of the proposed coal transportation project.

Table 13-2: List of experts/institutions consulted and their opinions

Name & Date	Organization & Position	Expert Opinion	Suggestion/recommendation
Dr. Ainun Nishat (Academician, Water Expert and Environmentalist)	Professor Emeritus, C3ER	<ul style="list-style-type: none"> Coal dust is a major concern for the environment. The proponent should be careful on this issue. The Passur River or coal transportation route passes beside the Sundarbans South Wildlife Sanctuary (World Heritage Site). This is a great concern of World Heritage Center (WHC). The Sundarbans functions as breeding ground of sea fish, shrimp, squid, etc. and the freshwater fish as well. The breeding grounds should be conserved with care and everybody has the responsibility from their respective places and positions. The proposed coal transportation route is connected with two dolphin sanctuary, e.g., Dhangmari and Chandpai. The proponent should be careful about the coal transportation activities so that the dolphin sanctuary and other biodiversity are not disturbed. 	<ul style="list-style-type: none"> The vessel crew should be aware about the WHS and advised not to drop any kinds of wastes into the water in and around the Sundarbans. The mother vessel and lighterage should have dust suppression system like auto sprinkler. The coal unloader should be with tends to zero coal spillage and dust dispersion technology. The FD, MPA, other Govt.agencies / BIFPCL will take responsibility of monitoring of fish breeding grounds. All of these concerns are considered in the EMP.
Dr. Sultan Ahmed (20.04.2016)	Joint Secretary, Department of Environment	<ul style="list-style-type: none"> Coal Quality is one of main concerning issue. The quality of the coal should be maintained properly. Seasonal wind direction and its relation with coal dust issue should be observed/ monitored. During coal loading/ unloading period or transshipment time coal spillage quantity on the Passur River should be measured. Water dynamics of the spillage points should be under consideration. If any heap occurs on River for coal spillage, necessary action should be taken immediately. Monitoring of bird population should be measured regularly Lighterage and mother vessel must be certified by 	<ul style="list-style-type: none"> BPDB/ sponsor company/ EPC contractor, Port Authority/BIWTA/DoE will take the responsibility regarding these issues. Besides all these issues will also be mentioned in EMP.

Name & Date	Organization & Position	Expert Opinion	Suggestion/recommendation
		<p>IMO</p> <ul style="list-style-type: none"> Dust and spillage monitoring and management system has to be taken in the implementation work. Emergency response measures after accidental issues should be taken immediately Focus on fish species to protect their breeding ground (if any) within the transportation route. Seasonal traffic control policy specially during spawning and breeding period of any fish species (If any mother fishery ground exists) Special attention on dolphin species and the impacts of coal transportation vehicles on their population (Water, noise pollution) & management issues should addressed. Night time movement of vessel should avoid as it is harmful for the wildlife (Noise, Light emission from the vessel), Speed limit within SB. 	
Mr. Md. Tariquul Islam. (20.04.2016)	ACF, Department of Forest, Dhaka	<ul style="list-style-type: none"> Impact of Fly Ash from the Coal Power Plant on surface water, ground water, sinking of ship, noise created by the vessel, light have to be clearly mentioned in the EIA. The Sundarbans regulations are more stringent than ECA so Sundarbans is not covered under ECA. Forest Department has taken up an alternate livelihood of the Sundarbans resources dependent people. 	<ul style="list-style-type: none"> Project authority should also follow the Sundarbans regulations including the regulation of DoE.
Mr. Jahiruddin Ahmed. (19.04.2016)	Conservator of Forest, Khulna.	<ul style="list-style-type: none"> Information related to sulfur and other ingredients contain in imported coal should be cleared in EIA report. Number of ship movement in daily or monthly basis should be specified in EIA. Discharge of Sulfur, Pb, Mercury etc. from fuel should be quantified in EIA 	<ul style="list-style-type: none"> Vessel survey has been conducted for seven days at different eight places mentioned in Chapter 5. This chapter has the details of vessel survey including fishing boat, passenger boat, cargo boat, oil carrier and tourist boat. This report has also considered maritime traffic

Name & Date	Organization & Position	Expert Opinion	Suggestion/recommendation
		<p>considering cumulative impact.</p> <ul style="list-style-type: none"> • An analysis required to identify whether any species of the route will be affected due to the project or not. • Draft of the ships may not enough to move those vessels in the existing channel. • If the channel need to be re-excavated, then where the spoil will be dumped. 	<p>including cargo handled at Mongla Port, mother vessel and lighterage, and inland traffic including Bangladesh-India IWT Protocol. Fuel consumption has been estimated for all kinds of vessels considered in this study.</p> <ul style="list-style-type: none"> • In air quality assessment, estimation of the emission factors considered max. 1% sulphur in coal (worst case scenario), 0.5% sulphur in HSD, 3.5% sulphur in HFO for baseline, project and future scenario (cumulative). • Impact of discharged sulfur, Pb, mercury etc from the fuel of coal transportation vessels should be in tolerance level of the existing species. Sponsor company (BIFPCL), Port Authority, DoE, FD will take the responsibility to monitor it. • Spoil from re-excavation should be properly managed because both sides of the river belong to the Sundarbans area. DoE, FD and BIWTA will take the responsibility to monitor it.
Dr. Mohd. Abdul Matin (24.04.2016)	General Secretary Bangladesh Poribesh Andolon (BAPA)	<p>Given opinion on Project Description: A discussion was held among the members of the National Committee for Saving the Sundarbans (NCSS), where Adv. Sultana Kamal chaired. In that meeting the Project Description was considered word for word and the observation was settled as follows:</p> <ul style="list-style-type: none"> • We did not get anything new in this document; most of the things were in 2012 EIA. • BAPA expressed full opinion on the IEE and EIA long back. When we told our position in full perspective of Rampal Project, it is not relevant now to make comment on a small chapter of a single issue (coal transfer) of the big project. Moreover your Project Description chapter deals 	<ul style="list-style-type: none"> • Coal transportation is another major issue for such a mega project, Rampal Maitree Power Plant. Realizing its sensitivity and significance, the DoE instructed the BIFPCL to conduct EIA study of coal transportation from Fairway Buoy up to the Plant jetty. • The EIA study is not alike other same kind of study for power plant. In this study, most of the critical issues are carefully addressed. • BIFPCL and MPA where applicable will take care all kinds of concern raised in this report.

Name & Date	Organization & Position	Expert Opinion	Suggestion/recommendation
		<p>only with the mechanical arrangement of carrying and transferring coal from big to small cargo ship, from small ship to Rampal jetty, jetty to plant etc.</p> <ul style="list-style-type: none"> To participate in your chapter means that we do not have problem with other parts of this project but in reality that is not the truth, everything of <i>this project is questionable from the Sundarbans' ecological perspective.</i> 	
Mr. Abdullah Harun Chowdhury. (19.04.2016)	Professor, Environmental Science (Khulna University)	<ul style="list-style-type: none"> The implementation of Rampal power plant is major concern for the Sundarbans forest. Coal transportation may also hamper natural ecosystem of the Sundarbans and habitat of fishes in the Passur River. 	<ul style="list-style-type: none"> BIFCL, BIWTA and Mongla Port Authority will take the responsibility to ensure the nature of the Sundarbans ecosystem and marine safety.
Mr. Mahmud Hasan Salim	Director, Planning. BIWTA	<ul style="list-style-type: none"> Salvage unit is not available for continuous service. Capacity of existing Crain is not enough if any accidental incidence is happened. No fire fighting unit is available in BIWTA or others. Inadequate navigational aids exist in the proposed coal transportation route. No shelter is available in the vicinity of the Transhipped area which is essential for the protection of crew from unavoidable weather condition. 	<ul style="list-style-type: none"> BIWTA and Port Authority will take the responsibility to ensure marine safety. BIWTA and Port Authority will be responsible to conduct regular hydrographical survey of the navigational channel. BPDB/ Sponsor Company/ EPC contractor, BIWTA and Port Authority will take the responsibility to construct shelter for the crew of transhipper. BIWTA and Port Authority will take the responsibility to ensure navigational aids (i.e. signal light and others).
Mr. Md.Shafiquel Haque.	Director, Port& Traffic Department. BIWTA		
Mr. Md. Saiful Islam	Joint Director, Marine Safety & Traffic Management. BIWTA		
Mr. Md.Saifur Rahman (24.04.2016)	Joint Director, Survey. BIWTA		
Mr. Kazi Golam Moktadir 10/05/16	Director, Traffice, Mongla Port Authority	<ul style="list-style-type: none"> Draft of the ships may not enough to move large vessels in the existing channel but lighterage may serve the purpose. The Mongla port authority hase the capacity to control the water traffic in Passur channel even though the number of vessel will rise in future due to coal transportation. Till now the Mongla port authority has no capacity to salvage any big ship if any accident occurs in the channel. 	<ul style="list-style-type: none"> BIWTA and Port Authority will take the responsibility to ensure navigational aids (i.e. signal light and others).

Name & Date	Organization & Position	Expert Opinion	Suggestion/recommendation
Commander A T M Rezaul Hasan 10/05/16	Commanding Officer, Coast Guard Base Mongla, Bangladesh Coast Guard	<ul style="list-style-type: none"> The overall security system in and around the coal transportation route is up to the mark and if required the coast guard authority will provide the security service for the betterment of Rampal power plant. Separate proposal already have been given for setting up of monitoring station at Harbaria and Akram point. Special concern has to be given for newly accreted charland (Bangabondhu Char) for security purpose. 	<ul style="list-style-type: none"> Bangladesh Coast Guard will take the responsibility to ensure the safety of different vessels in the channels.
Mr. Rajib Kumar Roy 11/05/16	Upazila Nirbahi Officer (UNO), Rampal, Bagherhat	<ul style="list-style-type: none"> Special concern should provide regarding health safety of coal load unload system and coal dumping point. Special care needs to be taken to avoid impact on the Sundarbans dependant livelihood groups (e.g. Bawali, Mawali, Fisher, wood collector, fuel wood collector, etc.). Coal based power plant may create employment opportunity for local people. 	<ul style="list-style-type: none"> BIFCL, BIWTA and Port Authority will take the responsibility to solve these issues and the administrative decision will provide from UNO as early as possible.
Mr. Joydev Kumar Paul 11/05/16	Upazila Fisheries Offices, Rampal	<ul style="list-style-type: none"> There is no legalized fishing area within MPA (coal transportation) route where fishers can catch fish. They mainly catch fish from far southern part of Dublar Char. The impact on fisheries sector for coal transportation is expecting to be very low. To avoid the negative impact from coal dust, coal container should be covered properly. 	<ul style="list-style-type: none"> BIFCL, BIWTA and Port Authority will take the responsibility to solve these issues and the administrative decision will provide from UNO as early as possible.



Key informant's Interview with Department of Environment (DoE)



Key informant's Interview with BIWTA



Key informant's Interview with Department of Forest (DoF)



Key informant's Interview with Mongla Port Authority





Key informant's Interview with Bangladesh Coast Guard (Mongla)



Key informant's Interview with Upazila Nirbahi Officer (UNO), Rampal

Figure 13-2: Participants in the Public Consultation Meetings

13.7 Focus Group Discussion (FGD)

982. Discussions were held with the affected communities at Joymanirgol, Sutarkhali and Baiddamari mouzas in Bagerhat, Khulna and Satkhira districts respectively. Stakeholders included farmer, fishermen, employee, businessmen and the Sundarbans dependent occupational groups i.e. fishermen, honey-collector. Indeed, some farmers are involved in multilevel income activities i.e. boating, honey collecting etc in the Project vicinity. Location and number of participants of each discussion are listed in Annex 13-1. During all discussions, same set of questions was used, but participants freely discussed all related issues and photographs of discussions have been documented. A total of 38 different occupational members were participated in the meeting which was conducted in mixed mode approach. FGDs were mainly focused on identifying the impact of livelihood of those occupational groups who might be affected due to coal transportation through the Passur River across the Sundarbans. Though participants did not show highly negative impact to the project, they raised some issues and opinion from their context for the betterment of the project and themselves as well (**Table 13-3**).

Table 13-3: Opinion and suggestions of local communities

Occupational group	Opinion	Suggestion
Fishers	<ul style="list-style-type: none"> • People of the project surrounding areas are not very much worried about this coal transportation project as ships are always moving through the peripheral channels. • People stated that some illegal businessman used toxic chemical in some channels for catching fish which was negatively impacted to the regular fishermen. • If any accidental cause occurred during transportation i.e. oil spillage and others, it might affect the fish species of that channel. 	<ul style="list-style-type: none"> • People suggested for separate alignment for the fishermen where they can catch fish without interrupting those vessels. • People requested to prohibit the illegal act (using toxic chemical) in those important channels. • Emergency response team should be established so that this accidental cause can be quickly resolved.
Boatmen	<ul style="list-style-type: none"> • Boatmen who move to the Sundarbans generally faced the fear of robbery. The project may increase the security/safety in the vicinity which may also be a positive sign for them. • It would be better if the existing navigational route is avoided for this coal transportation route. 	<ul style="list-style-type: none"> • People demanded strong safety/security team which will be helpful for both project authority and themselves. • Try to avoid existing navigational route from the proposed coal transportation route.
Honey collectors	<ul style="list-style-type: none"> • Honey collectors were not much anxious about the transportation side however, they said that if any ingredient of those vessels degraded the environmental condition it would impact to their livelihood by decreasing amount of honey. 	<ul style="list-style-type: none"> • People suggested that project authority should keep the consciousness on the environmental issues during the implementation of this project.
Others	<ul style="list-style-type: none"> • Some other professional groups (i.e. employee, businessman, student etc.) opined that the project would not be created any major problem if any accidental event is not occurred. • Possibility of shoreline/bank line erosion due to regular movement of large vessel for coal transportation. • People opined that Rampal power Plant Project may be helpful by generating alternative livelihood in the Project vicinity. 	<ul style="list-style-type: none"> • Special care needs to be taken to avoid those accidents or minimize the loss of intensity due to those accidents, if occurred. • Project authority should concern about bank line erosion and should arrange O & M fund for mitigating erosion issue.

Source: Field data



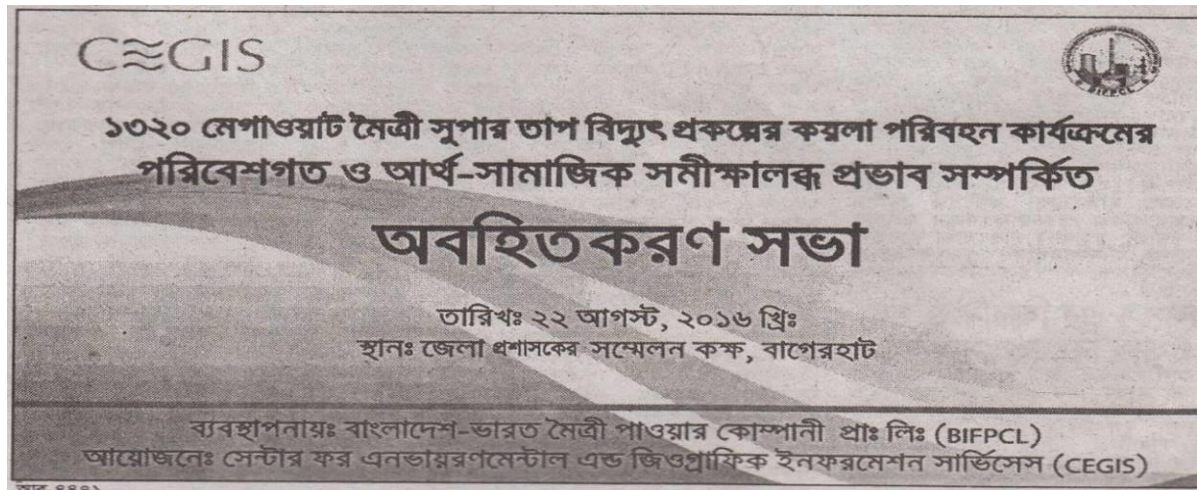
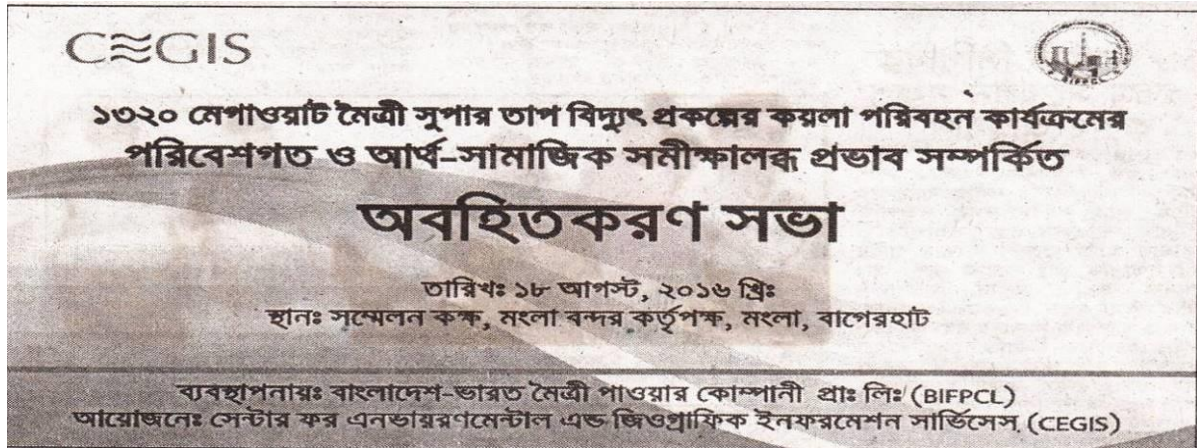
Figure 13-3: FGDs with affected communities in different places

13.8 EIA Disclosure

983. The regulatory aspect of an EIA study is to disclose Project related information to the stakeholders through a consultation process and to collect their comments and feedback and address those in the EIA report in proper manner. Mingling all sorts of information collected using different tools and techniques are presented in the report. . Disclosing the findings of the study in different means like uploading in the web site and through disclosure meeting with the stakeholders is also a part of regulatory aspect. The findings of the EIA study on the Coal Transportation have been disclosed to the local stakeholders in three different locations, such as Mongla, Bagerhat and Khulna. The principal aim of the meetings was to present the findings of the draft final EIA report and to obtain feedback from the participants of the meetings for the finalization of the report. In this regard, advertisement in the local daily newspaper 'The Dainik Purbanchal' was done separately for three places mentioned above for letting people know about the venue, date, time and purpose of the disclosure meetings (Figure 13-4). The detail schedule of the Public Disclosure Meetings (PDMs) is presented in Table 13-4 and some photographs of these meetings are given in Figure 13-5.

Table 13-4: Schedule of public disclosure meeting

Sl. No.	Meeting Venue	Type of consultation	Meeting date	Time
1	Conference Room, Mongla Port Authority, Mongla, Bagerhat	PDM	18 th August, 2016	10:00 hrs to 14:00 hrs
2	Conference Room, DC office, Bagerhat	,,	22 nd August, 2016	10:00 hrs to 14:00 hrs
3	Conference Room, DC office, Khulna	,,	23 rd August, 2016	10:00 hrs to 14:00 hrs



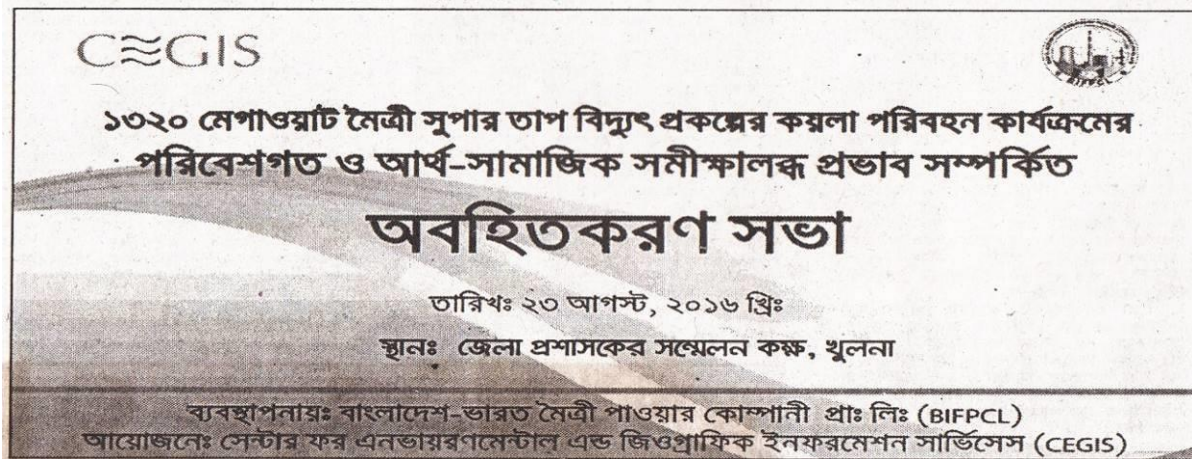


Figure 13-4: Advertisement for PDMs at Mongla, Bagerhat and Khulna



PDM at Conference Room, Mongla Port Authority, Mongla, Bagerhat



PDM at Conference Room, DC Office, Bagerhat



PDM at Conference Room, DC Office, Khulna

Figure 13-5: Participation of participants in the PDM sessions

984. The participants of these PDMs included Members of Parliament (MPs) from concerned constituencies, Deputy Commissioners (DCs), Chairman, Mongla Port Authority, Upazila Chairmen, Upazila Nirbahi Officers (UNOs), other concerned government officials, Journalists, NGO representatives, environmentalists and activists, local stakeholders, Managing Director of BIFPCL, Deputy Executive Director and other representatives of CEGIS. Among the dignitaries Mr. Talukder Abdul Khaleq, MP, Bagerhat Constituency 3, Mr. Mir Sowkat Ali Badshah, MP, Bagerhat Constituency 2 and Mr. Mizanur Rahman Mizan, MP, Khulna Constituency 2 attended the meetings. A total of 212 participants attended the public disclosure meetings. Among the participants, 54 were attended at Mongla PDM, 78 at Bagerhat PDM and 80 at Khulna PDM.

985. The attendees of the meetings expressed their views regarding coal transportation and its handling process. Issues raised in the meeting, responses and actions points are discussed below in **Table 13-5**:

Table 13-5: Comments and responses of Public Disclosure Meeting

Comments of the participants	Responses of CEGIS	Action Points
Meeting Venue: Conference Room, Mongla Port Authority		
What is the methodology to conduct this study and how primary as well as secondary data being incorporated in this report?	The study was conducted by following the DoE approved TOR and World Bank Group Guidelines where standards are absent in the ECR, 1997 and successive amendments. Some secondary information on chart datum (CD) and class vessel were collected from the Mongla Port Authority (MPA); but majority were primary data used in the preparation of the study report.	This is already done in EIA report
There is no citation about green plantation and community involvement in this report.	There is a provision of plantation program of about five hundred thousand plants in the open spaces of the Project site.	A MoU has already been signed between BIFPCL and Bangladesh Forest Department (FD) for planting of two lac plants. Already about 23,000 plant saplings have been planted.
There is sanctuary for Hilsa fish and Dolphin, Is there any impact on dolphin due to coal transportation?	The Passur Channel, designated route of the MPA has been selected for coal transportation. This route has been used for cargo transport for about 100 years. Dolphins are already habituated with the condition. The coal transportation will add only three vessels in two days which might have very insignificant impact on dolphin.	MPA will be responsible to monitor any impact on dolphin due to coal and other materials and goods transportation through the Passur Channel. This issue has been incorporated in the report.
Will Hilsa fish habitat be affected by coal transportation?	There is a nursery ground of Hilsa fish along the coast but very limited Hilsa fish movement along the Passur Channel. Class covered vessel, equipped with modern technology having self bilge water containment; transhipper with ante-spillage plates and covered conveyor belt will be used for transporting coal from the anchorage point to the Project jetty. So, there will be no or insignificant chance of Hilsa fish habitat disturbance. Moreover, due to increase of vessel movement in the channel catching juvenile fish will be greatly reduced; as a result fish population will increase in the Passur River.	The MoEF, MPA, other Govt. agency will take responsibility of monitoring of fish breeding grounds. This issue has been incorporated in the report.
What is the role of MPA in coal transportation?	The major roles of the MPA are: ✓ Selection of River Transportation Route. ✓ Routine survey of river draft and make the bathymetry available to the stake holders. ✓ Install signals to demark the MPA route.	Mongla Port Authority will take the responsibility to ensure these activities during coal transportation and other vessel movement through the MPA route. This issue has been incorporated in the report.

Comments of the participants	Responses of CEGIS	Action Points
	<ul style="list-style-type: none"> ✓ Maintenance of river draft as suitable for transporting coal and other goods and materials to the Project jetty; ✓ Supplying of trained pilot for piloting Handysize mother vessel up to the Mazhar Anchorage Point; ✓ Enforce maritime law and rules & regulation within the MPA jurisdiction. ✓ Responding to the emergencies if arise. Etc. 	
How MPA is capable to handle any accidental events occurred in coal transportation route?	MPA will respond promptly as a part of their Emergency Response Plan suggested in this study along with the salvage vessel.	This issue has been incorporated in the report.
Amount of coal to be transported to the Project jetty?	Maximum 4.7 million metric tons per annum	BIFPCL will be responsible to monitor every day the amount of coal and other goods and materials to be transported to the Project site jetty.
In case of capsizing of oil tanker?	Firstly, the coal transportation has no direct link with the oil tanker capsizing because compared to coal a very little quantity of Oil or oil product will be transported for the Coal power Plant. Most of the Oil and Oil product used in the South Western part of Bangladesh are transported through the MPA route. MPA has to strictly impose the maritime rules (national and international) to avoid capsizing of ship in the designated route. Secondly, in case of oil tankers or other river craft capsizing- MPA will take necessary action as per the Emergency Response Plan suggested under this study.	MPA is primarily responsible to respond and mitigate the incident within their jurisdiction. If they need or desire they would seek help of the other agencies or stakeholders to mitigate.
Is the Sundarbans 20 km apart from the Project site?	The distance between the nearest tip of the Sundarbans and the stack of the Project is about 14 km.	This issue has been incorporated in the report.
Would Indian Govt. approve this project if it were in their country?	Bangladesh and Indian Government's regulation on ECA is similar. Legally there is no bar to install Power Plants outside 10 km of ECA in India and Bangladesh as well.	N/A
Did the Project consider coal transportation using rail?	BIFPCL has kept the provision of coal transportation using rail if at time coal deposits of north Bangladesh developed and made available to Rampal Power Plant. But at this point such possibility is remote.	N/A
Ensure Employment opportunity for both skilled and unskilled labor.	BIFPCL already recruited some local laborers from the beginning of the construction activities.	BIFPCL and BPDB will be responsible to ensure employment opportunity for local people.
How alternative routes have been fixed for coal transportation and from which	Considering the required draft of ships, navigability of the route under consideration, the distance of route and other related	Detailed alternative route study have been delineated in the EIA report.

Comments of the participants	Responses of CEGIS	Action Points
countries coal will come for power plant?	factors alternative routes of coal transportation has been recommended. Coal for the project will be imported from Australia, South Africa and Indonesia.	
Was any community knowledge taken in the study?	The study at stages conducted numbers of public consultations meeting to gather community knowledge. The opinions of the local stakeholders have been recorded and reflected in the relevant Chapter: Stakeholder Consultation and Disclosure.	This is already mentioned in EIA report in Public Consultation Chapter.
Is there any Feasibility study conducted for this project?	Feasibility Study of the power plant was conducted by the NTPC and Coal Logistics study was conducted by the Price Water House Cooper's.	This is already mentioned in EIA report.
Accidental event of coal borne ship.	BIFPCL will engage modern class vessel which will have less susceptibility to accidental event.	MPA, BIFPCL and related government authorities will be responsible for these issues.
Given impetus on the arrangement of more similar workshop for positive propaganda regarding the establishment of power plant.	This is a good suggestion. BIFPCL should strengthen their permitting activity to meet the requirement	BIFPCL and BPDB will be responsible.
Where (how far) the coal dust will be settled?	For arresting coal dust, a number of management measures have been considered under this Project. These are: ✓ Dust suppression system ✓ Covered modern lighterage (class vessel) ✓ Closed conveyor belt ✓ Duly designed hopper ✓ Grabs equipped with dust cover plates etc. So, negligible amount of dust will escape and settle in the nearby area.	This is already mentioned in EIA report.
Would the effect of the project during construction and operation be monitored?	A consulting company has been engaged to monitor the effect of the project during construction and implementation of the project. The reports may be seen in the Web page of BIFPCL.	BIFPCL and BPDB will be responsible for monitoring of the changes (if any) between before and after project situation.
Is climate change considered here?	Climate change has been considered in the design stage of the Project. Based on climate change and other related issues, Project plinth level, ash pond, etc. have been designed.	Implementing agency will design the project activity considering climate change and other related issues.
Freshwater discharge through the Gorai River has been increased due to removal of silt from the Gorai Off-take. This will feed the Sundarbans and	These are statements only.	N/A

Comments of the participants	Responses of CEGIS	Action Points
facilitate mangrove trees. Dolphins and crocodiles were abundant in the 140 km long stretch of the Passur River. What is the present status of these animals? Poison fishing did a great harm to the Sundarbans fishery. Ghasiakhali canal dredging has been done and continuing for increasing navigability of the canal. There is also a river name Khorma beside Chandpai through which some vessel travelled.		
What is the Project life considered?	Project life of this Power Plant is considered 25 years.	N/A
<i>Note: These questions are raised by the following persons: Mr. SK Abdul Jalil, Commander, Nur-E-Alam Sheikh, Journalist, The Daily Independent, Mr. Suresh, Journalist, Prothom Alo, Mr. Imran Hossain, Bashundhara Group, Mr. Pollab Roy, Correspondent, Nobolok(NGO), Mr. Ahshan Iqbal, Rampal Upazila, Deputy Forester, Sundarbans East, Mongla, Mr. Talukder Abdul Khaleque, MP which represents the voice of all participants in that meeting</i>		
Meeting Venue: Conference Room, District Commissioner's Office, Bagerhat		
Should consider the probable impacts of Power Plant on the Sundarbans and World Heritage Site (WHS)	Possible impact on the Sundarbans and WHS have been duly considered in the coal transportation EIA study	DoE to monitor
No. of ships move through the Passur Channel	Maximum 143 nos. of mother vessels per year may anchor at the Passur River anchorage points and about 500 lighterage vessels may ply between anchorage points to Project site jetty annually against about 15,000 vessels of various size plying through the Passur Channel at present.	N/A
Search light how to manage?	Marine Vessel's search light operation will be used in controlled manner by following the IMO rules and regulations. Marine Vessel's (Ship) Captain will be responsible for such action and MPA will monitor the vessel operation.	MPA. This is already mentioned in EIA report
How oil spill will be managed if happen.	In case of any such event MPA is primarily responsible for emergency response. If necessary they would seek help from the other relevant stakeholders. In this regard an emergency response plan (ERP) has been suggested in the EIA report.	This is already mentioned in EIA report.
Is noise detrimental to the Sundarbans?	Vessel whistles will be blown in a very controlled manner. Noise from the vessel will reach the shore may not have any noticeable effect. Presently, everyday numbers of ships are plying through the Passur river. This route has been used for	This is already mentioned in EIA report.

Comments of the participants	Responses of CEGIS	Action Points
	cargo transport for about last 60 years. So far there is no noticeable impact on the Sundarbans and WHS has been reported.	
How much coal will be burnt per day? Is it 27,000 MT?	Maximum 12,000 tons of coal will be burnt everyday in the Rampal Coal Fired Power Plant. However, it may vary depending on the quality of coal.	N/A
Is it Thermal power plant?	Yes. It is a Thermal Power Plant.	N/A
Is it inside the Sundarbans by 4km?	No, it is at a distance of about 14 km from the nearest tip of the Sundarbans.	N/A
Is there any power plant in Calcutta? Why is it in the Sundarbans?	According to the available information there are nos. of Power Plants in and around Kolkata (Calcutta) city. The Power Plant is not in the Sundarbans, it is about 14 km away from the Sundarbans.	N/A
Will 12,000 tons of coal be burnt daily?	Yes, maximum 12,000 tons of Coal will be burnt everyday in Rampal Power Plant.	N/A
What will be the system of Coal Transportation	Coal will be carried by covered mother vessel from the importing port up to the anchorage point within Bangladesh. From anchorage point those will be lightered by environment friendly transshipper to lighterage covered class vessel and will be transported to the plant site jetty through the Passur river.	BIFPCL
What types of damage to be occurred in the Sundarbans?	If coal is transported maintaining IMO convention and suggested mitigation measures, there will not be any visible / noticeable/quantifiable impact on the Sundarbans.	N/A
Will coal be transported in covered state?	Yes, coal will be transported in covered vessel and covered conveyer belt.	This is already mentioned in EIA report.
How coal is unloaded?	By environment friendly transhipper in the anchorage point and by covered conveyer belt in the Plant Jetty.	This is already mentioned in EIA report.
<i>Note: These questions are raised by the following persons: Professor Mozaffar Hossain (Retd.), Chemical Expert, Sk. Azmal Hossain, Dr. Khan Kamaluddin Ahmed, Mr. Ahsanul Karim, Journalist, Bangladesh Protidin, Upazila Chairman, Civil Surgeon, President, Press club and Mr. Shoakat Ali Badshah, MP which represents the voice of all participants in that meeting</i>		
Meeting Venue: Conference Room, Divisional Commissioner's Office, Khulna		
Ensure proper implementation measures as it is suggested in EIA.	As per DoE rules the proponent has to follow the measures suggested in the approved EIA and implementation of the suggested measures needs to be monitored properly.	BIFPCL would be responsible for implementation and DoE for Monitoring. This is already mentioned in EIA report.
Investment and profit sharing planned should be disclosed properly	BPDB and NTPC will provide 15% equity and 70% loan will be borrowed from the EXIM Bank. Profit out of the Project will be shared equally by both the parties.	BPDB and BIFPCL will take appropriate actions in time.

Comments of the participants	Responses of CEGIS	Action Points
Is there any coal processing plant in the power plant complex area? Detail of its area and capacity.	No. there will not be any coal processing arrangement in the Plant area.	N/A
What would be the vessel controlling method in the transportation route?	It is the responsibility of the MPA to control and administer the vessels plying through their jurisdiction.	MPA
How the coal will be carried from anchorage point to Project jetty? What would be the salvage system?	Coal would be carried by covered class vessel from anchorage point to the project site jetty. Salvage procedure would be same as it is being practiced for other vessel under the MPA.	N/A
Is the draft of ships adequate to move freely in the transport route? If there need regular dredging how this cost will be managed by GoB or BIFPCL?	To maintain the river draft is the responsibility of MPA. To facilitate such service they collect fees from each ship/ vessel plying through this route.	MPA
What will be fuel of ships and how will be the oil spillage managed if any accident occurred?	Oil is the dominant fuel for the river craft throughout the world. There is very strict regulation of IMO to control oil spillage from the ships. MPA also has similar regulations.	MPA and DoE
What role will be played by DoE and FD in this project?	DoE has the regulatory and monitoring role. Forest Department has the monitoring role to assess the impact on their resources and suggest mitigation measures if any.	DoE and FD
Is the pollution due to the project fully measured from all dimensions?	Possible pollution from the Project has been estimated in all possible dimensions.	This is already mentioned in EIA report.
Contemporaneous EIA should be done measuring all the issues scientifically.	Environmental impact monitoring starting from the construction phase is being carried out and it will continue throughout the project life.	BIFPCL and DoE
What amount of coal will be transported daily?	Ten to twelve thousand tons of coal will be transported everyday to the Plant site jetty.	This is already mentioned in EIA report.
What will be the impact of bio-diversity, which types of species will be endangered due to the Project? Estimate the actual loss in quantity using the source of primary and secondary data.	If the EMP measures are followed (for which the proponent is committed) there will not be any quantifiable impact on neither the biodiversity nor any type of species will be endangered.	N/A
What will be the quality of coal (contained ingredients) and from where it will be imported?	The coal have GCV about 5200-6300 Kcal/kg, maximum sulphur and ash content of such imported coal will be less than 0.9% (average sulfur content is 0.6%) and 18% (avg. 10%) respectively. Accordingly Boiler of the power plant has been designed to cater coal of GCV 5200 kcal/kg to 6300 kcal/kg AR basis. Coal will be imported from Indonesia, Australia or South	This is already mentioned in EIA report.

Comments of the participants	Responses of CEGIS	Action Points
	Asia.	
Why not the Mongla-Ghasiakhali route is used for transportation?	No maritime vessel will able to sail through the Mongla-Ghasiakhali route mainly due to lack of required draft and also other consideration. Only inland river transport can sail through this route.	This is already mentioned in EIA report.
What will be the quality of vessels, what will be the speed of ships, and what types of toxic ingredient can be discharged from it?	IMO certified class vessel will carry coal from the source country to anchorage point and project site jetty. In this type of vessels necessary provisions are there so that discharge of toxic ingredient can be minimized. The vessel will maintain the speed limited by MPA.	MPA and BIFPCL
What change will be occurred in river morphology?	The vessel will maintain the speed limited by MPA so that there will not be any additional erosion due to transportations of coal and other materials. However due to natural reason there will be some erosion and accretion in the Passur River.	MPA
Local NGOs should have engaged in the study for getting actual primary field information.	During the study at cases local man power have been used to carry out the study from the field where possible and still being continued.	N/A
Propaganda of Rampal Power Plant should be stopped by executing numbers of national level workshops.	Yes, there should be a permitting team in the BIFPCL to publicize the project activity through Journal, Newspapers, workshops etc.	N/A
What are the core objectives to establish the power plant in the selected area while it is a controversial area and the project is not economically benefited as well?	The site was selected considering Social, Environmental and economically most suitable among other probable alternates.	N/A
What would be the effect on local population due to implementation of this project?	Effect (negative) on the local population was found to be least among the other alternate site. Local population will get economic benefits and benefits of local area development.	N/A
How the Coal will be managed when those will be transferred from mother vessel to lighter ship?	Coal will be lightered through the environmental friendly transshipper. So, there will not be any visible environmental impact.	BIFPCL
<p><i>Note: These questions are raised by the following persons: Abed Hossain Kabir, Red Crescent representative, Khandker Azizur, Md. Anisur Rahman Biswas, Acting Mayor, KCC, Mr. Nazrul Islam, President, Press Club, Mr. Mahamudul Sihab, Alhaj Md. Mijanur Rahman, MP, Khulna-2, Alamgir Kabir (Activist), Mr. Mahmud Reza, Md. Babul Hawlader (President, the Sundarbans Conservation National Committee), DFO, Sudarban Weat Forest Division, Mr. Iqbal Hossain Biplop, Secretary, BAPA, Mr. Engr. Enayet, KDA, Dr. Kazi Baizid Kabir which represents the voice of all participants in that meeting</i></p>		

14 Conclusions and Recommendations

14.1 Conclusions

986. The Environmental Impact Assessment (EIA) of the coal transportation study Project has identified that, the Project is unlikely to cause any significant adverse impact in the study area which comprises part of Sundarbans Reserve Forest. Many of the impacts are localized and short term or temporary in nature. Most of the identified impacts have already been addressed by appropriate embedded control measures in the Feasibility and Design Phase of the Project as well as additional mitigation measures and environmental management plan(EMP)suggested in this EIA Study Report. Moreover, the Project will also have several benefits to the study (Project) area through supporting economic growth in this region by opening avenues for future development, direct and indirect employment opportunities and improving local infrastructure facilities.

987. During the Feasibility and Design Phase, selection of coal logistics and transportation route has been selected through satisfactory consultation with relevant and responsible Authority as well as considering least adverse impacts on ambient environment, the Sundarbans Ecosystem; Dolphins and other aquatic organisms; Fisheries habitat and species of conservation significance.

988. During the Implementation Phase of the Project, the key adverse environmental issues to be considered are impacts on terrestrial breeding pools and pans, soil, air and water quality of nearby jetty construction site, lighting, ambient noise, underwater noise level, dust generation, aquatic wildlife, fisheries habitat and species of conservation significance(Dolphin).

989. During the Operation and Maintenance phase, there may be marginal impact on marine environment and safe transportation of coal; ambient environment; aquatic habitat; wildlife and other aquatic animals; the Sundarbans and the World Heritage Site (WHS) ecosystem and Mangrove forest, but localized and short term or temporary in nature. Identified environmental impacts will be induced from shipping and transportation of coal; transshipment; discharge from ships; movement of bulk carriers and lighterage; spillage of coal; accidental spills and leakage of hazardous materials including coal and oil to the Sundarbans river system during handling, transportation and storage at the Power Plant site and other associated activities, which were analyzed. The impact assessment and prescribed EMP along with embedded control suggests that these impact will have minimal effect on the sensitive receptors. In contrary, increased vessel movement during Operation and Maintenance Phase will positively impact on Fishery productivity as vessel movement activities may restrict Post Larvae (PL) catching which may facilitate wild shrimp production, mixing of oxygen into water and increase in dissolved oxygen.

990. Socio-economic environment of the study area will be benefited by creation of new employment opportunities and project induced economic activities throughout Implementation, Operation and Maintenance phase of the Project. Moreover, there will also be adverse socio-economic impacts on local community, existing livelihood, health and safety. The range of impact identified include conflicts with the local community and worker's culture, health and safety issues at workplace, social facilities and utilities, risk of spreading

communicable and sexually transmitted diseases and unhygienic conditions from migration of labor into the Project area, jetty construction activities and increased vessel movement in the Project areas.

991. The magnitude and significance of most of these impacts would be limited to only construction period and minimal in nature. Furthermore, considering the embedded control measures and the proposed mitigation measures the adverse impact of the project will be largely minimized.

992. The Implementation Phase of the Project will have an important role in the socio-economic development of the study area whereas the Operation and Maintenance Phase of the Project will play an important role for Power generation and supply to the national grid by ensuring uninterrupted supply of primary fuel to the Maitree Super Thermal Power Plant to be constructed at Rampal, Bagerhat. A reliable and enhanced electricity supply to the national power grid will support future economic development of various depended sectors of the South–West region of Bangladesh including agriculture and other manufacturing industry.

14.2 Recommendations

993. The EIA Report prepared for the Coal Transportation of Maitree Super Thermal Power Project recommended for approval from the DoE. It is expected that DoE while giving approval put conditions to strictly comply with the EMP requirements stipulated in the EIA report.

994. It is also recommended that IMA will monitor and audit the parameters suggested in the EMP in relation to the power plant and coal transportation. The monitoring and auditing outcome should be reported quarterly and annually and make available to the public in the public domain. As such, it will ensure the implementation of EMP suggested in the EIA.

Reference

- Achten, C. & Hofmann, T. (2009). "Native polycyclic aromatic hydrocarbons (PAH) in coals – A hardly recognized source of environmental contamination". *Science of the Total Environment*. Volume 407, Issue 8, pages 2461-2473.
- Agence France-Presse, Only 100 Tigers Left in Bangladesh's Famed Sundarbans Forest, (July 27, 2015), <http://www.theguardian.com/environment/2015/jul/27/only-100-tigers-left-in-bangladeshs-famed-sundarbans-forest>.
- Ahmed, A.; Aziz, A.; Khan, A.Z.M.N.A.; Islam, M.N.; Iqbal, K.F.; Nazma, M.; Islam, M.S. Tree diversity as affected by salinity in the Sundarbans Mangrove Forests, Bangladesh. *Bangladesh J. Bot.* 2011, 40, 197–202.
- Ahrens, M.J. & Morrissey, D.J. (2005). "Biological effects of unburnt coal in the marine environment". *Oceanography and Marine Biology*. Volume 43, pages 69-122.
- Alom, Z. 2013. *Waterways of the Sundarbans: Home to Freshwater Cetecean*. In: Reza Khan (editor): *Sundarban: Rediscovering Sundarban, The Mangrove Beauty of Bangladesh*. Dhaka: Nymphaea Publication. 178pp.
- Apurba R. G., Padmanabha C. and Sandipan P., 2006. Impact of diesel oil effluent in the mucosal surface of the alimentary canal of *Oreochromis nilotica* (Linnaeus): A scanning electron microscopic study. *Journal of Environmental Biology* January 2006, 27(1) 129-134.
- Aziz, A., and Paul, A. R., 2015. Bangladesh Sundarbans: Present Status of the Environment and Biota. *Diversity* 2015, 7(3), 242-269; doi:10.3390/d7030242.
- Biswas, Shekhar R., Choudhury, Junaid K., Nishat, A., Rahman, M. M., 2007. Do invasive plants threaten the Sundarbans mangrove forest of Bangladesh. *Forest Ecology and Management* 245 (2007) 1–9, ELSEVIER.
- Campbell, P.M. & Devlin, R. H. (1997). "Increased CYP1A1 and ribosomal protein L5 gene expression in a teleost: The response of juvenile Chinook salmon to coal dust exposure". *Aquatic Toxicology*. Volume 38, Issues 1-3, pages 1-15.
- Carlson, R. (1979). "Implications to the aquatic environment of polynuclear aromatic hydrocarbons liberated from Northern Great Plains coal". *Environmental Research Lab, Office of Research and Development, U.S. EPA 600/3-79-093*.
- Chantarasri S. Fisheries resources management for the Sundarbans reserved forest. In: *Integrated resource development of the Sundarbans reserved forest, Bangladesh (BGD/84/056)—Fourth draft final report*. Khulna, Bangladesh: FAO/UNDP, 1994, 171pp.
- Choudhury J. K., 1997 Sustainable management of coastal mangrove forest. Development and social needs. XI World Forestry Congress, Antalya, Turkey. Vol 6, T.38.6.
- Chowdhury R. A., Ahmed I., 1994 History of forest management Bangladesh. In: [Mangroves of the Sundarbans]. Hussain Z., Acharya G. (eds.), pp.155–180
- David A. L. and Barbara L. P. S., 2001. Spatial and temporal impacts of a diesel fuel spill on stream invertebrates. *Freshwater Biology* (2001) 46, 693±704.
- De Wolf, H., Ulomi SA, Backeljau T, Pratap HB, Blust R, (2001) Heavy metal levels in the sediments of four Dares Salaam mangroves accumulation in, and effect on the morphology of the periwinkle, *Littorariascabra* (Mollusca: Gastropoda). *Environ Int.* 26, 243-249.
- DoF, 2015. Fisheries Resources Survey System, 2013-14.

- CEGIS (2012). *Environmental and Social Study of the Gorai River Restoration Project*. CEGIS for Multi-Sector Planning, Dhaka.
- FD, 2010. *Integrated Resources Management Plans for the Sundarban (2010-2020)*, Vol. 1, Forest Department, Ministry of Environment and Forest, Government of Bangladesh, Dhaka.
- Gain D. and Das S. K., 2014 Present status and decreasing causes of shellfish diversity of Passur river, Sundarban, Bangladesh. *AACL Bioflux* 7(6):483-488.
- Gittins, S. P., 1981. *A survey of the primates of Bangladesh*. Unpublished report. Fauna Preservation Society, London. 64 pp.
- Guhathakurta H, Kaviraj A, (2000) Heavy metal concentration in water, sediment, shrimp (*Penaeus monodon*) and mullet (*Liza parsia*) in some brackish water ponds of the Sundarbans, India. *Marine Pollut. Bull.* 40, 914-920.
- Health and Safety Executive (2014). *Safety in Docks*. Retrieved from <http://www.hse.gov.uk/pubns/ priced/1148.pdf>
- Hendricks, H., 1975. The status of the tiger *Panthera tigris* (Linne, 1758) in the Sundarbans mangrove forest (Bay of Bengal). *Saugetierkundliche Mitteilungen* 23 : 161 - 199.
- Huq, K.A. Islam, M.S. and Hossain, M.A.R., 2001. A review on importance of sundarban mangrove fisheries of Bangladesh, *Bangladesh J. Fish.* Vol. 24(1-2): 73-85.
- Iftakhar M. S., Islam M. R., 2004. Degeneration of Bangladesh's Sundarban mangroves: a management issue. *The IntFor Rev* 2:123-135.
- INCOIS, 2017. *ESSO - Indian National Centre for Ocean Information Services*. An Autonomous Body under the Ministry of Earth Sciences, Govt. of India (<http://www.incois.gov.in>).
- Islam, M. S., Wahab M. A., 2005. A review on the present status and management of mangrove wetland habitat resources in Bangladesh with emphasis on mangrove fisheries and aquaculture. *Hydrobiologia* 542:165-190.
- Islam, M.S. (2014). *Biodiversity and livelihoods: A case study in Sundarbans Reserve Forest, World Heritage and Ramsar Site (Bangladesh)*. A Master thesis submitted of the requirements for the degree of Master of Science (M.Sc.) in Management of Protected Areas at the University of Klagenfurt, Austria.
- IUCN Bangladesh., 2015. *Red List of Bangladesh Volume 4: Reptiles and Amphibians*. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh, pp. xvi+320. (For Reptiles and Amphibians); <http://www.iucnredlistbd.org/Species/Group?code=RE>
- IUCN Bangladesh., 2015. *Red List of Bangladesh Volume 3: Birds*. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh, pp. xvi+676. (For Birds); <http://www.iucnredlistbd.org/Species/Group?code=BI>
- IUCN Bangladesh. 2015. *Red List of Bangladesh Volume 6: Crustaceans*. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh. pp. xvi+256. (For Crustaceans); <http://www.iucnredlistbd.org/Species/Group?code=CR>
- IUCN Bangladesh. 2015. *Red List of Bangladesh Volume 5: Freshwater Fishes*. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh, pp. xvi+360. (For Fishes); <http://www.iucnredlistbd.org/Species/Group?code=FI>
- IUCN Bangladesh. 2015. *Red List of Bangladesh Volume 2: Mammals*. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh, pp. xvi+232. (For Mammals); <http://www.iucnredlistbd.org/Species/Group?code=MA>
- IUCN Bangladesh. 2015. *Red List of Bangladesh Volume 7: Butterflies*. IUCN, International Union for Conservation of Nature, Bangladesh Country Office, Dhaka, Bangladesh, pp. xvi+400. (For Butterfly); <http://www.iucnredlistbd.org/Species/Group?code=BU>

- USAID, (2010) *Study on the Conservation and Management of Fisheries Resources of Sundarbans*. Retrieved from http://pdf.usaid.gov/pdf_docs/pnaed073.pdf
- IWM, (2013). *Final report of Ganges Basin Development Challenge: Assessment of the Impact of anticipated external drivers of change on water resources of coastal zone*, Institute of Water Modelling (IWM), Dhaka
- JOEC, 2002. *Oil Spill Impact on Sundarbans Mangrove Forest*. Japan Oil Engineering Company Ltd., Japan
- Johnson, R. & Bustin, R. M. (2006). "Coal dust dispersal around a marine coal terminal (1977-1999), British Columbia: The fate of coal dust in the marine environment". *International Journal of Coal Geology*. Volume 68, pages 57-69.
- Journal of Entomology and Zoology Studies* 2014; 2 (1): 29-32
- Khan, H.R (1983). *Irrigation water requirements in Bangladesh*. In *River Basin Development*; Zaman, M., Biswas, A.K., Khan, A.H., Nishat, A., Eds.; Tycooly International Publishing Ltd.: Dublin, UK, 1983; pp. 150–157.
- Khan, M. A. R., 1986. *Wildlife in Bangladesh mangrove ecosystem*. *Journal of the Bombay Natural History Society* 83: 32-48.
- Lacerda LD, Carvalho CEV, Tanizaki KF, Ovalle ARC, Rezende CE, (1993) *The biogeochemistry and trace metals distribution of mangrove rhizospheres*. *Biotropica* 25, 252-257.
- Lacerda LD, Martinelli LA, Rezende CA, OvalleARC, Victoria RL, Silva CAR, Nogueira, FB, (1988) *The fate of trace metals in suspended matter in a mangrove creek during a tidal cycle*. *Sci. Tot. Environ.* 75, 249-259.
- Laskar, M. R. *The Sundarbans; A Unique Wilderness of the World*, USDA Forest Service Proceedings v. 2, 143 (2000), http://www.fs.fed.us/rm/pubs/rmrs_p015_2/rmrs_p015_2_143_148.
- Leech, J. and S. S. Ali. 1997. *Extended Natural Resources Survey: Part IV – plant and animals species lists*. GoB/WB Forest Resources Management Project, Technical Assistance Component. Mandala Agricultural Development Corporation, Dhaka, Bangladesh.
- Maritime know how. (2014). Retrieved from *Emergency Procedures*: <http://www.maritimeknowhow.com/home/emergency-procedures/stranding-grounding>
- Milani, D., Reynoldson, T., Cheam, M., Garbai, G. & Rajkumar, J. (1999). "Local impacts of coal mines and power plants across Canada. II. Metals, organics and toxicity in sediments". *Water Quality Research of Canada*. Volume 34, Issue 4, page 609.
- National Patient Safety Agency (2008). *A risk matrix for risk managers*. Retrieved from <http://www.npsa.nhs.uk/nrls/improvingpatientsafety/patient-safety-tools-and-guidance/risk-assessment-guides/risk-matrix-for-risk-managers/>
- Ong-Che RG, Cheung SG, (1998). *Heavy metals in Metapenaeus, Eriocheirsinensis and sediment from the Mai Po Marshes, Hong Kong*. *Sci. Tot. Environ.* 214,87-97.
- Pautzke, C.F. (1938). "Studies on the effect of coal washings on Steelhead and Cutthroat Trout". *Transactions of the American Fisheries Society*, Volume 67, Issue 1, pages 232-233.
- Rahman M. T., Rahman M. S., Quraishi S.B., Ahmad J.U., Choudhury T.R., Mottaleb M.A., 2011. *Distribution of Heavy Metals in Water and Sediments in Passur River, Sundarban Mangrove Forest, Bangladesh*.
- Raymond D. Letterman †, William J. Mitsch, 1978. *Impact of mine drainage on a mountain stream in Pennsylvania*. *Environmental Pollution* (1978). Volume 17, Issue 1, Pages 53-73.
- Real C, Barreiro R, Carballeira A, (1993) *Heavy metal mixing behaviour in estuarine sediments in the Ria de Arousa (NW Spain)*. *Differences between metals*. *Sci. Tot. Environ.* 128, 51-67.

- Rosario, E. A. (1997). *The Conservation management plan of the protected areas other than those in the Sundarban forests*. In: *Bangladesh (Final Report)*. GoB/WB Forest Resources Management Project, Technical Assistance Component. Mandala Agricultural Development Corporation, Dhaka, Bangladesh
- Scullion J. & Edwards, R.W. (1980). "The effects of coal industry pollutants on the macroinvertebrate fauna of a small river in the South Wales coalfield". *Freshwater Biology*. Volume 10, Issue 2, pages 141- 162.
- Siddiqi, N.A. *Mangrove Forestry in Bangladesh*; Institute of Forestry and Environmental Sciences, Chittagong University: Chittagong, Bangladesh, 2001; p. 201.
- Sierra Clu (ND). *Public Health, Safety, and Environmental Impacts of Coal Transportation and Storage*. Retrieved from https://content.sierraclub.org/creative-archive/sites/content.sierraclub.org/creative-archive/files/pdfs/100_306_Louisiana Exports_FactSht-03_lowres.pdf
- Skuld (2012). *Shipping Regulations and Guidance - Safe shipment of coal*. Retrieved from http://www.skuld.com/Documents/Library/PI_Columns/SKULD_Safe%20Shipment%20of%20Coal.pdf
- Smith B. D., Braulik, G., Strindberg, S., Ahmed, B., & Mansur, R. (2008). Abundance of Irrawaddy dolphins (*Orcaella brevirostris*) and Ganges River dolphins (*Platanistagangeticagangetica*) estimated using concurrent counts made by independent teams in waterways of the Sundarbans mangrove forest in Bangladesh. *Marine Mammal Science*, 22, 527-547.
- Swift, M.C. (1985). "Effects of coal pile runoff on stream quality and macroinvertebrate communities". *Journal of American Water Resources Association*. Volume 21, Issue 3, pages 449-457.
- Terrados, J., Duarte, C.M., Fortes, M.D., Borum, J., Agawin, N.S.R., Back, S., Thampanya, U., KampNielsen, L., Kenworthy, W.J., Geertz-Hansen, O. & Vermaat, J. (1998). "Changes in community structure and biomass of seagrass communities along gradients of siltation in SE Asia". *Estuarine, Coastal and Shelf Science*. Volume 46, Issue 5, pages 757-768.
- Tiger Status Report of Bangladesh Sundarbans, 2015*
- UNESCO, World Heritage Committee: *The Sundarbans Bangladesh, Outstanding Universal Value (OUV)*, <http://whc.unesco.org/en/list/798>.
- Vanzella T.P., C.B.R. Martinez b, I.M.S. Colus, 2007. Genotoxic and mutagenic effects of diesel oil water soluble fraction on a neotropical fish species. *ELSEVIER. Mutation Research* 631 (2007) 36–43.
- Ward, C.R. (2002). "Analysis and significance of mineral matter in coal seams". *International Journal of Coal Geology*. Volume 50, Issues 1-4, pages 135-168.
- Weisenbacher, et al., *Conservation breeding of the Northern river terrapin Batagurbaska at the Vienna Zoo, Austria, and in Bangladesh*, *International Zoo Yearbook*, (January 2015), <http://onlinelibrary.wiley.com/doi/10.1111/izy.12070/full> at 31 and 37.
- Wilber D.H. & Clarke, D.G. (2001). "Biological effects of suspended sediments: A review of suspended sediment impacts on fish and shellfish with relation to dredging activities in estuaries". *North American Journal of Fisheries Management*. Volume 21, Issue 4, pages 855-875.