HOWE ENGINEERING PROJECTS (INDIA) PVT. LTD.
(Successor-in-interest with respect to the Engineering Consultancy Business of Howe (India) Pvt. Ltd.

50 Years 1966-2016

I-525/2017/IWAI-NW1/804 **03 February 2017**

Inland Waterways Authority of India,
(Ministry of Shipping, Government of India)
A-13, Sector-1
Noida – 201301 (U.P.)

Kind Attn.: Mr Pravir Pandey, Vice Chairman (Jal Vikas Marg)

Subject: Detailed Feasibility Study for Capacity Augmentation of National Waterway-1 & Detailed Engineering for its Ancillary Works and processes between Haldia to Allahabad (Jal Marg Vikas Project)

Regarding: Detailed Project Report – Haldia Terminal

Dear Sir,

Please find attached three copies of final "**Detailed Project Report – Haldia Terminal**" for the subject project

Thanking and assuring you of our best services always.

Yours faithfully,
For **Howe Engineering Projects (India) Pvt. Ltd.**

Sanjeev Dhar
Chief Executive Officer

Encl. as above.

HOWE ENGINEERING PROJECTS (INDIA) PVT. LTD.
Howe India House, 81, Nehru Place, New Delhi - 110 019
Phone : +91(011) 49508000 Fax : +91(011) 26467557
E-mail : howe@howeindia.com Web. : www.howeindia.com
CIN : U74140DL2013PTC255490

INLAND WATERWAYS AUTHORITY OF INDIA

(Ministry of Shipping, Government of India)

Detailed Feasibility Study for Capacity Augmentation of National Waterway-1 and Detailed Engineering for its Ancillary Works and Processes between Haldia to Allahabad (Jal Marg Vikas Project)

Detailed Project Report
Haldia Multimodal Terminal

February 2017

HOWE ENGINEERING PROJECTS (INDIA) PVT. LTD.
(Successor-in-interest with respect to the Engineering Consultancy Business of Howe (India) Pvt. Ltd.

PMC PROJECTS (INDIA) PRIVATE LIMITED
from vision to reality...

In JV with

HR Wallingford
Working with water

HOWE INDIA HOUSE, 81 NEHRU PLACE, NEW DELHI–110019, INDIA

Phone : +91(011) 49508000 ; Fax : +91(011) 26467557 ; E-Mail : howe@howeindia.com

Web : www.howeindia.com

	INLAND WATERWAYS AUTHORITY OF INDIA (Ministry of Shipping, Government of India)
PROJECT:	Detailed Feasibility Study for Capacity Augmentation of National Waterway-1 and Detailed Engineering for its Ancillary Works and Processes between Haldia to Allahabad (Jal Marg Vikas Project)
TITLE:	**Detailed Project Report – Haldia Terminal**
DOCUMENT NO.:	I-525/2016/DPR-HT/R-1

Rev. No.	Date	Description	Prepared by		Checked by		Approved by	
R-0	19-JAN-16	Detailed Project Report – Haldia Terminal						
R-1	03-FEB-17	Detailed Project Report – Haldia Terminal	K. Raj Kumar		H. Mehra	S.K. Agarwal	Sanjeev Dhar	

Table of Contents

EXECUTIVE SUMMARY 11

1 INTRODUCTION 18

1.1 Project Background 18
1.2 Need of the Project 18
1.3 Scope of Work 19
1.4 Organisation of the Report 19

2 PROJECT SITE ENVIRONMENT 21

2.1 Project Location 21
2.2 Land Availability 21
2.3 Infrastructure at the Project Site 21
2.3.1 Road Connectivity 21
2.3.2 Rail Connectivity 22
2.3.3 Air Connectivity 22
2.3.4 Sea link 22
2.3.5 Nearest Towns 22
2.4 Meteorological Parameters 22
2.4.1 Temperature 22
2.4.2 Wind 23
2.4.3 Relative Humidity 23
2.4.4 Rainfall 24
2.4.5 Depressions and Cyclones 24
2.4.6 Visibility 25
2.5 Oceanographic / River Conditions 25
2.5.1 Tides 25
2.5.2 Current 25
2.5.3 Waves 25
2.5.4 Discharge 25
2.5.5 Morphological condition 26
2.5.6 Existing Navigational Channel 27
2.6 Natural Hazards 27
2.6.1 Seismicity 27
2.7 Pipeline Corridor 27

3 FIELD SURVEYS AND INVESTIGATIONS 28

3.1 Topographic Surveys 28
3.2 Geotechnical Investigations 28
3.2.1 Landside Soil Profile 28
3.2.2 Riverside Soil Profile 29
3.3 Bathymetry Survey 29

4 TRAFFIC FORECAST 30

5 VESSEL SIZES 31

5.1 Vessel Sizes Recommended by IWAI 31
5.2 Vessel Sizes at Haldia Terminal 31

6 FACILITY REQUIREMENT 32

6.1 Traffic Forecast 32
6.2 Marine infrastructure 32
6.2.1 Navigational and Operational requirements 32
6.2.2 Turning circle dimensions and depth at Berth 35
6.2.3 Holding area 35
6.2.4 Berth Requirements 35
6.3 Shoreside Infrastructure 49
6.3.1 Storage Area Requirements 49
6.3.2 Utilities and Services 50

7 ALTERNATIVE LAYOUTS 52

7.1 Alternative Terminal Layouts 52
7.1.1 Alternative I 52
7.1.2 Alternative II 53
7.1.3 Alternative Layout III 53
7.1.4 Alternative I V 54
7.1.5 Alternative V 54
7.2 Multi Criteria Analysis of Alternative Terminal Layouts 55
7.3 Recommended Terminal Layout 56

8 DEVELOPMENT PLAN 57

8.1 Marine Facilities 57
8.1.1 Berths and Approach Trestles 57
8.1.2 Manoeuvring Area & Approach Channel 57
8.2 Onshore Facilities 58
8.2.1 Storage Areas 58
8.2.2 Fuel Bunkering 58
8.2.3 Buildings 59
8.2.4 Onshore Utilities 59
8.2.5 Mechanical Equipment 59
8.3 Layout Plan 59

9 PRELIMINARY ENGINEERING – CIVIL WORKS 60

9.1 Berthing Facilities 60
9.1.1 Deck Elevation 60
9.1.2 Water Levels 60
9.1.3 Design Dredged Level 60
9.1.4 Scour Depth 61
9.1.5 Geotechnical Criteria for Design of Jetties and Approach Trestles 61
9.1.6 Loads Considered for Design of Jetty 61
9.1.7 Load Combinations 65
9.1.8 Minimum Cover 65
9.1.9 Design Life 65
9.1.10 Serviceability Criteria 65
9.1.11 Materials and Material Grades 66
9.1.12 Proposed structural arrangement of berth 66
9.1.13 Approach Trestle 68
9.2 Site Grading & embankment of approach trestle 69
9.3 Dredging 69
9.3.1 Initial dredging 69

9.3.2 Annual Maintenance Dredging 69
9.3.3 Dredging Management 69
9.4 Storage Areas 74
9.4.1 Stockyard for Flyash, Natural Aggregates and POL 74
9.4.2 Storage Sheds 75
9.5 Terminal Buildings 75
9.5.1 Terminal Administration Building 75
9.5.2 Security Office 76
9.5.3 Weigh Bridge Building 76
9.5.4 Electrical Sub-station 76
9.5.5 Worker's Amenity Building 76
9.5.6 RIO Compressor Room 76
9.5.7 Overhead water tank and Underground reservoir 76
9.5.8 Gate house complex, Emergency exit Gate, Access Gate, Boundary Wall and Fencing 76
9.5.9 Design Criteria 77
9.6 Boundary Wall / Fencing 80
9.7 Internal roads 80
9.8 Water Supply 80
9.8.1 Assumptions 81
9.9 Sewerage System 82
9.10 Storm Water Drainage 82
9.11 Fire Fighting Facilities 82
9.12 Dust control 82
9.13 Navigational Aids 82

10 PRELIMINARY ENGINEERING - MATERIAL HANDLING SYSTEM/ EQUIPMENTS 84

10.1 Phase-1 84
10.1.1 Fly Ash Silos 84
10.1.2 Belt Conveyor / Pipe Conveyor System 86
10.1.3 Fixed Type Barge Loader 90
10.1.4 Mobile Harbour Cranes (MHC) 91
10.1.5 Front End Loader /Pay Loader & Dumpers 94
10.1.6 Road Weigh Bridge 94
10.1.7 Dumper trucks and Forklift 95
10.2 Phase-2 96
10.2.1 Flyash Handling 96
10.2.2 Storage Areas 96
10.2.3 Rail yard 96

11 PRELIMINARY ENGINEERING - ELECTRICAL AND CONTROL SYSTEM 97

11.1 Electrical Power Requirement 97
11.1.1 Source of Power Supply 97
11.1.2 System Description 97
11.1.3 Utilization Voltages 98
11.1.4 Electrical Substation (ESS) 98
11.1.5 Power Factor Correction 98
11.1.6 Distribution Transformer 98
11.1.7 Motors 99
11.1.8 HT Power Distribution System 99

11.1.9 LT Power Distribution System 99
11.1.10 Standby Power Supply 100
11.1.11 Illumination 100
11.1.12 Cables 101
11.1.13 Cable Trays & Accessories 101
11.1.14 Earthing & Lightning Protection 101
11.1.15 Ventilation and Air Conditioning (AC) System 102
11.1.16 Battery and Battery Charger 103
11.1.17 Closed Circuit TeleVision (CCTV) System 103
11.1.18 Control System 103
11.1.19 Safety Switches 105
11.1.20 3D Level Scanners 105
11.1.21 Communication System 106

12 FIRE FIGHTING 110

13 SEWAGE TREATMENT PLANT 111

13.1 General 111
13.2 Process Description 111
13.3 Blowers and Aeration System 112
13.4 Special Notes 113

14 EXTERNAL CONNECTIVITY 114

14.1 External Rail Connectivity 114
14.1.1 Existing Rail Connectivity 114
14.1.2 Proposed Rail Connectivity 114
14.2 External Road Connectivity 114
14.2.1 Existing Road Connectivity 114
14.2.2 Proposed road connectivity 115

15 ENVIRONMENTAL IMPACT ASSESSEMENT (EIA) & ENVIRONMENT MANAGEMENT PLAN (EMP) 116

16 COST ESTIMATE 121

16.1 Basis of Cost Estimates 121
16.2 Capital Cost Estimates 121
16.3 Detail Cost Estimates 124
16.4 Operation and maintenance (O&M) costs 129

17 PROJECT IMPLEMENTATION SCHEDULE 131

17.1 General 131
17.2 Basic consideration for Implementation 131
17.3 Pre-development activities 131
17.4 Construction activities 131
17.4.1 Development of Phase-1 131
17.4.2 Development of Phase-2 132

18 FINANCIAL AND ECONOMIC ANALYSIS 135

18.1 Introduction 135
18.2 General Assumptions 135
18.3 Construction Period and Project Life 135
18.4 Means of Finance 136

18.5 Income Tax Calculations 136
18.6 Tariff Analysis 136
18.6.1 Prevailing IWAI charges 136
18.6.2 Tariff considered for augmented NW-1 137
18.7 Capital Costs 140
18.8 Operation and Maintenance Costs 140
18.9 Traffic Detail and terminal capacity 141
18.10 Key Results - Financial Analysis 141
18.11 Economic Analysis 141
18.11.1 Approach and Methodology 142
18.11.2 Economic Factors considered 142
18.11.3 External Costs 143

List of Tables:

Table 0.1: Haldia MMT - 2020 to 2045 cargo forecast by cargo type (tons) 11
Table 0.2 : Design Vessel Size 12
Table 2.1 Recorded Mean Daily and Extreme Temperatures 22
Table 2.2 Mean Relative Humidity 23
Table 2.3 Annual Rainfall Data 24
Table 2.4 No. of Storms 24
Table 2.5 Tide Levels near Haldia 25
Table 2.6 Morphological Changes in Hugli River 27
Table 3.1 Landside Soil Profile 28
Table 3.2 Riverside Soil Profile 29
Table 4.1 Haldia MMT - 2020 to 2045 cargo forecast by cargo type (tons) 30
Table 5.1 Vessels that can Ply in Inland Waterways with LAD of 3.0 m 31
Table 5.2 Vessels Sizes for Various Commodities 31
Table 6.1 Traffic Forecast for the year 2020 to 2045 32
Table 6.2 Design Vessel Sizes 33
Table 6.3 Dredge depths required 33
Table 6.4 Considerations for Channel Width 34
Table 6.5 Channel Width 34
Table 6.6 Dimensions of Turning Circle 35
Table 6.7 Average Parcel Size 36
Table 6.8 Cargo Handling Rates in Different Phases of Terminal 40
Table 6.9 Norms for Berth Occupancy 41
Table 6.10 Recommended Berth Occupancy Factors for Haldia Terminal 41
Table 6.11 Requirement of Berths for Phase-1 42
Table 6.12 Overall Requirement of Berths for Phase-2 42
Table 6.13 Overall Requirement of Berths for Master Plan 43
Table 6.14 Berth Length – Phase-1 44
Table 6.15 Berth Length – Phase-2 44
Table 6.16 Berth Length – Master Plan 44
Table 6.17 Target Traffic for Phase-1 45
Table 6.18 Berth Requirement for Target Phase-1 Traffic 45
Table 6.19 Berth Length for Target Phase-1 Traffic 46
Table 6.20 Target Traffic for Phase-2 46
Table 6.21 Berth Requirement for Target Phase-2 Traffic 47
Table 6.22 Target Traffic for Master Plan 48

Table 6.23 Berth Requirement for Target Master Plan Phase Traffic 48
Table 6.24 Norms Adopted for Calculating Storage Area at IWT Terminal 49
Table 6.25 Storage Area Requirement in Different Phases for Haldia Terminal 49
Table 7.1 Maximum Throughput – Alternative I 52
Table 7.2 Maximum Throughput – Alternative II 53
Table 7.3 Maximum Throughput – Alternative III 53
Table 7.4 Maximum Throughput – Alternative IV 54
Table 7.5 Maximum Throughput – Alternative V 54
Table 7.6 Multi-Criteria Analysis of Alternatives 55
Table 8.1 Phase-wise No. of Berths 57
Table 8.2 Phase-wise Storage Area 58
Table 8.3 Phase-wise Requirement of Mechanical Equipment 59
Table 9.1 Water Levels Considered 60
Table 9.2 Dimensions of Self-Propelled Motor Vessels 60
Table 9.3 Basis for Design Dredge Level 60
Table 9.4 Safety Factors 61
Table 9.5 Berth Load Parameters for 3000 DWT vessel 63
Table 9.6 Permissible Crack Width 66
Table 9.7 Material specification 66
Table 9.8 Details of internal roads 80
Table 9.9 Water Demand for Terminal (Litre/per day) 81
Table 9.10 Capacity of U/G sumps, and OHT for Phase-1 development 81
Table 10.1 Summary of Phase-1 Mechanical Equipments 84
Table 10.2 Specification Data Sheet - Road Weigh Bridge 95
Table 11.1 Summary of Load Calculations 97
Table 15.1 Environmental Management Cost 118
Table 16.1 Capital Cost Estimate for Haldia Terminal – Phase-1 121
Table 16.2 Capital Cost Estimate for Haldia Terminal – Phase-2 123
Table 16.3 Capital cost estimate for Land & Site development and Dredging – Haldia Terminal 124
Table 16.4 Detail Cost Estimate for Berth – Haldia Terminal 124
Table 16.5 Detail Cost Estimate for Approach trestle – Haldia Terminal 126
Table 16.6 Detail cost estimate for Conveyor Gallery – Haldia Terminal 127
Table 16.7 Electrical distribution system & IT communication 129
Table 16.8 O&M Cost Estimates – Phase-1 129
Table 16.9 O&M Cost Estimates – Phase-2 130
Table 18.1: Phase–I: Project Development Schedule 135

Table 18.2: Fee and Charges as per IWAI 136
Table 18.3: Tariff Considered for Augumented NW-1 137
Table 18.4: Capital Cost for Phase-I Development of Haldia MMT 140
Table 18.5: Project Traffic Volume (Medium Augumentation Case - MAC) 141
Table 18.6: Project Traffic Volume (Base Case) 141
Table 18.7: Energy Consumption - Waterways, Road and Rail 143
Table 18.8: External Costs of Air Pollution - Waterways, Roadways and Railways 144
Table 18.9: External Cost of Noise Pollution 145
Table 18.10: External Cost of Soil and Water Pollution 145
Table 18.11: Accident Cost - Waterways, Roadways and Railways 146
Table 18.12 : Emission of Green House Gases 146
Table 18.13 : Surface Occupation 148
Table 18.14: Overall Incremental Economic Benefit from the project - MAC 148
Table 18.15: Overall Incremental Economic Benefit from the project – Base Case 148
Table 18.16 : Key Results of Economic Analysis 149

List of Figures:

Figure 0.1: Location of Site for Haldia Multimodal Terminal 11
Figure 0.2: Haldia MMT - Layout Plan of Terminal Facilities during Phase 1 Development 13
Figure 2.1 Location of Site for Haldia Multimodal IWT Terminal 21
Figure 2.2 Morphological changes in Hugli River 26
Figure 10.1 Typical Details of Mobile Harbour Crane 94
Figure 17.1 Project Implementation Schedule – Phase-1 133
Figure 17.2 Project Implementation Schedule – Phase-2 134

List of Annexures:

Annexure 1 – Power and Demand Load

List of Appendices:

APPENDIX A – Economic Benefit Calculation PHASE-1
APPENDIX B – Economic Benefit Calculation PHASE-2
APPENDIX C – Economic Internal Rate of Return Calculation PHASE-1
APPENDIX D – Economic Internal Rate of Return Calculation PHASE-2

List of Drawings:

S. No.	DWG. No.	TITLE
1	I-525/HT/201	Layout of Topography survey
2	I-525/HT/202	Layout of Bathymetry survey
3	I-525/HT/203	Location plan of Boreholes
4	I-525/HT/204	Layout plan of terminal facilities at Haldia Alternative-1 Recommended layout
5	I-525/HT/205	Layout plan of terminal facilities at Haldia Alternative-2
6	I-525/HT/206	Layout plan of terminal facilities at Haldia Alternative-3
7	I-525/HT/207	Layout plan of terminal facilities at Haldia Alternative-4
8	I-525/HT/208	Layout plan of terminal facilities at Haldia Alternative-5
9	I-525/HT/209	Layout plan of terminal facilities at Haldia Phase-1
10	I-525/HT/210	Layout plan of terminal facilities at Haldia Phase-2
11	I-525/HT/211	Layout of Manoeuvring area
12	I-525/HT/212	General arrangement of Jetty and Approach trestle
13	I-525/HT/213	Cross section of Jetty and Approach trestle (Sheet 1-2)
14	I-525/HT/213	Cross section of Jetty and Approach trestle (Sheet 2-2)
15	I-525/HT/214	Typical layout of Terminal Administration building
16	I-525/HT/215	Elevations of Terminal Administration building
17	I-525/HT/216	Typical layout & section of Worker's amenity building
18	I-525/HT/217	Typical layout & elevations of Security office and Weigh bridge control room
19	I-525/HT/218	Typical details of Covered storage shed
20	I-525/HT/219	General arrangement of Gate Complex
21	I-525/HT/220	Typical plan & elevation of Silo
22	I-525/HT/222	Typical plan and cross section of proposed bridge over ‘Green belt canal’
23	I-525/HT/223	Typical cross sections of Roads
24	I-525/HT/224	Schematic layout of Water supply system
25	I-525/HT/225	Layout of Storm water drainage
26	I-525/HT/226	Cross section of Fixed type barge loader
27	I-525/HT/227	Cross section of Mobile harbour crane
28	I-525/HT/228	Flow diagram of cargo handling system (Sheet - 1 of 2)
29	I-525/HT/228	Ga of fly ash silo & profile of pipe conveyor pc-1/pc-2 (Sheet - 2 of 2)
30	I-525/HT/229	Power single line diagram
31	I-525/HT/230	Sub-station equipment layout
32	I-525/HT/231	High mast & cable layout
33	I-525/HT/232	Control architecture
34	I-525/HT/233	Typical detail of boundary wall, fencing & boulder pitching
35	I-525/HT/234	Rail connectivity

EXECUTIVE SUMMARY

1 PROJECT LOCATION

The site proposed for the development of Haldia MMT is located on Hugli River at Latitude 22° 03' 30'' North and Longitude 88° 8' 40'' East, at Haldia in Purba Medinipur district of West Bengal.

Figure 0.1: Location of Site for Haldia Multimodal Terminal

2 TRAFFIC POTENTIAL

The traffic potential of Haldia MMT as provided by M/s Hamburg Port Consulting GmBH, the traffic consultant is presented below.

Table 0.1: Haldia MMT - 2020 to 2045 cargo forecast by cargo type (tons)

Cargo Type	2020		2025		2035		2045	
	Loaded	*Discharged*	*Loaded*	*Discharged*	*Loaded*	*Discharged*	*Loaded*	*Discharged*
Bagged (Fertilizer)			72,484		251,222		268,562	
Bagged (Food grains)		50,608		53,061		90,608		96,359
Container					335,762		437,585	
Dry bulk (Coal)	766,264		1,746,915		2,653,339		2,807,585	
Dry Bulk (Fly ash)	1,381,163		1,662,129		2,187,851		2,708,878	
Dry Bulk (Stone chips)		162,716		205,119		273,917		318,430
Dry bulk (Iron ore)						30,960		32,910
Neo-bulk	394,453	139,640	508,903	494,287	743,080	767,133	885,947	886,688
Total (tons)	***2,541,880***	***352,964***	***3,990,431***	***752,467***	***6,171,254***	***1,162,618***	***7,108,557***	***1,334,387***

Source: HPC report on Infrastructure requirement of individual terminals along National Waterways 1, dated 26th April 2016.

3 DESIGN VESSEL SIZE

The principal dimension of the design vessel considered to be handed at Haldia multimodal terminal is mentioned below:

Table 0.2 : Design Vessel Size

Vessel Type	Vessel Size (DWT)	LOA (m)	Beam (m)	Loaded Draft (m)
Barge	3,000	95	15	2.5

However, for flyash the design vessel has been considered as 1500 DWT, since these vessels will be primarily used for flyash export to Bangladesh via Sundarbans.

4 TARGETED TRAFFIC AND TERMINAL CAPACITY

Considering the restriction in the availability of water front, maximum of four berths can be developed. Therefore, alternate layouts have been worked out based on various cargo mixes and with subsequent discussion held with IWAI, the following commodities has been considered as the targeted cargoes and the individual berth capacities for handling the targeted commodities have been worked out based on mechanized handling method as described below:

4.1 Flyash

Fly ash shall be coming to the terminal through trucks and loaded to the silos pneumatically by pumps. Then it will be loaded to barges by barge loaders through pipe conveyor system.

4.2 Fertilizer

Fertilizer in bags shall be coming to the terminal through trucks and stored in the proposed covered shed. Then it will be transported to the berth through trucks and loaded on to the barges using mobile harbour crane.

4.3 Natural aggregates

Natural aggregate shall be coming to the terminal in barges which will be unloaded into trucks using mobile harbour cranes and then transported to the storage yard. Later it will be loaded onto the trucks using pay loader and transported to the hinterland by trucks.

4.4 Petroleum products and Edible oil (in drums)

Petroleum products in drums shall be coming to the terminal in barges which will be unloaded onto the berth using mobile harbour crane. The unloaded drums will be loaded onto trucks using forklifts and will be transported to the storage yard. Then it will be unloaded from trucks using forklifts and stored in the storage yard. Later, the drums will be loaded onto the trucks using forklift and transported to the hinterland. It is to be noted that edible oil being the export commodity, reverse handling process will be followed.

Accordingly, the berth capacity has been worked out and presented below in Table 3.

Table 3 : Berth Capacities

Commodity	No. of Berths	Berth Capacity in MTPA
Flyash	2	2.81
Fertilizer	2	0.11
Natural aggregates		0.16
Petroleum products and Edible oil (in drums)		0.10
Total	**4**	**3.18**

In addition, provision has been kept to handle containers in the future by using mobile harbour cranes.

5 PHASE -1 LAYOUT OF HALDIA MMT

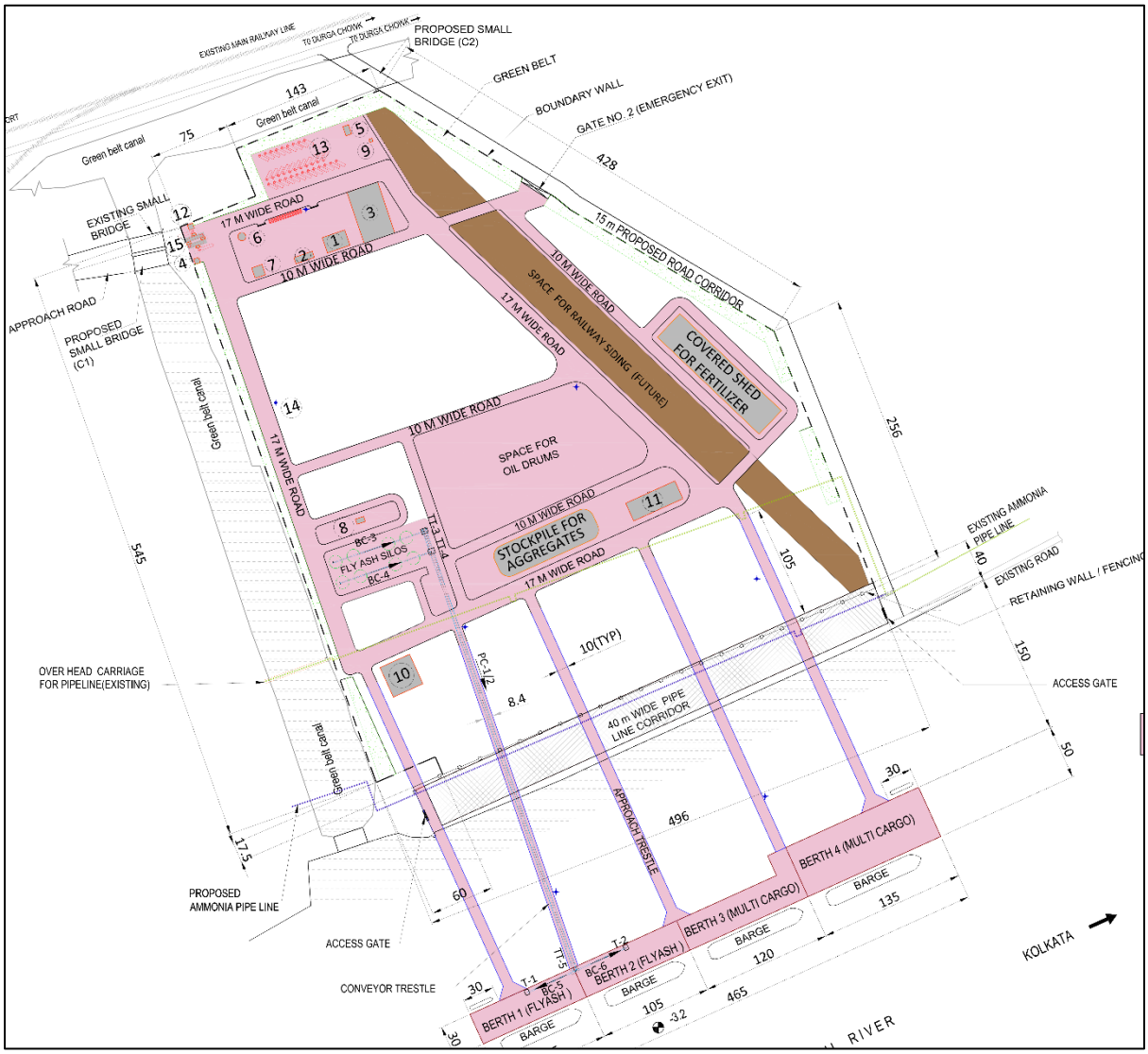


Figure 0.2: Haldia MMT - Layout Plan of Terminal Facilities during Phase 1 Development

6 DEVELOPMENT PLAN – MARINE FACILITIES

6.1 Phase-1 Development

6.1.1 Berthing Structures Including All Associated Facilities

There shall be 4 berths which are continuous with a total quay length of 465m which will be developed during Phase-1 development. Out of the 4 berths, two berth (Berth no.-01 & Berth no.-02) are for handling flyash and the other two berths are multi-cargo berths. Cargo vessels shall be berthed on the front side and survey vessels shall be berthed on the rear side ends of the berth. The top level of deck shall be +8.7 m with respect to CD. Berth no. 4 shall have provision for handling container cargo in future.

6.1.2 Approach Trestles

There shall be 4 approach trestles to connect the berths to the back-up area. The proposed approach trestles have to cross a pipeline corridor of 40 m comprising of ammonia pipelines and other commodity/utility pipelines, outside the terminal boundary. A minimum vertical clearance of 0.8 m has to be maintained between the top level of the ammonia pipelines and the soffit level of the approach trestle.

6.1.3 Conveyor System / Structures

Conveyor system is proposed to carry flyash from silos to the berth area so as to finally discharge the flyash into the barges using the barge loader. Conveyor gallery shall be 8.40 m wide.

6.1.4 Dredging

At the terminal about 0.3Mm^3 of maintenance dredging will be required to provide the berthing box, the turning/manoeuvring area for the berths and holding areas for barges anchored fore and aft adjacent to the channel leading into the turning area. The maintained width of this channel between the toe of the slopes is proposed to be 45m. The maintenance dredge volume for the approach channel which joins the terminal with the main NW1 deep water channel is about 0.5Mm^3.

It is considered that to maintain the turning/berthing/holding area at about 3.2m below CD, the further annual maintenance dredging will be about 0.5Mm^3/year. Similarly the further annual maintenance dredging requirement for the access channel is assessed to be about 1.8Mm^3/year. The dredging methodology to be adopted assumes permission will be granted for disposal to the existing offshore disposal site of KoPT at Sagar which is approximate 60km from the proposed terminal location.

6.2 Phase-2 Development

Conveyor system shall be extended to the proposed additional 8 nos. of silos during Phase -2 development.

7 DEVELOPMENT PLAN – ONSHORE FACILITIES

7.1 Phase - 1

7.1.1 Site Grading

The existing ground level varies from +4.95 m CD to +8.21 m CD. It is proposed to provide the formation level of +7.80m CD within the terminal area.

7.1.2 Stockyard

Stockyard shall be developed to 4 m high stockpiling of stone aggregate and 3 high stacking of oil drums with future provision. The stockyard shall have the provision to stack containers in future. Ground improvement shall be carried out to achieve required bearing capacity accordingly.

7.1.3 Terminal Buildings

The following terminal buildings are proposed for the Haldia terminal:

S. No.	Building	Type	Total Built up Area (m^2)
1	Terminal Administration Building	Two storey building	660
2	Worker's Amenity Building	Single storey building	121
3	Security Office	Single storey building	25
4	Electrical Substation	Two storey building	1,089
5	Weigh Bridge Building	Single storey building	25
6	RIO Control Room	Single storey building	40

7.1.4 Other Onshore Facilities

Other onshore facilities such as green belt development, internal roads and vehicle parking area, gate house complex, emergency exit gate & access gates, diversion of existing road, storm water drainage system, sewerage system, water supply system, firefighting system, electrical, communication & IT system shall be also developed to facilitate the flawless operation of the proposed terminal.

7.1.5 Material Handling System / Equipments

The mechanical equipment proposed in Phase-1 and Phase-2 of the terminal are given below:

S. No.	Equipment	No. of Equipment		
		Phase-1	Phase-2	Total
1.	Mobile Harbour Crane	2	-	2
2.	Silo with Foundation	8	8	16
3.	Fixed Barge Loader	2	-	2

S. No.	Equipment	No. of Equipment		
		Phase-1	Phase-2	Total
4.	Road Weigh Bridge	2	-	2
5.	Dumper Truck	10	-	10
6.	Fork Lift	2	-	2
7.	Front End Loader	1	-	1

7.1.6 External Road Connectivity

The existing approach road to the terminal will be retained in Phase-1. However, the existing riverside road leading to Tata chemicals factory will fall under the terminal area. It will have to be closed for terminal operation. Therefore, it is proposed to develop a 15 m wide diversion road for the same, on the western side of the terminal.

7.2 Phase–2 Development

7.2.1 Additional Silos

Additional 8 nos. silos with associated Conveyor System and controls shall be erected to handle the future increase in the flyash quantity.

7.2.2 Stockyard Development for Additional Storage

The stockyard area developed during Phase-1 for stacking natural aggregates and oil will be sufficient to handle the projected traffic volume. In order to have enhanced storage volume in future, the open area embarked for future storage shall be developed during phase-2 development.

7.2.3 Widening of Approach Road

To facilitate the incessant movement of trucks, it is proposed to widen the existing 2 lane road leading to the terminal into a 4 lane road.

7.2.4 Rail Siding

As per the traffic projection provided by M/s HPC, no rail borne traffic is envisaged but IWAI intends to develop rail siding during Phase -2 development to attract the future rail borne traffic. Accordingly, railway siding is proposed for phase-2 development. The wagon unloading / loading system has to be developed based on the rail borne traffic in the future.

8 IMPLEMENTATION SCHEDULE

The time frame for implementation of Phase-1 and Phase-2 is 30 months and 15 months, respectively.

9 COST ESTIMATES

9.1 Capital Costs

The capital cost estimates for Phase-1 and Phase-2 of the Terminal considering the base year rate is worked out to be Rs. 495 crores and Rs. 78 crores, respectively. The above cost is excluding the cost paid to KoPT towards land lease rent and cost to be paid to the local authorities for obtaining electrical & water supply connection. The dredging cost for terminal and approach channel along with navigational aids is included in the overall cost of fairway development and therefore not included under this terminal cost.

9.2 Operation and Maintenance Costs

The annual operation and maintenance costs of the facilities for Phase-1 of the terminal is worked out to be Rs. 31.34 crores considering the base year rate.

10 FINANCIAL AND ECONOMIC ANALYSIS

10.1 Financial Analysis

Based on the capital cost and operating expenditure, the financial analysis has been carried out considering 30 years of operation. The financial IRR is worked out to be negative for Phase-1 development.

10.2 Economic Analysis

The economic analysis for Haldia MMT is carried out considering various economic factors from the projects and the economic IRR is worked out as **17.07%** for Phase-1.

1 INTRODUCTION

1.1 Project Background

Inland Waterways Authority of India (IWAI), an autonomous organization under Ministry of Shipping (MoS), Govt. of India was constituted for development and regulation of inland waterways of the country.

Till now, five waterways namely (i) the Ganga-Bhagirathi-Hugli river system from Haldia to Allahabad (1620 km), (ii) the Brahmaputra from Dhubri to Sadiya (891 km), (iii) West Coast canal from Kottapuram to Kollam along with Champakara and Udyogmandal canals (205 km), (iv) Kakinada-Pondicherry canals integrated with rivers Godavari and Krishna (1095 km) and (v) East Coast canals along with river Brahmani and Mahanadi (621 km), have been declared as National Waterway No. 1, 2, 3, 4 & 5 respectively. Further, River Barak in its stretch from Lakhipur to Bhanga (121 km) in Assam is under active consideration for declaration as National Waterway.

In this connection, IWAI has appointed M/s Howe Engineering Projects (India) Pvt. Ltd. (HOWE) as Consultant for carrying out detailed feasibility study for capacity augmentation of NW-1 and detailed engineering for its ancillary works and processes between Haldia to Allahabad (Jal Marg Vikas Project).

The present submission deals with the Detailed Project Report (DPR) of the proposed facilities for Multimodal Terminal (MMT) at Haldia where NW1 connects with Hugli estuarine system.

1.2 Need of the Project

An efficient transport sector is vital for development of the economy of any country and to stimulate competitive business environment. Indian transport system comprises various modes, viz. Railways, Roadways, Inland Waterways, Coastal Shipping and Airways. The main modes of transport are rail and road which are overburdened and experiencing congestion.

India has large number of inland waterways consisting of rivers, canals, backwaters, creeks, and lakes etc. which have the potential for development of efficient waterways transport network. Inland Water Transport (IWT) is a fuel efficient, environment friendly and cost effective mode of transport having potential to supplement the overburdened rail and congested roads. Hence, it is proposed to develop inland water ways and terminals at certain locations for loading and unloading of cargo.

Haldia, being a riverine port location with good connectivity by Road and Rail, has tremendous potential for attracting traffic through IWT. It is favourably located to attract transhipment of import cargo to feed the requirements of Power Plants, Steel Plants and various industries in West Bengal, Bihar and UP located near NW1 route from Haldia to Allahabad. It has a favourable location for transporting Bangladesh cargo and linking NW-2 through which IWT traffic passes via Bangladesh as per Indo-Bangladesh Protocol.

With the above background the development of a multimodal terminal at Haldia has been initiated by IWAI to interlink IWT through NW1 with Hugli estuarine system.

1.3 Scope of Work

The broad scope of work for the project is to carry out a technical analysis together with Front-end Engineering and Design work, economic and financial analysis, procurement assessment, operation & management and monitoring & evaluation guideline.

The scope for preparation of the Detailed Project Report is as follows:

- Collection and review of the available data / reports.
- Undertake surveys to ensure adequacy and completeness of data and record details after physical verification, wherever necessary.
- Prepare detailed multimodal terminal layout plan, shore side infrastructure plan, bank protection work, land development plan along with design and structural drawings, specifications, cost estimates for all structures like berthing jetty, approach jetty, covered and open storage along with all allied structures / buildings / facilities like Administrative Buildings, Residential Accommodation, security office, customs enclosure, bunkering of fuel, water supply, electricity supply, firefighting including lighting, requirement of power, water supply, emergency and standby power supply, communication system, Drainage & Sewerage system, boundary wall, fencing, gates, internal roads, etc. Layout developed should permit expansion of terminals to cater to projected traffic beyond the assessed value for the projected time frame.
- Every estimate shall be duly supported by the justification of rates adopted / basis of rates adopted like CPWD rates / market rates / lowest offers / rates received etc.
- Preparation of realistic construction schedule for the ancillary structures indicating the sequence of activities duly considering the river characteristics in different seasons and priority and phasing of work along with phasing of expenditure.
- Preparation of specifications, bill of quantities, estimates and tender documents containing General condition of contract, special condition of contract, technical specification and NIT etc. to facilitate implementation of works after the finalization of Detailed Project Report.
- Preparation of Environment Management Plan
- Preparation of Resettlement Action Plan
- Work out cost benefit analysis, Financial Internal Rate of Return (FIRR) and Economic Internal Rate of Return (EIRR) of the project based on current Indian/International norms including SWOT analysis with detailed back up calculations, basis, assumption, justification etc. along with their source of information.

1.4 Organisation of the Report

The present submission is the Detailed Project Report as per the terms of the assignment. It spells out the project requirement, traffic projection, assessment of project facilities, development of facilities in phases till master plan, engineering of civil works and material handling system, onshore infrastructure, cost estimates and financial analysis etc. This report is organised in the following sections:

Chapter 1 - Introduction

Chapter 2 - Project Site Environment

Chapter 3 - Field Surveys and Investigations

Chapter 4 - Traffic Forecast

Chapter 5 - Vessel Sizes

Chapter 6 - Facility Requirements

Chapter 7 - Alternative Layouts

Chapter 8 - Development Plan

Chapter 9 - Preliminary Engineering – Civil Works

Chapter 10 - Preliminary Engineering – Material Handling System/ Equipments

Chapter 11 - Preliminary Engineering – Electrical and Control System

Chapter 12 - External Connectivity

Chapter 13 - Environmental Impact Assessment (EIA) & Environment Management and Monitoring (EMP)

Chapter 14 - Cost Estimates

Chapter 15 - Project Implementation Schedule

Chapter 16 - Financial and Economic Analysis

2 PROJECT SITE ENVIRONMENT

This chapter provides information on location, meteorological, oceanographic parameters, connectivity and existing features to have a complete understanding on the site conditions and to enable proper planning and design of terminal facilities.

2.1 Project Location

The site is located on Hugli River at Latitude 22° 03' 30'' North and Longitude 88° 8' 40'' East, at Haldia in Purba Medinipur district of West Bengal. Google image of the proposed terminal is shown in figure below:

Figure 2.1 Location of Site for Haldia Multimodal IWT Terminal

2.2 Land Availability

The multi-cargo Inland Water Transport (IWT) terminal is proposed in an area of 61 acres adjacent to Haldia Dock. The land belongs to Kolkata Port Trust and has already been handed over to IWAI on a long term lease basis.

2.3 Infrastructure at the Project Site

The infrastructure near the project site is as follows:

2.3.1 Road Connectivity

The terminal has a good connectivity with national highway network. The nearest national highway from the terminal is NH-41, which connects Haldia Port to Kolaghat on NH-6 (part of Golden Quadrilateral). The terminal is about 6 km from NH-41 and is connected by a two lane road. Kolaghat is connected to Orissa, Jharkhand, Kharagpur, Bankura, Purulia and Durgapur through NH-6 and to North Bengal, Bangladesh via Petrapole and Bhojadanga Land Custom Stations through NH-34. A state highway connecting Haldia with Kolaghat via Tamluk town, the district headquarters, can also serve as an alternate connectivity. A 4-Lane expressway

linking Haldia to Kolkata via Raichak-Kukrahati is going to be developed. The land acquisition for this road is nearing completion.

2.3.2 Rail Connectivity

The terminal has a good connectivity with railway network. The nearest railway head is Durgachowk Railway Station, which is about 3 km from the terminal. The siding to Haldia terminal is about 0.2 km from the project site.

2.3.3 Air Connectivity

The nearest airport is Netaji Subhash International Airport in Kolkata which is about 130 km from the project site.

2.3.4 Sea link

The terminal is located about 60 km from the Bay of Bengal and is connected to the sea by Hugli River. Haldia dock, which is a major port, is adjacent to the project site.

2.3.5 Nearest Towns

The nearest towns are Haldia and Durgachowk, which are about 8 km and 0.5 km from the project site, respectively.

2.4 Meteorological Parameters

The meteorological data of the project site is obtained from the Climatological Handbook of India, 1971 to 2000 published by Indian Meteorology Department. The nearest IMD observatory to Haldia is Ulberia, which is located at 22° 30' N latitude and 87° 57' E longitude. The various meteorological observations of the same are presented below.

2.4.1 Temperature

The temperatures vary from 7.2°C to 41°C. The mean daily maximum and minimum air temperatures along with the extremes for each month are as given below:

Table 2.1 Recorded Mean Daily and Extreme Temperatures

Month	Recorded Temperature (°C)			
	Mean Daily Maximum	Mean Daily Minimum	Highest Maximum	Lowest Minimum
January	25.7	12.7	33.2	7.8
February	28.6	15.9	36.4	7.2
March	33.0	20.7	40.3	12.2
April	35.0	24.1	41.0	12.9
May	35.0	25.4	38.7	17.8
June	33.7	26.2	40.0	19.3

Month	Recorded Temperature (°C)			
	Mean Daily Maximum	Mean Daily Minimum	Highest Maximum	Lowest Minimum
July	32.2	26.0	36.1	16.2
August	31.8	26.1	36.7	16.4
September	32.0	25.8	36.1	17.6
October	31.8	23.9	34.0	17.2
November	29.3	18.6	32.9	12.2
December	26.6	13.8	32.9	9.4

Source: IMD

2.4.2 Wind

The mean wind speed at the project site is found to be in the range of 0.72 m/s to 2.14 m/s. The wind direction is mostly from south-east to south-west. The basic wind speed at 10 m height for the project site is 55 m/s (198 km/h) as per IS 875 (Part 3).

2.4.3 Relative Humidity

The humidity is moderate to high throughout the year with the mornings being more humid than evenings. The mean relative humidity for each month of the year measured during mornings and evenings is as tabulated below:

Table 2.2 Mean Relative Humidity

Month	Mean Relative Humidity (%)	
	Morning (0830 hrs)	Evening (1730 hrs)
January	85	63
February	81	58
March	80	58
April	80	70
May	80	74
June	84	79
July	88	84
August	88	84
September	88	83
October	84	78
November	83	71
December	84	66

Source: IMD

2.4.4 Rainfall

The area is dominated by south-west monsoon during June to September and north-east monsoon during December to March. The area received almost 74% of the rainfall during south-west monsoon. The average annual rainfall in the region is about 1618.1 mm. The month-wise distribution of the average rainfall recorded for each month of the year is as follows:

Table 2.3 Annual Rainfall Data

Month	Monthly Total (mm)	Number of Rainy Days	Heaviest Fall in 24 Hours (mm)	Year
January	11.3	0.9	59.9	1977
February	23.7	1.5	44.6	1992
March	33.9	2.1	86.6	1981
April	52.8	3.6	54.1	1971
May	126.1	6.4	85.9	1973
June	242.6	11.7	266.8	1984
July	343.8	15.0	186.8	1990
August	332.5	15.8	255.0	1971
September	307.5	12.1	409.3	1978
October	97.5	5.5	80.0	1973
November	33.4	1.4	199.8	1986
December	13.0	0.6	91.6	1981
Total	**1618.1**	**76.7**		

Source: IMD

2.4.5 Depressions and Cyclones

The Hugli estuary is located at the apex of the Bay of Bengal and is prone to storm surges caused by tropical cyclones that take place between May and December. A total number of 346 storms occurred within 100 km of the mouth of the Hugli estuary during 1936 to 2006.

Table 2.4 No. of Storms

Storm Type	Wind Speed (kmph)	Number of Occurrences
Depressions	< 63 kmph	266
Cyclonic storms	63 - 87 kmph	39
Severe cyclonic storms	> 87 kmph	41
Total		**346**

2.4.6 Visibility

The visibility in the project area is generally good throughout the year, except for a few days during the winter season and during periods of heavy rain. On an average, the visibility is less than 4 km for about 110 days in a year.

2.5 Oceanographic / River Conditions

2.5.1 Tides

Hugli River experiences semi-diurnal tide with two high and two low tides in a day. The following are the tidal levels at the site.

Table 2.5 Tide Levels near Haldia

Highest High Water	(+) 7.26 mCD
Mean High Water Spring	(+) 5.70 mCD
Mean High Water	(+) 5.01 mCD
Mean High Water Neap	(+) 4.26 mCD
Local Mean Water Level	(+) 3.23 mCD
Mean Sea Level	(+) 2.80 mCD
Mean Low Water Neap	(+) 2.10 mCD
Mean Low Water	(+) 1.34 mCD
Mean Low Water Spring	(+) 0.80 mCD
Chart Datum	0.46 m below K.O.D.S. (Khirdirpur Old Dock Sill)
Lowest Low Water	(-) 0.07 mCD

Source: Hugli River Tide Table 2015 published by Survey of India

The tidal effect is noticeable up to a distance of 300 km from the mouth of the Hugli River.

2.5.2 Current

Maximum ebb current of 4 knots and flood tide current of 6 knots occur in the river.

2.5.3 Waves

The sea waves mostly approach the Hugli River from SSW to WSW and wave heights near the terminal site would be 0.5 m and 3.0 m during the operating and storm conditions respectively.

2.5.4 Discharge

The fresh water discharge into the Hugli River ranges from a peak of 4,250 m^3/s to almost zero during the dry season. The average values of fresh water discharge are 3,000 m^3/s during southwest monsoon season and 1,000 m^3/s during November to May. Normally fresh water

discharges are regulated by Farakka Barrage situated upstream of Hugli River to maintain water levels at Kolkata. The Hugli River discharges a sediment load of about 20 to 25 million tons per annum.

2.5.5 Morphological condition

Hugli River is characterized by the presence of a large number of tidal bars and tidal islands of which Sagar island, Ghormara Island, Balari bar and Nayachara Island are the most important. The formation of the islands, shoals, mud flats, etc. restrict the navigation channel to a draft less than 6 m. The morphological changes in Hugli River from 1904 to 2008 are shown in figure below.

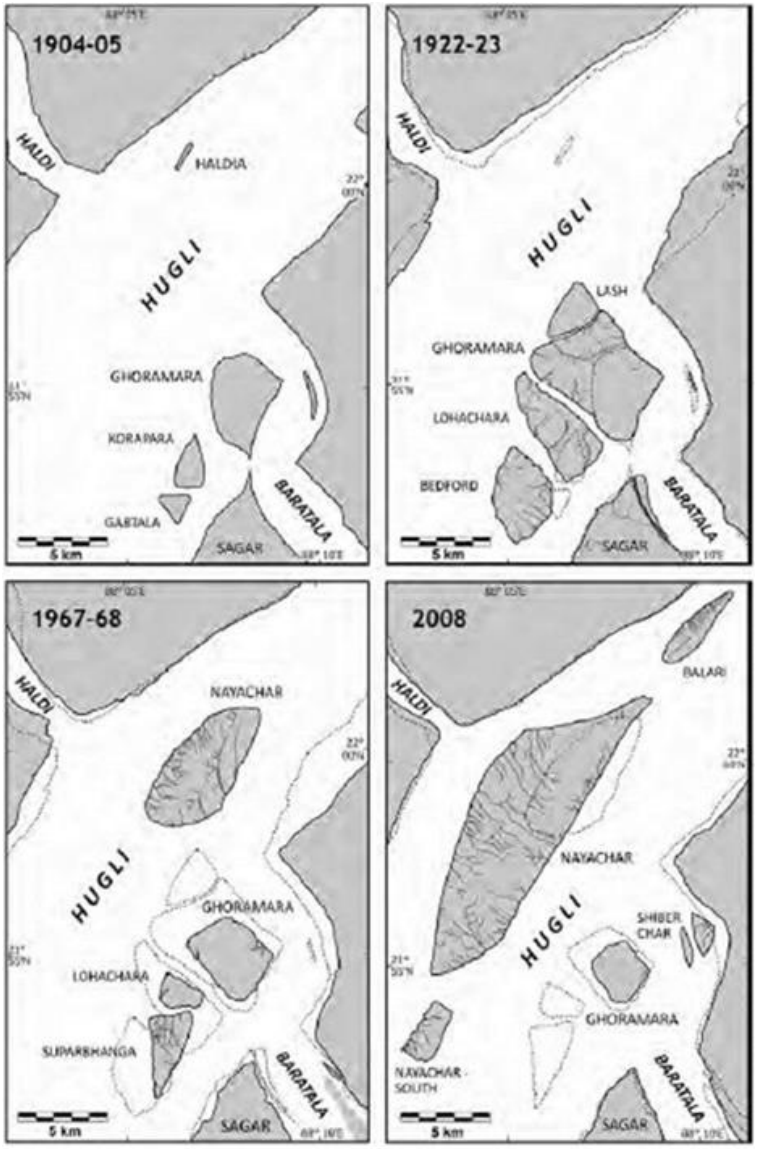


Figure 2.2 Morphological changes in Hugli River

From the above figure, it can be seen that there are significant morphological changes in the Hugli River. Few islands like Lohachara, Korapara, Gabtala, Bedford, and Suprabhanga have vanished completely and new islands like Nayachara Island and Balari bar have formed.

Table 2.6 Morphological Changes in Hugli River

Year	Area in Sq. km			
	Sagar Island	Ghoramara	Nayachara Island	Balari Bar
1951	285.40	38.23	30.16	
1973	244.00	13.41	27.43	
1990	236.95	6.67	42.11	
2000	247.47	5.52	53.74	1.10
2011	239.23	4.37	45.86	6.70
2015	235.00	4.30	64.00	7.00

2.5.6 Existing Navigational Channel

The existing navigation channel from Bay of Bengal to Kolkata Port in the Hugli River shifts erratically. In an estuary like Hugli with high tidal range supported by persistent flood and ebb flows and charged with sediment load and river discharges, the bed configuration changes drastically under differing flow regimes. The position of the channel in rivers like Hugli shifts back and forth as large as 900m. The movement of sand bars and shoals occur most frequently during the abrupt falling stage of the river (October and November) and the shift is quite sudden and erratic.

2.6 Natural Hazards

2.6.1 Seismicity

The terminal falls under the seismic Zone III as per IS: 1893 – 2000.

2.7 Pipeline Corridor

Two ammonia pipelines of M/s Tata Chemical, being maintained by M/s Sanjana Cryogenic, pass through the proposed terminal site. It is proposed to relocate these pipelines into a 40 m wide pipeline corridor adjacent to the river bank. The pipeline will be laid above ground in the pipeline corridor.

3 FIELD SURVEYS AND INVESTIGATIONS

The secondary data on the topography of the terminal site, landside as well as riverside geotechnical data and bathymetric data of the river was not available. These details were collected by carrying out field surveys and investigations.

3.1 Topographic Surveys

The topographic survey of site was carried out by M/s Ocean Science and Surveying Pvt. Ltd during August 2015. The results of the topographic survey are as follows:

- The existing ground level in the terminal area varies from (+) 5.07 mCD to (+) 8.38 mCD.
- About 80% of the terminal area has a ground level between (+) 6.00 mCD and (+) 7.00 mCD
- About 10% of the terminal area near the south-west corner has ground level varying between (+) 5.00 m CD and (+) 6.00 mCD
- The ground level near the north-west and western boundaries is more than (+) 7.00 mCD

The topographic survey data is enclosed as **Drawing I-525-HT-201**.

3.2 Geotechnical Investigations

The landside and riverside geotechnical investigations were carried out by M/s Xplorer Consultancy Services Pvt. Ltd. during December 2015. The borehole locations are shown in **Drawing I-525-HT-203**. The boreholes were driven up to a depth of about 60 m below the ground / bed level and soil samples were collected at regular intervals.

3.2.1 Landside Soil Profile

The soil profile comprises of layers of silty sand / silty clay of varying properties. A typical summary of the landside soil profile is given below (Borehole No. 4).

Table 3.1 Landside Soil Profile

LAYER DETAILS					Field N-Value	Bulk Density *(t/m³)*	Shear Strength parameter
No.	Brief Description	RL *(m)*		Thickness *(m)*			
		From	To				
—	Fill consisting of silty clay with sand, kankar, brick pieces etc.	+98.6 (G.L.)	+96.6	2.0	–	§1.800	–
I	Soft/firm silty clay with occasional laminations of silt / fine sand	+96.6	+87.6	9.0	2	1.815	c=1.6t/m²
		+87.6	+82.1	5.5	4 & 6	1.833	c=2.4t/m²
II	Medium dense silty fine sand with a thin band of firm silty clay from 18.6m to 20.0m depth	+82.1	+80.0	2.1	*19	§1.900	§Φ=32.5°
		+80.0	+78.6	1.4	7	§1.850	§c=3.5t/m²
		+78.6	+75.6	3.0	*11	§1.780	§Φ=30°

III	Firm silty clay with varying percentage of decomposed / semi-decomposed wood	+75.6	+62.6	13.0	6 to 9	1.754	c=3.5t/m^2
IV	Stiff to very stiff silty sandy clay	+62.6	+58.6	4.0	18 & 20	1.988	§c=9.5t/m^2
V	Dense to very dense silty sand	+58.6	+54.1	4.5	§*30	§2.020	§Φ=35.5°
VI	Stiff / very stiff silty clay with brown spots	+54.1	+48.6	5.5	22 to 24	1.965	§c=11.5t/m^2
		+48.6	+42.6	6.0	13 to 16	1.929	§c=7.0t/m^2
VII	Medium dense / dense silty fine sand	+42.6	+38.4 (T.L)	4.2	§*30	§2.020	§Φ=35.5°
G.L= Ground Level, T.L.= Termination Level, * = Corrected N value, § = Suggested Value							

3.2.2 Riverside Soil Profile

The soil profile comprises of layers of silty sand / silty clay of varying properties. A typical summary of the riverside soil profile is given below (Borehole No. 12).

Table 3.2 Riverside Soil Profile

LAYER DETAILS					Field N-Value	Bulk Density *(t/m^3)*	Shear Strength parameter
No.	Brief Description	RL *(m)*		Thickness *(m)*			
		From	To				
I	Very soft / soft to firm silty clay with occasional laminations of silt / fine sand; medium dense silty fine sand with clay as binder observed from 12.0m to 14.0m depth	+91.0 (B.L.)	+85.0	6.0	1	§1.700	–
		+85.0	+79.0	6.0	5 & 8	1.837	c=3.0t/m^2
		+79.0	+77.0	2.0	*17	§1.870	§Φ=32°
		+77.0	+76.0	1.0	–	1.919	c=5.6t/m^2
III	Firm silty clay with varying percentage of decomposed / semi-decomposed wood	+76.0	+61.0	15.0	6 to 9	1.775	c=3.1t/m^2
IV	Very stiff sandy silty clay with kankars	+61.0	+59.0	2.0	18	1.974	§c=9.0t/m^2
V	Dense / very dense silty sand	+59.0	+54.0	5.0	§*30	§2.020	§Φ=35.5°
VI	Very stiff silty clay with yellow spots	+54.0	+51.0	3.0	28	1.994	§c=14.0t/m^2
		+51.0	+44.0	7.0	15 to 19	1.948	§c=8.5t/m^2
		+44.0	+39.3	4.7	21 to 28	1.986	§c=12.5t/m^2
VII	Medium dense to dense / very dense silty fine sand	+39.3	+36.0	3.3	*28	§2.010	§Φ=35°
		+36.0	+30.7 (T.L)	5.3	§*30	§2.020	§Φ=35.5°
B.L = Bed Level, T.L.= Termination Level, * = Corrected N value, § = Suggested Value							

3.3 Bathymetry Survey

The bathymetry survey of site was carried out by M/s Ocean Science and Surveying Pvt. Ltd during December 2015. The existing river bed level near the proposed terminal varies from (-) 1.10 mCD to (-) 2.50 mCD. The bathymetric survey data is enclosed as **Drawing I-525-HT-202**.

4 TRAFFIC FORECAST

IWAI has appointed M/s Hamburg Port Consulting, GmBH and M/s Universal Transport Consulting, GmBH as consultants for carrying out market analysis of Multi-modal terminal at Haldia.

On the basis of the collected origin-destination pairs (O/D-pairs), the Consultants forecasted the traffic for Haldia MMT from base year 2015 until 2045 as mentioned in the below table.

Table 4.1 Haldia MMT - 2020 to 2045 cargo forecast by cargo type (tons)

Cargo Type	2020		2025		2035		2045	
	Loaded	***Discharged***	***Loaded***	***Discharged***	***Loaded***	***Discharged***	***Loaded***	***Discharged***
Bagged (Fertilizer)			72,484		251,222		268,562	
Bagged (Food grains)		50,608		53,061		90,608		96,359
Container					335,762		437,585	
Dry bulk (Coal)	766,264		1,746,915		2,653,339		2,807,585	
Dry Bulk (Fly ash)	1,381,163		1,662,129		2,187,851		2,708,878	
Dry Bulk (Stone chips)		162,716		205,119		273,917		318,430
Dry bulk (Iron ore)						30,960		32,910
Neo-bulk (Steel, Textile, Petroleum, Project cargo)	394,453	139,640	508,903	494,287	743,080	767,133	885,947	886,688
Total (tons)	***2,541,880***	***352,964***	***3,990,431***	***752,467***	***6,171,254***	***1,162,618***	***7,108,557***	***1,334,387***

Source: HPC report on Infrastructure requirement of individual terminals along National Waterways 1, 26th April 2016.

5 VESSEL SIZES

The size of vessels that would call at any terminal will generally be governed by the following aspects:

- The trading route
- Availability of a suitable vessel in the market
- Available facilities mainly navigational channel and manoeuvring areas including the draft
- The available facilities for loading & unloading
- Volume of annual traffic to be handled and the likely parcel size as per the requirements of the user agency.

5.1 Vessel Sizes Recommended by IWAI

The size of vessels calling at the proposed IWT terminal at Haldia is restricted by the availability of draft in the navigation channel of National Waterway-1. It is assured that LAD of 3.0 m shall be maintained by IWAI for movement of vessels in Haldia-Farakka stretch. Based on the LAD of 3.0 m in the navigational channel, IWAI recommended that self-propelled barges of sizes presented in table below can ply in the inland waterways.

Table 5.1 Vessels that can Ply in Inland Waterways with LAD of 3.0 m

Tonnage (T)	Length (m)	Beam (m)	Draft (m)
650 - 1000	60 - 80	8.20	2.20
1000 - 1500	80 - 85	9.50	2.20
1500 - 3000	85 - 95	15.00	2.50

5.2 Vessel Sizes at Haldia Terminal

The following main cargo commodities for proposed terminal at Haldia have been identified:

- Fly ash
- Other Cargo such as fertiliser, natural aggregates, petroleum products.

The vessel sizes in which various commodities will be transported are considered as follows:

Table 5.2 Vessels Sizes for Various Commodities

Vessel Type	Vessel Size (DWT)	LOA (m)	Beam (m)	Loaded Draft (m)
Flyash export to Bangladesh	1,500	85	9.50	2.2
Fertiliser / Natural aggregates/ Petroleum products through NW1	3,000	95	15.00	2.5

6 FACILITY REQUIREMENT

The marine infrastructure and shore based infrastructure shall be planned and developed to cater to the cargo forecast. Development of the terminal infrastructure shall also be suitably phased in such a way that the initial phases integrate well with subsequent phases.

6.1 Traffic Forecast

As the IWT sector is in a nascent stage, the diversion of traffic to IWT would depend on the government policies and several other factors. Hence on a conservative side, the traffic projection for the base case is considered for the terminal development. The traffic forecast as per the traffic report by M/s Hamburg Port Consulting GmBH and M/s Universal Transport Consultancy GmBH is as follows:

Table 6.1 Traffic Forecast for the year 2020 to 2045

Cargo Type	2020		2025		2035		2045	
	Loaded	***Discharged***	***Loaded***	***Discharged***	***Loaded***	***Discharged***	***Loaded***	***Discharged***
Bagged (Fertilizer)			72,484		251,222		268,562	
Bagged (Food grains)		50,608		53,061		90,608		96,359
Container					335,762		437,585	
Dry bulk (Coal)	766,264		1,746,915		2,653,339		2,807,585	
Dry Bulk (Fly ash)	1,381,163		1,662,129		2,187,851		2,708,878	
Dry Bulk (Stone chips)		162,716		205,119		273,917		318,430
Dry bulk (Iron ore)						30,960		32,910
Neo-bulk (Steel, Textile, Petroleum, Project cargo)	394,453	139,640	508,903	494,287	743,080	767,133	885,947	886,688
Total (tons)	***2,541,880***	***352,964***	***3,990,431***	***752,467***	***6,171,254***	***1,162,618***	***7,108,557***	***1,334,387***

Source: HPC report on Infrastructure requirement of individual terminals along National Waterways 1, 26th April 2016.

6.2 Marine infrastructure

The marine infrastructure comprises of jetties and manoeuvring areas like approach channels, turning circle, berthing pockets, holding area, etc.

6.2.1 Navigational and Operational requirements

The basic navigational and operational requirements to service the vessels calling at a port / terminal are:

- Sufficient depth in manoeuvring area and at the berths
- Sufficient depth and width in approach channel
- Adequate berthing infrastructure including berth fixtures like fenders

- Mooring system
- Navigational aids

Dimensions of navigable water ways generally comply with guidelines provided in the BIS Code of Practice IS: 4651– 1980 “Code of Practice for Planning and Design of Ports and Harbours - Part V - Layout and Functional Requirements” and as per PIANC guidelines for Design guidelines for Habour approach channels.

6.2.1.1 Design Vessels

The dimensions of manoeuvring areas are dependent on the design vessels arriving at the terminal and details of the same is presented in table below.

Table 6.2 Design Vessel Sizes

Vessel Type	Vessel Size (DWT)	LOA (m)	Beam (m)	Loaded Draft (m)
Barges	3,000	95	15	2.5

6.2.1.2 Availability of Sufficient Depths

The depth available near the water front of terminal varies from (-) 0.80 mCD to (-) 1.50 mCD at a distance of 200 m from the river bank. The water depths downstream of the terminal up to Haldia Dock vary from (-) 1.00 mCD to (-) 9.00 mCD.

Generally, the depth in the manoeuvring areas is determined by:

- Vessel’s loaded draft
- Water level and tidal variations
- Sedimentation pattern in the region

As per IS 4651 (Part V), under keel clearance to be provided is 20% in unsheltered areas. Considering the design vessels the required depths are as follows:

Table 6.3 Dredge depths required

Description	Barge
Draft (m)	2.5
Under keel clearance (@20%) (m)	0.5
Allowance for siltation (m)	1
Channel depth required (m)	**4**
Tidal window (MLWS) (m)	0.8
Dredge level below CD	**3.2**

The development at Haldia terminal is planned for barges only. The barges are assumed to have a loaded draught of 2.5 m requiring a depth of 4 m on the berth for safe passage (including allowance for under keel clearance & siltation).

By considering the tidal advantage (MLWS) of 0.8 m, a draft of 3.2 m water level is required for the safe passage of barges and to ensure continuous terminal operations, dredging shall be carried out in the turning circle, berth pockets, holding area and approach channel.

IWAI desires that dredging is to be carried out along with the terminal construction to avoid idling of terminal operations for want of access channel.

6.2.1.3 Channel Alignment

The alignment of the approach channel is in the W-E direction with a bearing of 28^{o} with respect to north for 0.60 km and then the channel alignment changes to 34^{o} with respect to north. The two legs of the channel will be connected by a curve having a radius of 150 m towards Salukhali channel.

6.2.1.4 Channel Length

The length of the approach channel is approximately 7.00 km.

6.2.1.5 Channel Depth

The proposed depth of the approach channel is (-) 3 mCD excluding any siltation allowances.

6.2.1.6 Channel Width

The channel width for a one way channel is arrived based on the following considerations as per PIANC guidelines:

Table 6.4 Considerations for Channel Width

Basic manoeuvring lane	1.5 B
Bank Clearance (both sides sloping)	2 x 0.3 B
Allowance for currents	0.7 B
Allowance for depth	0.1 B
Allowance for channel bottom	0.1 B
Total	**3.0 B**

Based on the above, the channel width in the straight leg of the channel for 3,000 DWT vessel is as follows:

Table 6.5 Channel Width

	Straight leg
Channel Width (m)	45 (3 x 15*)

** The beam of 3000 DWT vessel is 15 m.*

6.2.2 Turning circle dimensions and depth at Berth

6.2.2.1 Turning Circle

The turning circle, required to swing and berth the vessels, is very important and must have proper configuration, dimensions and access. As per IS: 4651 (Part V) – 1980, the minimum diameter of the turning circle should be 1.7 to 2.0 times (1.7 for protected locations and 2.0 for exposed locations) the length of the largest vessel.

Keeping these requirements in view, the dimensions of the turning circles would be as hereunder:

Table 6.6 Dimensions of Turning Circle

Vessel Size	LoA (m)	Draft (m)	Diameter (m) 2.0 x LoA	Dredged Depth (m w.r.t. CD)
3,000 DWT	95	2.50	190	(-) 3.2

6.2.2.2 Depth at Berths

Based on Table 6.3, the dredge level at berth location is as follows:

- Barge jetties : (-) 3.20 mCD

6.2.3 Holding area

The holding area is proposed adjacent to the channel leading into the turning circle having two patches of about 360 m x 30 m on either side of the access channel to accommodate 6 barges (3 barges in one patch) and also an additional holding area in the main river to the North of Balari Bar as shown in **Drawing I-525-HT-211**.

6.2.4 Berth Requirements

In order to work out the berth requirements to meet the projected traffic, it is necessary to define the following governing parameters:

- Average parcel size
- Cargo handling arrangement
- Cargo handling rates
- Number of operational days per year
- Number of working hours per day
- Effective working hours per day
- Time required for peripheral activities

Each of the above parameters are discussed below.

6.2.4.1 Average Parcel Size

Though the design vessel size is the guiding parameter in arriving at the dimensions of the navigable water ways, in actual practice vessels of various sizes will arrive at the IWT terminal. For ascertaining the requirement of number of berths, it is prudent to consider the average parcel size for each commodity and details of the same are presented below.

Table 6.7 Average Parcel Size

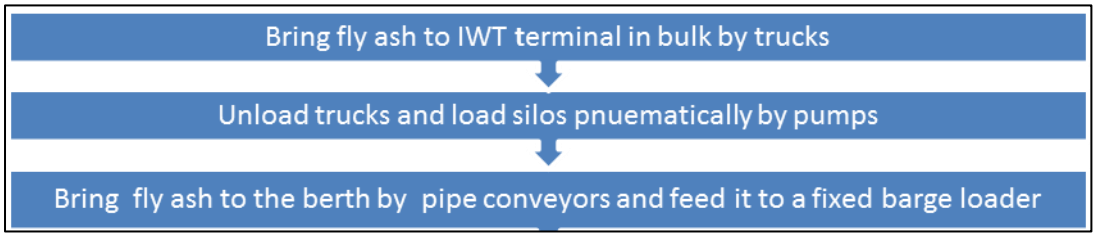
Commodity	Average Parcel Size (T)
Flyash	1,000
Fertiliser	1,500
Natural Aggregate	1,500
Petroleum Products	500
Iron Ore	1,000
Project Cargo	500
Gypsum	1,000
Coal	1,500

6.2.4.2 Cargo Handling Arrangements

For estimating the required number of berths, the handling arrangements assumed for various commodities of the IWT terminal at Haldia are described below:

6.2.4.2.1 Fly Ash

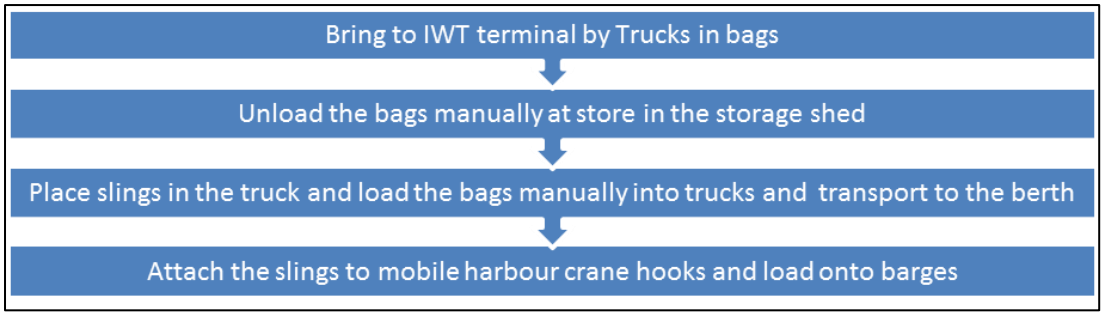
Fly ash will come in to the terminal by trucks and loaded to the silos pneumatically by pumps. Then it will be loaded to barges by barge loaders through pipe conveyor system.



It is expected that with the above handling arrangement about 8,000 T of fly ash can be handled per day at one berth.

6.2.4.2.2 Fertiliser

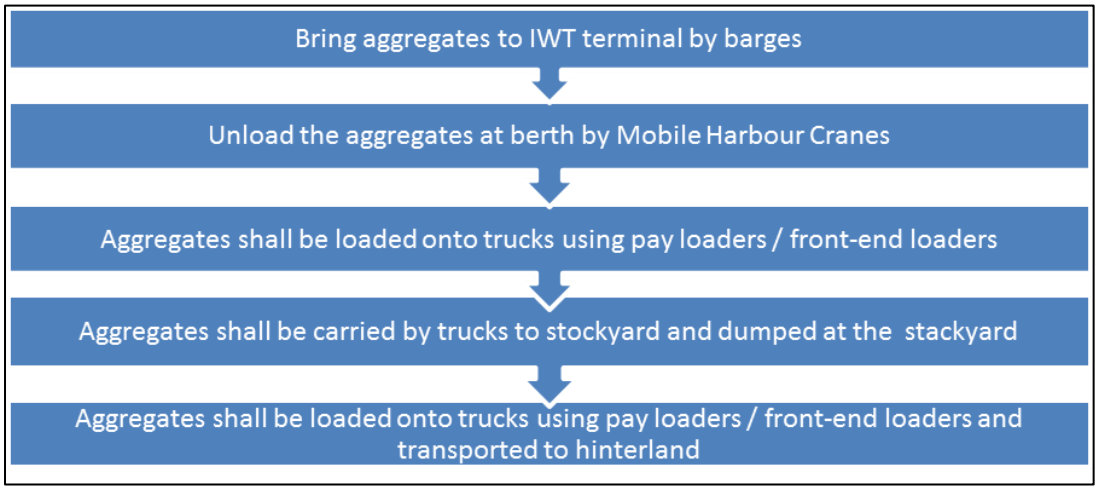
Fertiliser will come into the terminal by trucks in bags and stored in a covered shed. Then it will be transported to jetty by trucks and loaded on to the barges by mobile harbour crane.



It is expected that with the above handling arrangement about 3000 T of aggregates can be handled per day at one berth.

6.2.4.2.3 Natural Aggregates

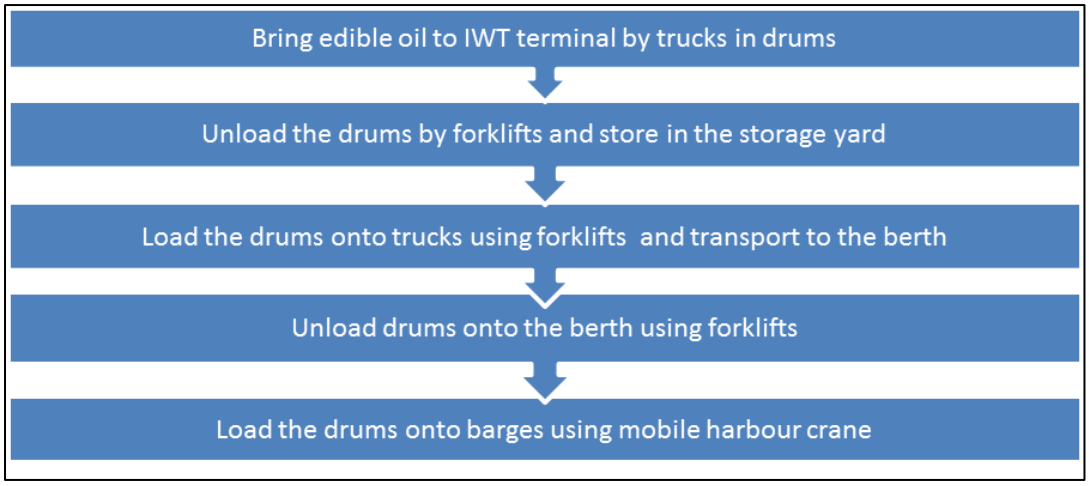
Natural aggregate will come to the terminal by barges and unloaded by mobile harbour crane into trucks and transported to the storage yard. Then it will be loaded to trucks by pay loader and transported to the hinterland by trucks.



It is expected that with the above handling arrangement about 1,600 T of aggregates can be handled per day at one berth.

6.2.4.2.4 Edible Oil

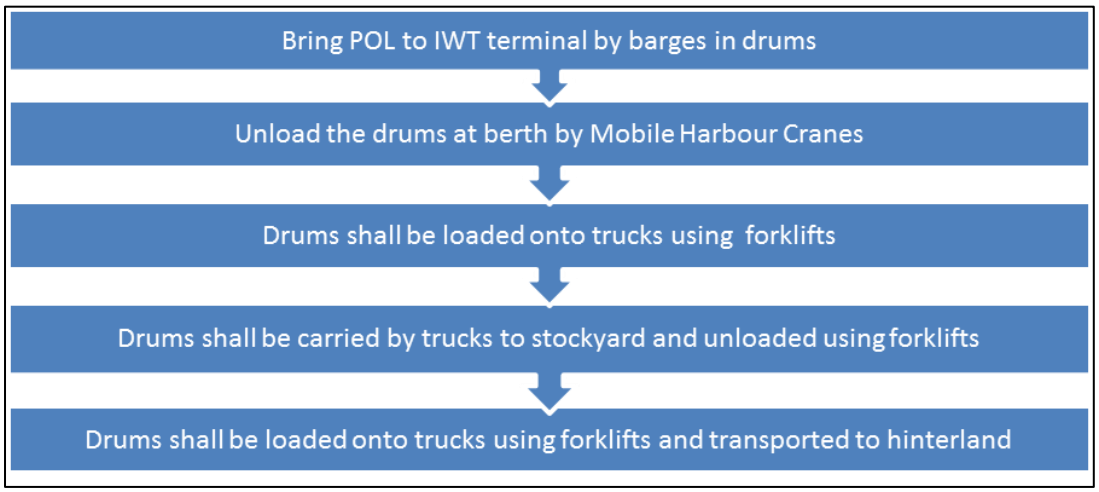
Edible Oil will come into the terminal by trucks in drums and stored in an open area. Then it will be transported to jetty by trucks and loaded on to the barges by mobile harbour crane.



It is expected that with the above handling arrangement about 320 T of edible oil can be handled per day at one berth.

6.2.4.2.5 POL

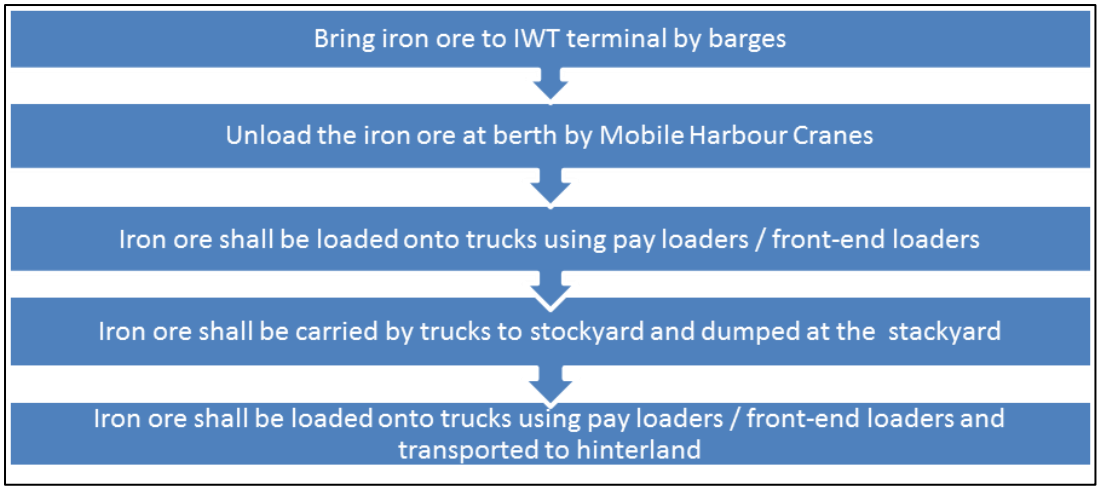
POL will come to the terminal by barges in drums and unloaded by mobile harbour crane onto berth. Drums will be loaded onto trucks with the help of forklifts and transported to the storage yard. Then it will be unloaded from trucks by forklifts and stored in the storage yard. At the storage yard, it will loaded onto trucks with a forklift and transported to the hinterland.



It is expected that with the above handling arrangement about 320 T of POL can be handled per day at one berth.

6.2.4.2.6 Iron ore

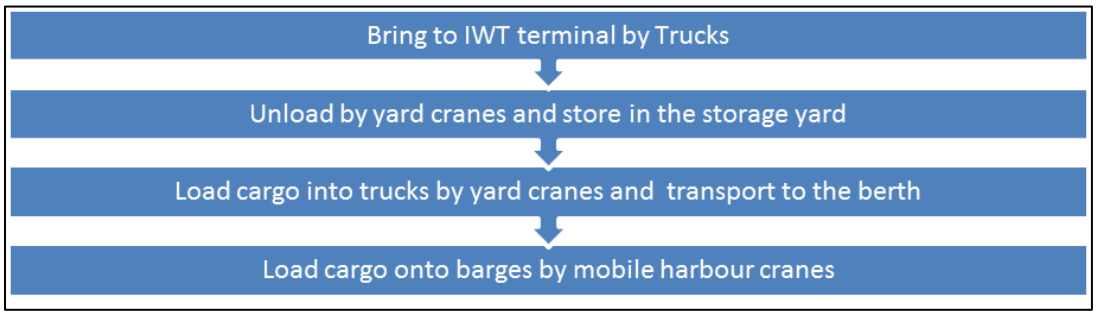
Iron ore will come to the terminal by barges and unloaded by mobile harbour crane into trucks and transported to the storage yard. Then it will be loaded to trucks by pay loader and transported to the hinterland by trucks.



It is expected that with the above handling arrangement about 3,000 T of iron ore can be handled per day at one berth.

6.2.4.2.7 Project Cargo

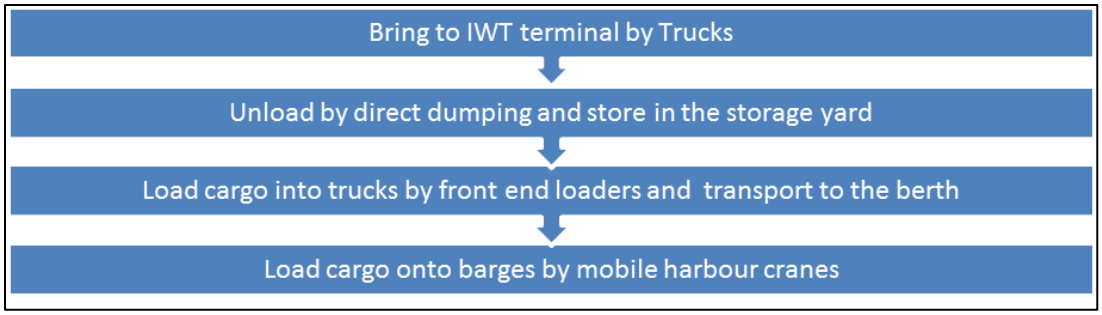
Project cargo will come into the terminal by trucks and stored in open area. Then it will be transported to jetty by trucks and loaded on to the barges by mobile harbour crane.



It is expected that with the above handling arrangement about 1,000 T of project cargo can be handled per day at one berth.

6.2.4.2.8 Gypsum

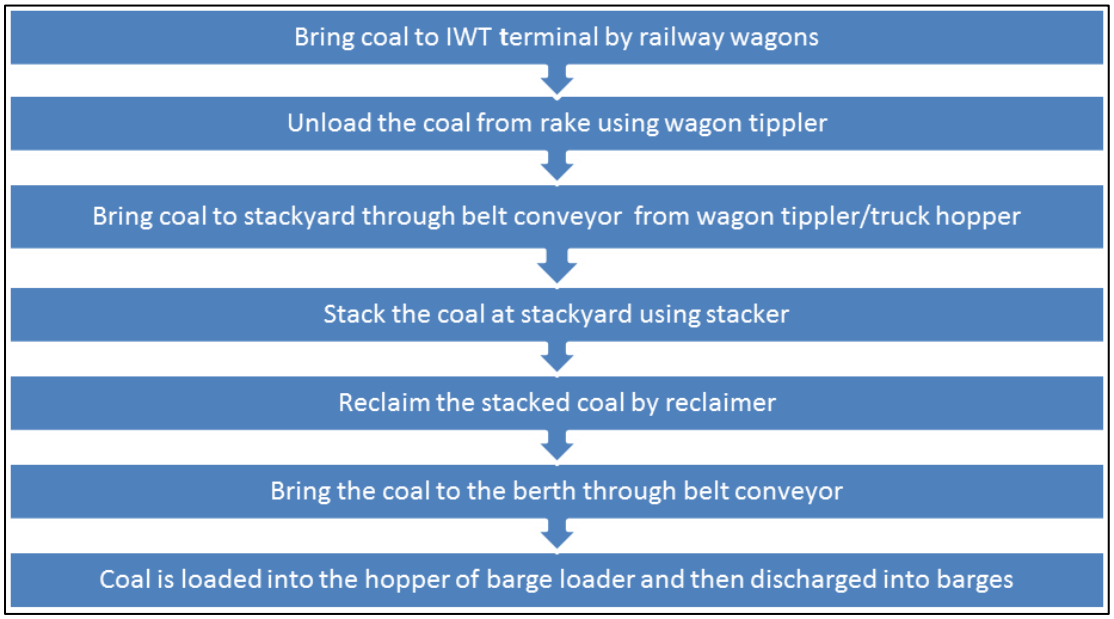
Project cargo will come into the terminal by trucks and stored in open area. Then it will be transported to jetty by trucks and loaded on to the barges by mobile harbour crane.



It is expected that with the above handling arrangement about 2,400 T of gypsum can be handled per day at one berth.

6.2.4.2.9 Coal

Coal would arrive at the terminal in railway wagons, unloaded by a wagon tippler and conveyed to the stockyard by conveyor. The coal will be stacked in the stockyard by means of a stacker. From the stackyard, the coal will reclaimed by a reclaimer and conveyed to the berth by means of conveyor and loaded to barges by means of barge loader.



It is expected that with the above handling arrangement about 20,000 T of coal can be handled per day at one berth.

6.2.4.3 Cargo Handling Rates

Based on the above cargo handling arrangements for various commodities, the cargo handling rates assumed in different phases are presented in table below:

Table 6.8 Cargo Handling Rates in Different Phases of Terminal

S. No.	Cargo	Handling Rate (TPH)		
		Phase-1	Phase-2	Master Plan Phase
1.	Coal	1,000	1,000	1,000
2.	Fly Ash	400	400	400
3.	Fertilizer	150	150	150
4.	Natural Aggregates	80	80	80
5.	Petroleum Products	16	16	16
6.	Other Cargo			
a.	Iron Ore	150	150	150
b.	Project Cargo	50	50	50
c.	Steel	50	50	50
d.	Textile	50	50	50

6.2.4.4 Number of Operational Days

It is assumed that Haldia Terminal will work seven days a week, which brings the effective number of working days to 315 days per year, allowing for 50 non-operational days due to weather and other reasons.

6.2.4.5 Number of Operational Hours

The productive cargo handling hours on an average in a day when the vessels are at berth has been taken as 20 hours to account for shift changes, equipment position changes and for any unplanned stoppages.

6.2.4.6 Time Required for Peripheral Activities

Apart from the actual time for loading / unloading cargo, additional time is required for other activities such as berthing, de-berthing and other incidental activities, for which 1 hour has been considered per barge.

6.2.4.7 Allowable Levels of Berth Occupancy

Berth occupancy is expressed as the ratio of the total number of days per year that a berth is occupied by a vessel (including the time spent in peripheral activities) to the number of terminal operational days in a year. High levels of berth occupancy will result in bunching of vessels resulting in undesirable pre-berthing detention. For limited number of berths and with random arrival of vessels, the berth occupancy levels have to be kept low to reduce this detention. The norms generally followed for planning the number of berths, in ports worldwide and in Indian ports are indicated in the table below:

Table 6.9 Norms for Berth Occupancy

No. of Berths	International Standards	Indian Practice	
		Bulk Cargo	General Cargo
1	40 %	60 %	70 %
2	50 %	70 %	70 %
3	55 %	70 %	70 %
4	60 %	70 %	75 %
5	65 %	70 %	75 %
6 and above	70 %	70 %	75 %

Source: UNCTAD Publication

In the IWT, random arrival of vessels can be reduced by regulation of the vessel movements. The following berth occupancy factors are recommended while planning of Haldia Terminal:

Table 6.10 Recommended Berth Occupancy Factors for Haldia Terminal

No. of berths	Recommended Berth Occupancy (%)
1	70
2 or more	75

6.2.4.8 Berth Requirements

Based on the considerations discussed above, the requirements of cargo handling berths for Haldia Terminal in Phase-1, Phase-2 and Master Plan Phase have been calculated as shown in tables below.

Table 6.11 Requirement of Berths for Phase-1

S. No.	Description	Unit	Flyash	Coal	Food grains	Natural aggregate	Petroleum	Other Cargo	
								Project Cargo	Textile
1	Cargo volume	Million T	1.38	0.77	0.05	0.16	0.47	0.01	0.06
2	Average parcel size	T	1,000	1,500	1500	1,500	500	500	500
3	Number of vessels	Nos.	1,381	511	34	108	941	13	114
4	Effective working hours	Hours	20	20	20	20	20	20	20
5	Average cargo handling rate	T per hr	400	1,000	150	80	16	50	50
6	Service time per vessel	Hours	2.50	1.50	10.00	18.75	31.25	10.00	10.00
7	Addl. time for peripheral activities	Hours	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	Total time per vessel	Hours	3.50	2.50	11.00	19.75	32.25	11.00	11.00
9	Total berth days reqd.	Days	230	60	18	106	1,510	7	62
10	**Number of berths**	**Nos.**	**1**	**1**					**7**
11	Operational days	Days	315	315					315
11	Total berth days available	Days	315	315					2,205
12	**Berth occupancy**	**%**	**73.02**	**19.05**					**77.23**

Thus the number of berths required for Phase-1 traffic is 9 nos.

Table 6.12 Overall Requirement of Berths for Phase-2

S. No.	Description	Unit	Flyash	Coal	Fertiliser	Food grains	Natural aggregate	Container	Iron ore	Petroleum	Other Cargo		
											Project Cargo	Steel	Textile
1	Cargo volume	Million T	2.19	2.65	0.25	0.09	0.27	0.34	0.03	1.29	0.01	0.01	0.20
2	Average parcel size	T	1,000	1,500	1,500	1,500	1,500	1,200	1,000	500	500	500	500
3	Number of vessels	Nos.	2,188	1,769	167	60	183	280	31	2,581	20	22	397
4	Effective working hours	Hours	20	20	20	20	20	20	20	20	20	20	20
5	Average cargo handling rate	T per hr	400	1,000	150	150	80	20	150	16	50	50	50
6	Service time per vessel	Hours	2.50	1.50	10.00	10.00	18.75	60.00	6.67	31.25	10.00	10.00	10.00
7	Addl. time for peripheral activities	Hours	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	Total time per vessel	Hours	3.50	2.50	11.00	11.00	19.75	61.00	7.67	32.25	11.00	11.00	11.00
9	Total berth days reqd.	Days	365	206	90	33	179	852	12	4,140	11	12	215

S. No.	Description	Unit	Flyash	Coal	Fertiliser	Food grains	Natural aggregate	Container	Iron ore	Petroleum	Other Cargo		
											Project Cargo	Steel	Textile
10	**Number of berths**	**Nos.**	**2**	**1**									**23**
11	Operational days	Days	315	315									315
11	Total berth days available	Days	630	315									7,245
12	**Berth occupancy**	**%**	**57.94**	**65.40**									**76.52**

Thus the number of berths required for Phase-2 traffic is 26 nos.

Table 6.13 Overall Requirement of Berths for Master Plan

S. No.	Description	Unit	Flyash	Coal	Fertiliser	Food grains	Natural aggregate	Container	Iron ore	Petroleum	Other Cargo		
											Project Cargo	Steel	Textile
1	Cargo volume	Million T	2.71	2.81	0.27	0.10	0.32	0.44	0.03	1.49	0.01	0.01	0.25
2	Average parcel size	T	1,000	1,500	1,500	1,500	1,500	1,200	1,000	500	500	500	500
3	Number of vessels	Nos.	2,709	1,872	179	64	212	365	33	2,984	26	28	508
4	Effective working hours	Hours	20	20	20	20	20	20	20	20	20	20	20
5	Average cargo handling rate	T per hr	400	1,000	150	150	80	20	150	16	50	50	50
6	Service time per vessel	Hours	2.50	1.50	10.00	10.00	18.75	60.00	6.67	31.25	10.00	10.00	10.00
7	Addl. time for peripheral activities	Hours	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	Total time per vessel	Hours	3.50	2.50	11.00	11.00	19.75	61.00	7.67	32.25	11.00	11.00	11.00
9	Total berth days reqd.	Days	452	218	97	35	208	1,110	12	4,787	14	15	275
10	**Number of berths**	**Nos.**	**2**	**1**									**28**
11	Operational days	Days	315	315									315
11	Total berth days available	Days	630	315									8,820
12	**Berth occupancy**	**%**	**71.75**	**69.21**									**74.30**

Thus the number of berths required for Master plan Phase traffic is 31 nos.

6.2.4.9 Length of the Berths

The requirement of the berth length for various commodities is estimated below:

Table 6.14 Berth Length – Phase-1

Commodity	Vessel Length	Clearance	Berth Length (m)	No. of Berths	Total Length (m)
Flyash	80	25	105	1	105
Coal	95	25	120	1	120
Food grains	95	25	120	7	840
Natural aggregate					
Petroleum products					
Project Cargo					
Textile					
Total				**9**	**1,065**

Table 6.15 Berth Length – Phase-2

Commodity	Vessel Length	Clearance	Berth Length (m)	No. of Berths	Total Length (m)
Flyash	80	25	105	2	210
Coal	95	25	120	1	120
Fertilizer	95	25	120	23	2,760
Food grains					
Natural aggregate					
Container					
Iron ore					
Petroleum products					
Project Cargo					
Steel					
Textile					
Total				**26**	**3,090**

Table 6.16 Berth Length – Master Plan

Commodity	Vessel Length	Clearance	Berth Length (m)	No. of Berths	Total Length (m)
Flyash	80	25	105	2	210
Coal	95	25	120	1	120
Fertilizer	95	25	120	28	3,360
Food grains					
Natural aggregate					
Container					

Commodity	Vessel Length	Clearance	Berth Length (m)	No. of Berths	Total Length (m)
Iron ore					
Petroleum products					
Project Cargo					
Steel					
Textile					
Total				**31**	**3,690**

However, the water front available at the Haldia terminal is 495 m and the berths are to be planned within the available water front. The maximum berth length that can be accommodated within the waterfront considering the unit berth lengths mentioned above is 480 m and the number of berths is 4 nos. Hence the cargo volume that can be handled at the terminal will be limited by the berth capacity and all commodities cannot be handled at the terminal.

6.2.4.10 Target Commodities

Considering the hinterland proximity, the target commodities considered are as follows.

- Fly ash
- Fertiliser
- Natural aggregates
- Petroleum products

6.2.4.11 Target Traffic for Phase-1

The Phase-1 development is planned to cater to the traffic projection of the base case scenario in 2020. The target traffic for Phase-1 is as follows:

Table 6.17 Target Traffic for Phase-1

Commodity	Berth Capacity (MTPA)
Flyash	1.38
Natural aggregates	0.16
Petroleum products	0.12
Total	**1.66**

6.2.4.12 Berth Requirement for Target Phase-1 Traffic

The berth requirement for the target Phase-1 traffic is as follows:

Table 6.18 Berth Requirement for Target Phase-1 Traffic

S. No.	Description	Unit	Flyash	Natural Aggregate	Petroleum Products
1	Cargo Volume	Million T	1.38	0.16	0.12
2	Average Parcel Size	T	1,000	1,500	500
3	Number of Vessels	Nos.	1,381	108	240
4	Effective Working Hours	Hours	20	20	20
5	Average Cargo Handling Rate	T per hr	400	80	16
6	Service Time per Vessel	Hours	2.50	18.75	31.25
7	Time for Peripheral activities	Hours	1.00	1.00	1.00
8	Total Time per Vessel	Hours	3.50	19.75	32.25
9	Total Berth Days Reqd.	Days	230	106	385
10	Number of berths	Nos.	2	2	
11	Operational days	Days	315	315	
12	Total berth days available	Days	630	630	
13	Berth occupancy	%	36.51	77.94	

There is spare capacity at fly ash berths in Phase-1 (year 2020) as per above table. Hence, the same berths can handle more cargo in the subsequent years, considering the optimal berth occupancy of 75%.

The requirement of the berth length for target Phase-1 traffic is estimated below:

Table 6.19 Berth Length for Target Phase-1 Traffic

Commodity	Berth Length (m)	No. of Berths	Total Length (m)
Flyash	105	2	210
Natural aggregates	120	2	240
Petroleum products			
Total		**4**	**450**

6.2.4.13 Target Traffic for Phase-2

The Phase-2 development is planned to cater to the traffic projection of the base case scenario in 2035. The target traffic for Phase-1 is as follows:

Table 6.20 Target Traffic for Phase-2

Commodity	Berth Capacity (MTPA)
Flyash	2.19
Fertilizer	0.11
Natural aggregates	0.16

Commodity	Berth Capacity (MTPA)
Petroleum products	0.10
Total	**2.56**

6.2.4.14 Berth Requirement for Target Phase-2 Traffic

The berth requirement for the target Phase-1 traffic is as follows:

Table 6.21 Berth Requirement for Target Phase-2 Traffic

S. No.	Description	Unit	Flyash	Fertilizer	Natural Aggregate	Petroleum Products
1	Cargo Volume	Million T	2.19	0.11	0.16	0.10
2	Average Parcel Size	T	1,000	1,500	1,500	500
3	Number of Vessels	Nos.	2,188	73	107	220
4	Effective Working Hours	Hours	20	20	20	20
5	Average Cargo Handling Rate	T per hr	400	150	80	16
6	Service Time per Vessel	Hours	2.50	10.00	18.75	31.25
7	Time for Peripheral activities	Hours	1.00	1.00	1.00	1.00
8	Total Time per Vessel	Hours	3.50	11.00	19.75	32.25
9	Total Berth Days Reqd.	Days	365	40	105	353
10	Number of berths	Nos.	2	2		
11	Operational days	Days	315	315		
12	Total berth days available	Days	630	630		
13	Berth occupancy	%	57.94	73.97		

In phase-2, the flyash traffic is increased in which the same can be handled in the number of berths provided in Phase-1. Hence, the requirement of the berth length for target Phase-2 traffic is same as mentioned in Phase-1.

6.2.4.15 Target Traffic for Master Plan

The Master Plan Phase development is planned to cater to the traffic projection of the base case scenario in 2045. There is spare capacity at fly ash berths in Phase-1 (year 2020) as per above table. Hence, the same berths can handle more cargo in the subsequent years,

considering the optimal berth occupancy of 75%. Considering berth capacities the Master Plan traffic is presented in table below.

Table 6.22 Target Traffic for Master Plan

Commodity	MTPA
Flyash	2.71
Fertilizer	0.11
Natural aggregates	0.16
Petroleum products	0.10
Total	**3.08**

6.2.4.16 Berth Requirement for Target Master Plan Phase Traffic

The berth requirement for the target Master Plan Phase traffic is as follows:

Table 6.23 Berth Requirement for Target Master Plan Phase Traffic

S. No.	Description	Unit	Flyash	Fertilizer	Natural Aggregate	Petroleum Products
1	Cargo Volume	Million T	2.71	0.11	0.16	0.10
2	Average Parcel Size	T	1,000	1,500	1,500	500
3	Number of Vessels	Nos.	2,709	73	107	220
4	Effective Working Hours	Hours	20	20	20	20
5	Average Cargo Handling Rate	T per hr	400	150	80	16
6	Service Time per Vessel	Hours	2.50	10.00	18.75	31.25
7	Time for Peripheral activities	Hours	1.00	1.00	1.00	1.00
8	Total Time per Vessel	Hours	3.50	11.00	19.75	32.25
9	Total Berth Days Reqd.	Days	452	40	105	353
10	Number of berths	Nos.	2	2		
11	Operational days	Days	315	315		
12	Total berth days available	Days	630	630		
13	Berth occupancy	%	71.75	73.97		

Since the traffic to be handled in Master Plan Phase is arrived with the berth facilities provided in the Phase-1, the requirement of the berth length for target Master Plan Phase traffic is as given in Table 6.19.

6.3 Shoreside Infrastructure

The shore based infrastructure comprises of cargo storage areas, terminal buildings, road and rail networks, conveyor and pipeline networks, utilities and services such as power and water supply, drainage, sewerage, etc.

6.3.1 Storage Area Requirements

As per industry practice and UNCTAD guidelines, the storage capacity at terminal for a particular commodity should at least cater to the higher of the following:

- 22 days storage (6% of the annual cargo throughput); or
- 1.5 times the maximum parcel size.

Other factors to be taken into account in determining the size of the terminal storage areas are material densities, angle of repose, average stacking height, etc. The norms adopted for calculating the storage areas in Haldia terminal for various commodities are given below:

Table 6.24 Norms Adopted for Calculating Storage Area at IWT Terminal

S. No.	Commodity	Parcel Size (T)	Criteria for providing storage area		
			% of Annual Throughput Considered	Storage Capacity (T)	Material Density T/m^3
1.	Flyash	1,000	9 to 10 barge loads	9,600	1.4
2.	Fertiliser	1,500	6%	5,727	-
3.	Natural aggregates	1,500	6%	8,100	1.6
4.	Petroleum products	500	6%	2,000	0.8

** Storage capacity of flyash is kept minimum, since the source of flyash is from nearby power plants. The provision has been kept to increase the storage capacity subsequently when traffic will increase.*

Based on the above criteria the storage area worked out in different phases for the Haldia terminal is given in table below:

Table 6.25 Storage Area Requirement in Different Phases for Haldia Terminal

S. No.	Commodity	Storage Area (in m^2)		
		Phase-1	Phase-2	Master Plan (Total)
1	Flyash	4,400	5,000	9,400
2	Fertiliser	3,900	-	3,900
3	Natural aggregates	3,000	-	3,000

4	Petroleum products in drums	19,000	-	19,000
5	Future storage	37,500	-	37,500
	Total	**67,800**	**5,000**	**72,800**

The above storage areas duly account for the circulation space within the storage area for effective stacking/removal of cargo.

6.3.2 Utilities and Services

6.3.2.1 Buildings

Various buildings envisaged in the terminal will be as follows:

- Terminal administration building
- Worker's amenity building
- Electrical substation building
- Security office
- Weigh bridge control room
- RIO / Air compressor room for ash handling
- Gate house complex

6.3.2.2 Bunkering

Fuel oil bunkering is proposed in the terminal for supplying fuel to the barges and a space provision is made for the same. The bunkering facility will be developed by agencies experienced in operation and maintenance of such facilities.

6.3.2.3 Communications

IWT terminal will be provided with modern telecommunication system consisting of telephone, telefax, e-mail etc.

6.3.2.4 Water Supply

Total water demand is broadly classified in the following categories:

- Potable water for consumption of terminal personnel.
- Potable water for vessels calling at the terminal.
- Water for dust suppression.
- Other uses like greenery etc.

Water supply system details are provided in Chapter 9.

6.3.2.5 Power Supply

The power is required at the terminal for the following activities:

- Mechanised cargo handling equipment and other equipment
- Lighting of the terminal area
- Offices and transit sheds
- Miscellaneous

Based on the above requirements the power demand is calculated and presented in Chapter 11. The power will be drawn from the nearest substation to the terminal and internal electrical distribution system shall be planned according to required HT and LT supply.

6.3.2.6 Road Network

As the mode of transport of the commodities to / from the terminal is by road, a well-developed internal and external road network is required. Adequate area is provided for internal road network running throughout the whole terminal.

A diversion road of 15 m wide corridor is provided on the North-East side of the terminal and an approach road of 20 m wide will provide access to the terminal.

6.3.2.7 Rail Network

The mode of transport of the commodities to / from the terminal is by road only. Space provision is made for development of rail yard to accommodate new / emerging business needs in future.

6.3.2.8 Green Belt

A 10 m wide green belt is proposed along the boundary of the proposed IWT terminal.

6.3.2.9 Storm Water Drainage

A network of covered storm water drain with setting pond will be provided. Run off from the storage areas will be routed through collection pits.

6.3.2.10 Sewerage System

Sewerage from toilets, bathrooms, kitchens etc. will be collected and treated in sewage treatment plant.

7 ALTERNATIVE LAYOUTS

This chapter outlines the alternative layouts considered for development of the berthing facilities at IWT terminal. The alternatives were evaluated considering traffic mix, operational, navigational, environmental, cost aspects, etc. to arrive at the optimum layout. The following sections provide a description of the alternatives and their evaluation.

7.1 Alternative Terminal Layouts

In order to have flexibility in handling barges of different sizes and optimize terminal efficiency, continuous berth is considered for the alternatives. In the proposed layouts, the berths are located 200 m from the river bank where 1.4 m – 1.5 m LAD is available. Looking into the bathymetry in front of the terminal location there is no option of extending the jetty sufficiently far off shore to find acceptable natural depth in the order of 3 m LAD. This means that a dredged berth pocket will be required which will be a sediment trap and will require frequent dredging. In such a case it is sensible to locate the dredged berth box (i.e. quay line) away from the shoreline to allow space for the river bed bathymetry to evolve after the berth box has been constructed and avoid the potential for erosion of the shore line. A further advantage is that the tidal currents will be higher and better aligned further offshore and hence some degree of natural scour of the berth box may occur. There is also space to accommodate extending the berth box to either end of the quay line to provide an opportunity for trapping sediment at either end of the berth box away from the active berths. Accordingly the positions of the berths are kept same in the alternate layouts. Five (5) alternative terminal layouts are conceptualized, which are as follows:

7.1.1 Alternative I

In this alternative, four jetties (berths 1 to 4) are proposed – two jetties (berths 1 & 2) for handling fly ash and two jetties (berths 3 & 4) for handling other cargo like fertilizer, POL, stone aggregate. The jetties are aligned parallel to the river bank, which are connected to the backup area by approach trestles. The maximum cargo that can be handled at the terminal is as follows:

Table 7.1 Maximum Throughput – Alternative I

Commodity	Throughput (MTPA)
Fly ash	2.71
Fertilizer	0.11
Natural Aggregates	0.16
POL	0.10
Total	**3.08**

Adequate area is provided for storage of fly ash, POL, fertilizer and aggregate. The layout has some flexibility by keeping provision of adequate space for open / covered storage area and development of rail yard to accommodate new/ emerging business needs in future.

The layout of Alternative I is presented in **Drawing I-525/HT/204**.

7.1.2 Alternative II

In this alternative also, four jetties (berths 1 to 4) are proposed – two jetties (berths 1 & 2) for handling fly ash, one jetty (berth 3) for domestic coal and one jetty (berth 4) for handling other cargo like POL, fertilizer & stone aggregate. The arrangement of jetties is same as in Alternative I. The cargo volume that can be handled at the terminal is as follows:

Table 7.2 Maximum Throughput – Alternative II

Commodity	Throughput (MTPA)
Fly ash	2.71
Coal	2.40
Fertilizer	0.11
Natural Aggregates	0.16
POL	0.04
Total	**5.42**

Adequate area is provided for storage of domestic coal, fly ash, POL, fertilizer and aggregate. The layout does not have flexibility as compared to Alternative I since most of the storage space is occupied by fly ash silos, coal stackyard and wagon unloading system. Rail yard is provided for receipt of domestic coal.

The layout of Alternative II is presented in **Drawing I-525/HT/205**.

7.1.3 Alternative Layout III

In this alternative also, four jetties (berths 1 to 4) are proposed – one jetty (berth 1) for handling coal, three jetties (berths 2, 3 & 4) for handling other cargo like fertilizer, POL, stone aggregate. The jetties are aligned parallel to the river bank and are connected to the backup area by approach trestles. The cargo volume that can be handled at the terminal is as follows:

Table 7.3 Maximum Throughput – Alternative III

Commodity	Throughput (MTPA)
Coal	2.80
Fertilizer	0.11
Natural Aggregates	0.16
POL	0.17
Total	**3.24**

Adequate area is provided for storage of domestic coal, POL, fertilizer and aggregate. Rail yard is provided for receipt of domestic coal. Fly ash cannot be handled with the proposed

arrangement. The layout does not have flexibility to accommodate new / emerging business needs in future.

The layout of Alternative III is presented in **Drawing I-525/HT/206**.

7.1.4 Alternative IV

In this alternative, five jetties (Berths 1 to 5) are proposed – two jetties (Berths 1 & 2) for handling fly ash; two jetties (Berths 3 & 4) for handling other cargo like fertilizer, POL, stone aggregate; one jetty (Berth 5) for handling coal is proposed for transshipment of imported coal from costal vessel to IWT barge. The jetties (berth 1 to 4) are aligned parallel to the river bank, which are connected to the backup area by approach trestles. The berth 5 is placed parallel to berth 4 and connected by an approach trestle. The maximum cargo that can be handled at the terminal is as follows:

Table 7.4 Maximum Throughput – Alternative IV

Commodity	Throughput (MTPA)
Fly ash	2.71
Fertiliser	0.20
Natural Aggregates	0.30
POL	0.06
Coal	2.80
Total	**6.07**

Adequate area is provided for storage of fly ash, POL, fertilizer and aggregate. The layout has some flexibility by keeping provision of adequate space for open / covered storage area and development of rail yard to accommodate new / emerging business needs in future. The water front area to be extended for the coal transshipment in Berth 5 will be very expensive due to requirement of additional dredging to accommodate coastal vessel movement at this location.

The layout of Alternative IV is presented in **Drawing I-525/HT/207**.

7.1.5 Alternative V

In this alternative, five jetties (Berths 1 to 5) are proposed – two jetties (Berths 1 & 2) for handling fly ash; two jetties (Berths 3 & 4) for handling other cargo like fertilizer, POL, stone aggregate; one jetty (Berth 5) for handling coal as transshipment. The jetties (Berth 1 to 4) are aligned parallel to the river bank, which are connected to the backup area by approach trestles. The berth 5 is arranged perpendicular to berth 4. The maximum cargo that can be handled at the terminal is as follows:

Table 7.5 Maximum Throughput – Alternative V

Commodity	Throughput (MTPA)
Fly ash	2.71

Fertiliser	0.20
Natural Aggregates	0.22
POL	0.05
Coal	2.80
Total	**5.98**

Adequate area is provided for storage of fly ash, POL, fertilizer and aggregate. The layout has some flexibility by keeping provision of adequate space for open / covered storage area and development of rail yard to accommodate new / emerging business needs in future. The arrangement of coal transshipment berth is well exposed to current and not recommended from morphological considerations.

The layout of Alternative V is presented in **Drawing I-525/HT/208**.

7.2 Multi Criteria Analysis of Alternative Terminal Layouts

The alternative layouts have been evaluated to select the most suitable layout through a process of Multi Criteria Matrix (MCM) analysis considering the following criteria:

a. Cargo Handling Capacity

b. Environmental aspects

c. Scope for accommodating new / emerging business

d. Construction Cost

The comparison of these layouts is presented in Table below.

Table 7.6 Multi-Criteria Analysis of Alternatives

Criteria	Alternative I	Alternative II	Alternative III	Alternative IV	Alternative V
Cargo Handling Capacity	**3.08 MTPA** As per the traffic projections, the fly ash traffic is continuously increasing and will overtake coal in 2025. This layout can cater to the need of flyash handling till 2035.	**5.42 MTPA** Fly ash handling capacity will be similar to Alternative I. However, developing fully mechanized coal berth having some risks, if domestic coal traffic is not diverted from present rail mode.	**3.24 MTPA** Developing the terminal primarily for coal has some considerable risks if domestic coal traffic is not diverted from present rail mode.	**6.07 MTPA** Initially the terminal is ready to handle fly ash and multi cargo, the considerable risk is the same when domestic coal is not diverted from present rail mode.	**5.98 MTPA** This is the same as Alternative IV without a trestle. The considerable risk is the same when domestic coal is not diverted from present rail mode.

Criteria	Alternative I	Alternative II	Alternative III	Alternative IV	Alternative V
Environmental Aspects	Fly ash handling proposed through silo, piped conveyor and barge loader to minimize dust generation.	Even though pneumatic handling system for fly ash is proposed to minimize dust generation, there will be moderate dust generation due to coal storage and handling.	The impact will be similar to Alternative II.	The impact will be similar to Alternative II.	The impact will be similar to Alternative II.
Scope for accommodating new / emerging business	There is sufficient scope for accommodating new / emerging business	The scope for accommodating new / emerging business is moderate.	There is no scope for accommodating new / emerging business.	There is no scope for accommodating new / emerging business.	There is no scope for accommodating new / emerging business.
Capital Cost	The capital cost for development is approximately Rs. 450 crores.	The capital cost for development is approximately Rs. 550 crores.	The capital cost for development is approximately Rs. 520 crores.	The capital cost for development is approximately Rs. 635 crores.	The capital cost for development is approximately Rs. 610 crores.

7.3 Recommended Terminal Layout

Based on multi criteria matrix presented above, Alternative-I having moderate cargo handling capacity is selected as preferred alternative for development of IWT Terminal at Haldia to avoid risks for catering higher volume of diverted traffic. In the initial stage, during the discussions held with IWAI on the Alternative I, they desired that one jetty need to be added in the layout for transshipment of coal from 6000 T vessel to 3000 T barge and also provision has to be kept in one berth for container handling. Subsequently a decision was taken by IWAI to delete Coal transshipment berth and accordingly Alternative IV and V was not considered.

The length of jetties (berths 1 to 4) provided in Alternative I is about 465 m. The water front available at the Haldia terminal is 495 m and the jetties were planned within the available water front.

In the present scenario, the flyash traffic is considered as more assured than coal traffic at the Haldia multi modal terminal and accordingly Alternative-I having two (2) jetties (flyash handling out of 4 jetties) as shown in **Drawing I-525/HT/204** is recommended for further detailing in the present DPR.

8 DEVELOPMENT PLAN

This chapter describes the plan for development of the terminal infrastructure in various phases.

8.1 Marine Facilities

8.1.1 Berths and Approach Trestles

Considering IWAI's requirement, it is proposed to take up the proposed development in two stages Phase-1 and Phase-2.

8.1.1.1 Phase-1

It is proposed to develop berths 1 to 4 in Phase-1. Berths 1 and 2 have been dedicated for fly ash handling. Berths 3 & 4 are planned to handle any bagged / palletized / drum and bulk cargo except liquid bulk. The total length of berths 1 & 2 is 210 m (2 x 105 m) and width is 30 m. The length of berth 3 is 120 m and width is 30 m. Container handling provision is kept in berth 4 and its length and width are 135 m and 50 m, respectively. The berths will be connected by approach trestles for movement of trucks, vehicles and maintenance equipment.

8.1.1.2 Phase-2

No additional berths and approach trestles are envisaged due to limitation of space.

8.1.1.3 Master Plan

Development of additional jetties with connectivity to backup area is not possible due to limitation of waterfront availability. Hence, further berth development is not considered for the Master Plan stage.

Table 8.1 Phase-wise No. of Berths

S. No.	Commodity	Number of Berths		
		Phase-1	Phase-2	Master Plan (Total)
1.	Flyash	2	-	2
2.	Fertiliser / natural aggregate / POL	2	-	2
Total		**4**	**-**	**4**

8.1.2 Manoeuvring Area & Approach Channel

8.1.2.1 Phase-1

The manoeuvring area for development of terminal in Phase-1 comprises of approach channel, turning circle and berthing area. It is proposed that the barges will move in 45 m wide channel, with 3 m LAD as perTable 6.5 and Table 6.3 respectively. To enable continuous

operations of the terminal, the approach channel, turning circle and berth pockets will be dredged to (-) 3.2 m CD. The diameter of the turning circle is 190 m.

8.1.2.2 Phase-2

Same as Phase-1.

8.1.2.3 Master Plan

Same as Phase-1.

8.2 Onshore Facilities

8.2.1 Storage Areas

8.2.1.1 Phase-1

It is proposed to develop 8 silos for flyash storage in Phase-1. The storage area for fertilizer, aggregates and oil drums will be developed in Phase-1.

8.2.1.2 Phase-2

In Phase-2, it is proposed to 8 additional silos for fly ash storage. The storage facilities for other cargo are same as in Phase-1. Also, it is proposed to develop future storage area for new commodities such as containers, etc.

8.2.1.3 Master Plan

The entire storage area is developed in Phase-1 and Phase-2.

Table 8.2 Phase-wise Storage Area

S. No.	Commodity	Storage Area (in m^2)		
		Phase-1	Phase-2	Master Plan (Total)
1	Flyash	4400	5000	9400
2	Fertiliser	3900	-	3900
3	Natural aggregates	3000	-	3000
4	Petroleum products in drums	19000	-	19000
5	Future storage	37500	-	37500
	Total	**67800**	**5000**	**72800**

8.2.2 Fuel Bunkering

It is proposed to provide an area of 1,500 sq.m. for bunkering of fuel so as to meet the fuel requirement of barges calling at the terminal.

8.2.3 Buildings

The following buildings are envisaged in the onshore area of the terminal.

- Terminal administration building
- Worker's amenity building
- Electrical substation building
- Security office
- Weigh bridge control room
- RIO / Air compressor room for ash handling
- Gate house complex, Emergency exit gates, access gates, boundary wall and fencing.

All the buildings will be developed in Phase-1 itself.

8.2.4 Onshore Utilities

Onshore facilities such as roads, drainage, sewerage, water supply, communication system will be developed in Phase-1 only.

8.2.5 Mechanical Equipment

The mechanical equipment proposed in various phases is as follows:

Table 8.3 Phase-wise Requirement of Mechanical Equipment

S. No.	Equipment	No. of Equipment		
		Phase-1	Phase-2	Master Plan (Total)
1.	Mobile harbour crane	2	-	2
2.	Silo with Conveyor system	8	8	16
3.	Fixed barge loader	2	-	2
4.	Road Weigh Bridge	2	-	2
5.	Dumper truck	10	-	10
6.	Fork lift	2	-	2
7.	Front end loader	1	-	1

8.3 Layout Plan

The layout plans of Phase-1 and Phase-2 are enclosed as **Drawing I-525/HT/209 & I-525/HT/210**, respectively. The layout of Master Plan is same as Phase-2.

9 PRELIMINARY ENGINEERING – CIVIL WORKS

9.1 Berthing Facilities

The design criteria for berthing facilities are provided in the following sections.

9.1.1 Deck Elevation

The deck of the jetty should be high enough so that during normal conditions it would be possible to inspect and repair the structural elements like deck and beams at all water levels. Based on the deck level of the berths in the surrounding areas, it is proposed to keep the deck elevation at (+) 8.70 mCD.

9.1.2 Water Levels

The following water levels have been considered at the Site.

Table 9.1 Water Levels Considered

Highest High Water	(+) 7.26 mCD
Mean High Water Spring	(+) 5.70 mCD
Local Mean Water Level	(+) 3.23 mCD
Mean Low Water Neap	(+) 2.10 mCD
Mean Low Water Spring	(+) 0.80 mCD

9.1.3 Design Dredged Level

The design dredged level for the structural design of the berths is considered for the maximum vessel size. From the list of self-propelled motor vessels shown in Table 9.2, the design vessel size considered is 3,000 DWT.

Table 9.2 Dimensions of Self-Propelled Motor Vessels

Vessel Size (DWT)	Length (m)	Beam (m)	Draft (m)
650 - 1,000	60 - 80	8.20	2.20
1,000 - 1,500	80 - 85	9.50	2.20
1,500 - 3,000	85 - 95	15.00	2.50

The basis for arriving at the design dredge level is as follows:

Table 9.3 Basis for Design Dredge Level

S. No.	Description	Draft (m)
A	Draft of design vessel size	2.50
B	Allowance for Under keel clearance (@20%)	0.50
C	Allowance for siltation	1.00

S. No.	Description	Draft (m)
D	Channel depth required (A + B + C)	4.00
E	Tidal window (MLWS)	0.80
F	**Dredge level below CD (D - E)**	**3.20**

9.1.4 Scour Depth

With reference to CWPRS model study report near to the proposed Haldia IWT terminal, the parameters for scour depth are as follows:

- Velocity of stream : 1.75 m/s
- Mean discharge : 3,000 m^3/s
- Water level at highest discharge : (+) 4.00 mCD
- Scour level : (-) 25.53 mCD say (-) 25.00 mCD.

9.1.5 Geotechnical Criteria for Design of Jetties and Approach Trestles

The brief description of the existing geotechnical information at site has been provided in Section 3.2 of this report. Preliminary design of the jetties and approach trestles has been carried out based on the subsoil profiles discussed in Section 3.2.

The following safety factors are used to establish the safe geotechnical working load capacities of the piles given in Table below:

Table 9.4 Safety Factors

End Bearing	SF = 2.5
Skin Friction on compression piles	SF = 2.5
Skin Friction on tension piles	SF = 3.0
Lateral Load	SF = 2.0

The design pile penetration depths have been estimated based on the generalized soil profile in order to develop adequate capacity to resist the maximum computed axial bearing and pull out loads, if any.

9.1.6 Loads Considered for Design of Jetty

The major loads considered for the design of the various components of the jetty are:

i. Dead Load

ii. Live Load

iii. Berthing Load

iv. Mooring Load

v. Current Load

vi. Wind Load

vii. Temperature Load

viii. Earthquake Load

ix. Wave load

x. Slamming forces

9.1.6.1 Dead Load

The dead load comprising the self-weight of the structure plus superimposed loads of permanent nature are considered as per IS: 875 (Part-I) 1987. Following unit weights are used to assess the self-weights of the structural elements in design

- Reinforced Concrete : 25.0 kN/m^3
- Mass Concrete : 24.0 kN/m^3
- Structural Steel : 78.5 kN/m^3
- Seawater density : 10.25 kN/m^3

9.1.6.2 Live Load

The live load to be considered on the deck of jetty includes the following loads:

- Uniform distributed Live load of 3.5 T/m^2 for Berth No. 1, 2 & 3 and approach trestles
- Uniform distributed Live load of 5 T/m^2 for Berth No. 4
- IRC class A/AA /70 R vehicle for all berths and approach trestles
- Loads due to mobile crane with a 50 T lifting capacity on hook at 17 m radius for berths only

9.1.6.3 Berthing Load

9.1.6.3.1 Berthing Energy

The design vessels are assumed to approach the berths under difficult berthing conditions at an angular approach of 10°. Based on this criterion the approach velocity perpendicular to the berth has been calculated to arrive at the design berthing energy for various design vessels.

9.1.6.3.2 3000 DWT Vessel

Berthing loads are considered as per IS: 4651 Part III. The Berthing energy calculated for 3,000 DWT vessel using IS: 4651 as per details below:

Table 9.5 Berth Load Parameters for 3000 DWT vessel

Dead Weight Tonnage (DWT)	3,000
Displacement Tonnage (DT)	3,990
Overall Length, LOA (m)	95
Beam Width, B (m)	15
Loaded Draft, d (m)	2.5
Berthing Velocity (m/s)	0.45

The design berthing energy works out to 59 Tm considering required safety factors.

9.1.6.3.3 Fendering System

Considering the level variation of the order of 7.33 m between high water level and low water level at the site and also the variation in the sizes of vessels to be handled at the jetty, the fendering system is designed such that sufficient contact area between the hull of the vessel and the fender face is ensured at all water levels. It is required to provide a suitable fender system, not only to absorb the design berthing energy of the vessel but also to keep the vessel's hull pressure below the limit of 20 T/m^2.

9.1.6.3.4 3000 DWT vessel

Based on these criteria, arch fenders of AN 800, grade E3.0 of Trellborg make or equivalent are proposed at each fender pile.

9.1.6.4 Mooring Load

Mooring force of 30 T, as per Table-4, IS: 4651- Part III, shall be applied at any of the bollard location.

9.1.6.5 Current Load

The current loads on the structure shall be applied on the submerged parts of the structure as per IS: 4651 - Part III. The current velocities considered are as given below:

- Operation condition : 1 m/s
- Extreme condition : 3 m/s

9.1.6.6 Wind Load

The wind load on structure is considered as per IS: 875-Part III. The basic wind speed (V_b) for operational and extreme condition shall be 24 m/s and 55 m/s respectively.

9.1.6.7 Temperature Load

- Berth and approach trestles shall be designed for temperature variation of (± 15^0 C)
- Coefficient of thermal expansion for RCC structure is taken as $11.7x10^{-6}$/ °C.
- In temperature analysis, long term elastic modulus of the concrete is taken as half the instantaneous elastic modulus of the concrete.

9.1.6.8 Earthquake Load

Earthquake load shall be considered in design as applicable for the site as per IS 1893-Part I. The design horizontal seismic coefficient α_h is calculated based on the following parameters:

α_h = Z I (Sa/g) / (2R), where

Z = Zone factor = 0.16

I = Importance factor = 1.5

R = Response reduction factor = 5

S_a/g = Average response acceleration coefficient, which depends on Time Period of the Structure

The Time Period, T of the structure will be evaluated by STAAD Analysis considering Dead Load and 50% Live Load.

9.1.6.9 Wave Load

During the operation and storm condition, the wave height shall be considered as 0.50 m and 3.00 m respectively.

9.1.6.10 Slamming forces

The wave slamming forces are nothing but the uplift force experienced by the structure (horizontal member) when above water and subjected to oscillatory wave action. The same shall be calculated based on the Coastal Engineering Manual.

$F_U = C_U A_Z \gamma_w w^2 / 2g$, where

F_U = Uplift force

C_U = Laboratory derived slamming co-efficient

A_Z = Projected area of solid body in the horizontal plane

γ_w = Density of sea water

w = Vertical component of flow velocity at level of object

9.1.7 Load Combinations

The above loads with appropriate load combinations, as per IS 4651-Part IV have been applied on the different components of the jetty.

9.1.8 Minimum Cover

Clear cover to any reinforcement shall be as mentioned here under but shall not be less than the diameter of such reinforcement.

- Pile : 75 mm
- Top, bottom & side of footing (if any) : 75 mm
- Beams : 50 mm
- Slab : 50 mm

9.1.9 Design Life

The permanent works shall be designed and constructed to give the following design lives:

- Jetty and approach trestle - 50 years
- Fenders, Bollards and ladders - 8 years

9.1.10 Serviceability Criteria

9.1.10.1 Deflection Limit

The Deflection at the deck level is generally considered as H/350 in operating condition and H/250 in extreme condition. H is the distance from the average point of fixity to the top elevation of deck.

9.1.10.2 Crack Width

The crack width is calculated for service load combinations in accordance with IS: 4651-Part IV.

Table 9.6 Permissible Crack Width

Exposure Zone	Maximum Crack Width (mm)	
	Sustained Load	Transient Load
Atmospheric zone – above splash zone	0.2	0.3
Splash zone – zone between CD and design wave height above MHWS	0.1	0.2
Continuous sea immersion zone	0.2	0.3
Below seabed level	0.3	0.3

9.1.11 Materials and Material Grades

The specifications are given below:

Table 9.7 Material specification

Structural Concrete	M-40
Wearing coat	M-40 of 75 mm average thickness
Reinforcement	High corrosion resistant Thermo-mechanically treated bars of Fe-500 grade in accordance with IS:1786.
Cement	Ordinary Portland Cement of minimum grade 53 as per IS: 12269. In addition, cement in accordance with IS:456 and IS:4651 Part 4 shall be considered. If Chloride & Sulphate content as per the soil investigation report are found on the higher side then the following measures shall be adopted: **Chlorides** • Prestressed Concrete or grouting Mortar: 500mg/l • Concrete with reinforcement or embedded metal parts: 1000 mg/l • Concrete without reinforcement or embedded metal parts: 4500 mg/l **Sulphur** The sulphur content of the water must not be more than 2000 mg/l else following measures shall be adopted: • Use of Sulphate resistance cement • Low water/cement ratio • Curing suited to the structure
Structural Steel	As per IS:2062 (Grade-A) with minimum thickness of 10 mm
Protective coating to structural steel	Minimum DFT of 240 micron after sand blasting to SA 2.5 grade.

9.1.12 Proposed structural arrangement of berth

9.1.12.1 Phase-1

In Phase-1, the proposed jetty having 4 berths is aligned parallel to the river bank and access to the bank for operations and maintenance is provided through an approach trestle

connecting the jetty to the bank. Of the 4 berths, two berths (berth nos. 1 & 2) are for handling fly ash and two berths (berth nos. 3 & 4) are for handling other cargo like fertilizers, natural aggregates, POL and container.

There shall be a continuous berth of 465 m length with suitable expansion joints for handling import / export cargo, which is at a distance of about 140 m from the river bank. Of the total length of 465 m of the berth, 330 m is of 30 m width and 135 m is of 50 m width. For handling containers, the width of the berth no. 4 for has been increased from 30 m to 50 m to accommodate storing two rows of container boxes and movement of vehicles. Cargo vessels will be berthed on the front side of Berth 1, 2, 3 & 4 and survey vessels will be berthed on the rear side ends of Berth 1 & 4. The top level of deck shall be (+) 8.70 m with respect to CD.

The berth is of open piled structure with deck slab. The substructure of the jetty consists of the following:

- For berths nos. 1, 2 & 3 - four rows of vertical bored cast-in-situ piles of 1.2 m diameter spaced at 7.5 m c/c in the longitudinal direction and at 7 m c/c in the transverse direction
- For berths nos. 1, 2 & 3 - One row of fender piles of 1.2 m diameter spaced at 7.5 m c/c in the longitudinal direction
- For berth no. 4 - seven rows of vertical bored cast-in-situ piles of 1.2 m diameter spaced at 6.25 m c/c in the longitudinal direction and at 7 m c/c in the transverse direction
- For berth no 4 - One row of fender piles of 1.2 m diameter spaced at 6.25 m c/c in the longitudinal direction on the front side of the jetty
- The founding of the piles will be at (-) 60.00 mCD

The superstructure for all the berths consists of the following:

- 1.2 m x 1.6 m cross beams over panel piles
- 1.0 m x 1.5 m longitudinal beam over cross beams
- Cast in situ deck slab of 500 mm thick

The general arrangement of proposed berth with trestles showing typical plan and section are presented in the **Drawing I-525/HT/212 & I-525/HT/213**.

The berth nos. 1 and 2 shall be designed and constructed to operate fixed barge loader. The berth nos. 3 and 4 shall be designed and constructed to operate mobile harbor crane. Berth no. 4 shall have provision for handling container cargo in future.

The jetty shall have utility trench/duct to carry pipe lines, cables etc., and it shall run all along the berth. The trench covers shall be seated properly and shall be intact with the trench side walls.

The jetty shall have all the required accessories/fixtures including but not limited to the following:

- Fenders including all its ancillaries

- Bollards
- Mooring rings on berth face
- Safety ladders
- Handrails
- Wooden / stainless steel rubbing strip for the protection of edges of berth from rubbing of mooring ropes.
- Drain pipes shall be embedded at regular intervals. The proposed jetty shall be provided with suitable slope to drain off storm water.
- Galvanized iron edge angles at various locations including on the sides of openings/pits.
- Marking on top of deck slab

9.1.12.2 Phase-2

In Phase-2, the conveyor system with fixed hopper and 8 nos. of Silos along with preparation of future storage area is proposed to develop.

9.1.13 Approach Trestle

Phase-1 - Approach trestles from backup area to berth nos. 1 to 4

The proposed approach trestles have to cross a pipeline corridor of 40 m comprising of ammonia pipelines and other commodity / utility pipelines, outside the terminal boundary. A minimum vertical clearance of 0.8 m has to be maintained between the top level of the ammonia pipelines and the soffit level of the approach trestle.

The formation level of approach trestle increases from (+) 7.80 mCD at the backup area to (+) 10.90 mCD above the pipeline corridor and then it reduces to (+) 8.70 mCD at berth. The gradient of the formation level of the approach trestle shall be 1 in 30 from steel girder towards berth for a distance of 82 m and continues straight for a distance of 58 m reaching the berth.

The approach trestles (1 to 4) comprises of embankment, superstructure with one through type steel truss girder and remaining with RCC structure is conveyor trestle / conveyor gallery. The types of bearings for the approach trestles and conveyor trestle are as follows:

- Neoprene / Elastomeric
- POT-PTFE
- Roller-Rocker (only for through type steel girder and conveyor trestle)

Approach trestle is designed to cater to the movement of vehicular traffic IRC class AA, class 70R, etc. in addition to the movement of maintenance cranes, when necessary. The retaining structure of the embankment is of reinforced earth wall. The design shall be carried out as per IRS-SP-102-2014 and other applicable Indian Standards. The gradient of the embankment shall not be steeper than 1 in 30.

The typical span arrangement of the approach trestles (1 to 4) and dimensions of other structural elements are shown in **Drawing I-525/HT/213**.

9.2 Site Grading & embankment of approach trestle

The existing ground level in the terminal area varies from (+) 4.64 mCD to (+) 7.95 mCD. The proposed formation level of the terminal is (+) 7.80 mCD and therefore significant amount of filling would be required. The quantity of earthwork in filling is estimated as 3,85,000 cum. approx. To avoid formation of water pools and also enable proper drainage, there will be no phasing in site grading.

The embankments of approach trestle shall be made by earth fill with boulder pitching as shown in Drawing I-525-HT/233.

9.3 Dredging

9.3.1 Initial dredging

As adequate depth is not available at the proposed terminal location, dredging is required in the approach channel, turning circle and berthing areas. The dredging requirement for the terminal will be based on dredging on berth pocket, turning circle and approach channel up to (-) 3.2 m in Phase-1 for 3,000 DWT barge, which is as follows:

- Phase-1 - 8,00,000 cum

The dredging shall be carried out by means of cutter suction dredgers and shall be dumped at approved offshore dumping ground of HDC / KoPT at Sagar about 65 km from Haldia MMT.

9.3.2 Annual Maintenance Dredging

The annual maintenance dredging during the operation phase is very high, as the sediment deposition rates are very high at the proposed site. The quantity of annual maintenance dredging considered is as follows:

- Phase-1 - 23,00,000 cum

The above figures are tentative and subject to validation by model studies.

9.3.3 Dredging Management

9.3.3.1 Layout

The Haldia MMT is for barges only and is to be operational 24 hours a day. The barges are assumed to have a loaded draught of 2.5m requiring a water depth of 3m on the berth and for safe passage (excluding any siltation allowance). The 24/7 operations require barges to be able to move on and off the terminal promptly after loading/unloading and sufficient space for vessels to move onto the terminal as soon as practical after a berth has been vacated. A nearby holding area facilitates this activity. A channel linking the terminal to the NW1 waterway to the north will further facilitate movement of the barges. It is proposed that up

to three barges are held either side of the access channel, anchored fore and aft, leading away from the turning area to the north-north-east. This holding area can provide accommodation for a total of up to six barges waiting to move onto the terminal. Additional holding capacity will be in the main river to the north of Balari Bar. Dredged depths are assumed to provide 3.2m of water depth at lowest water level, referred to as 3.2m below Chart Datum (CD).

9.3.3.2 Estimated initial dredge requirements

At the terminal about 0.3Mm^3 of capital dredging will be required to provide the berthing box, the turning/manoeuvring area for the berths and holding areas for barges anchored fore and aft adjacent to the channel leading into the turning area. The access channel to join the terminal with the main NW1 deep water channel between Sagar and Tribeni is proposed to run north-north-east from the terminal inshore of Balari Island and then across the Balari Bar. The maintained width of this channel between the toe of the slopes is proposed to be 45m. The capital dredge volume for this channel is about 0.5Mm^3. The greatest depth of dredging is required at the northern end of the channel where the channel crosses the high point over Balari Bar before joining the naturally deeper water of the main channel within which the NW1 waterway is located. A number of surveys have been undertaken over the Balari Bar (OSaS, IWAI and KoPT). These surveys indicate least depths over the Bar of between 0.3m above CD (where CD is 2.82 m below MSL) to drying at 0.5m.

In line with KoPT experience in terms of maintaining the approaches to Haldia Dock and the evidence of rapid morphological response to training works that have been constructed in this part of the estuary it must be recognised that siltation rates in dredged areas in this part of the river will be high. This means that during the capital dredging of the navigable area there will be a requirement to also remove natural infill as the capital works progress. Care will have to be taken when contracting this work to ensure that the dredge contractor has dredging plant of a suitable capacity to deliver the final project requirement. With high on-going infill it would also make sense that the contractor who installs the works is also contracted to maintain the works for a fixed period of time thereafter. Similarly the capital works should not be completed significantly in advance of the terminal construction to avoid unnecessary maintenance.

9.3.3.3 Estimated maintenance dredge requirements

It is considered that to maintain the turning/berthing/holding area at about 3.2m below CD the annual maintenance dredging will be about 0.5Mm^3/year. By keeping the total width of the dredged area perpendicular to the flow to a minimum dimension the volume of infill should be limited in this area. This is why it is recommend to install the holding area upstream of the turning area and parallel to the access channel (i.e. in line with principal tidal flows) and anchoring of barges fore and aft so that there is no requirement to accommodate the barges swinging on the turn of the tide.

The annual maintenance dredging requirement for the access channel is assessed to be about 1.8Mm^3/year. The part of the channel closest to the terminal is aligned slightly across the tidal flow but will be protected from wave action. The length of channel over the shoal is more exposed to wave action and here sediment should be more mobile resulting in higher

infill rates. The total annual estimate for infill is about 2.3Mm^3/year. This high rate of infill would mean that left unmaintained the dredged areas would rapidly loose depth and probably be almost totally infilled within a year, noting that the rate of infill will reduce as the channel reduces in depth/extent. The high infill rate demonstrates the need for ongoing maintenance of the dredged areas.

These estimated rates of siltation make the access channel to the Haldia MMT the location of highest expected infill and maintenance on NW1 and justifies special attention of dredging methodology in this area.

9.3.3.4 Dredging options at the terminal

The dredging methodology at Haldia will be linked to disposal options and will be dependent upon the type of plant that a contractor has available. On first consideration the disposal options include:

- placement ashore;
- loading of barges/hoppers with disposal to a permitted offshore site;
- disposal via pipeline;
- side-casting; and
- Dispersion by water injection dredging.

It is understood that placement of material ashore is not a viable option in proximity to the Haldia MMT as there is no approved disposal area nearby.

The presently permitted sea disposal site is the Sagar Dump Ground site used by KoPT which is some 65km seawards of the Haldia MMT which is an option for shallow draught sea-going self-propelled barges loaded by CSD or a small trailer suction hopper dredger (TSHD) which could also load barges or operate independently.

Dredging with a CSD and disposal via a pipeline could be practical during the capital phase of the project but is less practical during near continuous operations as the pipeline and CSD may obstruct navigation in the 45m wide navigation channel. Permission would be required for disposal via pipeline.

Side-casting using a small TSHD is a potential form of maintenance operation but would result in some re-siltation of dredged material within the maintained areas. Permission would be required for side-casting.

Ploughing or bed levelling in conjunction with the use of a TSHD would improve efficiency allowing material to be picked up at the toe of the slopes to improve removal from the channel cross-section.

Water injection dredging could be viable on the flood tide at the northern end of the access channel with material mobilised from the access channel into the natural deep water to the north of the Balari Bar. Options for use of water injection dredging on the ebb tide in the southern part of the dredged areas are limited as there is no adjacent naturally deep area into

which to relocate the infilled material. Permission would be required for use of water injection dredging.

It is considered that the disposal option likely to be most acceptable is the use of the offshore disposal site near Sagar Island.

9.3.3.5 Recommended approach to initial dredging

It is considered that capital dredging at the terminal for the berth and manoeuvring area would be undertaken by a combination of cutter suction dredger (CSD) and back hoe dredger (BHD) loading barges which dispose of material offshore to sea – as depths are improved the dredging plant to undertake the maintenance could commence working and eventually take over. Dredging could take place on two fronts: one from the terminal going northwards and one from the northern end of the access channel going southwards.

Sea-going self-propelled split hopper barges would be used to transport dredged material to the existing offshore disposal site some 65km offshore of the Haldia MMT. Some very shallow draught barges will be required to operate in the tidal window. It is likely that the capacity of such a sea-going barge having a draught of 2.5 to 3m will be order 600m^3. Some larger barges (1,000 to 1,500m^3) could also be used, either partially laden or working with the tidal window. With a typical speed of 8 knots the average round trip to and from the offshore disposal site would take about 9 hours (~ a tidal cycle) to complete. Ideally seaward passage would be on the ebb and the return on the flood tide reducing fuel usage. As a consequence convoys of barges would operate and the total number and capacities of barges in the fleet would need to account for this. Depending upon tidal windowing it may be possible to load larger sea-going barges and schedule their laden transit to the disposal site to coincide with higher water levels, return to the dredge site would be facilitated by the barge being unladen.

CSD production rates are likely to be of the order of 800m^3/hour of in-situ material when dredging. The dredged mixture in the pipe will be about 20% solids with hourly combined discharge rates (water and solids) of about 4,000m^3. CSD operations at Haldia will likely be restricted by the periods of strong tidal currents. It may be more practical to cease dredging operations when the flow presents a risk of turning the CSD on the spud during the dredging cycle than to either re-orientate the CSD with respect to the tidal current or reduce the swing width.

Loading shallow draught sea-going barges with the CSD would be inefficient. Under continuous operation a 600m^3 hopper barge would be filled by the continuous discharge of the mixture of water and solids from the CSD within about 10 minutes. Overflow would be required to produce a more economic load of sediment in the barge before transportation seawards. The overflow, however, would return back to the seabed at the point of the barge loading and this may then require some re-dredging. With a 600m^3 barge being loaded every 30-60 minutes with an average load equivalent to about 250-300m^3 of in-situ material, allowing for downtime, 10-15 barges would likely be required to support daylight operations of a CSD (with production equivalent to about 3,000m^3 of in-situ material per day – including tidal restrictions on operations). A CSD working at a rate of 3,000m^3/day with 10-15 barges could deliver about 90,000m^3 of the capital dredge volume in a month.

To make for more efficient dredging and to dredge in some of the corners of the berthing area the use of a BHD loading barges is also proposed. The in-situ production rate of the BHD will likely be less than that of the CSD, say 100-200m^3/hour. Working in daylight hours only a BHD might fill two sea-going barges per day (equivalent to say 800m^3 of in-situ material per day). The barges could then potentially make the return trip to the offshore disposal site overnight. A third barge would provide some contingency. A BHD working at a rate of 800m^3/day with three barges could deliver about 24,000m^3 of the capital dredge volume in a month.

A combination of BHD and CSDs working for 7-8 months with an extensive sea-going barge fleet (13-18 @ 600m^3 hopper capacity, fewer if larger deeper draught vessels could also be utilised) disposing offshore could deliver the capital dredge volume. Practically speaking they may need to work for longer, including removal of some of the natural infill before other dredging plant can be used to manage the natural infill.

If a combination of BHD and CSD is to be used then it would make sense for all the barges to be equipped for management of overflow should the barge be loaded by CSD. It would also be sensible for a barge loading pontoon to be used for loading the barges from the CSD so that they could be loaded away from the CSD. The barge loading would however need to be positioned in water deep enough to accommodate the loading of the barges and overflow at low water.

9.3.3.6 Recommended approach to maintenance dredging

There is expected to be a need for near continuous maintenance dredging of the approach channel, berth and turning area for the Haldia MMT. Typically navigation channels in tidal waters are maintained with trailer suction hopper dredgers (TSHD). The TSHD would dredge moving slowly against the tidal current. Once the hopper was full of water and sediment overflow would commence. Economic loading of the hopper would be completed within an hour. Only a small sea-going TSHD could be used for round the clock dredging of the Haldia access channel (with hopper capacities of up to about 1,000m^3). With a sailing speed of 10 knots the trip to and from the offshore disposal site would take about 7 hours. The overall cycle time would be about 8 hours. With a daily production equivalent to about 80% of the hopper capacity about 2,400m^3 of in-situ deposited material, equivalent to about 800,000m^3/year if a 1,000m^3 hopper capacity TSHD could operate for about 90% of the time..

Three small TSHDs would have sufficient capacity to maintain the access channel and berth area and because of their manoeuvrability they would not present a significant disruption to barge traffic using the channel. They could be supported by a BHD loading barges and a plough working in the terminal area.

However, an alternative TSHD methodology could be employed with the TSHDs adapted to load sea-going self-propelled barges (the same barges used for the capital dredging). The TSHD and barge would pass side by side through the access channel working into the tide. The TSHD discharging into the barge rather than into its own hopper. The TSHD operation would be timed so as to fill a barge on each pass along the access channel. With anticipated high fines content in the infilling material there would be little benefit in overflowing of the barge during loading. It should be practical to make 3 dredging passes through the channel on the ebb tide and 3 dredging passes on the flood tide over a single tidal cycle. This would

require one small TSHD and six 1,000m^3 capacity barges. Production over the tidal cycle would be about 4,800m^3, equivalent to about 1,600,000m^3/year if the TSHD could operate for about 90% of the time during the daylight tide. This would lead additional time for the TSHD to undertake a single load of dredging each day from the berth/turning area or elsewhere, equivalent to about 250,000m^3/year.

To make for more efficient maintenance dredging in some of the corners of the berthing area the use of a BHD loading barges is also proposed. The in-situ production rate of the BHD undertaking maintenance dredging will likely be 200m^3/hour. Working in daylight hours only a BHD might fill two 1,000m^3 capacity sea-going barges per day (equivalent to say 1,600m^3 of in-situ material per day). The barges could then potentially make the return trip to the offshore disposal site overnight. A BHD working at a rate of 1,600m^3/day for about 80% of the time could contribute about 470,000m^3/year towards the management of the maintenance dredging volume.

A plough operated by a tug boat would be useful in conjunction with the TSHD to remove high spots and pull material away from the berth pockets and the holding areas in between vessel movements if required.

9.3.3.7 Summary

The dredging methodology to be adopted assumes permission will be granted for disposal to the existing offshore disposal site at Sagar. This will need confirmation.

Capital dredging is proposed to be undertaken with CSD and BHD loading sea-going self-propelled split hopper barges (600m^3 to 1,500m^3 capacity). One CSD working with a BHD could complete the work in 7-8 months. As the channel was deepened it would become necessary to utilise the maintenance dredging plant.

For maintenance dredging it is proposed that a small TSHD is adapted so as to also be able to load the sea-going self-propelled split hopper barges. This would be supplemented with plough and BHD dredgers.

9.4 Storage Areas

9.4.1 Stockyard for Flyash, Natural Aggregates and POL

The flyash will be stored in silos which will be constructed on pile foundation.

The top 2m of the stockyard shall be heaving compacted in layers of 225 mm. Open stockyard shall be developed to 4 m high stockpiling of stone aggregate and 3 high stacking of oil drums. The stockyard should also have provision to stack 4 high containers in future. Ground improvement, shall be required to achieve required bearing capacity accordingly.

The ground is well compacted for a depth of 2 m in layers of 225 mm with the road roller; in which the top layer of the ground is then compacted with stone aggregate of specified sizes in uniform thickness by a vibratory roller to proper grade and camber.

Density of stone aggregate : 1.6 T/cum

9.4.1.1 Phase-1

The top 2 m of the Stockyard shall be heavily compacted in layers of 225 mm. In Phase-1, the top 150 mm of stockyard area for natural aggregates and POL is proposed to be hard stand consisting of gravel / brick ballast / crushed stone packed properly, with interstices filled with sand.

Cement concrete paver blocks with proper interlocking shall be provided at truck access areas near the flyash silos. The paver blocks shall be placed on 50 mm thick compacted bed of fine sand layer and the spacing between the blocks shall be filled with sand. The paver blocks shall be of M35 grade concrete with approved colour, design and pattern.

9.4.1.2 Phase-2

The top 2 m of the Stockyard shall be heavily compacted in layers of 225 mm. In Phase-2, the top 150 mm of future storage area and the pockets between approach trestles shall be hard stand consisting of gravel / brick ballast / crushed stone packed properly, with interstices filled with sand.

9.4.2 Storage Sheds

Bagged cargo / Fertiliser cannot be stored in open atmosphere and requires covered storage sheds. The sheds shall be mainly built using structural steel for the frames and galvanised sheets for roofing and cladding. Grade slab are provided for maintaining the finished floor level so as to give a plinth height of not less than 500 mm above Finished Ground level. Retaining wall of adequate height shall be provided around the shed for optimising the storage capacity.

Based on the review of geotechnical data it is assessed that pile foundations might be necessary. The proposed storage size is 130 m x 30 m to accommodate 5,760 tons of bagged cargo.

Details are shown in the **Drawing I-525/HT/218** which is only indicative and may undergo changes based on the design.

9.5 Terminal Buildings

The following terminal buildings are proposed for the Haldia terminal:

9.5.1 Terminal Administration Building

It will be 2-storied building housing the following:

- Administration wing of the terminal including documentation
- Terminal operations wing

It is assessed that the terminal administration building will have a total floor area of 660 sqm (330 sqm per floor). Typical Layout and Elevations of Terminal Administration Building are shown in **Drawings I-525/HT/214** and **I-525/HT/215** respectively.

9.5.2 Security Office

This will be a single storied building for security personnel with a storage shed of about 25 sqm, and shall be provided near the terminal entrance. Details of security office are shown in **Drawing I-525/HT/217**.

9.5.3 Weigh Bridge Building

This will be a single storied weigh bridge building with a storage shed of about 25 sqm, and shall be provided near the terminal entrance. Details of weigh bridge building are shown in **Drawing I-525/HT/217**.

9.5.4 Electrical Sub-station

The electrical sub-station shall be located near stockpile for aggregates. This will be a two storied building with a floor area of 1090 sqm (545 sqm per floor). The details of electrical sub-station are shown in **Drawing I-525/HT/230**.

9.5.5 Worker's Amenity Building

Worker's Amenity Building with bath and lavatory facilities shall be located near terminal administration building. This will be a single storied building with a floor area of 121 sqm. Details of Worker's Amenity Building are shown in **Drawing I-525/HT/216**.

9.5.6 RIO Compressor Room

The RIO (Remote Input Output) compressor room shall be located near silos. This will be a single storied building with a floor area of 40 sqm.

9.5.7 Overhead water tank and Underground reservoir

The overhead water tank and underground reservoir are of RCC structure catering to the supply of water. The minimum capacity of the overhead tank shall be 60 m^3 and the minimum capacity of the underground sumps should be 200 m^3.

The broad design parameters for water supply system are given below:

- Wastage and leakage in system: 15% of total theoretical demand
- Hydraulic design of the pipeline shall be using Hazen-Williams formula
- All pipelines shall be laid 1.2 m below ground

9.5.8 Gate house complex, Emergency exit Gate, Access Gate, Boundary Wall and Fencing

A gate house complex shall be provided in the western boundary of the terminal at the location shown in the overall layout. Typical details and dimensions of gate house complex is shown in **Drawing I-525/HT/219**.

The boundary wall, fencing, access gate and emergency exit gate shall be provided as mentioned in **Drawing No. I-525/HT/233**.

9.5.9 Design Criteria

All designs of RCC structures other than liquid retaining structures shall be carried out as per IS 456. The buildings shall be provided with adequate arrangements for plumbing, sanitary, electrical fittings, illumination, water distribution etc. The aspects considered for construction of buildings

- Floor to floor height of buildings is arrived considering the bylaws of National Building Code.
- Finished floor level of buildings is considered 500 mm above the finished ground level
- Grade Slab

All ground floors shall be of R.C.C. (M-20) with minimum thickness of 150 mm over 75mm thick P.C.C. (M-10) base. The sub base of 230 mm thick Stone/bolder soling over compacted earth is proposed. The floor finish of 40 mm thick including 13 mm thick metallic hardener topping is proposed. Floor top is proposed to be laid to slope minimum 1:100 towards floor drain for floor washing.

- A 750 mm wide plinth protection is proposed around each building.
- All external walls shall be of 230 mm thick, all partition walls shall be minimum 115 mm thick with 1:4 cement mortar
- Stair Case
- Clear width : 1.2 m
- Tread width : 250 mm
- Riser : 180 mm
- Continuous Hand rail is proposed.

9.5.9.1 Foundations

Based on the review of geotechnical data, it is assessed that pile foundations will be necessary for buildings.

9.5.9.2 Loads

9.5.9.2.1 Dead Load

The unit weight of all other materials shall satisfy the requirements of IS: 875.

9.5.9.2.2 Live Load

Live load shall be considered as given below and shall also satisfy the requirements of IS: 875.

Flat Roof	150 kg/m^2 + Dust load of 50 kg/m^2 hanging load for pipe shall be considered as 100 Kg/m^2 and 50 Kg/m^2 for electrical, ventilation & air conditioning (wherever applicable)
Non-accessible roof	75 kg/m^2 + Dust load of 50 kg/m^2
Inclined roof	Roof slope upto 10 Deg.: 75 Kg/m^2 +50 Kg/m^2 Roof slope above 10 Deg.: [(75-(θ-10) x2] + 50 Subjected to a minimum of (40+50) =90 Kg/ m^2 For sloping roofs with slope greater than 10°, members supporting the roof purlins, such as trusses, beams, girders etc. may be designed for two-thirds of live load stated above
MCC Floor	300 kg/m^2 +1.2T/m of Panel

9.5.9.2.3 Seismic Load

- Zone factor : Corresponding to seismic zone-III
- Importance factor : 1.50
- Response reduction factor : 5

9.5.9.2.4 Equipment Load

The Substation building is to be designed to accommodate anticipated static and dynamic loading from electrical equipment. Where the uniform floor live load adequately accounts for the equipment weight, the weight of such equipment as a dead load need not be considered.

9.5.9.2.5 Impact Factor

- For Manual monorail/Hoist design an impact factor of 1.20 shall be considered in design.
- For Electrical monorail/Hoist design an impact factor of 1.25 shall be considered in design.

9.5.9.3 Load Combinations

The load combinations are in accordance with IS: 456, IS: 800.

9.5.9.4 Minimum Cover

Clear cover to main reinforcement shall be as mentioned hereunder but shall not be less than the diameter of such reinforcement.

Pile	75 mm
Top, bottom & side of footing (if any):	50 mm
Pedestal / column	
- Below ground	50 mm
- Above ground	40 mm

Beams	25 mm
Slab	20 mm
Face of walls & grade beam	50 mm (in contact with soil)
Face of walls not exposed to soil	25 mm (min.) or dia of main bar
At each end of reinforcing bar	20 mm or twice the dia of bar whichever is greater
Columns of max. dimension 200mm or under and with longitudinal reinforcement diameter not exceeding 12mm	25 mm

9.5.9.5 Serviceability Checks

Crack width of all the structural elements shall be calculated wherever necessary as per IS: 456.

9.5.9.6 Material Specification

The specifications are as given in this volume.

Structural Concrete	M-30
Levelling Concrete	M-10 of 100 mm thick
Reinforcement	Thermo-mechanically treated high corrosion resistant steel of grade equivalent to Fe-500
Cement	Ordinary Portland Cement of minimum grade 53 as per IS:8112. In addition, cement in accordance with IS:456 & IS:4651 Part 4 shall be considered.
Structural Steel	As per IS:2062 (Grade-A) with minimum thickness of 10 mm
Protective coating to structural steel	Minimum DFT of 240 micron after sand blasting to SA 2.5 grade.

If Chloride & Sulphate content as per the soil investigation report is found on the higher side. i.e.

- Chlorides
- Prestressed Concrete or grouting Mortar:-500mg/l
- Concrete with reinforcement or embedded metal parts:-1000 mg/l
- Concrete without reinforcement or embedded metal parts:-4500 mg/l
- Sulphur
- The Sulphur content of the water must not be more than 2000 mg/l
- Measures
    - Use of Sulphate resistance cement
    - Low water/cement ratio

- Curing suited to the structure

9.6 Boundary Wall / Fencing

It is proposed to provide boundary wall of 2.4 m height using brick masonry with barbed wire fencing. The boundary wall shall be provided along the periphery of the terminal area except the water-front side.

It is to be noted that Tata chemical's 40m wide pipeline corridor passes between the terminal area and the existing river-side road. The river-side road also belong to IWAI. Therefore, it is proposed to provide fencing on the river-side of the terminal as indicated in **Drawing I-525/HT/233** along with access gate on both sides to facilitate the access to the pipelines for Tata Chemical's personnel.

The boundary wall is classified under 3 types, i.e. Type - A, Type - B and Type – C. Type - A wall runs in the South side of the terminal between the access gates. Type - B wall runs in the West side of the terminal from the 40 m pipeline corridor to the entry / exit gate of the terminal proceeding to the north side up to bridge (C2). Type - C wall runs in the East side of the terminal till the access gate covering the periphery of the terminal. Details of the wall is as indicated in **Drawing I-525/HT/233**.

9.7 Internal roads

Based on the traffic study, it is implicit that both the import and export cargoes will be carried to and from the hinder land through road only. Therefore, providing well-planned internal road network is essential for effective functioning of the terminal. Accordingly, the internal roads were provided with the capacity to cater the traffic of Phase-1 and Phase-2.

Along the periphery of the terminal area, a flexible pavement road of 4-lane road has been proposed and 2-lane road has been provided for the internal connecting roads having 2.5% cross slope and drains wherever necessary as shown in **Drawing I-525/HT/223**. The length and width of the internal roads are given below:

Table 9.8 Details of internal roads

Right of Way	Length
17 m	1500 m
10 m	1800 m

9.8 Water Supply

Fresh water supply required for terminal activities has been estimated based on the annual demand required for the flawless operation of the terminal. It is assumed that the water will sourced through water tankers which will be of potable quality. Water will be required at the terminal for the following activities:

- Supply to vessels (potable water used in vessels for drinking, cooking and ablution purposes).

- Supply to terminal users
- Environmental conservation and maintenance of greenery in the terminal area
- Miscellaneous purposes

9.8.1 Assumptions

The following assumptions have been considered to calculate the total water requirement.

- It is envisaged that during Phase-1, about 150 persons will be working in Haldia MMT considering three shift operation. It is expected that, the additional number of persons required during Phase-2 operation will be comparatively negligible.
- The total number of visitors including truck operators will be around 150 numbers per day.
- It is assumed that on an average two vessels in a day will avail the bunkering facility in Haldia MMT and the water requirement for a barge will be approx. 15 KLD.

The water requirement for the terminal are provided in Table below:

Table 9.9 Water Demand for Terminal (Litre/per day)

S. No.	Facilities	Water Demand (KLD)
1	Terminal Personnel & Users	20
2	Supply to vessels	30
3	For miscellancous actitivites including washing, cleaning, mobbing etc	5
	Total Potable Water Requirement (Litre / day)	**55**

Raw water received from source will be collected in an underground sump. Raw water pumps will be used to transfer water from the underground sump to the adjacent overhead tanks. From there, it will be transferred to administrative building, worker's amenity building, electrical substation and to the bunkering points on berth through gravity. The capacity of underground sump (U/G sump) and overhead tank (OHT) required for Phase-1 development are shown in Table below:

Table 9.10 Capacity of U/G sumps, and OHT for Phase-1 development

Description	Capacity (KL)
Capacity of U/G sump	200
Capacity of Over Head Tank	80

The STP (Sewage Treatment Plant) treated water will be used. The treated sewage shall be used for greenery. The additional water requirement for Phase-2 is comparatively trifling and therefore no augmentation in the water supply system is envisaged for Phase-2 development.

9.9 Sewerage System

Based on the number of persons working in the terminal and water requirement mentioned in the above section, the quantity of sewage that is expected to be generated from Haldia MMT will be 18 KLD. Accordingly, it is proposed to provide a sewage treatment plant of capacity 20 KLD which will suffice for both Phase-1 and Phase-2.

9.10 Storm Water Drainage

To facilitate the flawless disposal of storm water, covered storm water drains is proposed across the terminal as shown in **Drawing I-525/HT/225**. The storm water runoff from the drains will be collected into the settling pond which will allow the suspended particles to settle down before getting discharged into the 'Green Belt Canal'.

9.11 Fire Fighting Facilities

It is envisaged to provide fire extinguishers in the buildings and covered shed. In the oil drums storage area, foam type fire extinguishers and sand buckets will be provided and in emergency case, it is proposed to avail the fire tenders from the existing Haldia Dock Complex fire station which is located at Chiranjibpur or from other nearby fire stations. As the stone-chips are non-hazardous cargo, no firefighting system is envisaged in stone chip stockyard.

9.12 Dust control

Suitable dust extraction system will be provided for fly ash handling in silos and also in the conveyor system as mentioned in Chapter 10.

In case of stone chips, the volume that will be stacked in the terminal area will be comparatively trivial and therefore dust suppression can be carried out by spraying water through flexible hoses.

9.13 Navigational Aids

Navigational aids are required to be provided to ensure safe and efficient navigation of vessels while transiting in the navigational channel as well as in the manoeuvring areas near the terminal. Marker buoys will be provided alongside the channel and maneuvering areas to aid the navigation.

The navigation aids are detailed in paras below.

There will be a pair of marker buoys at the beginning on either side of the channel. Thereafter, pairs of Marker Buoys shall be provided along the 7 km long approach channel at a spacing of about 2.5 km and at the periphery of the maneuvering area near terminal. Provision of 8 buoys are kept for marking the channel and manoeuvring area. The channel marker buoys will be procured as part of the navigation channel for the entire NW1.

The channel marker buoys will have the following characteristics:

Material	Rotationally moulded in low density uv-stabilised virgin polyethylene
Body diameter	1800 mm
Day Mark	PE Module (as per IALA)
Radar reflector	To be provided
Light Range	3.5 – 4 nautical miles (T=0.74)
PLC Programmer all functions for monitoring of buoy and light	To be provided
Remote Monitoring Unit for buoy position and light	To be provided
Power	Solar plus backup battery for optimum autonomy
Mooring arrangement	250 kg M.S. stockless anchor with 26 mm dia chain

10 PRELIMINARY ENGINEERING - MATERIAL HANDLING SYSTEM/ EQUIPMENTS

10.1 Phase-1

As already discussed in Chapter 6, the commodities like Fly ash shall be handled at the terminal in Phase-1 by using Flyash silos, Belt Conveyors, Belt Pipe Conveyors and Fixed type Barge Loaders. The other cargos like Aggregates / Fertilizer and Oil Drums shall be handled at jetty with the help of Mobile Harbour Cranes and trucks / dumpers.

The summary of mechanical equipments proposed in Phase-1 of the terminal is given below:

Table 10.1 Summary of Phase-1 Mechanical Equipments

S. No.	Equipment Type	Number of Equipment
1.	Fly Ash Silos	8
2.	Conveying System	Lot
3.	Fixed Barge Loaders	2
4.	Mobile Harbour Cranes	2
5.	Front End Loader/Pay Loader	1
6.	Dumpers	10
7.	Road Weigh Bridge	2
8.	Fork lift	2

The flow diagram of cargo handling system that would be followed in Phase-1 is presented in **Drawing I-525/HT/228**.

As presented in the flow diagram the details of Ash Silo and Mechanical Equipments including broad specifications are discussed below:

10.1.1 Fly Ash Silos

8 Nos. storage silos each to store 1200 MT of dry fly ash with plus 10% margin shall be provided. Storage silos shall be of conical bottom type with the provision of air slides / fluidizing pads at the bottom. Storage silos shall be provided to store precipitator fly ash with adequate air space. This silo shall be used to collect dry fly ash from the bulk carrier and further loaded to barges by conveyor system.

The silos shall be Steel constructed, water tight and relatively air tight with minimum 12 mm thick MS plate conforming to relevant Indian Standards and Specifications. The silo shall be completed in all aspect including stairs case, civil foundations, lugs, supporting structures etc. and designed for minimum 30 year life.

Design shall be as per IS: 9178 (Part 1 to Part 3)

All silo components shall have Zinc coating. ISO 12944 shall be followed for carrying out the painting job for taking care of Cleaning, Protective Coating and Painting designed for service life of 15 yrs.

The Silos are to be top loading and bottom discharge. The intake capacity of each Silo shall be minimum 40 Tons per Hour (TPH) and discharge capacity is about 200 Tons per Hour (TPH).

Each dry fly ash storage silo shall be provided with following arrangement for loading and unloading the fly ash.

1. There shall be pneumatic unloading fly ash facility consist of electrical operated compressor, pneumatic pipe up to silo top with all necessary fitting.

2. Dust Extraction System shall be fitted on each silo to collect dust from the silo. The system shall be complete in all respect, the system shall be capable to collect the dust from bottom discharge conveyor also.

3. Bag filters shall be provided on the storage silos for cleaning the aeration and displaced air before venting out.

4. The dust loading from the outlet of the bag filters shall not exceed 50 mg/Nm^3 under any operating condition with 10 per cent bags plugged.

5. The provision of a proven dust collection system in the storage silos that separate out bulk of the ash from the conveying air shall be provided before the air is extracted through the bag filters.

6. Each storage silo shall be provided with a separate and dedicated floor aeration system. This aeration should only be required during silo unloading and should not be in operation during storage periods.

7. Chute along with rotary feeder for unloading the dry fly ash into corresponding belt conveyor

8. The pressure / vacuum relief valves in the storage silos shall be provided.

9. Flow controls for the ash shall be adjusted with the help of flap gate (electric operated).

10.1.1.1 Components of Silo

1. Manhole for men for maintenance to be provided at top of silo.

2. 3D level scanner shall be provided at each silo top to monitor the level of ash in silos.

3. Silo roof to be equipped with peripheral walkway with railing at eave height and middle of the roof.

4. Roof step ladder with railing to be provided and it should also have access with overhead walkway.

10.1.1.2 Instruments

Each silo shall be provided with following instruments as a minimum:

a)	Silo ash level switches (High and Low)	:	1 No.
b)	Differential pressure gauge across the bag filter	:	1 No.
c)	Differential pressure switch across the bag filter	:	1 No.
d)	Pressure gauge at the inlet of the bag filter	:	1 No.
e)	Differential pressure gauge across the vent filter	:	1 No.
f)	Differential pressure switch across the vent filter	:	1 No.
g)	Pressure gauge at the inlet of the vent filter.	:	1 No.

The Ash Handling System shall be designed for operating at wind speed of 24 m/sec and at 45^{o} C temperature.

10.1.2 Belt Conveyor / Pipe Conveyor System

10.1.2.1 Conveyor

A) The conveyor shall have a sturdy, welded, structural steel frame and supports for mounting all the machinery. Frame shall be designed suitably for the belt tension, clearances etc. Frame shall be fabricated from steel conforming to IS: 2062. Anti-friction bearings with double labyrinth dust seals and easily accessible pressure gun lubrication fittings shall be provided.

B) It shall be possible to operate the telescopic movement of the spout, within the operating range while the machine is operating at its full capacity.

C) All bearings shall be Spherical roller bearings with plummer blocks lubricated by grease.

10.1.2.2 Belting

The belting for conveyor shall be of suitable EP belt for heavy duty application and shall have adequate number of plies to withstand the tension and support load, adequately; top and bottom cover thickness shall not be less than 8 mm and 3 mm respectively.

The rated maximum allowable tension shall be 140 per cent of the normal working tension.

The ratio of breaking strength to rated allowable working tension shall be minimum nine (9).

Belt shall be pre-stretched and cut edge type construction.

Belts supplied shall not blister or separate in the plies or at seams or stretch more than two and half per cent of their original length within one year of installation and normal operation.

Belt construction shall be such that in the case of edge damage, ply separation and ingress of moisture shall not take place.

(A) Belting shall conform to latest revision of IS: 1891 (Part I), IS: 11592-2000 and other relevant Indian Standards.

(B) Belts shall have hot vulcanized joints after erection.

10.1.2.3 Idlers

All carrying idlers for shuttle conveyors carrying material in bulk shall be single roll flat type and shall be fitted on fixed type supports on the Shuttle conveyor stringer frame.

Carrying Idlers shall be suitable for required belt widths. All carrying Idlers shall be spaced at 550 mm centres. Carrying idlers shall have troughing up to 45 degree.

Outside diameters of normal carrying and impact rolls shall be 139.7 mm respectively.

Idler rolls shall be made of electric resistance welded (ERW) tube and minimum wall thickness shall be 4.85 mm. Mechanical properties of the idler tubes shall be equivalent or better than YSt 210 grade as per IS: 9295.

Return idlers shall be Flat type. Diameter of each return roll shall be 127 mm. Return idlers shall be placed at 3.3 m centres. The return idlers shall be fitted on fixed type supports on the Shuttle conveyors.

Brackets for the idlers shall be of fabricated steel and shall have ample strength and rigidity to operate under all conditions without vibration or chatter. Use of Cast Iron support brackets are not acceptable. The bases shall be provided with slotted holes with two bolts of min 16 mm on each end.

Bearing housing shall be made of min 3 mm cold deep drawn rolled carbon (CDDRC) pressed steel.

Idler shaft material shall be EN8 or better steel.

Idlers shall be easily removable type and designed for continuous duty.

All idler bearings shall be 'Sealed, lubricated for life' type. Deep groove ball bearings shall be used. The bearings shall be chosen for life L-10 equal to 50,000 hours minimum. All bearings shall be protected by double labyrinth seals. The bearing seals shall have minimum resistance to rotation. Lubrication fittings for the labyrinth seals shall be provided in the case of idlers provided at loading points, for the purpose of occasional greasing to keep the dirt and dust out. Felt seals will not be accepted.

All idlers and assemblies shall conform to latest edition of IS: 8598 or equivalent.

Internal rolling friction resistance of idler rolls shall not exceed 0.015 while testing.

10.1.2.4 Pulleys

Pulleys shall be made of welded steel and stress relieved in the furnace before machining. All hubs shall be of forged steel and end discs shall be accurately machined for concentricity.

Pulley shall be straight faced. Drive and discharge pulleys shall be of same diameter provided with 16 mm thick diamond type grooved rubber lagging. The rubber hardness shall be IRHD 60.

All pulleys shall be statically balanced. The balance weight shall not exceed 1% of the total weight of the pulley.

The pulleys shall have minimum rim and disc thickness of 12 mm. The face width of pulleys shall be as per relevant IS Standards suitable for belt. The face run-out on diameter shall not be more than 0.5 mm.

The run-out tolerance after lagging shall not be greater than 0.5 mm on diameter.

Bearings for all pulleys shall be antifriction double row, self-aligning, spherical roller bearings mounted on adapter sleeves. All Plummer blocks housings shall be of cast steel construction with double / triple labyrinth seals.

All pulley bearings shall have life of 50,000 hours.

10.1.2.5 Belt Weighers

Belt weigher shall be provided in the system at appropriate locations for measurement of cargo handled. The belt scale shall be load cell type and shall be continuous operating. Accuracy shall be 0.25%.

Provisions for local and remote measurement of instantaneous throughput and to falling shall be made. Signals for remote indication and overload alarm shall be provided. Local control panel including rate indicator and totalizer shall be provided. The load cells shall be completely sealed, water and dust proof, and maintenance free.

10.1.2.6 Belt Cleaners

Multiple blade spring operated belt scraper of proven design shall be provided at the discharge end of belt conveyors for effective cleaning of the belt and ensure no spillage of the material from return belt. The discharge from the belt scraper shall fall within the transfer chute. A V type Plough Scraper shall be provided on return belt at the discharge end.

10.1.2.7 Safety & Control Devices

All conveyors, unless mentioned otherwise, to be equipped, but not limited to the following:

One no. Belt side travel switches to stop drive units for protecting belt from rubbing the structural parts.

Motion (under speed) switches to stop the motor when the speed of the equipment drops below a specified value or if normal speed is not reached within a specified time, and to signal starting and stopping of preceding conveyor/equipment.

10.1.2.8 Drive Unit

Drive shall be through reversible Geared Motor/Motor & shaft mounted Gear box, flexible couplings and brake etc. Gear type shall be Bevel Helical of reputed make.

10.1.2.9 Dust Extraction System

a) Dust control and abatement systems shall be provided to contain escape of dust into atmosphere while the facilities at the terminal are in operation. The systems shall be designed to conform to the permissible limit of dust emission by the concerned statutory pollution control authorities.

b) However, the concentration of RSPM-10 shall be limited to an average 5 mg/normal cum over and above the ambient dust concentration measured at a circumferential distance of 5 m from the dust generation source.

c) The filtering efficiency shall not be less than 95%.

d) Dust Extraction System shall be designed in accordance with ACGIH & APPCB norms.

10.1.2.10 System Requirement

The following Dust Control System shall be provided

S. No	Facilities	Dust Control System
1.	At Transfer Towers	Insertable Pulse Jet compact bag filter
	At Towers	
	At Barge loader	

10.1.2.11 Design Requirements for Dust Extraction System

Dust control at discharge and receipt points in the transfer towers shall comprise of reverse pulse jet compact bag filters with independent fan. However, the reverse air jet shall be provided through a common air compressor for all the dust extraction units.

The Dust Extraction System shall consist of, but not limited to:

i) Compact reverse pulse jet unit with Insertable bag filters suitable for working at the ambient conditions.

ii) The filter media shall be of standard dimension using surface filtration technique so as to reduce the need of formation of primary cake for better reverse air jet cleaning process. The fabric shall be abrasion and static charge resistant, non-woven needle

felt made from polyester or polypropylene. The bag filters shall be suitably supported from within with steel cages.

iii) The Air to Cloth ration shall be suitable maintained for the efficient working of filter

iv) Filter bags under cleaning cycle shall be 25 – 30% depending upon the system design.

v) Centrifugal air fans with backward curved blades. The capacities of the fans shall be as required at each potential dust generation point. The indicative particulars of transfer towers are given hereunder:

vi) A common Air Compressor shall be provided for the supply of reverse air jet to each dust extraction unit in the dust control system. The air compressor shall be able to deliver air at the required pressure at the inlet to pulse jet valve but shall not be less than 7 Kg/Cm^2. The system provider may arrive at the capacities and operating pressure based on his system design. However, other parameters specified shall be adhered to.

10.1.3 Fixed Type Barge Loader

10.1.3.1 General

The Barge loader shall be fixed type machine conforming to the general arrangement and geometry shown on the **Drawing I-525/HT/226**. It shall be suitable for loading barges up to 1500 DWT at all load / ballast and tide conditions.

Barge loader shall comprise a main portal gantry supporting a Conveyor with a telescopic spout.

Equipment shall receive material from the conveyor BC-5 & BC-6.

10.1.3.2 Superstructure

A. The Superstructure shall be of robust design and provide access for inspection, adjustment and maintenance of all mechanical equipment including idlers, etc.

B. The conveyor may be designed as a built in dust proof enclosure and shall include walkways on both sides. The conveyor return idlers shall be located above the walkway and be accessible for replacement from the walkway.

C. The conveyor shall discharge through a telescopic spout which shall be capable of being expandable in the vertical direction. The telescopic chute shall be provided with insertable bag filter to control the dust emission while loading into the barges.

The telescopic chute shall be electric power driven with suitable gear box, input/ output couplings.

The speed of telescopic chute shall be limited to maximum 5 m/min.

The spout shall be lined with durable and replaceable SS-304 Liners. Liner plate thickness shall not be less than 3 mm.

10.1.3.3 Technical Parameter

The following parameters shall be adhered to in the bid. Berth layout, travel rail span, Barge sizes and dimensions, clearances, berth conveyor details, etc., are given in the attached drawing. Those listed but not given here shall be supplied with the bid:

Cargo	Fly Ash
Barge loading Capacity Rated Design	 400 TPH 500 TPH
Barge Size	Up to 1,500 DWT
Conveyor Outreach	31 m (approx.) from the centreline of feeding point and minimum 7 m from the centreline of fender pile

10.1.3.4 Barge loading Operation

Barge loader shall be manually operated from the local Push Button Station have following interfaces:

- Conveyor shall start before the berth conveyor,
- The belt scale on the conveyor BC-5 & 6 shall be pre-set from the discharge of the required tonnage. The belt-scale shall be re-set to a fresh tonnage once the earlier target has been reached.

10.1.4 Mobile Harbour Cranes (MHC)

10.1.4.1 Operating Conditions

Mobile Harbour Crane shall be of rubber-tyred, self-contained construction and shall be equipped with a diesel engine as a prime mover for crane operation and travelling. The crane shall be of four-rope construction and shall be designed and equipped for multi-purpose operation like general cargo handling, bagged cargos, heavy lift operation as well as containers with automatic Spreader and bulk handling with suitable four rope grab. Crane will cater to barge up to 3,000 DWT size with the dimension of 95 m x 15 m x 2.5 m.

Being a new terminal and to have edge in the industry market, equipment should have maximum efficiency to perform highest in its class.

10.1.4.2 Main Technical Requirements

The following minimum operating characteristics are required:

10.1.4.3 Load Capacities

10.1.4.3.1 General Cargo Handling

The crane shall have a lifting capacity of minimum 50T on hook up to a radius of 17 m from crane centerline.

10.1.4.3.2 Four Rope Grab Operation

The crane shall have a lifting capacity of minimum 20T in grab mode up to a radius of 20 m from crane centerline.

10.1.4.3.3 For Container Handling

The crane shall have a lifting capacity of minimum 30T under spreader up to a radius of 20 m from crane centerline. Spreader weight is about 7.6 t.

Total weight of the loaded container is considered as 30 T.

10.1.4.4 Classification of Crane and Machinery

The crane and its machinery shall be classified according to the FEM 1.001 (Rules for the Design of Hoisting Appliances) and shall have the following minimum classifications:

10.1.4.4.1 Crane Classification

Heavy lift operation 50T on hook	– A3
Grab Operation	– A6
Container Operation	– A5

10.1.4.5 Operating Speeds

The following speeds shall be provided as a minimum:

Hoisting/ Lowering	0 - 50 m/min
Slewing	0 - 1.2 rpm
Luffing	0 - 40 m/min
Travelling	0 - 60 m/min

10.1.4.6 Main Dimensions

Minimum outreach of the boom from crane centerline	: 20 m
Height of boom pivot point above ground	: minimum 8 m
Height of eye level in tower cab	: minimum 13 m

Maximum hoisting height on hook above ground : minimum 33.5 m

Minimum hoisting height on hook below ground : 10 m

10.1.4.7 Quay Load Arrangements

Uniformly distributed load under pad : 1.5 T/m^2

Max. Load per tyre : 5 T

10.1.4.8 Environmental Conditions

The crane shall be designed to work safely and reliably under the following environmental conditions:

Daily temperature range variation	: ± 15^0 C
Maximum operating wind speed	: 24 m/s
Maximum wind speed for travelling	: 24 m/s
Maximum wind speed out of operation with boom in steepest position	: 46 m/s
Maximum gradient for travelling	
- in direction of travel	: 6 %
- perpendicular to direction of travel	: 2.5 %

10.1.4.9 Safety Devices

The crane shall provide the following safety equipment as a minimum:

- Safe load indicator
- Mechanical interlock of chassis and superstructure during travelling
- Stabiliser monitoring
- State-of-the-art electronic limit switching system
- Safety valves at hydraulic cylinders
- Anemometer
- Emergency stop buttons at various locations of the crane
- Video camera at the boom tip
- Appropriate lighting system for night-time operation
- Crane management system (optional)

Figure 10.1 Typical Details of Mobile Harbour Crane

10.1.5 Front End Loader /Pay Loader & Dumpers

The front end loader / pay loader is used for heaping up the stone chips within the stockyard and loading in dumpers for transporting to Berth. The general technical parameters governing the design of the pay loader shall be as follows:

- Capacity of bucket : 3 cum
- Bucket width : About 3 m
- Static tipping load : About 13 T
- Operating height : Not less than 5.4 m
- Turning radius : Not more than 6.5 m
- Dump angle : Not less than 50
- Dump reach : Not less than 2.4 m

10.1.5.1 Dumpers

Dumpers of 20T capacity powered by diesel engine will be used for transferring cargo from Jetty to open / covered storage area and vice versa.

10.1.6 Road Weigh Bridge

The weigh bridge structure shall be robust in construction with ample safety margin above the rated capacity.

The lower structure of the platform shall comprise of wide flanged steel beams and high grade tested steel. The structure shall be sand blasted to SA 2½ grade and suitably painted with special anti-corrosion epoxy based paint.

The assembly shall be designed to compensate for expansion and contraction between the Weigh Bridge and foundation, caused by temperature variation.

The load cells shall be sealed and compression type suitable for pit less weigh bridge installation.

The load cells (6 nos.) shall be of rated capacity 23T (approx.) each having safe overload limit of 150% and breaking load of 300% of rated capacity.

Each load cell shall have safe temperature range 0-65 degree Celsius and shall be weather proof IP-68 protection.

Weigh bridge electronics shall be micro controller based with standard software capable of providing various kind of information on selectable basis.

The system shall be provided with communication facility with the main PIC in the control room and a real time clock to print date and time on the printouts.

The system shall be provided with suitable PC with software and dot matrix printer of latest technology. The specifications for same are as given below:

Table 10.2 Specification Data Sheet - Road Weigh Bridge

S. No.	Description	Data
1.	Type	Pit less, Static
2.	Capacity	60T
3.	Accuracy	± 0.05% of Full scale
4.	Platform size	15 m x 3 m
5.	Trucks to be weighed	Heavy duty Trucks / dumpers
6.	Operator interface	Menu driven
7.	PC & Printer	Required
8.	Auto zero & Auto Calibration	Required
9.	Anti-skid to plate	Required
10.	Stamping by W&M Inspector	Required

10.1.7 Dumper trucks and Forklift

Dumper trucks powered by a diesel engine shall be provided, to operate in all weather conditions. The minimum capacity of the dumper truck shall be 20 tons.

Forklift is powered by a diesel engine to operate in all weather conditions. The capacity of the equipment shall be 10 T and to be supplied with drum handling attachment. The drum handling equipment should be capable of handling 4 drums at a time.

The forklift shall conform to IS 4357 - 1974 for stability testing of fork lift trucks. The acceptance criteria of fork lift trucks shall conform to IS 10517 - 1983.

10.2 Phase-2

10.2.1 Flyash Handling

Additional 8 nos. silos with associated Conveyor System (BC-1 & BC-2) and controls will be constructed for handling increased volume of flyash expected at the terminal in this phase.

10.2.2 Storage Areas

Additional open storage area for the following commodities will be developed.

Aggregates - 3,000 sqm

Petroleum products in oil drums - 19,000 sqm

The covered shed of 3,900 sqm proposed in Phase-1 will be adequate for 0.12 MTPA of bagged cargo.

10.2.3 Rail yard

Rail yard shall be developed as shown in **Drawing I-525/HT/234**. Storage and handling facilities for the rail borne traffic is not provided as the type of commodity and traffic is unknown. However, provision for future is considered.

11 PRELIMINARY ENGINEERING - ELECTRICAL AND CONTROL SYSTEM

11.1 Electrical Power Requirement

The main power requirement for electrical load in the Construction of IWT Terminal at Haldia on National Waterway-1 project shall be on account of Pipe Conveyors (2 Nos.), Belt Conveyors (4 Nos.), Barge Loaders (2 Nos.), Overhead Water Pump, Sewage Treatment Plant, Weigh Bridge, Belt Scale & Flap gates for Phase-1 and Belt Conveyors (2 Nos.) etc. for Phase-2. Other infrastructure such as general lighting, power for auxiliary services like dust extraction system, etc. will also need their share of electric power.

In case of operational power, all the installed loads shall not be required simultaneously. For instance, in case of barge loader, Dust extraction System etc., all the loads shall not be operating simultaneously. Similarly all the running conveyors shall also not draw maximum power at the same time.

All Electrical and controls equipment shall be designed for an ambient temperature of 45^{o}C.

Taking all such aspects and applying suitable diversity factors, the computation for estimated connected power and demand load are shown in the attached **Annexure-1,** summary of which is given below:

Table 11.1 Summary of Load Calculations

Description	PHASE	Connected Load	Demand Load
Total Load (HT & LT)	PHASE-1	2,773 kW	1,474 kW
Total Load (HT & LT)	PHASE-2	1,774 kW	738 kW

11.1.1 Source of Power Supply

Power at 11kV shall be made available upto a DP (Double Pole) Structure adjacent or within the Project boundary by West Bengal State Electricity Distribution Company Limited (WBSEDCL). Beyond this DP structure, power shall be fed to the Metering cubicle of WBSEDCL through buried 11kV cable by WBSEDCL. DP structure shall also be provided by either WBSEDCL. 11kV cable from metering cubicle of WBSEDCL to 11kV switchgear Incomer shall be in the scope of the EPC contractor. Further Power distribution shall be as per the attached **Power Single Line Diagram I-525/HT/229**.

11.1.2 System Description

Power at 11kV received at the incomer of HT Switchgear shall be fed at the same voltage to High Power Consuming Equipment (> 110kW) like Pipe Conveyor, Barge Loaders, Transformers, Dust Extraction System and HT Capacitor Bank etc. as per requirement of Phase-1 & Phase-2 respectively as also shown in attached **Power Single Line Diagram I-525/HT/229**.

11.1.3 Utilization Voltages

The particulars of Power Supply shall be as follows:

Voltage	11kV ± 10% & 415V ± 10%
Phase	11kV (3 Phase 3 Wires) 415V (3 Phase 4 Wires)
Frequency	50 Hz ± 3%
Combined Voltage & Frequency Variation	10%
Fault Level	26.3kA for 3 second at 11kV 50kA for 1 second at 415V
System Earthing 415 V	 Solidly Earthed
Control Circuits	
Circuit Breaker Protection & Tripping	110 V DC, 2 Wire grounded
Control System	
Server, PLC, FI (Intelligent) I/O VDU, Keyboard, Printer	240 V ± 10%, AC, 50 HZ ± 3%, 1 Ph, 2 Wire All equipment shall have internal close loop regulation & spike arrestors
UPS System, Field Hooters	240 V ± 10%, AC, 50 HZ ± 3%, 1 Ph, 2 Wire

11.1.4 Electrical Substation (ESS)

One number ESS is proposed to be located and constructed progressively as shown in the **Drawing I-525/HT/230**. Switchgear room on the Ground Floor shall be housing Metering Panel WBSEDCL, Transformers, Diesel Generator set, 11kV HT Switchgear Panel, 415V Power Control Center (PCC) and various distribution Boards etc.

Control room on the First Floor of ESS shall be housing Programming Station, Server Station, Operating Station, CCTV Control Station, PLC Panel, UPS & 64" LED Screen. First Floor shall also have facility of Store Room, Pantry, Conference Room and Toilet.

11.1.5 Power Factor Correction

11 kV & 415V capacitor banks with Automatic Power Correction Panels shall be provided at ESS as shown in the attached **Power Single Line Diagram I-525/HT/229** to achieve power factor of 0.95 lag on 11 kV & 415V bus respectively. One number capacitor bank each for 11kV & 415V shall be installed in Phase-1 which will be addition of both Phase-1 & Phase-2 capacitor banks.

11.1.6 Distribution Transformer

11kV voltage is further stepped down to 415V through two numbers of distribution transformers, which shall be installed in Phase-1 each capable of handling 100% load at a time

for both the phases (Phase-1 & Phase-2). Transformer of rating 11kV/433V, 1250 KVA, indoor Dry type, having off circuit tapping of +/-10%, in steps of 2.5%, winding temperature detectors with scanner for temperature alarm and trip, door safety limit switch and accessories is proposed for this project.

11.1.7 Motors

All Motors including and below 110 kW shall be 415V and all motors above 110 kW shall be 11 kV. Motors shall be energy efficient (IE3), squirrel cage induction type.

11.1.8 HT Power Distribution System

11kV HT Switchgear Panels are proposed at ESS as shown in the **Drawing I-525/HT/230**. All relays in these HT Switchgear Panels shall have intelligent type Multifunction relays (Numerical relays) and meters shall be of digital type with RS 485 communication port facility both for relays & meters. Lamps shall be LED type. Busbars shall be high conductivity Aluminium alloy @ 1.0 Amps/mm^2 current density for HT Switchgear panels. One of each type of feeder, shall be provided as spare. The enclosure protection shall be IP54 minimum for indoor installation and IP55 minimum for outdoor installation.

11kV HT Switchgear Panel shall be provided with Vacuum Circuit Breaker (VCB) and Vacuum Contactor (VC) with HT Fuse of suitable breaking capacities but not less than 26.3KA for 3 second.

All of the above panels are shown in the attached **Power Single Line Diagram I-525/HT/229**.

11.1.9 LT Power Distribution System

One number of 415V Power Control Centre (PCC) is proposed at ESS as shown in the **Drawing I-525/HT/230**. All relays in this LT Switchgear Panel shall have intelligent type Multifunction relays (Numerical relays) and meters shall be of digital type with RS 485 communication port facility both for relays & meters. Lamps shall be LED type. Busbars shall be high conductivity Aluminium alloy @ 1.0 Amps/mm^2 current density for PCC, ACDB & MLDB. Bus bar shall be of high conductivity electrolytic grade Copper @1.25 Amps/mm^2 current density for other distribution boards (like LDB, PDB, CDB etc.). PCC shall feed power at 415V to the various LT Loads such as Belt conveyor motors, ACDBs, MLDB/LDBs, Distribution Boards (DBs) etc. The enclosure protection shall be IP54 minimum for indoor installation and IP55 minimum for outdoor installation.

PCC shall be provided with Air Circuit Breaker (ACB) and moulded case circuit breaker (MCCB) of suitable breaking capacities but not less than 50KA for 1 second. The rupturing capacity of miniature circuit breaker (MCB) used in DB's/SB's/FP's for further distribution shall not be less than 10 KA.

Industrial power sockets 240V 15A, minimum 2 Nos. shall be installed at each floor of Electrical Substation, RIO/Compressor Room, Terminal Admin. Building, Worker's Amenity Building, Security Office, Weigh Bridge Building, Sewage Treatment Plant, Covered shed, Transfer towers etc. & at a distance of every 30m in case of Conveyors.

Welding socket 415V TPN and earth 63A, minimum 2 Nos. shall be installed at each floor of Electrical Substation, RIO/Compressor Room, Terminal Admin. Building, Worker's Amenity Building, Security Office, Weigh Bridge Building, Sewage Treatment Plant, Covered shed, Transfer towers etc. & at a distance of every 30m in case of Conveyors.

All of the above panels are shown in the attached **Power Single Line Diagram I-525/HT/229**.

11.1.10 Standby Power Supply

Silent Diesel generator (DG) set has been envisaged for feeding 100% indoor lighting & 20% High Mast Load requirements. One number 300 kVA DG set is proposed in Phase-1 capable of handling emergency loads for both the phases (Phase-1 & Phase-2).

11.1.11 Illumination

The illumination level in various areas to be maintained at the working plane are mentioned below and for other areas not mentioned below it shall be based on National Electric Code.

Location	Average lux level	Type of Luminaire
Stockpile and Jetty Area	30	2x400W HPSV twin lamp & 1x1000W Flood Light, weather proof, Heavy duty High Mast(30 m) light in die cast Aluminium alloy housing
Electrical Substation, Transformer, DG Room, Worker's Amenity Building, Sewage Treatment Plant, RIO/ Compressor Room, Waste Collection Center, Weigh Bridge Building & Security Office	200	General Purpose Industrial compact batten suitable for 2x20 W LED Tube Light fitted with Aluminium heat sink
Terminal Admin. Building & Control Room	300	34Watt LED Panel with ultramodern recess mounting luminaire suitable for armstrong/grid/POP ceiling complete with separate electronic driver & high brightness Surface Mounted Device (SMD) LEDs
Storage shed	100	Open type vertical Medium Bay LED luminaire with high power COB 50W LED as light source
Belt Conveyors walkways, Transfer Towers	50	Vertical/Horizontal surface mounting pressure die-cast aluminium well glass luminaires with high power 40W LED as light source
Electrical Substation, RIO/Compressor Room, Terminal Admin Building, Worker's Amenity Building, Security Office, Weigh Bridge, STP, Covered Shed, Transfer Towers, conveyor galleries, all exit / entry points etc.	10	Battery operated emergency lighting unit consist of aesthetically designed rechargeable 5 Watt LED lantern with dimming and SOS feature. Battery shall be rechargeable Li-ion type & 5V DC Li-ion charger with 1 hour battery backup

Wherever required poles of suitable height with fittings shall also be installed for outdoor lighting of the buildings.

One number of MLDB is proposed. MLDB shall receive dual power from respective PCC and DG supply, which in turn shall feed various LDBs of Phase-1 & Phase-2 as shown in attached **Power Single Line Diagram I-525/HT/229**. 1:1 Lighting trans-formers shall be placed at MLDB to maintain voltage drop within the permissible limits.

11.1.12 Cables

Power distribution at 11 kV shall be done through 11 kV (E), XLPE, stranded aluminium conductor, armoured, overall FRLS PVC sheathed cable laid on cable trays, ducts, directly buried in ground and in trenches, etc. as per site requirement.

LT power distribution to various LT motors and services such as illumination, firefighting, air conditioning, water supply etc. shall be done through 1.1 kV grade XLPE insulated, stranded aluminium conductor, armoured, overall FRLS PVC sheathed power cables. Laying of cables shall be done as per site requirement.

Internal wiring shall be done in recessed PVC conduit or on surface with GI conduit and single core PVC insulated FRLS copper wire.

11.1.13 Cable Trays & Accessories

FRP type cable trays & its accessories shall be considered for the project. Thickness of the various components shall be as per the calculations and these calculations shall be submitted by EPC Contractor for client approval before starting the manufacturing.

11.1.14 Earthing & Lightning Protection

An efficient earthing and lightning protection system shall be designed to ensure protection of men & material in worst of the weather conditions. Suitable Lightning protection system shall be installed as per the guide lines of the IS/IEC-62305:2010 (Superseding IS-2309: 1989).

All equipment of substation and various other services / equipment shall be earthed at two points. There shall be one earth grid formation using 75 x 8 mm GI strip and all equipment earthing shall be connected to this earth grid through Aluminium wire with PVC coating or GI strip as per the requirement. This grid shall be connected with number of pipe electrodes. However, the neutrals of transformers and DG sets shall be earthed separately. Each neutral shall be connected to 2 numbers separate pipe earth electrodes. Earthing system shall be designed in principle as per IS: 3043, however for chemical earthing IEEE: 80-2000 shall also be followed.

For lightning protection separate earth pits shall be provided. Exact number of earth pits shall be worked out after earthing and lightning protection calculation has been carried out measuring the soil resistivity at site.

Earth (chemical) pits shall be based on High Conductivity Technology. In this technology of chemical earthing, a compound of high electrical conductivity shall be filled up in the space

around the ground electrode, so that the earth resistance value would decrease appreciably. Minimum Electrode size shall be as per the latest amendments of IS: 3043.

The high Conductive Compound shall be able to perform in any weather and soil Conditions and shall have following properties;

1) It shall have high electrical conductivity, which should remain constant and unaffected by changes in temperature & moisture.

2) It shall permanently remain embedded and should neither dissolve in and swept away by water.

3) It shall have an ability to absorb large amount of water and retain the same over a long periods of time.

4) It shall decreases earth pit resistance with passage of time.

5) Solubility: Shall be partly miscible; so that it does not dissolve fully like common salt and thus increasing the Earth Pit Life.

6) The pH value shall be near neutral so that it does not pollute soil or water and also does not corrode earth electrode.

7) It shall be maintenance free Compound so that there shall be no need of extra water pouring at regular interval as in conventional earthing material, because it should retain the moisture.

8) Chemical Compound shall be thermally conductive, in order to maintain a constant Earth resistance in temperature range of -50 to +60 degree Celsius.

9) The Compound shall have relatively High conductivity so that it can create very low resistance even in rocky areas.

10) It shall have low earth resistance, carries high peak current repeatedly.

11) It shall have a Long and reliable life.

12) It shall be easily installed in any soil conditions.

11.1.15 Ventilation and Air Conditioning (AC) System

Electrical Substation at Ground Floor, WBSECL metering room, Battery room RIO/ Compressor Room (Compressor Area), Worker's Amenity Building, STP (Pump room), all toilets & pantries shall be provided with exhaust fans for ventilation to ensure proper maintenance of temperature inside the panel room and removal of additional heat produced due to various switchgears.

Split AC shall be used for Control Room, RIO/Compressor Room (For Panel area), Security Office & Weigh Bridge building. The offices in the Terminal Admin. Building shall be Air-conditioned through centralized AC so as to maintain an inside temperature of 27^{o}C.

Tentative layout of the various rooms is shown in the drawings mentioned below:

a) Typical Layout of Terminal Administration Building, **I-525/HT/214**

b) Typical Layout & Section of Worker's Amenities Building, **I-525/HT/216**

c) Substation Equipment Layout, **I-525/HT/230**

d) Typical Layout & Elevations of Security Office and Weigh Bridge Control Room, **I-525/HT/217**

e) Layout Plan (Phase-1 & Phase-2) of Terminal Facilities at Haldia, **I-525/HT/209 and I-525/HT/210**

11.1.16 Battery and Battery Charger

One number dual Battery and Battery Charger with DC Distribution Board shall be provided for the control, protection, interlocks and indication of switchgear panels.

11.1.17 Closed Circuit TeleVision (CCTV) System

To ensure surveillance of required locations as well as create secured record for post event analysis, CCTV system is proposed. The system shall provide an online display of video images on LED monitors located in Control Room and PTZ (360O) cameras at various locations like Gate Complex, Terminal Administration building & at all berths etc. as per **Drawing I-525/HT/231**. The core of the surveillance system shall be Network Video recorder (NVR) server. System shall also have operating systems, appropriate software, networking equipment and other essential components.

11.1.18 Control System

The Control system shall be installed to ensure safe and reliable operation of conveyors, dust extraction system and others facilities. PLC system shall read the inputs, perform all system logic, conduct online diagnostics, sequencing control and control the outputs. The processor based central control system is envisaged to control and monitor the material handling operations in the IWT Terminal so as to carry out the operation in an integrated mode from "Control Room".

The Control Network shall be used for providing automation functions, interlocking, sequence starting, monitoring and supervisory functions with Belt Conveyors, Pipe Conveyors and Dust Extraction System for Fly Ash Handling Facility.

The Control Network shall also be used for providing monitoring and supervisory functions, interconnection with Equipment/Machines having its own Control Systems like Mobile Harbour Crane, Barge Loaders, Weigh Bridge etc.

The core of the system shall consist of an Operating station, Programming Station & Server station (all the computers shall be latest version of the Industrial PCs - IPC as on the date of bidding) with printer and along with centralized real –time redundant PLC system (One online and the other in hot standby excluding I/O modules), sharing a RAID 6 (redundant array of

independent disk) data storage system and a data network, with shared high-capacity data backup and off-site data archiving as per attached **Drawing, I-525/HT/232**, Control Architecture.

The control system would incorporate all safety interlocks to ensure complete safety to operating personnel and to avoid any damage to equipment due to mal-functioning.

The control system shall generally be based on the following principles:

i) To start equipment in either of the two modes i.e. 'Local' or 'Remote'

ii) To trip off minimum equipment in the desired sequence during abnormal operating conditions, leaving all the other equipment running, which may safely be permitted to continue the operations

iii) To annunciate the fault which has tripped equipment along-with the cause for tripping

iv) To prevent restarting of the equipment until safe conditions have been restored

v) To retain maximum flexibility of operation consistent with safety

vi) To prevent mal-operation of equipment on interruptions

vii) To stop all the running equipment simultaneously by pressing Emergency Stop Push Button

viii) To stop running equipment in the reverse order with time lag during normal stop.

Processor would perform all operational and control functions. Processor would collect all the field related data from local field devices like local push button station, pull chord switch, belt sway switch, zero speed switch, local control panels etc. via junction boxes by means of data bus cable.

The control network shall be real-time network, requiring long time continuous operation. During normal operations, the system cannot be shut off and it shall be possible to replace the components without shutting off the power. It shall be feasible to program the system online.

Proper care shall be taken in data transfer so as to achieve quick response while transmitting control and management information. The response time should not be more than one millisecond. The network system shall have fault clearance functions, secure transmission of data through error checking routines on all data transmitted. The networks shall use open systems (universal protocol) technology, support multiple industrial standards, allow a combination of multiple communication agreements, and shall have the capability to join wider networks in future through the server.

The analogue module system shall have provision to accept signals from other subsystems generating 4-20mA analogue signals. Proper conversion to standard units shall be done by control software.

Redundancy (100% hot standby) is provided in the PLC's so that in case of failure of any of the processors, the hot stand by processor shall take over automatically. The changeover shall be smooth. Redundancy shall be provided for complete processor subsystem including CPU, memory, power supply.

Input/output units shall be capable of accepting discrete, analogue and digital input and output devices. If the number of slots for input and output modules in the controller rack is not sufficient, expansion units shall be connectable to the CPU by means of interface modules.

Each Input and Output module shall be electrically isolated from the controllers through opto-couplers or isolation transformers and shall withstand severe voltage transients without damage or adverse effect on the controller. Output modules shall incorporate self-contained damping networks and voltage limiting devices to prevent false triggering of outputs and to suppress line voltage spikes.

PLC power supply units must have self-test facilities for detecting under voltage and also must be able to give alarm and switch over to UPS mode in case the output voltage is + 20% above the normal value.

A SCADA system shall be provided to control and monitor operation of the proposed facility.

11.1.19 Safety Switches

Safety switches for conveyors shall mainly consist of the Zero Speed Switches (ZSS), Belt Sway Switches (BSS), Pull Chord Switches (PCS) and Belt Take-up Switches (BTS).

PCS shall be installed @ 30m on both sides of each pipe/belt conveyor to stop the conveyor instantly when an accident happens. BSS shall be installed @ 50m to stop drive unit for protecting belt from rubbing against the structural parts on both sides of each pipe/belt conveyor. One number ZSS shall be provided to stop the motor when the speed of the equipment drops below a specified value or if normal speed is not reached within a specified time, and to signal starting and stopping of preceding conveyor/ equipment.

PCS and BSS shall be microprocessor based addressable type and shall be connected to the Master Unit for monitoring, which in turn shall communicate with the PLC. This Master unit shall be placed in the Field / Remote I/O panel as shown in the attached Control Architecture.

BTS switches shall be provided and installed so as to be actuated by an extreme movement of the conveyor belt take ups, should the belt tension not be adequate for any reason.

11.1.20 3D Level Scanners

3D Level Scanners are proposed to be installed in each of the Fly ash Silos. For power supply to the scanners and data communication from scanners to the PLC, local control panel (one number for 4 scanners as per **Drawing, I-525/HT/232**, **Control Architecture**.) is proposed to be installed below the Silos. Multicore cables shall carry data from these Local panels to the PLC.

11.1.21 Communication System

Telephone System

EPABX system of 200 lines is proposed for this project.

Public Address (PA) System

No PA system is proposed for this project.

Annexure - 1

11kV HT LOAD CALCULATION - PHASE 1						
S.NO.	**Equipment**	**Connected load (KW)**	**Utilization Factor (%)**	**Maximum Demand (KW)**	**TOTAL CAPACITANCE LOAD**	
1	Conv. PC-1	132	0.80	106	106	
2	Conv. PC-2	132	0.80	106	106	
5	DES FAN above Silo-1	175	0.8	140	140	
6	DES FAN above Silo-2	175	0.8	140	140	
7	DES FAN above Silo-3	175	0.8	140	140	
8	DES FAN above Silo-4	175	0.8	140	140	
9	DES FAN above Silo-5	175	0	0	0	
10	DES FAN above Silo-6	175	0	0	0	
11	DES FAN above Silo-7	175	0	0	0	
12	DES FAN above Silo-8	175	0	0	0	
13	LT LOAD	1109.2		703	771	
	Total HT & LT Load in kW	**2773**		**1474**	**Capacitance Load PHASE-1A**	**771**
					Capacitance Load PHASE-1B	**560**
					Total Capacitance Load	**1331**
					Multiplying Factor (0.75 to 0.95)	0.553
					Required Capacitance	**736**
					CAPACITOR BANK SELECTED	**750 kVAR**

LT LOAD CALCULATION - PHASE 1							
S.NO.	Equipment	Connected load (KW)	Utilization factor (%)	Maximum Demand (KW)	DG Rating (kVA)	TOTAL CAPACITANCE LOAD	
1	Conv. BC-3	37	0.8	30	0	30	
2	Conv. BC-4	37	0.8	30	0	30	
3	Conv. BC-5	30	0.8	24	0	24	
4	Conv. BC-6	30	0.8	24	0	24	
5	Flap Gate(2x3.7kW)	7.4	0	0	0	0	
6	Belt Scale (2x0.5kW)	1	0.8	1	0	1	
7	Barge loader-1	37	0.70	26	0	26	
8	Barge loader-2	37	0.70	26	0	26	
9	Telescopic Chute for Winch Operation-1	15	0.70	11	0	11	
10	Telescopic Chute for Winch Operation-2	15	0.70	11	0	11	
11	DES Compressor for carrying Bulk Carrier Unloading and loading to SILOs- Working	30	0.80	24	0	24	
12	DES Compressor for carrying Bulk Carrier Unloading and loading to SILOs-Standby	30	0	0	0	0	
13	Root Blower/ Rotary Feeder (16 X 3.75 kW)	60	0.50	30	0	30	
14	DES Transfer Tower/ Telescopic Chute(9x3.5kW)	31.5	0.8	25	0	25	
15	DES Compressor Transfer Tower(3x5kW)	15	0.8	12	0	12	
16	Overhead Water Pump	30	1	30	0	30	
17	Sewage Treatment Plant	7.5	1	8	0	8	
18	Electric Hoist (5 X 5.9kW)	29.5	0	0	0	0	
19	Miscellenous SILO (8x10kW)	80	0.5	40	0	40	
20	DES LCP (Compressor) above Silo-1	5.5	0.8	4	0	4	
21	DES LCP (Compressor) above Silo-2	5.5	0.8	4	0	4	
22	DES LCP (Compressor) above Silo-3	5.5	0.8	4	0	4	
23	DES LCP (Compressor) above Silo-4	5.5	0.8	4	0	4	
24	DES LCP (Compressor) above Silo-5	5.5	0	0	0	0	
25	DES LCP (Compressor) above Silo-6	5.5	0	0	0	0	
26	DES LCP (Compressor) above Silo-7	5.5	0	0	0	0	
27	DES LCP (Compressor) above Silo-8	5.5	0	0	0	0	
28	Weigh Bridge(including control room) (2x3kW)	6	0.8	4.8	0	5	
29	MLDB Load	326	1	326.3	198.0	326.3	
30	ACDB (For Welding Socket Load)	168.0	0	0	0	0	
31	Battery Charger	5.0	1	5.0	5.0	5.0	
	LT Load in kW - PHASE- 1A	**1109.2**		**703.2**	**203.0**	**703**	
	LT Load in kW - PHASE- 1B	**374.2**		**177.8**	**7.0**	**Capacitance Load PHASE-1A**	**703**
	Total LT Load (PHASE-1A + PHASE-1B)			**881.0**	**210.0**	**Capacitance Load PHASE-1B**	**178**
	Load in kW at 90% Diversity factor			**792.9**	**189.0**	**Total Capacitance Load**	**881**
	Load in kVA at .95 pf			834.6	236.3	Multiplying Factor (0.75 to 0.95)	0.553
	Load at 120% Overload			1001.5	283.5	Required Capacitance	487
	TRANSFORMER & DG RATING SELECTED			**1250 kVA**	**300 kVA**	**CAPACITOR BANK SELECTED**	**600 kVAR**

11kV HT LOAD CALCULATION - PHASE 2					
S. No.	Equipment	Connected load (KW)	Utilization Factor (%)	Maximum Demand (KW)	Total Capacitance load
1	DES FAN above Silo-9	175	0.8	140	140
2	DES FAN above Silo-10	175	0.8	140	140
3	DES FAN above Silo-11	175	0.8	140	140
4	DES FAN above Silo-12	175	0.8	140	140
5	DES FAN above Silo-13	175	0	0	0
6	DES FAN above Silo-14	175	0	0	0
7	DES FAN above Silo-15	175	0	0	0
8	DES FAN above Silo-16	175	0	0	0
9	LT LOAD	374.2		178	0
	Total HT & LT Load in kW	**1774**		**738**	**560**

LT LOAD CALCULATION -PHASE 2						
S.NO.	Equipment	Connected load (KW)	Utilization factor (%)	Maximum Demand (KW)	DG Rating (kVA)	Total Capacitance load
1	Conv. BC-1	37	0.8	30	0	30
2	Conv. BC-2	37	0.8	30	0	30
3	Flap Gate(2x3.7kW)	7.4	0	0	0	0
4	DES Compressor for carrying Bulk Carrier Unloading and loading to SILOs-Working	30	0.80	24	0	24
5	DES Compressor for carrying Bulk Carrier Unloading and loading to SILOs-Standby	30	0.00	0	0	0
6	Root Blower/ Rotary Feeder (16 X 3.75 kW)	60	0.50	30	0	30
7	Electric Hoist (2 X 5.9kW)	11.8	0	0	0	0
8	Miscellaneous SILO (8x10kW)	80	0.5	40	0	40
9	DES LCP (Compressor) above Silo-9	5.5	0.8	4	0	4
10	DES LCP (Compressor) above Silo-10	5.5	0.8	4	0	4
11	DES LCP (Compressor) above Silo-11	5.5	0.8	4	0	4
12	DES LCP (Compressor) above Silo-12	5.5	0.8	4	0	4
13	DES LCP (Compressor) above Silo-13	5.5	0	0	0	0
14	DES LCP (Compressor) above Silo-14	5.5	0	0	0	0
15	DES LCP (Compressor) above Silo-15	5.5	0	0	0	0
16	DES LCP (Compressor) above Silo-16	5.5	0	0	0	0
17	LDB Load	7.0	1	7.0	7.0	7.0
18	PDB (For Welding Socket Load)	30.0	0	0	0	0
	Total LT Load in kW	**374.2**		**178**	**7.0**	**178**

12 FIRE FIGHTING

The firefighting system that is to be installed in the buildings, covered shed and oil storage area shall consist of extinguishers having dry powder stored pressure by nitrogen gas with inbuilt pressure gauge to indicate pressure.

S. No.	Area	Class of fire	Classification of occupancy	System proposed
1	Buildings and covered shed	A, B & C	Ordinary hazard	Dry powder stored pressure confirming to IS:13849. Pressurized by nitrogen gas with in-built pressure gauge to indicate pressure.
2	Oil drum storage area	A & B	Ordinary Hazard	Foam type extinguisher conforming to IS:10204

13 SEWAGE TREATMENT PLANT

13.1 General

The sewage treatment plant of 20 KLD (FAB technology) shall be provided which should be compact, odour free and shall consume low power.

Plant shall be installed below ground level or at any desirable depth and shall generate minimum amount of excess sludge. Waste water after treatment below shall be suitable for A/C cooling towers irrigation and scrubber make-up.

Parameters for design of sewage treatment plant:

Natural of effluent	Domestic sewage
Daily average flow	180 cu.m/day
pH	6.0 - 8.8
BOD	280 - 380 Mg/L.
Suspended solids	200 - 480 Mg/L.
COD	600 - 800 Mg/L.
Oil & Grease	20 Mg/L.
Coliform count	< 106 - 107 (Assumed)

Standards of the effluent discharge after treatment shall be as follows:

Parameters	Value
pH	6.0 - 8.8
BOD	Less than 20 Mg/L.
Suspended solids	Less than 10 Mg/L.
COD	Less than 180 Mg/L.
Oil & Grease	Less than 10 Mg/L.
Coliform count	< 103 at the CCT outlet

13.2 Process Description

In order to conserve water, the treatment plant shall be designed to ensure that treated effluent (water) characteristics are well below the permissible limits, even under varying flow condition which are typical for such systems. The selected process shall be able to withstand the shock load situation. To achieve same plant room areas, it is proposed to better use the principle of aerobic attached growth process.

The treatment plant shall be designed with a capacity to handle 20kl/day of wastewater. Wastewater will flow via gravity collection system through a bar screen chamber to a sump

chamber. A bar screen shall be provided at the inlet point in the bar screen chamber and the wastewater will flow through this bar screen into the sump. Bar screen shall also be designed that it can be cleaned manually by going down to a platform in the chamber. Two horizontal centrifugal pumps shall be provided in the sump to pump the collected wastewater to the reactor. Air will be introduced in the sump through pipe grid, to avoid the sewage from becoming septic.

Wastewater from the sump shall be lifted by means of effluent lifting pumps into Equalized Reactors where BOD/COD reduction is achieved by virtue of aerobic microbial activity. Reactor would be running in series. Oxygen required will be supplied through course bubble air diffusers.

The excess bio-solids washed in the biological process are separated in the downstream Clarifier/Tube Settler Tank. The clear supernatant will be collected in the Chlorine water tank cum filter feed tank. The treated sewage is further pumped through filtration units. The sewage after CCT is disinfected and shall meet the coliform norms of <1000 counts with minimal dosage of sodium hypochlorite. The coliform count in the treated effluent shall be almost nil.

The tertiary treatment consists of removing the residual suspended solid load, by filtering through Dual Media Filter and passing the water through activated Carbon Filter so that traces of BOD/COD and excess chlorine are removed. The tertiary treated water is stored in the final holding tank and can be safely used for irrigation purpose.

For cooling tower make-up the treated sewage from final holding tank is further passed through softening plant for cooling tower makeup purpose.

The biological sludge generated from the reactor which is settled in the Clarifier/Tube settler, is pumped into sludge sump, the sludge shall be pumped and filled in a tanker for suitable disposal by client.

13.3 Blowers and Aeration System

The treatment plant shall be provided with rotary positive displacement blower with a common base and a central panel, belt drive system, drip proof induction type electric motors, necessary valves including a pressure relief valve and intake and discharge silencing. Each blower motor unit shall be housed in an enclosure. All piping and related accessories necessary to connect the blowers to the plant air header shall be provided by the plant manufacturer.

All air piping form the blower motor unit to the air header shall be approved steel pipe with malleable iron fittings. Flexible reinforced rubber connecting sleeves shall be provided wherever required.

Each air diffusion device shall be connected to the air header with individual 28-80 dia drop piping's in SS 304. The drop pipe assembly shall be connected to the air header in a manner to permit raising the dropping and diffusion device above the water surface quickly and without disturbing airflow to the other diffusers. Each diffuser drop pipe shall be equipped

with non-clog fine bubble diffusers of sufficient quantity to keep pressure loss through the drop pipe assembly to a minimum. The air diffusion devices shall be designed to distribute air over the entire length of the tank and to have efficiency such that an adequate supply of oxygen is maintained in the tanks of treat the sewage load for which the plant is designed. The blowers shall be coupled with VFD for optimizing the energy consumption depending on the oxygen demand which shall be coupled with a proportion type (DO) Dissolved Oxygen controller.

13.4 Special Notes

Cost of pump shall include provision of isolation valves at inlet and outlet, non-return valves at outlet, pressure gauge, and steel channel arrangement at base, power and control cable from and to electrical panel, level controllers and alarm system.

- Providing of air educator system shall be made for following through MS epoxy painted piping, fittings and valves
- Sludge recycle piping from clarifier
- Sludge waste piping from clarifier
- Skimmer return piping from clarifier
- Contractor to note that all submersible pipelines shall be in SS 304.

14 EXTERNAL CONNECTIVITY

14.1 External Rail Connectivity

14.1.1 Existing Rail Connectivity

There is an existing main railway line adjacent to the proposed Haldia terminal. It is a Broad gauge (BG) route running in directions to Haldia port through G.M. yard from Durga chowk. It has a spur line going to Haldia Dock Complex railway line network.

14.1.2 Proposed Rail Connectivity

Phase-1:

The traffic projection for Haldia MMT indicates arrival of domestic coal only at the terminal by rail. No other cargo need rail connectivity. The domestic coal is considered as diverted cargo and development of handling facilities will be costly proposition and having risks if such cargo movement is not materialised through IWT in future. Hence rail connectivity is not planned but space provision has been kept in the terminal layout so that railyard can be developed if required in future.

Phase-2:

Rail connectivity from the existing main railway line is proposed for future rail borne traffic as shown in **Drawing I-525/HT/234**. One rail bridge has to be provided over the existing green belt canal providing access from the existing main railway line to the Haldia terminal. Since the space inside terminal is not adequate to accommodate full rake length of 700 m, it is proposed to split the rake in two section for handling cargo and shunting purposes. The engine escape line has been kept accordingly.

Storage scheme and cargo handling equipment facilities are not provided in this layout as the commodity and traffic is unknown. Thus the cost estimate for proposed rail alignment along with the bridge is only taken into consideration and the cost for storage and cargo handling equipment is not worked out.

14.2 External Road Connectivity

14.2.1 Existing Road Connectivity

During the site visit and as per topography survey, it is observed that there is an existing approach road which is well connected from the round circle junction to the proposed Haldia terminal. The existing road is a two lane road for a stretch of 800m having a width of 7m.

There is an existing culvert which is 31 m in length and 13.80 m in width crossing through the green belt canal from the proposed terminal leading to the round circle junction and providing access to Haldia port, Bandar station, Mecheda chowk crossing and Tata Chemicals.

The existing road network leads to the Haldia Township in one direction and to Durga chowk in the other.

14.2.2 Proposed road connectivity

14.2.2.1 Approach Road

The truck traffic movement for Haldia MMT is expected to be initially 600 trucks / day which is expected to increase to 800 trucks / day. This will lead to queuing in the approach road of the terminal and hence the existing two lane road will not be sufficient to handle such truck movement. Therefore, the existing two lane road will be widened to four lane road along with the development of an additional bridge to cater the terminal traffic.

The proposed widening is recommended to cater the projected truck movements without affecting efficiency in evacuation rate and to avoid creating congestion in the entry point of the terminal.

The widening of approach road providing access to the terminal is planned considering the site flexibility:

- The bridge (C1) is proposed to the right side of the existing culvert with reference to vehicles inbound to the terminal as shown in the **Drawing I-525/HT/204**. In this scenario, the proposed approach road is well planned by not obstructing the existing UPL's boundary wall providing access to the terminal.

14.2.2.2 Diversion Road to Tata Chemicals

The existing riverside road leading to Tata chemicals factory will be closed in view of the development of the terminal. There is a 15 m wide corridor between east side boundary wall of Haldia MMT and Tata chemicals. In that corridor two lane road can be provide (7m carriage way) for the diversion of truck traffic for Tata chemicals and others. The road is connected to the main road through a bridge (C2) leading to Haldia township in the west and to Durga chowk in the east as shown in the **Drawing I-525/HT/223**.

15 ENVIRONMENTAL IMPACT ASSESSEMENT (EIA) & ENVIRONMENT MANAGEMENT PLAN (EMP)

The environmental impact assessment study has been carried out by M/s EQMS India Pvt. Ltd. and the summary of EIA and EMP study is summarised below.

Project involves development of a terminal at Haldia, West Bengal on River Hugli. Terminal is being developed with varying designed capacity to handle the cargo. Capacity of the terminal is about 3.08 MTPA of cargo. Materials like fly ash will be transported majorly along with other materials like stone aggregate, fertilizers & POL. Total area of terminal site is 61.0 acres which is located in Industrial Zone of Haldia Dock Complex and whole land is Government land. Project development comprises of construction of 4 nos. of berths & approach trestles, 16 nos. of silos for fly ash storage, stockyards for stone aggregates, fertilizers & POL, internal roads, water approach channel, administration building, worker's amenity building, lighting tower, power supply system, fire-fighting system, sewerage system, storm water management system, waste management system and green belt development system.

The proposed terminal project will be developed in phases, i.e. phase-1 & phase-2. Phase-1 will comprises of all the proposed developments except 8 nos. of fly ash storage silos and its conveyors out of proposed 16 nos. of silos and stockyard development area (future storage).

Land is vacant land with scanty shrubs and herbs which is to be removed before construction and few trees are present along the existing road (to be diverted) will be retained as greenbelt. No change in land use is anticipated as terminal site already exists within Industrial area. Land is flat with ground level variation of 4-9 m. Project site is connected with NH 41 through approach road of 6 km running along Western boundary of the site, internal road of 10 m and (along the boundary) 17 m are proposed to be constructed within terminal site for internal movement. For development of terminal, existing pipeline of Tata Chemicals and existing road to Mitsubishi plant will be shifted. Pipeline will be shifted towards the River bank and a 40 m wide corridor will be reserved for pipeline. Road to Mitsubishi plant will be realigned to Eastern boundary of the terminal. New road of 15 m width will be constructed which will connect Haldia Mecheda Road to Mitsubishi Plant.

Baseline study has been carried out at the project site to study the existing condition of environmental and social parameters at site. Climate of the study area is typically moderate as it is located in coastal area. Dominant wind direction of the study area is S & SE during post-monsoon and N & NW during pre-monsoon period. As per air quality monitoring study, it is found that ambient air quality of the site is within permissible limits as per NAAQS, 2009. However levels of PM10 are observed to be higher. Noise levels at the site and in nearby areas are also found to be within the permissible limits as per CPCB standards for Industrial area. Project site is located in the Haldia Industrial Area. The area was classified as Critically Environmentally Polluted Area by CPCB and further exploitation of air & water quality was restricted in the area. However moratorium has now been lifted from Haldia. As per CPCB, it is also found that the area is classified as notified zone for extraction of ground water. No ground water extraction is proposed in the project in both construction and operation phase. Ground water in the shallow aquifers, i.e. to depth of 120-300 mbgl are brackish to saline. Ground water in deeper aquifers is fresh and potable for drinking purpose with some treatment. However Fe levels in ground water is higher in some part of district. Water quality

of the River Hugli is found to be equivalent to D Class Waterbody as per CPCB classification and is fit for propagation of Wildlife & Fisheries. River bed sediments of the River Hugli were also studied along the stretch near the terminal site and they are found to be non-toxic with very low concentration of pesticides and other chemicals like DDT, Endosulphan, Lindane & methyl Parathion. Soil of the area is Clayey sand and is slightly alkaline in nature. It is moderately fertile with low to medium NPK value. Site lies within the Industrial area thus no significant vegetation or habitat for wildlife is present in the study area. Vegetation mainly comprises of road side vegetation and some of the commonly found fauna species are Albizzia lebbeck, Casuarina equisetifolia, Phoenix sylvestris, Delonix regia, Acacia spp, Azadirachta indica, Delbergi sisso, Xanthium strumarium, Nerium indicum, Parthenium spp. Calotropis procera, Lantana camara, Casia tora, Vitex negundo, Zizyphus mauritiana, Canabis sativa, Argemon maxicana, Sida spp etc. No significant wildlife was observed at site and in study area. Hugli River is rich in flora and fauna and variety of planktons, fishes and other aquatic life is present in the River. However no RET species was found to be present at terminal site or in study area

On the basis of the baseline data and associated project activities, impacts of the project activities on social and environmental parameters were analysed. It is predicted that project will have impact on air, water, noise, soil, drainage, hydrology and ecology and socio-economy of the area. However, mitigation measures and management plans are proposed for mitigating the anticipated negative impacts of the project.

Environment management plans are prepared to prevent / control / abatement of pollution resulting from project activities in different stages. Environment management plan defines the institutional framework responsible for implementation of EMP, environment monitoring plan and environment management budget.

As per the EIA study, it is concluded that the project “development of terminal at Haldia” is beneficial for the economic development of country by increasing the efficiency of freight transportation and beneficial for environment by shifting freight load from road/railway to waterways and cutting down carbon emission. However, project development will have many impacts on social and environmental parameters. Mitigation measures and management plans are prepared in line with impacts anticipated. If the proposed mitigation measures are taken and environment management plan is implemented, anticipated negative impacts of project can be reduced and benefits can be further enhanced. The project will overall bring development in the area.

The total budgetary cost as estimated by M/s EQMS India Pvt. Ltd. for Environment Management and Monitoring Plan is approximately Rs. 0.945 Crores. Break-up for the same is given in table below:

Table 15.1 Environmental Management Cost

Component	Item	Unit	Quantity	Rate	Amount
DESIGN AND CONSTRUCTION STAGE					
Technical Support	• Environmental Social Impact Assessment Study, Bio-diversity Conservation Plan, Preparation of EMP	Lump sum	-	-	15,00,000
Greenbelt development	• Plantation in terminal site	No. of trees	1200 trees	500 Rs/tree	6,00,000
	• Survival loss including aftercare	No. of trees	1200 trees	100 Rs/tree	1,20,000
Drainage Congestion and disposal of accumulated water	• Provision of adequate surveillance	Covered in project design and engineering cost			
Erosion & Sedimentation	• Embankment, and River Bank Protection Measures	Already existing river protection works. Addition, if required are covered in project design and engineering cost			
Land	• Compensation against land	No land acquisition involved			
Soil	• Soil contamination protection (Septic tanks, grease taps etc.) and rehabilitation of borrow areas/debris disposal site/plant site & labour camps	Covered in project design and engineering cost			
Noise	• Canopy for DG sets • PPEs like ear plug • Timely maintenance of the machinery, equipment and vehicles • Barricading the site	Covered in project design and engineering cost			
Water	• Provision of storm water and wastewater management system	Estimated @ RS 5,00,000 for construction site & 5,00,000 for labour camps (2 camp sites)			15,00,000
	• Construction of soak pits at construction sites & labour camps	Estimated @ RS 3,00,000 per site estimated three			9,00,000
	• Provision of clean drinking & domestic water facility at labour camps and construction site	20,000 Per month for 30 months			6,00,000
Dust Management during construction	• Water Sprayer / Watering for Dust suppression	Covered in project design and engineering cost			

Component	Item	Unit	Quantity	Rate	Amount
Safety	• Appointment of Safety Officers	Covered in project design and engineering cost			
	• Safety signage, speed breakers, fire-fighting measures etc.	Covered in project design and engineering and cost			
	• Provision of trainings and PPE to workers	To be included in construction cost			To be part of contractors costs
Health	• Health checkup camps for construction workers	Camps	2 camp /year	4 lakhs/ camp	8,00,000
Environmental Monitoring in the construction phase	• Terrestrial and Aquatic Fauna	3,00,000 per season (Once in six month)			6,00,000
	• Ambient Air Quality	50,000 per monitoring for 30 months (Once in two month)			7,50,000
	• Surface Water Quality	24,000 for upstream & downstream (Once in month)			7,20,000
	• Drinking Water Quality	12,000 (Once in month)			3,60,000
	• Noise & Vibration	10,000 per monitoring for 30 months (Once in month)			3,00,000
	• Soil Quality, Erosion & Siltation and River Bed Sediment	50, 000 per Six months			2,50,000
		SUB TOTAL (DESIGN AND CONSTRUCTION STAGE)			90,00,000 0.90 Crores
TRAINING and AWARENESS					
Training	• Environmental training & awareness	-	-	Included in overall NW-1 Project Budget	-
ESTABLISHMENT AND SYSTEMS					
Establishment	• Supervision Consultant (environment and Social)	-	-	Included in overall NW-1 Project Budget	-
	• Construction Stage (Site Environmental officer)	-	-	Included in overall NW-1 Project Budget	-
	• Operation Stage	-	-	Included in overall NW-1 Project Budget	-

Component	Item	Unit	Quantity	Rate	Amount
Management Systems	• Adoption of EHS management systems	-	-	Included in overall NW-1 Project Budget	-
	• Management Information and tracking system	-	-	Included in overall NW-1 Project Budget	-
SUBTOTAL (ESTABLISHMENT & TRAINING and MANAGEMENT SYSTEM)					-
SUB TOTAL (Construction, and Operation and mobilization)					0.90 Cr
CONTINGENCIES @ 5 % on total Environmental Costs					0.045 Cr
GRAND TOTAL (in Rs)					0.945 Cr

16 COST ESTIMATE

In this chapter, an estimate of the capital cost for both the phases viz. Phase-1 and Phase-2 has been prepared for the most optimal layout. The annual operation and maintenance cost of facilities that would be incurred annually for both the above mentioned phases is also provided.

16.1 Basis of Cost Estimates

The quantities for various project components has been arrived based on the preliminary engineering carried out by the consultant. Further, the cost estimate has been arrived on the basis mentioned below.

- The cost estimates for onshore civil works has been prepared on the basis of the rates provided in "Delhi Schedule of Rates – 2014"
- The cost estimates for the offshore civil works has been arrived based on the rates taken from current works of similar nature, updated rates of works of similar nature completed in the recent past and from Consultant's in-house data bank
- The cost estimate for equipment is based on Consultant's in-house data bank and budgetary quotations
- Taxes / Duties as applicable has been included

16.2 Capital Cost Estimates

The item-wise capital cost estimate for Phase-1 and Phase-2 for the development of Haldia terminal is presented in below:

Table 16.1 Capital Cost Estimate for Haldia Terminal – Phase-1

S. No.	Item		Quantity	Unit	Rate (Rs.)	Capital Cost (Rs. in Cr.)
1.	**LAND & SITE DEVELOPMENT**					**15.00**
	1.1	Site clearance		LS		0.20
	1.2	Demolition of boundary wall & other structures		LS		0.20
	1.3	Earth filling	3,84,297	cum	325	12.50
	1.4	Slope protection		LS		2.10
2.	**JETTY INCLUDING APPROACH TRESTLES**					**275.00**
	2.1	Berths				177.00
	2.2	Approach trestles				90.00
	2.3	Conveyor gallery				8.00
3.	**STOCKYARD DEVELOPMENT**					**7.50**
	3.1	Stockyard development with ground improvement		LS		7.50
4.	**BUILDINGS & SHED**					**13.71**
	4.1	Terminal administration building	660	sqm	40,000	2.64
	4.2	Worker's amenity building	121	sqm	25,000	0.30
	4.3	Electrical substation building	1,089	sqm	25,000	2.72

S. No.	Item		Quantity	Unit	Rate (Rs.)	Capital Cost (Rs. in Cr.)
	4.4	Security office	25	sqm	18,000	0.05
	4.5	Weigh bridge control room	25	sqm	18,000	0.05
	4.6	RIO / Air compressor room for ash handling	40	sqm	25,000	0.10
	4.7	Gate house complex		LS		2.00
	4.8	Storage Shed	3,900	sqm	15,000	5.85
5.	**ROADS, BRIDGES & PAVED AREAS**					**20.36**
	5.1	Diversion road to Tata chemical with bridge		LS		5.00
	5.2	Internal roads		LS		14.00
	5.3	Paved areas with compaction	9,739	sqm	1,391	1.36
6.	**UTILITIES AND OTHERS**					**18.35**
	6.1	Water supply and distribution		LS		1.50
	6.2	Storm water drainage work		LS		2.30
	6.3	Sewerage system		LS		0.50
	6.4	Electrical distribution system & IT communication		LS		14.00
	6.5	Firefighting system		LS		0.05
7.	**WALL & FENCING**					**3.26**
	8.1	Boundary wall		LS		3.26
8.	**EQUIPMENTS**					**99.20**
	8.1	Mobile harbour crane	2	No.	1500,00,000	30.00
	8.2	Silo with foundation	8	No.	300,00,000	24.00
	8.3	Conveyor system with fixed hopper & foundation		LS		32.40
	8.4	Fixed barge loader	2	No.	300,00,000	6.00
	8.5	Road Weigh Bridge	2	No.	20,00,000	0.40
	8.6	Dumper truck	10	No.	50,00,000	5.00
	8.7	Fork lift	2	No.	30,00,000	0.60
	8.8	Front end loader	1	No.	80,00,000	0.80
9.	**ENVIRONMENTAL MANAGEMENT PLAN (EMP)***			LS		**0.95**
A	**TOTAL COST (1 to 9)**					**453.32**
B	CONTINGENCY (3%)					13.60
C	**TOTAL PROJECT COST (A + B)**					**467.00**
D	SERVICE TAX (15% ** OF 40% OF TOTAL PROJECT COST)					28.02
E	**GRAND TOTAL (C + D)**					**495.00**

Note:
*** Cost received from M/s EQMS**
**** Varies as applicable**

Note: As per estimation provided by the environment consultant (M/s EQMS India Pvt. Ltd.) the cost for Environment Management Plan (EMP) is worked out to be 0.95 Crores.

Table 16.2 Capital Cost Estimate for Haldia Terminal – Phase-2

S. No.	Item		Quantity	Unit	Rate (Rs.)	Capital Cost (Rs. in Cr.)
1.	**STOCKYARD DEVELOPMENT**					**14.80**
	1.1	Stockyard development works		LS		14.80
2.	**ROADS, BRIDGES & PAVED AREAS**					**0.66**
	2.1	Paved areas with compaction	4,709	sqm	1,391	0.66
3.	**RAIL CONNECTIVITY**					**18.41**
	3.1	Earth works & Permanent way		LS		5.98
	3.2	S&T and OHE		LS		2.43
	3.3	Bridge over canal		LS		10.00
4.	**UTILITIES AND OTHERS**					**3.00**
	4.1	Electrical distribution system & IT communication		LS		3.00
5.	**EQUIPMENTS**					**35.30**
	5.1	Silo with foundation	8	No.	300,00,000	24.00
	5.2	Conveyor system with fixed hopper & foundation		LS		11.30
A	**TOTAL COST (1 to 5)**					**72.17**
B	CONTINGENCY (3%)					2.17
C	**TOTAL PROJECT COST (A + B)**					**74.34**
D	SERVICE TAX (15% ** OF 40% OF TOTAL PROJECT COST)					4.46
E	**GRAND TOTAL (C + D)**					**78.80**

Note:
**** Varies as applicable**

*Note: The cost provided for Phase-2 is based on 2015 price and no inflation is considered. With the assumption the construction of Phase-2 will commence by December 2018, the project cost would become **Rs. 82.74 Crores considering 5% inflation per year**.*

The following items have not been included in the above cost estimate.

- Land lease amount: The land proposed for the development of Haldia inland waterways terminal belongs to Haldia Dock Complex (HDC) which would be given to IWAI on lease for 30 years. One-time lease rent of Rs. 40.59 crores would be paid to HDC by IWAI which is not included in the above estimate.
- Dredging: To facilitate the navigation of the vessels, dredging needs to be carried out at approach channel, berth pocket and turning circle.
- For the augmentation of NW-1, dredging needs to be carried out for the entire stretch of NW-1. Dredging volume of Haldia terminal comparative small, it will be beneficial to exclude the dredging and supply of navigational aids for Haldia Terminal development package and to include it in the overall NW-1 dredging package. Therefore, same is not included in the above mentioned cost estimate.
- Approach road with bridge, dredging and Electricity & Water connection cost estimates are not considered in Phase-1 and Phase-2.

Table 16.3 Capital cost estimate for Land & Site development and Dredging – Haldia Terminal

S. No.	Item	Quantity	Unit	Rate (Rs.)	Capital Cost (Rs. in Cr.)
1.	**LAND LEASE AMOUNT & R&R**		**LS**		**40.59**
2.	**DREDGING**				**32.00**
2.1	Berthing box / Turning circle / Holding area	3,00,000	cum	400	12.00
2.2	Approach channel	5,00,000	cum	400	20.00
3.	**ROADS & BRIDGES**		**LS**		**2.70**
3.1	Approach road with bridge		LS		2.70
4.	**ELECTRICITY & WATER SUPPLY CONNECTION**		**LS**		**10.00**

16.3 Detail Cost Estimates

The breakup of major components of the capital cost estimates of the Haldia terminal for individual phases is furnished in the following tables

Table 16.4 Detail Cost Estimate for Berth – Haldia Terminal

Item No.	Description of Item	Qty.	Unit	Rate (Rs.)	Amount (Rs. in Cr.)
1.	Mobilisation of all plant and equipment for the jetty construction and demobilisation of the same after completion of the works.	1	LS		14.00
2.	Construction of 1200 mm dia bored cast-in-situ piles for berth with m.s. liner, boring in all types of soil /Hard strata stabilising unlined soil using any other approved method during excavation, providing reinforcement as per design/ drawing providing and placing M40 grade concrete by means of tremie or any other approved method, providing all necessary labour, materials, plant tools etc.				
i	Shift & set up piling plant & equipment at each pile location	410	No.	50,000	2.05
ii	Supply, fabricate and driving mild steel liner (8 mm thick) including transport, alignment, pitching in position as required	4,008	T	55,000	22.05
iii	Driving the steel liners (8 mm thick) upto the required depth below bed level	13,038	m	2,500	3.26
iv	Boring through all types of soil strata	23,288	m	3,500	8.15
v	Cut & dress pile head to required lines & levels	410	No.	5,500	0.23
3.	Supply & placing in position design mix cement concrete grade M40 in pile shaft by means of tremie or any other approved method using 20 mm MSA including cost of all labour and materials but excluding the cost of steel reinforcement.	30,614	cum	8,000	24.49

Item No.	Description of Item	Qty.	Unit	Rate (Rs.)	Amount (Rs. in Cr.)
4.	Supplying corrosion resistant deformed bars grade Fe 500, cutting, bending, tying with 1.5 mm dia annealed binding wire & placing in position reinforcement cage including cleaning, straightening, tack/lap/butt welding with approved electrodes, etc. with all labour and materials complete for 1200 mm dia piles.	6,123	T	68,100	41.70
5.	Supply & place in position to lines & levels cast in-situ design & precast units mix cement concrete of grade M40 for pile cap, deck slab and beams including providing formwork shuttering, machine mixing, compacting, curing of concrete, centering, including providing pockets, openings, recesses, champhering where required and rendering if required to give a smooth and even surface in any shape etc. complete as directed with all labour and materials but excluding the cost of steel reinforcement.	18,148	cum	8,000	14.52
6.	Supplying corrosion resistant deformed bars grade Fe 500, cutting, bending, tying with 1.5 mm dia annealed binding wire & placing in position reinforcement cage including cleaning, strengthening tack/ lap/ butt welding with approved electrodes, etc. with all labour and materials complete for deck slab and beams.	3,630	T	68,100	24.72
7.	Supply & place in position to lines & levels cast in-situ design mix cement concrete for wearing coat of average thickness 75 mm including provision of formwork, machine mixing, placing in panels, compacting, curing, etc. complete with all labour and materials.	1,249	cum	6,000	0.75
8.	Providing and fixing cast steel bollards of 30 T capacity complete with base plate & H.T. anchor bolts of appropriate length, nuts washers, etc. including grouting with cement concrete M40 under base plate, filling the cavity with concrete grade M15, painting etc. complete.	75	No.	1,50,000	1.13
9.	Design, supply, assemble and fix in position in the required lines and levels arch type AN 800 E 3.0 grade rubber fenders of Trellborg or equivalent make of length 3m with steel plates manufactured as per manufacturer's specifications as directed by the Engineer.	67	No.	24,00,000	16.08
10.	Carrying out load test of pile including construction of test caps, accessories and dismantling same after test etc.	5	No.	10,00,000	0.50
11.	Supplying, fabricating, painting, welding, drilling, grouting & fixing in position etc. complete various miscellaneous items such as steel inserts, hand railing, coping fender, ladders, handhold, expansion joints, mooring rings, nut, bolts, washers, bituminous filler etc. in precast & in-situ concrete components in accordance with the drawings & as directed by the Engineer.		LS		3.00
				Total	**177.00**

Table 16.5 Detail Cost Estimate for Approach trestle – Haldia Terminal

Item No.	Description of Item	Qty.	Unit	Rate (Rs.)	Amount (Rs. in Cr.)
1.	Mobilisation of all plant and equipment for the jetty construction and demobilisation of the same after completion of the works.	1	LS		7.00
2.	Construction of 1200 mm dia bored cast-in-situ piles for berth with m.s. liner, boring in all types of soil /Hard strata stabilising unlined soil using any other approved method during excavation, providing reinforcement as per design/ drawing providing and placing M40 grade concrete by means of tremie or any other approved method, providing all necessary labour, materials, plant tools etc.				
i	Shift & set up piling plant & equipment at each pile location	210	No.	50,000	1.05
ii	Supply, fabricate and driving mild steel liner (8 mm thick) including transport, alignment, pitching in position as required	2,027	T	55,000	11.15
iii	Driving the steel liners (8 mm thick) upto the required depth below bed level	6,678	m	2,500	1.67
iv	Boring through all types of soil strata	11,928	m	3,500	4.17
v	Cut & dress pile head to required lines & levels	210	No	5,500	0.12
3.	Supply & placing in position design mix cement concrete grade M40 in pile shaft by means of tremie or any other approved method using 20 mm MSA including cost of all labour and materials but excluding the cost of steel reinforcement.	15,557	cum	8,000	12.45
4.	Supplying corrosion resistant deformed bars grade Fe 500, cutting, bending, tying with 1.5 mm dia annealed binding wire & placing in position reinforcement cage including cleaning, straightening, tack/ lap/ butt welding with approved electrodes, etc. with all labour and materials complete for piles.	2,333	T	68,100	15.89
5.	Supply & place in position to lines & levels cast in-situ design & precast units mix cement concrete of grade M40 for pile cap, deck slab and beams including providing formwork shuttering, machine mixing, compacting, curing of concrete, centering, including providing pockets, openings, recesses, champhering where required and rendering if required to give a smooth and even surface in any shape etc. complete as directed with all labour and materials but excluding the cost of steel reinforcement.	9,551	cum	8,000	7.64
6.	Supplying corrosion resistant deformed bars grade Fe 500, cutting, bending, tying with 1.5 mm dia annealed binding wire & placing in position reinforcement cage including cleaning, strengthening tack/ lap/ butt welding with approved electrodes, etc. with all labour and materials complete for deck slab and beams.	1,433	T	68,100	9.76
7.	Supply & place in position to lines & levels cast in-situ design mix cement concrete for wearing coat of average thickness 75 mm including provision of formwork, machine mixing, placing in panels, compacting, curing, etc. complete with all labour and materials.	669	cum	6,000	0.40

Item No.	Description of Item	Qty.	Unit	Rate (Rs.)	Amount (Rs. in Cr.)
8.	Carrying out load test of pile including construction of test caps, accessories and dismantling same after test etc.	3	No.	10,00,000	0.30
9.	Supplying, fabricating, painting, welding, drilling, grouting & fixing in position etc. complete various miscellaneous items such as steel inserts, hand railing, coping fender, ladders, handhold, expansion joints, mooring rings, nut, bolts, washers, bituminous filler etc. in precast & in-situ concrete components in accordance with the drawings & as directed by the Engineer.		LS		3.00
10.	Structural steel work riveted, bolted or welded in built up sections, trusses and framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete.	1,404	T	73,950	10.38
11.	Preparation of reinforced earth wall by providing required excavation & filling of subgrade in foundation, placement of leveling pad, facing panels and drainage bay, installing geo-grid, back filling and also providing in-situ mix concrete & reinforcements of required grade in accordance with the drawings & as directed by the Engineer.		LS		5.00
				Total	**90.00**

Table 16.6 Detail cost estimate for Conveyor Gallery – Haldia Terminal

Item No.	Description of Item	Qty.	Unit	Rate (Rs.)	Amount (Rs. in Cr.)
1.	Mobilisation of all plant and equipment for the jetty construction and demobilisation of the same after completion of the works.	1	LS		1.00
2.	Construction of 600 mm dia bored cast-in-situ piles for berth with m.s. liner, boring in all types of soil /Hard strata stabilising unlined soil using any other approved method during excavation, providing reinforcement as per design/ drawing providing and placing M40 grade concrete by means of tremie or any other approved method, providing all necessary labour, materials, plant tools etc.				
i	Shift & set up piling plant & equipment at each pile location	59	No.	50,000	0.30
ii	Supply, fabricate and driving mild steel liner (8 mm thick) including transport, alignment, pitching in position as required	292	T	55,000	1.61
Iii	Boring through all types of soil strata	3,056	m	3,500	1.07
iv	Cut & dress pile head to required lines & levels	59	No.	5,500	0.03
3.	Supply & placing in position design mix cement concrete grade M40 in pile shaft by means of tremie or any other approved method using 20 mm MSA including cost of all labour and materials but excluding the cost of steel reinforcement.	1,023	cum	8,000	0.82

Item No.	Description of Item	Qty.	Unit	Rate (Rs.)	Amount (Rs. in Cr.)
4.	Supplying corrosion resistant deformed bars grade Fe 500, cutting, bending, tying with 1.5 mm dia annealed binding wire & placing in position reinforcement cage including cleaning, straightening, tack/ lap/ butt welding with approved electrodes, etc. with all labour and materials complete for piles.	123	T	68,100	0.84
5.	Supply & place in position to lines & levels cast in-situ design & precast units mix cement concrete of grade M40 for pile cap, deck slab and beams including providing formwork shuttering, machine mixing, compacting, curing of concrete, centering, including providing pockets, openings, recesses, champhering where required and rendering if required to give a smooth and even surface in any shape etc. complete as directed with all labour and materials but excluding the cost of steel reinforcement.	829	cum	8,000	0.66
6.	Supplying corrosion resistant deformed bars grade Fe 500, cutting, bending, tying with 1.5 mm dia annealed binding wire & placing in position reinforcement cage including cleaning, strengthening tack/ lap/ butt welding with approved electrodes, etc. with all labour and materials complete for deck slab and beams.	124	T	68,100	0.85
7.	Providing and laying in position ready mixed plain cement concrete, with cement content as per approved design mix and manufactured in fully automatic batching plant and transported to site of work in transit mixer for all leads, having continuous agitated mixer, manufactured as per mix design of specified grade for plain cement concrete work, including pumping of R.M.C. from transit mixer to site of laying and curing, excluding the cost of centering, shuttering and finishing, including cost of curing, admixtures in recommended proportions as per IS : 9103 to accelerate/ retard setting of concrete, improve workability without impairing strength and durability as per direction of the Engineer-in charge.	35	cum	5,997	0.02
8.	Carrying out load test of pile including construction of test caps, accessories and dismantling same after test etc.	2	No.	10,00,000	0.20
9.	Supplying, fabricating, painting, welding, drilling, grouting & fixing in position etc. complete various miscellaneous items such as steel inserts, hand railing, coping fender, ladders, handhold, expansion joints, mooring rings, nut, bolts, washers, bituminous filler etc. in precast & in-situ concrete components in accordance with the drawings & as directed by the Engineer.		LS		1.00
				Total	**8.00**

Table 16.7 Electrical distribution system & IT communication

Item No.	Description of Item	Qty.	Unit	Rate (Rs.)	Amount (Rs. in Cr.)
1.	Including supplying, installation, testing and commissioning of Power Distribution System (HT, LT switch gears, Transformer, capacitor banks, distribution boards, battery and battery charger & control room building safety equipment, etc.		LS		3.50
2.	Including supplying, installation, testing and commissioning of D.G. set		LS		0.50
3.	Including supplying, installation, testing and commissioning of illumination system (Indoor lighting / outdoor high mast)		LS		1.30
4.	Including supplying, installation, testing and commissioning of cables and cable trays with accessories		LS		5.10
5.	Including supplying, installation, testing and commissioning of Earthing and Lighting protection		LS		0.60
6.	Including supplying, installation, testing and commissioning of control equipments along with control cabling (PLC, CCTV, RIO and LED screens)		LS		2.90
7.	Communication and IT		LS		0.10
				Total	**14.00**

16.4 Operation and maintenance (O&M) costs

Operation and maintenance costs have been calculated as described below:

The following considerations has been taken to the repair and maintenance costs.

a) Civil works – 1 %

b) Mechanical works – 5 %

c) Electrical works – 5 %

d) Utilities – 5 %

The operation costs for maintenance dredging, manpower, electricity, water and fuel charges is calculated for each phase, i.e. Phase-1 and Phase-2 as mentioned in the tables below:

Table 16.8 O&M Cost Estimates – Phase-1

S. No.	Item		Quantity	Unit	Rate	Unit	Annual Costs (Rs. in Crores)
A.	**REPAIR AND MAINTENANCE COSTS**						**9.78**
	1.	Civil Works	334.82	Rs. in crores	1.00	% of Cost	3.35
	2.	Mechanical and Electrical Works	113.20	Rs. in crores	5.00	% of Cost	5.66
	3.	Utilities	15.30	Rs. in crores	5.00	% of Cost	0.77

S. No.	Item	Quantity	Unit	Rate	Unit	Annual Costs (Rs. in Crores)
B.	**OPERATION COSTS**					**16.37**
	1. Manpower Costs	4.00	Rs. in crores	1.00	LS	4.00
	2. Electricity					
	a. Electricity Consumption	8,84,400	units / month	6.87	Rs. / unit	7.29
	b. Fixed Charges on Demand Load	1,552	kVA / month	320.00	Rs. / unit	0.60
	3. Water	18,720	kL / annum	10.00	Rs. / kL	0.02
	4. Fuel charges	992	kL / annum	45.00	Rs. / L	4.46
C.	**TOTAL - (A) + (B)**					**26.15**
D.	Admin, Insurance and Miscellaneous expenses					5.20
E.	**TOTAL ANNUAL OPERATION AND MAINTENANCE COSTS - (C) + (D)**					**31.35**

Table 16.9 O&M Cost Estimates – Phase-2

S. No.	Item	Qty.	Unit	Rate	Unit	Annual Costs (Rs. in Cr.)
A.	**REPAIR AND MAINTENANCE COSTS**					**2.07**
	1. Civil Works	15.46	Rs. in crores	1.00	% of Cost	0.15
	2. Mechanical and Electrical Works	38.30	Rs. in crores	5.00	% of Cost	1.92
B.	**OPERATION COSTS**					**12.43**
	1. Manpower Costs	4.00	Rs. in crores	1.00	LS	4.00
	2. Electricity					
	a. Electricity Consumption	4,42,800	units / month	6.87	Rs. / unit	3.65
	b. Fixed Charges on Demand Load	777	kVA / month	320.00	Rs. / unit	0.30
	3. Water	18,720	kL / annum	10.00	Rs. / kL	0.02
	4. Fuel charges	992	kL / annum	45.00	Rs. / L	4.46
C.	**TOTAL - (A) + (B)**					**14.50**
D.	Admin, Insurance and Miscellaneous expenses					5.20
E.	**TOTAL ANNUAL OPERATION AND MAINTENANCE COSTS - (C) + (D)**					**19.70**
	Note: Phase-2 O&M cost estimates include Phase-1 repair and maintenance cost					

Note: The quantity of annual maintenance dredging is around 23,00,000 cum; on a rate of Rs. 400/cum it would cost Rs. 92 crore.

17 PROJECT IMPLEMENTATION SCHEDULE

17.1 General

The implementation schedule for the development of both Phase-1 and Phase-2 for the development of Haldia MMT and its associated facilities are presented in this chapter. The probable time schedule for various activities from onset to completion of the project and commencement of operation are also discussed in this chapter.

17.2 Basic consideration for Implementation

For timely completion of the project, identification of major project components and sequential planning of various modules is very important for any project. The major components of Haldia MMT includes both the construction of offshore and onshore facilities, apart from installation of mechanical and electrical equipments.

The offshore facilities includes development of berth, approach trestles with steel girder and dredging whereas the development of onshore facilities includes site development, stockyard development, construction of buildings, storage shed, silos, development of internal roads, and providing utilities like water supply system, sewerage system, storm water drainage system and firefighting facility.

The schedule has been prepared with the presumption that IWAI will be developing the project in phase-wise (Phase-1 and Phase-2) through EPC contract.

17.3 Pre-development activities

The various activities to be carried out prior to commencement of construction, includes selection of site, preparation of Detailed Project Report, surveys and investigation, Social and Environmental Impact Assessment, preparation of tender document, Bid process management, selection of EPC contractor and award of work to the selected contractor. It is assessed that the lead time required to carry out the bid process management and selection of EPC contractor would be 3 months.

The schedule for the project also depends on the schedule of various Statutory Clearances required from different Statutory Agencies for the development of the project and therefore, all the requirement clearances need to be in place before the start of the construction activities.

17.4 Construction activities

17.4.1 Development of Phase-1

The following are the major activities involved for effective completion of Phase-1, which involves engineering, procurement, construction and commencement of operational activities.

- Detailed Engineering

- Site development including site clearance, demolition of boundary wall and earth filling
- Development of stockyard
- Construction of silos with conveyor gallery for handling fly ash
- Construction of covered storage shed for handling fertilizer
- Construction of building, internal road, water supply system, storm water drainage system, electrical, firefighting system and other utilities
- Construction of Approach Trestle including earth reinforced wall, and steel girder for crossing over ammonia pipeline.
- Construction of berth of length 465m and
- Supply, installation and commission of barge loaders, mobile harbour cranes and other equipments

17.4.2 Development of Phase-2

The schedule has been with the presumption that the construction of Phase-2 will be commenced immediately after the completion of Phase-1 without any lead time. Therefore, the pre-development activities required for Phase-2 needs to be commenced prior to the commencement of Phase-2 construction.

The Phase-2 construction involves construction of 8 nos. of silos and development of stockyard for future storage, all other required facilities required for phase-2 will be developed in Phase-1.

Implementation schedule indicating timelines for Phase-1 and Phase-2 is presented in figure below:

Figure 17.1 Project Implementation Schedule – Phase-1

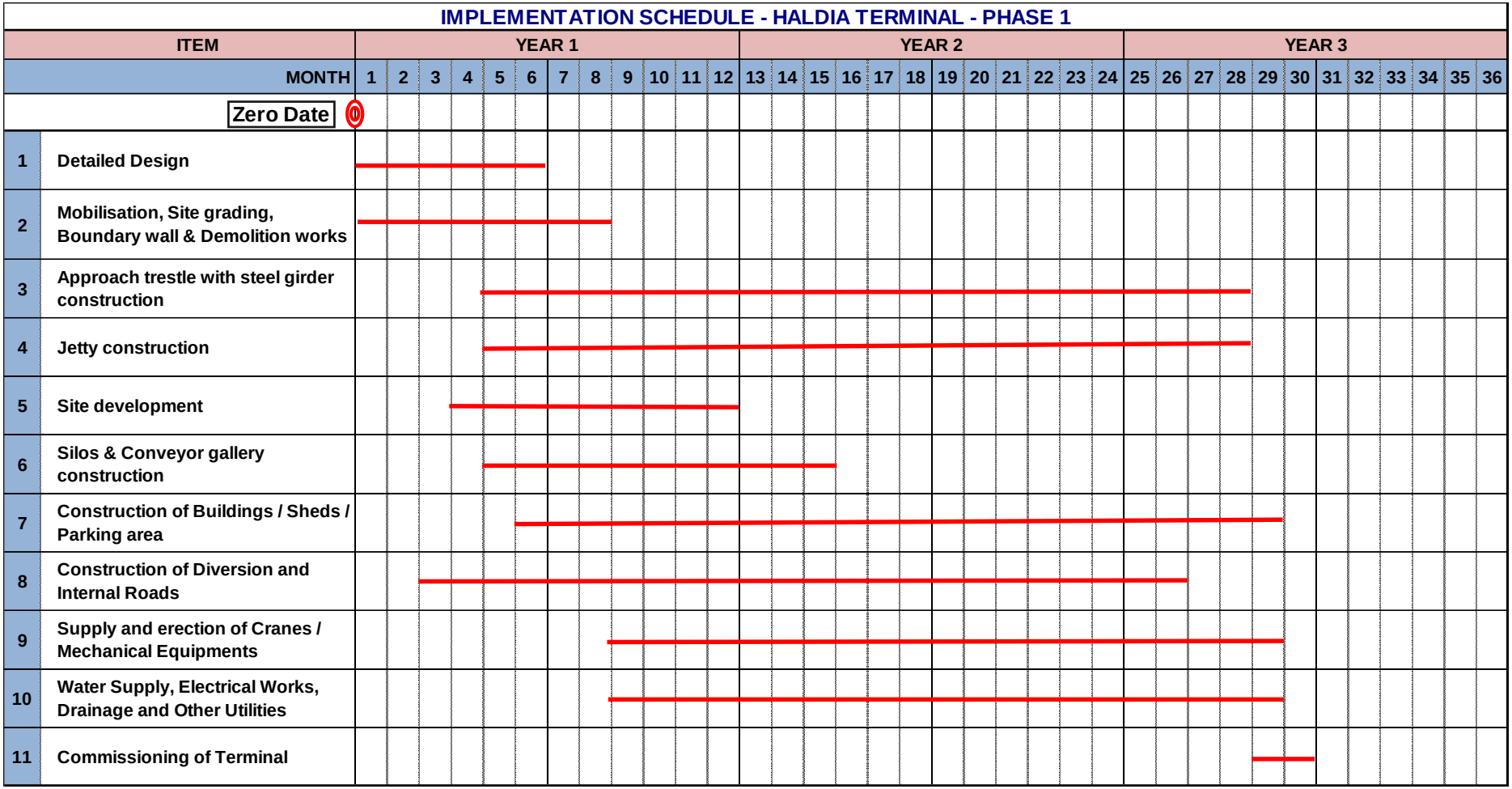
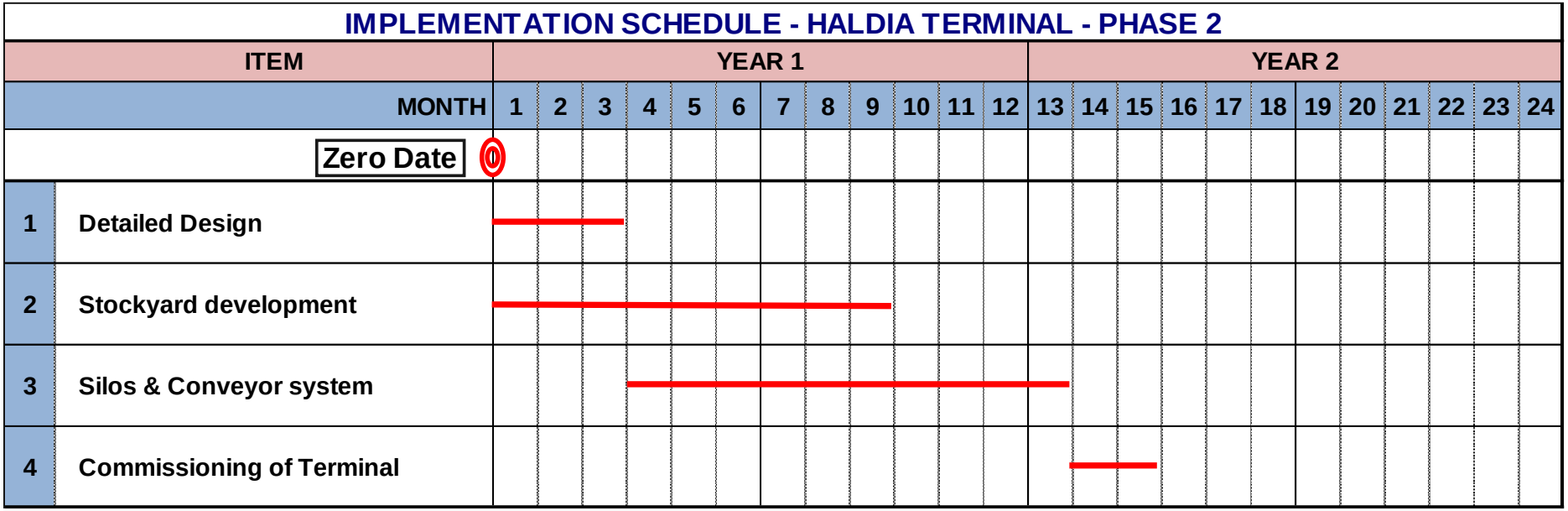


Figure 17.2 Project Implementation Schedule – Phase-2



18 FINANCIAL AND ECONOMIC ANALYSIS

18.1 Introduction

Financial feasibility is a key determinant in a business oriented investment decision. For the projects of public/national interest like development of Haldia Multi-modal Terminal, the viability of the project depends on the economic feasibility which acts as the deciding factor. In this note, economic and financial viability for the development of Haldia Multimodal terminal has been carried out and presented.

18.2 General Assumptions

Following are the key assumptions considered for carrying out the Financial and Economic Analysis for Capacity Augmentation of National Waterways-1.

The inputs are taken from the technical studies carried out by M/s HOWE Engineering Projects (India) Pvt.Ltd and traffic study carried out by M/s HPC Consultant.

The inflation rate of 5% per annum is considered based on CPI index and as per Indian government's targeted inflation rate.

The cost of diesel is considered as Rs. 55/ litre (June 2016 price) and same has been escalated for the forthcoming years.

As per World bank data, the purchasing power parity (PPP) of India is 0.3, whereas the PPP of France is 1.1 (Source : data.worldbank.org)

The analysis has been carried out for Phase-I development

Even though the inland waterways has various socio-economic benefits, this study is restricted to the economic factors mentioned in the below section.

18.3 Construction Period and Project Life

As per the proposed schedule of implementation, the project start date is assumed as 1st June 2016 and project life is considered as 30 years. Terminal-wise implementation schedule considered in the economic model is presented below.

Table 18.1: Phase–I: Project Development Schedule

Construction Start Date for 1st Phase	1-Jan-17
Construction period for 1st Phase(mths)	30
Operation Start (1st Phase)	1-Jul-19
Project Life considered (Years)	30
End Date	31-Jan-47

18.4 Means of Finance

The financial analysis is carried out presuming that the entire capital expenditure will be invested in the form of fund and therefore no debt component is considered.

18.5 Income Tax Calculations

IWAI is registered with the Income Tax Department, Ghaziabad under section 12 A (a) and has got exemption of income tax under section 10(23) (c) (iv) of Income Tax Act. Therefore, income tax is not considered in the Financial Analysis.

18.6 Tariff Analysis

18.6.1 Prevailing IWAI charges

The 'Fee and Charges (Effective from July 16, 2011)' published by Inland Waterways Authority of India (IWAI) are given below.

Table 18.2: Fee and Charges as per IWAI

S. No.	Description	Unit	Amount (in Rs)
1	Waterway Usage Charges	Rs/GRT/km	0.02
2	Vessel Related Charges		
a.	Berthing Charges	Rs/ 24hrs	1000
b.	Pilotage	Rs/ 24hrs	750
3	Cargo Related Charges		
a.	Terminal Charges - Dry Cargo	Rs/ton	1
b.	Transit shed charges:		
	For first seven days	Rs/ton	0
	Next Fourteen days	Rs/ton	5
	Further Fourteen days	Rs/ton	10
	After 35 days	Rs/tons	40
c.	Open storage charges - Hard stand		
	For first seven days	Rs/ton	0
	Next Fourteen days	Rs/ton	2
	Further Fourteen days	Rs/ton	4
	After 35 days	Rs/tons	16

S. No.	Description	Unit	Amount (in Rs)
d.	Open storage charges -open area		
	For first seven days	Rs/ton	0
	Next Fourteen days	Rs/ton	1
	Further Fourteen days	Rs/ton	2
	After 35 days	Rs/tons	8
4	Miscellaneous Charges		
a.	Crane hire charges		
	<= 5t cranes	Rs. / 8 hrs	800.00
	5 to 20t cranes	Rs. / 8 hrs	2,000.00
	> 20t cranes	Rs. / 8 hrs	2,500.00
b.	Forklift Hire Charges	Rs. / 8 hrs	600.00

18.6.2 Tariff considered for augmented NW-1

Vessel Related Charges

To carry out the tariff estimation, the vessel related charges has been considered as per the prevailing IWAI charges.

Cargo Related Charges

At present, IWAI is charging Rs. 1 per ton as the terminal charges. In addition, to carry out the loading/unloading operations, the terminal users can hire the cranes and fork lift.

In case of the proposed Haldia MMT, the cargo handling will be carried out through various mechanised/semi-mechanised systems. Considering this, it may not be feasible to adopt the prevailing IWAI's cargo related charges for the proposed Haldia MMT. Therefore, the scale of rates published by Kolkata Port Trust for Inland Water vessels have been adopted for cargo related charges as mentioned below.

Table 18.3: Tariff Considered for Augumented NW-1

Vessel related charges		
Berthing Charges	Rs/ 24hrs	1000
Pilotage	Rs/ 24hrs	750
Cargo Related Charges		
Coal		

Coal handled through other than mechanical system	Wharfage	Rs. / Tonne	18
	Transfer of Thermal coal from unloading point to stack point	Rs. / Tonne	40.5
	Transfer of Thermal coal from stack point to hook point	Rs. / Tonne	54
	Coal - non -mechanized handling charges	Rs. / Tonne	112.5
Handled through Mechanical handling	Wharfage	Rs. / Tonne	40.5
	Tippling of Thermal Coal wagon by Wagon Tippler	Rs. / Tonne	40.5
	Coal - mechanized system - handling charges	Rs. / Tonne	81
Stone chips/Lime Stone/Sand			
Handling through other than mechanical system	Wharfage	Rs. / Tonne	18
	shore handling charges	Rs. / Tonne	48.6
	non -mechanized handling charges	Rs. / Tonne	66.6
Handled through Mechanical system	Wharfage	Rs. / Tonne	21.6
	mechanized handling charges	Rs. / Tonne	21.6
Bagged Cargoes (Cement, Food grains, fertilizer, plastic granular & textiles)			
Handling through other than mechanical system	Wharfage	Rs. / Tonne	18
	shore handling charges	Rs. / Tonne	48.6
	Bagged cargoes - non-mechanized handling charges	Rs. / Tonne	66.6
Iron Ore			
Iron ore handled through other than mechanical system	Wharfage	Rs. / Tonne	18
	Transfer of Iron Ore (other than through mechanical system), from unloading point to Stack point, including loading at unloading point and unloading at Stack point	Rs. / Tonne	45
	Transfer of Iron Ore (other than through mechanical system), from stack point/unloading point to Hook point,	Rs. / Tonne	58.5

	including loading at stack point/unloading point and unloading at hook point as well as heaping of cargo for vessel feeding		
	Iron ore - non -mechanized handling charges	Rs. / Tonne	121.5
Handled through Mechanical handling	Wharfage	Rs. / Tonne	36.00
	Tippling of iron ore by Wagon Tippler	Rs. / Tonne	36
	Iron ore - mechanized system - handling charges	Rs. / Tonne	72
Logs & woods			
Handling through other than mechanical system	Wharfage	Rs. / Tonne	18
	shore handling charges	Rs. / Tonne	38.88
	non-mechanized handling charges	Rs. / Tonne	56.88
Steel Products			
Handling through other than mechanical system	Wharfage	Rs. / Tonne	18
	shore handling charges	Rs. / Tonne	64.8
	non-mechanized handling charges	Rs. / Tonne	82.8
Paper, statues, project cargoes & petroleum products(in drums)			
Handling through other than mechanical system	Wharfage	Rs. / Tonne	18
	shore handling charges	Rs. / Tonne	40.5
	non-mechanized handling charges	Rs. / Tonne	58.5
Containers			
Container handling charges	Wharfage	Rs. / Tonne	90
	Transportation of container from quay to container yard or vice versa	Rs. / Tonne	118.8
	Transportation of container from container yard to truck or vice versa	Rs. / Tonne	89.1
	Container handling charges	Rs. / Tonne	297.9

18.7 Capital Costs

Table 18.4: Capital Cost for Phase-I Development of Haldia MMT

S. No.	Description	Capital Cost (Rs. In Cr.)
1.	Land Lease Rent and R&R	40.59
2.	On Shore Civil Works	59.83
3.	Off Shore Civil Works	275.00
4.	Mechanical Works	99.20
5.	Electrical Works & It Communication	14.00
6.	Utilities	5.30
A	Total	493.92
B	Contingency (3%)	14.82
C	Total Project Cost (A + B)	508.74
D	Service Tax (15% * Of 40% Of Total Project Cost)	30.52
E	Grand Total (C + D)	539.26

For the augmentation of NW-1, dredging needs to be carried out for the entire stretch of NW-1. Dredging volume of Haldia terminal comparative small, it will be beneficial to exclude the dredging and supply of navigational aids for Haldia Terminal development package and to include it in the overall NW-1 dredging package. Therefore, same is not included in the above mentioned cost estimate. In addition, a lump sum cost of Rs. 10 crore has been considered in the financial model towards obtaining electrical and water supply connection.

In addition, the service tax component estimated in the costing model is considered only for the financial analysis and not for economic analysis as it is only a transfer payment within the economy.

18.8 Operation and Maintenance Costs

As per the industry norms, the repair and maintenance cost have been calculated under various heads, as described below.

1% of capital cost for Civil Works

5% of capital cost for Utilities

5% of capital cost for Mechanical and Electrical Works

In addition, operating expenses would be incurred on day to day basis which includes administrative expenses, salaries, expenses towards electricity, fuel, payment of insurance premium etc.

18.9 Traffic Detail and terminal capacity

The traffic potential for NW1 provided by the traffic expert, M/s HPC Consultants is considered for carrying out the analysis.

Table 18.5: Project Traffic Volume (Medium Augumentation Case - MAC)

Year	2020 [MTPA]	2025 [MTPA]	2035 [MTPA]	2045 [MTPA]
Projected Traffic Volume	7.44	8.04	9.06	10.06

Table 18.6: Project Traffic Volume (Base Case)

Year	2020 [MTPA]	2025 [MTPA]	2035 [MTPA]	2045 [MTPA]
Projected Traffic Volume	2.76	2.99	3.36	3.53

Based on the infrastructure facilities provided and handling rate considered, the terminal capacity has been worked out as 3.18 MTPA.

18.10 Key Results - Financial Analysis

Based on the financial analysis carried out taking into consideration of the above mentioned factors, the financial IRR has worked out to be negative for Phase-1 development considering both the base case traffic and medium augmentation case traffic.

Based on the sensitivity analysis carried out by the Consultant, it has been observed that under the following conditions the FIRR would be positive for MAC:

Having the tariff rate 2 times higher than that of the existing tariff rate;

By increasing the year-on-year tariff rate by 4% (in addition to 5% inflation rate);

By increasing the tariff rate by 1.5 times that of existing rate and also having year-on- year increase in tariff rate by 2% (in addition to 5% inflation rate)

By increasing the tariff rate by 1.5 times that of existing rate and also by increasing in tariff rate by 7% once in 3 years (in addition to 5% y-o-y inflation rate)

18.11 Economic Analysis

In this section, economic analysis has been carried out for ‘Capacity Augmentation of National Waterway – 1 (Jal Marg Vikas)’ based on various socio-economic factors as mentioned below.

18.11.1 Approach and Methodology

The economic analysis of the project has been evaluated based on the following scenarios.

'With Project' Scenario and

'Without Project' Scenario

Both 'with project' and 'without project' scenarios have been quantified over the full life of the project. Also the 'incremental situation' or 'Benefit from the project' have been arrived by comparing the 'with project' scenario and 'without project' scenario wherein in the former case, the cargoes will be transported through barges and in later case, cargoes will be transported through road & rail.

18.11.2 Economic Factors considered

Following are the factors that are considered to carry out the economic analysis for this project.

- Energy Consumption
- Air Pollution
- Emission of CO2
- Noise Pollution
- Soil and Water Pollution
- Accidents
- Surface Occupation
- Benefit from exporting flyash
- Energy Consumption

Transport infrastructure plays a key role in the economic development of a country and an efficient transport sector, particularly for transportation of bulk goods is vital for development of any country. As per the World Bank study, Indian logistics cost is one of the highest in the world. As per this study, the logistics cost is 6% to 8% of the total value of goods in developing countries, 10% of the total values of goods in China whereas the cost of logistics in India is 14% of the total value of goods. By using the energy efficient mode of transportation, the logistics cost can be drastically reduced which in turn will boost the economy of the country.

In this section, a comparative study on the energy performance of inland shipping versus that of other land transportation modes has been carried out.

The energy consumption pattern of waterways, roadways and railways is illustrated in the below table, which is based on the 'Eleventh Working Group Report on Shipping and IWT' and 'Working Group Report on Railways'.

Table 18.7: Energy Consumption - Waterways, Road and Rail

Energy Consumption	Waterways		Road		Rail	
	Mj/t km	litre/Tkm	Mj/t km	litre/Tkm	Mj/t km	litre/Tkm
11th Working Group Report on shipping and IWT (Based on EU: Progress Report on short sea shipping 1999)		0.0048		0.0313		0.0089
Report of Working Group on Railways-2012			1.3550	0.0350	0.2550	0.0066
'Energy Consumption' considered for the Study		0.0048		0.0313		0.0089

For the present study, the energy consumption pattern published by `11th Working Group Report on shipping and IWT' has been considered for further analysis.

18.11.3 External Costs

Transport contributes significantly to economic growth. Unfortunately, most forms of transport do not only affect society in a positive way but also give rise to side effects. In contrast to the benefits, the cost of these effects of transport are generally not borne by the transport users and hence not taken into account when they make a transport decision. Therefore these effects are generally labelled as external effects. The various cost associated with the external effects are described below.

18.11.3.1 Air Pollution

Transport related air pollution causes damages to humans, biosphere, soil, water, buildings and materials. The most important pollutants are the following:

- Particulate matters
- Nitrogen oxides
- Sulphur oxide
- Ozone
- Volatile organic compounds

Several studies have been carried out to estimate the level of impact caused due to the air pollution triggered by road, rail and inland shipping. Subsequently, the cost factor was arrived for the air pollution by critically valuating various cost elements like valuation of human life, market prices for crops, valuation of building damages, and valuation of long term risks in biosphere. The external cost of air pollution arrived by various studies are listed below:

Table 18.8: External Costs of Air Pollution - Waterways, Roadways and Railways

Inland Water Transportation	Unit	Cost	Cost (in Rs/tkm)
Total Transportation System Study - Planning Commission Report	Rs / t km	0.0300	0.0300
Union Internationale des Chemins de fer (PIANC)	€/Tkm	0.0040	0.0011
le Groupe d'Economie des Transports de l'ULB (PIANC)	€/ Tkm		
Bundesamt fur Umweltschutz (PIANC)	€/Tkm	0.0014	0.0004
Cost considered for the study			0.0300
Roadway	Unit	Cost	Cost (in Rs/tkm)
Total Transportation System Study - Planning Commission Report	Rs / t km	0.2020	0.2020
Union Internationale des Chemins de fer (PIANC)	€/Tkm	0.0122	0.0033
le Groupe d'Economie des Transports de l'ULB (PIANC)	€/ Tkm	0.0329	0.0090
Bundesamt fur Umweltschutz (PIANC)	€/Tkm	0.0096	0.0026
Cost considered for the study			0.2020
Railway	Unit	Cost	Cost (in Rs/tkm)
Total Transportation System Study - Planning Commission Report	Rs / t km	0.0366	0.0366
Union Internationale des Chemins de fer (PIANC)	€/Tkm	0.0122	0.0033
le Groupe d'Economie des Transports de l'ULB (PIANC)	€/ Tkm	0.0329	0.0090
Bundesamt fur Umweltschutz (PIANC)	€/Tkm	0.0096	0.0026
Cost considered for the Study			0.0366

18.11.3.2 Noise Pollution

Noise costs consist of costs for annoyance and health. The external cost of noise pollution arrived by various studies are listed in the below table. The cost factors for noise pollution are available only based on European conditions and are mentioned in Euros. Same has been converted to Rupees based on the purchasing power parity as mentioned in the Key Assumptions.

Table 18.9: External Cost of Noise Pollution

Inland Water	Unit	Cost	Cost (in Rs/tkm)
Union Internationale des Chemins de fer (PIANC)	€/Tkm	Nil	Nil
le Groupe d'Economie des Transports de l'ULB (PIANC)	€/ Tkm	Nil	Nil
Bundesamt fur Umweltschutz (PIANC)	€/Tkm	Nil	Nil
Cost considered for the study			
Roadways	Unit	Cost	Cost (in Rs/tkm)
Union Internationale des Chemins de fer (PIANC)	€/Tkm	0.0119	0.0032
le Groupe d'Economie des Transports de l'ULB (PIANC)	€/ Tkm	-	-
Bundesamt fur Umweltschutz (PIANC)	€/Tkm	0.0018	0.0005
Cost considered for the Study			0.0012
Railways	Unit	Cost	Cost (in Rs/tkm)
Union Internationale des Chemins de fer (PIANC)	€/Tkm	0.0044	0.0012
le Groupe d'Economie des Transports de l'ULB (PIANC)	€/ Tkm	0.0010	0.0003
Bundesamt fur Umweltschutz (PIANC)	€/Tkm	0.0035	0.0009
Cost considered for the study			0.0008

18.11.3.3 Soil and Water Pollution

The external cost of soil & water pollution arrived by various studies and it is observed that only roadways tends to produce soil & water pollution as mentioned.

Table 18.10: External Cost of Soil and Water Pollution

Roadways	Unit Rs/t km	Cost	Cost in Rs.
Union Internationale des Chemins de fer (PIANC)	€/Tkm	-	-
le Groupe d'Economie des Transports de l'ULB (PIANC)	€/ Tkm	-	-
Bundesamt fur Umweltschutz (PIANC)	€/Tkm	0.0020	0.0005
Cost considered for the Study			0.0005

18.11.3.4 Reduction in Accidents

The external cost for accident considered for three modes of transportation is mentioned below.

Table 18.11: Accident Cost - Waterways, Roadways and Railways

Accident Cost		Unit	Cost	Cost (in Rs/tkm)
Waterways	Total Transportation System - Planning commission	Rs./Tkm	Nil	Nil
	Union Internationale des Chemins de fer (PIANC)	€/Tkm	Nil	Nil
	le Groupe d'Economie des Transports de l'ULB (PIANC)	€/Tkm	Nil	Nil
	Bundesamt fur Umweltschutz (PIANC)	€/Tkm	Nil	Nil
	Cost considered for the Study		Nil	Nil
Roadways	Total Transportation System - Planning commission	Rs./Tkm	0.0620	0.0620
	Union Internationale des Chemins de fer (PIANC)	€/Tkm	0.0208	0.0057
	le Groupe d'Economie des Transports de l'ULB (PIANC)	€/Tkm	0.0353	0.0096
	Bundesamt fur Umweltschutz (PIANC)	€/Tkm	0.0091	0.0025
	Cost considered for the Study			0.0620
Railways	Total Transportation System - Planning commission	Rs./Tkm	0.0010	0.0010
	Union Internationale des Chemins de fer (PIANC)	€/Tkm	0.0008	0.0002
	le Groupe d'Economie des Transports de l'ULB (PIANC)	€/Tkm	0.0005	0.0001
	Bundesamt fur Umweltschutz (PIANC)	€/Tkm	0.0006	0.0002
	Cost considered for the study			0.0010

18.11.3.5 Emission of Green house gases

Table 18.12 : Emission of Green House Gases

CO2 Emission form various transport modes	
	Freight Transport (gm/tkm)

	As per '12th Five Year Plan'	Mckinsey 'Transforming the railway's logistics infrastructure 2010'	International Union of Railways
Road	160	64	84
Rail	29	28	17
Waterways	31	15	
	As per 'Federal Environmental Agency' the cost of one ton of CO2 emitted	: € 70	

		Cost (in Rs/tkm)
Waterways	As per '12th Five Year Plan'	0.0006
	Mckinsey 'Transforming the railway's logistics infrastructure 2010'	0.0003
	International Union of Railways	-
	Cost considered for the study	0.0006
Roadways	As per '12th Five Year Plan'	0.0031
	Mckinsey 'Transforming the railway's logistics infrastructure 2010'	0.0012
	International Union of Railways	0.0016
	Cost considered for the study	0.0031
Railways	As per '12th Five Year Plan'	0.0006
	Mckinsey 'Transforming the railway's logistics infrastructure 2010'	0.0005
	International Union of Railways	0.0003
	Cost considered for the study	0.0006

18.11.3.6 Surface Occupation

Table 18.13 : Surface Occupation

Surface Occupation		Unit	Cost	Cost (in Rs/tkm)
Waterways	As per Bundesamt fur Umweltschutz (PIANC)	€/Tkm	-	-
Roadways		€/Tkm	0.0006	0.0002
Railways		€/Tkm	0.0002	0.0001

18.11.3.7 Benefit from export of flyash to Bangladesh

As per the traffic study carried out by M/s HPC Consultant, the volume of fly ash exported from the hinterland of Haldia to Bangladesh (through Durgapur, Budge Budge and Kolaghat) is 1.33 MTPA in 2014. To estimate the economic benefit, it is assumed that the maximum cumulative handling capacity of the existing terminals is 1.33 MTPA and out of which 50% of the traffic will be diverted to Haldia MMT.

Based on the prevailing market rate, the domestic cost of fly ash is considered to be Rs. 450 /tonne. As per M/s HPC Consultant's traffic report, it is considered that the fly ash is exported to Bangladesh at $15/tonne.

Overall Incremental Economic Benefit from the project:

The overall incremental economic benefit from the augmentation of National Waterways-1 is presented below.

Table 18.14: Overall Incremental Economic Benefit from the project - MAC

Overall Incremental Economic Benefit (in Rs. Mn)	1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
	31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
	0	0	0	898	1319	1886	2691	3456	4200

Table 18.15: Overall Incremental Economic Benefit from the project – Base Case

Overall Incremental Economic Benefit (in Rs. Mn)	1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
	31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
	0	0	0	864	1263	1684	2243	2956	3651

18.11.3.8 Observation on Key Results – Economic Analysis

Table 18.16 : Key Results of Economic Analysis

S. No.	Project Economic Parameters	Output
Medium Augmentation Case		
1	EIRR (Economic Internal Rate of Returns)	17.04%
2	ENPV@12% (Economic Net Present Value)	Rs. 2989 Mn
Base Case		
1	EIRR (Economic Internal Rate of Returns)	16.00%
2	ENPV@12% (Economic Net Present Value)	Rs. 2213 Mn

The EIRR for the project has been worked, considering the economic benefit generated from the capacity augmentation of NW-1 and it is overserved that the project is economically viable.

Annexure 1 – Detailed Economic Cost Estimation – Base Case

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
Energy Consumption										
Without Project Scenario										
Road Transportation										
Road - Energy Consumption	Rs/ Tkm	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41
Road- Total Energy Consumption	in Rs. Mn	0.00	0.00	0.00	231.40	314.20	426.85	577.71	760.90	943.30
Rail Transportation										
Rail Transportation										
Rail - Energy Consumption	Rs/ Tkm	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Rail- Total Energy Consumption	in Rs.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	in Rs. Mn	0.00	0.00	0.00	231.40	314.20	426.85	577.71	760.90	943.30
With Project Scenario										
Waterways Transportation										
Waterways - Energy Consumption Cost	Rs/ Tkm	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Waterways- Total Energy Consumption Cost	in Rs. Mn	0.00	0.00	0.00	42.69	57.97	78.75	106.58	140.38	174.03
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	188.71	256.23	348.10	471.13	620.52	769.27
Air Pollution										
Without Project' Scenario										
Road Transportation										
Unit Cost	Rs/ Tkm	0.21	0.22	0.23	0.26	0.33	0.42	0.54	0.68	0.83
Total cost	in Rs. Mn	0.00	0.00	0.00	33.15	45.02	61.16	82.77	109.02	135.15
Rail Transportation										
Unit Cost	Rs/ Tkm	0.038	0.040	0.042	0.047	0.060	0.076	0.097	0.124	0.151
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Without Project' Scenario - Total cost	in Rs. Mn	0.00	0.00	0.00	33.15	45.02	61.16	82.77	109.02	135.15

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
With' Project Scenario										
Waterways Transportation										
Unit Cost	Rs/ Tkm	0.032	0.033	0.035	0.038	0.049	0.062	0.080	0.102	0.123
Total cost	in Rs. Mn	0.00	0.00	0.00	5.89	8.00	10.87	14.72	19.38	24.03
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	27.26	37.01	50.28	68.06	89.64	111.12
Noise Pollution										
Without Project' Scenario										
Road Transportation										
Unit Cost	Rs/ Tkm	0.001	0.001	0.001	0.002	0.002	0.003	0.003	0.004	0.005
Total cost	in Rs. Mn	0.00	0.00	0.00	0.20	0.28	0.38	0.51	0.67	0.83
Rail Transportation										
Unit Cost	Rs/ Tkm	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.003
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Without Project' Scenario - Total cost	in Rs. Mn	0.00	0.00	0.00	0.20	0.28	0.38	0.51	0.67	0.83
With' Project Scenario										
Waterways Transportation										
Unit Cost	Rs/ Tkm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	0.20	0.28	0.38	0.51	0.67	0.83
Soil and Water Pollution										
Without Project' Scenario										
Road Transportation										
Unit Cost	Rs/ Tkm	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002
Total cost	in Rs. Mn	0.00	0.00	0.00	0.09	0.12	0.17	0.22	0.29	0.36
Rail Transportation										

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
Unit Cost	Rs/ Tkm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Without Project' Scenario - Total cost	in Rs. Mn	0.00	0.00	0.00	0.09	0.12	0.17	0.22	0.29	0.36
With' Project Scenario										
Waterways Transportation										
Unit Cost	Rs/ Tkm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	0.09	0.12	0.17	0.22	0.29	0.36
Accidents										
Without Project' Scenario										
Road Transportation										
Unit Cost	Rs/ Tkm	0.065	0.068	0.072	0.079	0.101	0.129	0.165	0.210	0.255
Total cost	in Rs. Mn	0.00	0.00	0.00	10.18	13.82	18.77	25.41	33.46	41.48
Rail Transportation										
Unit Cost	Rs/ Tkm	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.003	0.004
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Without Project' Scenario - Total cost	in Rs. Mn	0.00	0.00	0.00	10.18	13.82	18.77	25.41	33.46	41.48
With' Project Scenario										
Waterways Transportation										
Unit Cost	Rs/ Tkm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	10.18	13.82	18.77	25.41	33.46	41.48
Surface occupation										
Without Project' Scenario										
Road Transportation										

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
Unit Cost	Rs/ Tkm	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0004	0.0006	0.0007
Total cost	in Rs. Mn	0.0000	0.0000	0.0000	0.0273	0.0371	0.0504	0.0682	0.0898	0.1113
Rail Transportation										
Unit Cost	Rs/ Tkm	0.00006	0.00006	0.00006	0.00007	0.00009	0.00011	0.00014	0.00018	0.00022
Total cost	in Rs. Mn	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Without Project' Scenario - Total cost	in Rs. Mn	0.00	0.00	0.00	0.03	0.04	0.05	0.07	0.09	0.11
With' Project Scenario										
Waterways Transportation										
Unit Cost	Rs/ Tkm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	0.03	0.04	0.05	0.07	0.09	0.11
Flyash - Benefit from Export to Bangladesh										
Without Project' Scenario										
Domestic market price of fly ash	in Rs./t	446.25	468.56	491.99	542.42	692.28	883.54	1,127.65	1,439.20	1,749.36
Deducting local transportation and handling charges	in Rs./t	-	-	-	-	-	-	-	-	-
Unit Rate- Export-parity price of Flyash	in Rs./t	446.25	468.56	491.99	542.42	692.28	883.54	1,127.65	1,439.20	1,749.36
Without Project' Scenario - Total cost	in Rs. Mn	-	-	-	871.73	1,306.37	1,732.27	2,293.91	3,024.72	3,731.85
With' Project Scenario										
CIF cost at point of import (Bangladesh inland waterways terminal	in $/t	15.75	16.54	17.36	19.14	24.43	31.18	39.80	50.80	61.74
Deducting Freight, insurance & handling	in $/t	1.58	1.65	1.74	1.91	2.44	3.12	3.98	5.08	6.17
FOB	in $/t	14.18	14.88	15.63	17.23	21.99	28.07	35.82	45.72	55.57

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
FOB (in Rupees)	in Rs./t	921.38	967.44	1,015.82	1,119.94	1,429.36	1,824.26	2,328.27	2,971.53	3,611.91
Deducting export duties	in Rs./t	-	-	-	-	-	-	-	-	-
Deducting Haldia Terminal handling charges	in Rs./t	42.51	44.63	46.87	51.68	65.96	84.20	107.47	137.17	166.75
Deducting local transportation cost	in Rs./t	106.27	111.58	117.18	129.19	164.91	210.49	268.68	342.92	416.87
Unit Rate - Export-parity price of Flyash	in Rs./t	772.60	811.23	851.76	939.07	1,198.49	1,529.57	1,952.11	2,491.44	3,028.29
Total cost - Export-parity price of Flyash	in Rs Mn	-	-	-	1,509.19	2,261.61	2,998.86	3,971.06	5,236.18	6,460.15
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	637.46	955.24	1266.59	1677.14	2211.46	2728.30
Overall Incremental Economic Benefit from the project	in Rs. Mn	0	0	0	864	1263	1684	2243	2956	3651

Annexure 2 – Snapshot of Economic Analysis – Base Case

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-45
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-46
Traffic	MMTPA	-	-	-	2.55	2.85	2.94	3.03	3.11	3.15
Capital Cost	Rs. '000	1,405,947	1,968,633	2,027,692	-	-	-	-	-	-
Benefit from the project										
Revenue from operation	Rs. '000	-	-	-	145,523	206,503	272,875	360,260	471,893	610,824
Other Revenue	Rs. '000	-	-	-	-	-	-	-	-	-
Economical Benefit	Rs. '000	-	-	-	863,929	1,262,740	1,684,336	2,242,540	2,956,134	3,798,251
Total Benefit from the project	Rs. '000	-	-	-	1,009,452	1,469,243	1,957,211	2,602,800	3,428,027	4,409,075
Operation Expenses										
Repair and Maintenance	Rs. '000	-	-	-	123,083	135,894	150,038	165,654	182,895	201,931
Operating Cost (Variable)	Rs. '000	-	-	-	267,850	301,612	339,825	383,101	432,141	487,745
Total OPEX	Rs. '000	-	-	-	390,934	437,506	489,863	548,755	615,036	689,676
Net Cash Flow	Rs. '000	(1,405,947)	(1,968,633)	(2,027,692)	618,518	1,031,737	1,467,348	2,054,045	2,812,991	3,719,398
Economic IRR		16.00%								

Annexure 3 – Snapshot of Financial Analysis – Base Case

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-45
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-46
Capital Cost	Rs. '000	1,460,555	2,081,126	2,143,560	-	-	-	-	-	-
Benefit from the project										
Revenue from operation	Rs. '000	-	-	-	145,523	206,503	272,875	360,260	471,893	610,824
Other Revenue	Rs. '000	-	-	-	-	-	-	-	-	-
Economic Benefit	Rs. '000	-	-	-	-	-	-	-	-	-
Total Benefit from the project	Rs. '000	-	-	-	145,523	206,503	272,875	360,260	471,893	610,824
Operation Expenses										
Repair & Maintenance	Rs. '000	-	-	-	123,083	135,894	150,038	165,654	182,895	201,931
Operating Cost (Variable)	Rs. '000	-	-	-	267,850	301,612	339,825	383,101	432,141	487,745
Total OPEX	Rs. '000	-	-	-	390,934	437,506	489,863	548,755	615,036	689,676
Net Cash Flow	Rs. '000	(1,460,555)	(2,081,126)	(2,143,560)	(246,016)	(231,066)	(217,144)	(188,804)	(143,569)	(79,428)
Financial IRR	(-)ve									

Annexure 4 – Detailed Economic Cost Estimation – Medium Augmentation Case

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
Energy Consumption										
Without Project Scenario										
Road Transportation										
Road - Energy Consumption	Rs/ Tkm	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41	1.41
Road- Total Energy Consumption	in Rs. Mn	0.00	0.00	0.00	472.69	603.28	769.96	985.37	1254.18	1524.46
Rail Transportation										
Rail Transportation										
Rail - Energy Consumption	Rs/ Tkm	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Rail- Total Energy Consumption	in Rs.	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	in Rs. Mn	0.00	0.00	0.00	472.69	603.28	769.96	985.37	1254.18	1524.46
With Project Scenario										
Waterways Transportation										
Waterways - Energy Consumption Cost	Rs/ Tkm	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Waterways- Total Energy Consumption Cost	in Rs. Mn	0.00	0.00	0.00	92.60	118.18	150.83	193.03	245.69	298.64
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	380.09	485.10	619.13	792.34	1008.49	1225.83

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
Air Pollution										
Without Project' Scenario										
Road Transportation										
Unit Cost	Rs/ Tkm	0.21	0.22	0.23	0.26	0.33	0.42	0.54	0.68	0.83
Total cost	in Rs. Mn	0.00	0.00	0.00	67.73	86.44	110.32	141.18	179.70	218.42
Rail Transportation										
Unit Cost	Rs/ Tkm	0.038	0.040	0.042	0.047	0.060	0.076	0.097	0.124	0.151
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Without Project' Scenario - Total cost	in Rs. Mn	0.00	0.00	0.00	67.73	86.44	110.32	141.18	179.70	218.42
With' Project Scenario										
Waterways Transportation										
Unit Cost	Rs/ Tkm	0.032	0.033	0.035	0.038	0.049	0.062	0.080	0.102	0.123
Total cost	in Rs. Mn	0.00	0.00	0.00	12.79	16.32	20.83	26.65	33.93	41.24
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	54.94	70.12	89.49	114.53	145.77	177.18
Noise Pollution										
Without Project' Scenario										
Road Transportation										
Unit Cost	Rs/ Tkm	0.001	0.001	0.001	0.002	0.002	0.003	0.003	0.004	0.005

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
Total cost	in Rs. Mn	0.00	0.00	0.00	0.42	0.53	0.68	0.87	1.11	1.35
Rail Transportation										
Unit Cost	Rs/ Tkm	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.003
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Without Project' Scenario - Total cost	in Rs. Mn	0.00	0.00	0.00	0.42	0.53	0.68	0.87	1.11	1.35
With' Project Scenario										
Waterways Transportation										
Unit Cost	Rs/ Tkm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	0.42	0.53	0.68	0.87	1.11	1.35
Soil and Water Pollution										
Without Project' Scenario										
Road Transportation										
Unit Cost	Rs/ Tkm	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002
Total cost	in Rs. Mn	0.00	0.00	0.00	0.18	0.23	0.30	0.38	0.49	0.59
Rail Transportation										
Unit Cost	Rs/ Tkm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
Without Project' Scenario - Total cost	in Rs. Mn	0.00	0.00	0.00	0.18	0.23	0.30	0.38	0.49	0.59
With' Project Scenario										
Waterways Transportation										
Unit Cost	Rs/ Tkm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	0.18	0.23	0.30	0.38	0.49	0.59
Accidents										
Without Project' Scenario										
Road Transportation										
Unit Cost	Rs/ Tkm	0.065	0.068	0.072	0.079	0.101	0.129	0.165	0.210	0.255
Total cost	in Rs. Mn	0.00	0.00	0.00	20.79	26.53	33.86	43.33	55.15	67.04
Rail Transportation										
Unit Cost	Rs/ Tkm	0.001	0.001	0.001	0.001	0.002	0.002	0.003	0.003	0.004
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Without Project' Scenario - Total cost	in Rs. Mn	0.00	0.00	0.00	20.79	26.53	33.86	43.33	55.15	67.04
With' Project Scenario										
Waterways Transportation										
Unit Cost	Rs/ Tkm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	20.79	26.53	33.86	43.33	55.15	67.04
Surface occupation										
Without Project' Scenario										
Road Transportation										
Unit Cost	Rs/ Tkm	0.0002	0.0002	0.0002	0.0002	0.0003	0.0003	0.0004	0.0006	0.0007
Total cost	in Rs. Mn	0.0000	0.0000	0.0000	0.0558	0.0712	0.0909	0.1163	0.1480	0.1799
Rail Transportation										
Unit Cost	Rs/ Tkm	0.00006	0.00006	0.00006	0.00007	0.00009	0.00011	0.00014	0.00018	0.00022
Total cost	in Rs. Mn	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Without Project' Scenario - Total cost	in Rs. Mn	0.00	0.00	0.00	0.06	0.07	0.09	0.12	0.15	0.18
With' Project Scenario										
Waterways Transportation										
Unit Cost	Rs/ Tkm	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total cost	in Rs. Mn	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	0.06	0.07	0.09	0.12	0.15	0.18

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
Flyash - Benefit from Export to Bangladesh										
Without Project' Scenario										
Domestic market price of fly ash	in Rs./t	446.25	468.56	491.99	542.42	692.28	883.54	1,127.65	1,439.20	1,749.36
Deducting local transportation and handling charges	in Rs./t	-	-	-	-	-	-	-	-	-
Unit Rate- Export-parity price of FlyAsh	in Rs./t	446.25	468.56	491.99	542.42	692.28	883.54	1,127.65	1,439.20	1,749.36
Without Project' Scenario - Total cost	in Rs. Mn	-	-	-	604.09	1,007.62	1,562.20	2,379.02	3,070.20	3,731.85
With' Project Scenario										
CIF cost at point of import (Bangladesh inland waterways terminal	in $/t	15.75	16.54	17.36	19.14	24.43	31.18	39.80	50.80	61.74
Deducting Freight, insurance & handling	in $/t	1.58	1.65	1.74	1.91	2.44	3.12	3.98	5.08	6.17
FOB	in $/t	14.18	14.88	15.63	17.23	21.99	28.07	35.82	45.72	55.57
FOB (in Rupees)	in Rs./t	921.38	967.44	1,015.82	1,119.94	1,429.36	1,824.26	2,328.27	2,971.53	3,611.91
Deducting export duties	in Rs./t	-	-	-	-	-	-	-	-	-
Deducting Haldia Terminal handling charges	in Rs./t	42.51	44.63	46.87	51.68	65.96	84.20	107.47	137.17	166.75

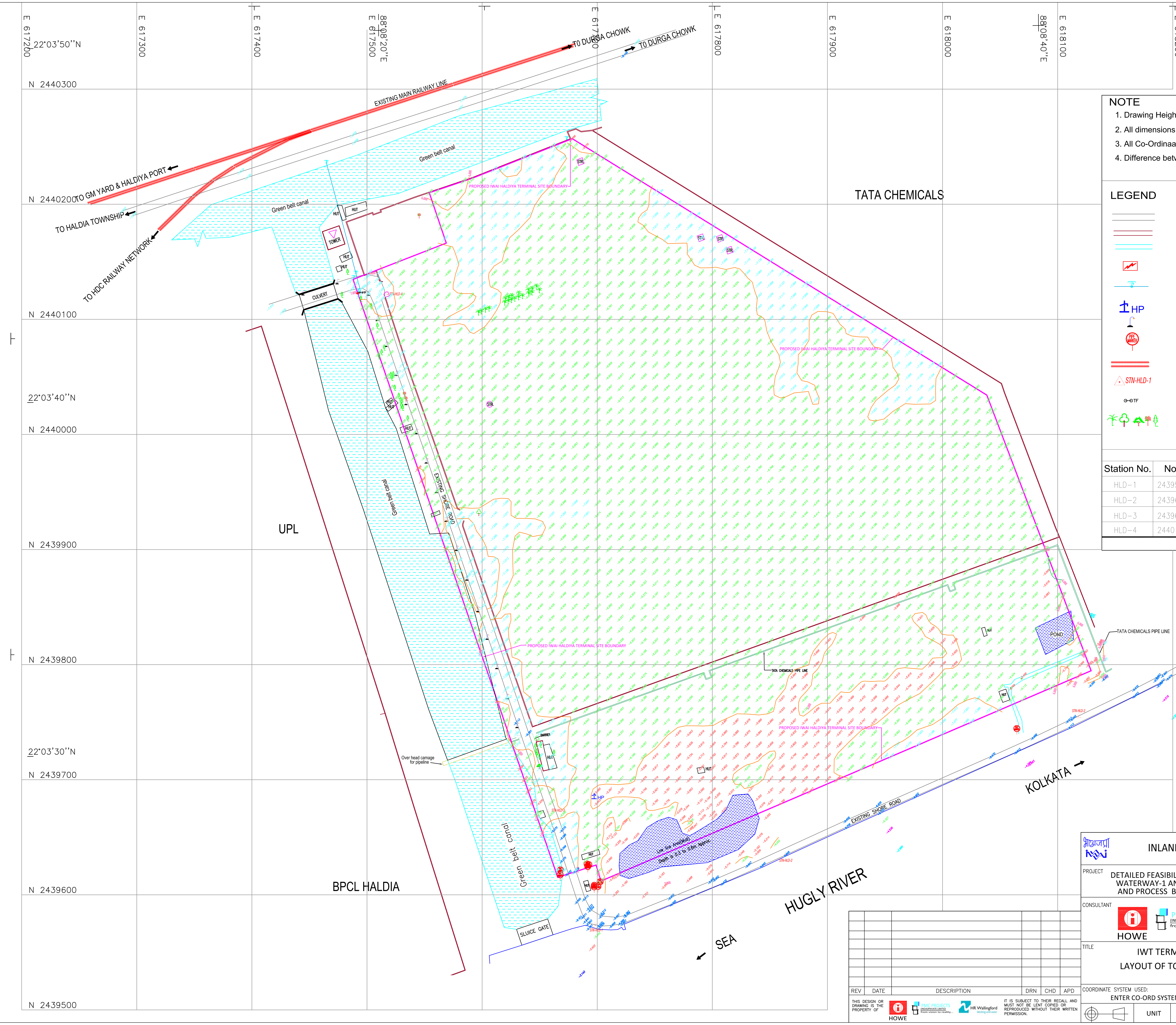
		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-44
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-45
Deducting local transportation cost	in Rs./t	106.27	111.58	117.18	129.19	164.91	210.49	268.68	342.92	416.87
Unit Rate - Export-parity price of Flyash	in Rs./t	772.60	811.23	851.76	939.07	1,198.49	1,529.57	1,952.11	2,491.44	3,028.29
Total cost - Export-parity price of Flyash	in Rs Mn	-	-	-	1,045.83	1,744.41	2,704.45	4,118.39	5,314.92	6,460.15
Incremental Benefit from the project	in Rs. Mn	0.00	0.00	0.00	441.75	736.79	1142.24	1739.37	2244.71	2728.30
Overall Incremental Economic Benefit from the project	in Rs. Mn	0	0	0	898	1319	1886	2691	3456	4200

Annexure 5 – Snapshot of Economic Analysis – Medium Augmentation Case

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-45
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-46
Capital Cost	Rs. '000	1,405,947	1,968,633	2,027,692	-	-	-	-	-	-
Benefit from the project										
Revenue from operation	Rs. '000	-	-	-	130,863	191,199	272,225	387,052	497,207	634,661
Other Revenue	Rs. '000	-	-	-	-	-	-	-	-	-
Economic Benefit	Rs. '000	-	-	-	898,219	1,319,375	1,885,786	2,690,943	3,455,870	4,331,387
Total Benefit from the project	Rs. '000	-	-	-	1,029,082	1,510,575	2,158,011	3,077,996	3,953,076	4,966,048
Operation Expenses										
Repair and Maintenance	Rs. '000	-	-	-	123,083	135,894	150,038	165,654	182,895	201,931
Operating Cost (Variable)	Rs. '000	-	-	-	267,850	301,612	339,825	383,101	432,141	487,745
Total OPEX	Rs. '000	-	-	-	390,934	437,506	489,863	548,755	615,036	689,676
Net Cash Flow	Rs. '000	(1,405,947)	(1,968,633)	(2,027,692)	638,148	1,073,069	1,668,148	2,529,241	3,338,040	4,276,372
Economic IRR		17.04%								

Annexure 6 – Snapshot of Financial Analysis – Medium Augmentation Case

		1-Jan-17	1-Apr-17	1-Apr-18	1-Apr-20	1-Apr-25	1-Apr-30	1-Apr-35	1-Apr-40	1-Apr-45
		31-Mar-17	31-Mar-18	31-Mar-19	31-Mar-21	31-Mar-26	31-Mar-31	31-Mar-36	31-Mar-41	31-Mar-46
Capital Cost	Rs. '000	1,460,555	2,081,126	2,143,560	-	-	-	-	-	-
Benefit from the project										
Revenue from operation	Rs. '000	-	-	-	130,863	191,199	272,225	387,052	497,207	634,661
Other Revenue	Rs. '000	-	-	-	-	-	-	-	-	-
Economic Benefit	Rs. '000	-	-	-	-	-	-	-	-	-
Total Benefit from the project	Rs. '000	-	-	-	130,863	191,199	272,225	387,052	497,207	634,661
Operation Expenses										
Repair and Maintenance	Rs. '000	-	-	-	123,083	135,894	150,038	165,654	182,895	201,931
Operating Cost (Variable)	Rs. '000	-	-	-	267,850	301,612	339,825	383,101	432,141	487,745
Total OPEX	Rs. '000	-	-	-	390,934	437,506	489,863	548,755	615,036	689,676
Net Cash Flow	Rs. '000	(1,460,555)	(2,081,126)	(2,143,560)	(260,127)	(246,439)	(217,953)	(162,245)	(118,163)	(55,615)
Financial IRR	(-)ve									



NOTE

1. Drawing Height in metres and decimetres, reduced to Chart Datum
2. All dimensions, Co-ordinates, elevations are in metres and decemetres.
3. All Co-Ordinaates are in WGS 1984 grid system
4. Difference between Mean Sea Level (MSL) & Chart Datum (CD) is 3.23m.

LEGEND

- ROAD EDGE
- COMPOUND WALL
- CANAL
- ELECTRIC JUNCTION BOX
- ELECTRIC POWER LINE
- HP HAND PUMP
- LAMP POST
- PIPE MARKER
- RAILWAY TRACK
- STN-HLD-1 REFERENCE SURVEY POINT
- TRANSFORMER
- COCONUT TREE/MANGO TREE/BANIYAN TREE/PALM TREE & etc.
- GROUND LEVEL

HORIZONTAL CONTROL STATION

Station No.	Northing	Easting	R.L	Remarks
HLD-1	2439573.5616	617698.1898	9.198	ON SECURITY CABIN FDN
HLD-2	2439634.9229	617863.8190	9.119	ON ROAD
HLD-3	2439672.0100	617657.2278	8.218	ON ROAD
HLD-4	2440121.5280	617517.4944	10.690	ON ROAD

REV	DATE	DESCRIPTION	DRN	CHD	APD

THIS DESIGN OR DRAWING IS THE PROPERTY OF HOWE / PMC PROJECTS / HR Wallingford. IT IS SUBJECT TO THEIR RECALL AND MUST NOT BE LENT COPIED OR REPRODUCED WITHOUT THEIR WRITTEN PERMISSION.

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE | PMC PROJECTS (INDIA) PRIVATE LIMITED, from vision to reality... | HR Wallingford, Working with water

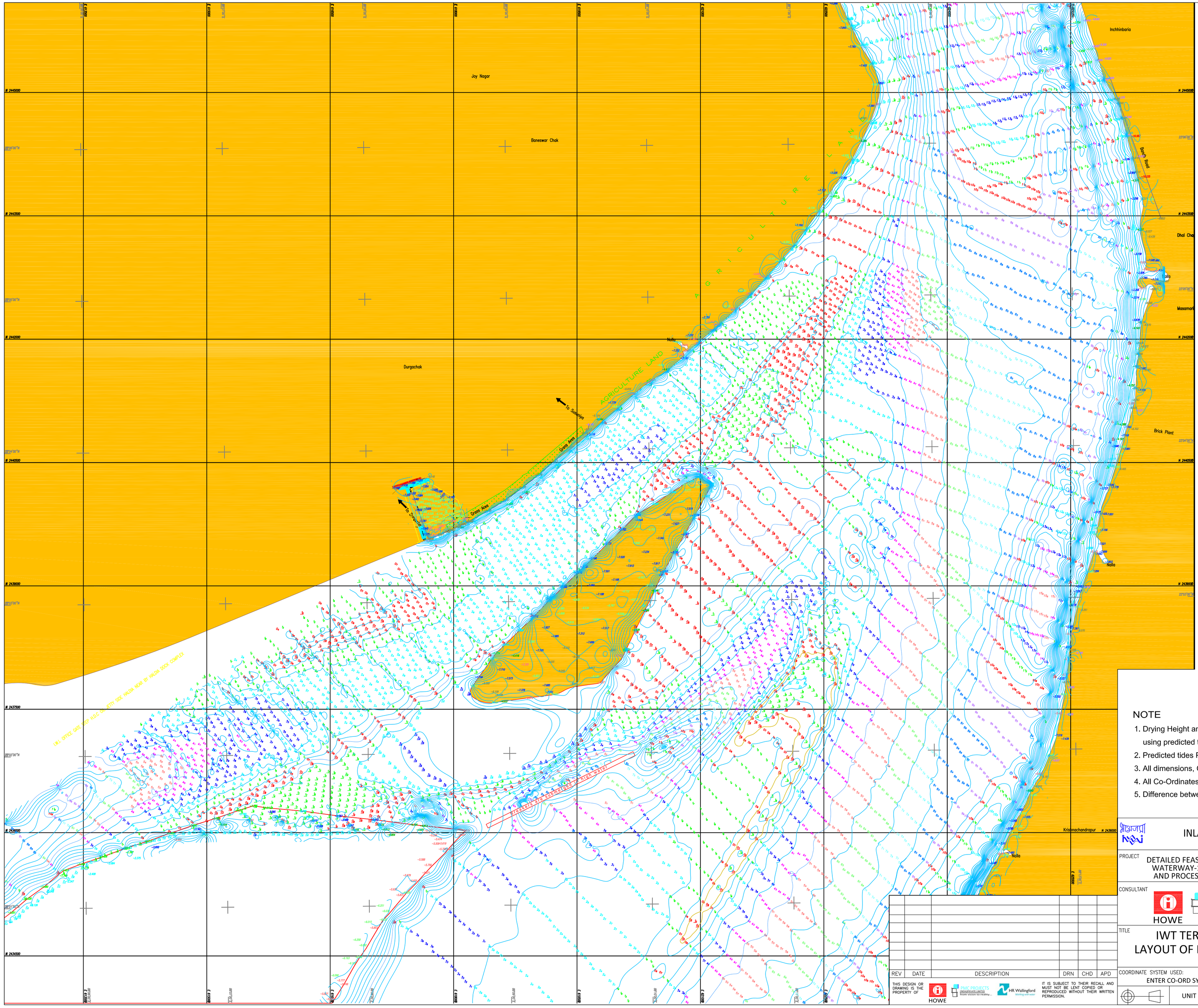
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA
LAYOUT OF TOPOGRAPHY SURVEY

JOB. NO. I-525
DRG. NO. HT-201

COORDINATE SYSTEM USED:
ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:1600 | Size : A1 | REV. 0



LEGEND

N 2438800	UTM Grid Line & Text
0_5 1_1 1_4	Colour coded heights in metres and decimetres above Chart Datum at 1m intervals
0_5 1_2 1_4	Colour coded drying depths in metres and decimetres below Chart Datum at 1m intervals
	Minor contour shown at 1m intervals.
	Major contour shown at 1m intervals.

Geodetic parameters

Horizontal Coordinate System	:	WGS84
Geodetic Datum / Spheroid	:	WGS84
Semi-Major Axis (a) (meters)	:	6 378 137.000m
Semi-Minor Axis	:	6 356 752.314m
Inverse Flattening	:	298.2572
Projection	:	Universal Transverse Mercator
Longitude of Origin (CM)	:	87° E (Zone 45)
Latitude of Origin	:	0° N (Equator)
Hemisphere	:	North
False Easting	:	500 000 m
False Northing	:	0 m
Scale Factor at CM	:	0.9996
Units	:	Metres

NOTE

1. Drying Height and Depths in metres and decimetres, reduced to Chart Datum using predicted tide at Haldia stn.
2. Predicted tides Provided by IWAI.
3. All dimensions, Co-ordinates, elevations are in metres and decimetres.
4. All Co-Ordinates are in WGS 1984 grid system & Height & Depth are in Chart Datum.
5. Difference between Mean Sea Level (MSL) & Chart Datum (CD) is 3.23m.

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA
LAYOUT OF BATHYMETRY SURVEY

JOB. NO. I-525 | DRG. NO. HT-202

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:22000 | Size : A1 | REV. 0

CO-ORDINATE IN UTM		
BOREHOLE MARKED	EASTING	NORTHING
BH1	617591.00	2440210.60
BH2	617689.20	2440109.00
BH3	617768.80	2440029.40
BH4	617918.00	2440052.30
BH5	617655.00	2439854.70
BH6	618021.00	2439930.60
BH7	617755.60	2439699.20
BH8	618029.00	2439827.00
BH9	617783.00	2439536.00
BH10	618099.00	2439684.00
BH11	617903.00	2439495.00
BH12	618042.00	2439566.00

N

BH1
BH2
BH3
BH4
BH5
BH6
BH7
BH8
BH9
BH10
BH11
BH12

KOLKATA

SEA

HUGLI RIVER

LEGEND:

PROPOSED TERMINAL

BOREHOLE LOCATION

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

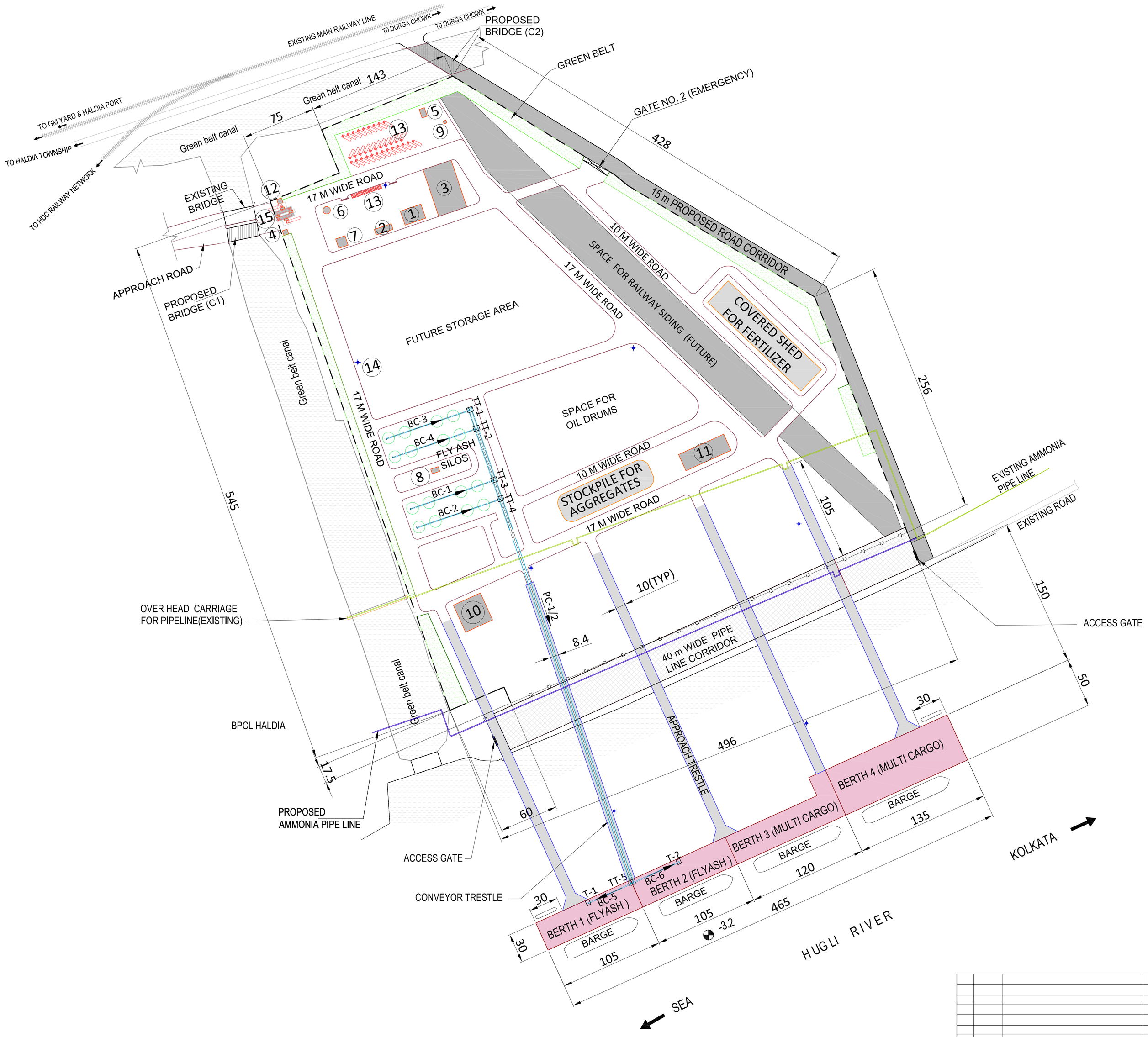
TITLE: IWT TERMINAL AT HALDIA
LOCATION PLAN OF BOREHOLES

JOB. NO. I-525

DRG. NO. HT-203

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:2000 | Size : A1 | REV. 0



LEGEND:

S.NO.	DESCRIPTION
1	TERMINAL ADMINISTRATION BUILDING
2	WORKER'S AMENITY BUILDING
3	FUEL BUNKER
4	SECURITY OFFICE
5	SEWAGE TREATMENT PLANT
6	OVERHEAD WATER TANK
7	UNDERGROUND RESERVOIR
8	RIO (REMOTE INPUT OUT PUT)/ COMPRESSOR ROOM FOR ASH HANDLING
9	WASTE COLLECTION CENTER
10	SETTLING POND
11	ELECTRICAL SUB STATION
12	WEIGH BRIDGE CONTROL ROOM
13	VEHICLE PARKING AREA
14	HIGHMAST LIGHTING TOWERS
15	GATE HOUSE COMPLEX

LEGEND:

SYMBOL	DESCRIPTION
TT	TRANSFER TOWER
T	TOWER
BC	BELT CONVEYORS
PC	PIPE CONVEYORS

N

NOTES:

1. ALL DIMENSIONS ARE IN METER
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

ALTERNATIVE-1 FLYASH, AGGREGATES, FERTILIZER, PETROLEUM PRODUCTS & EDIBLE OIL

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

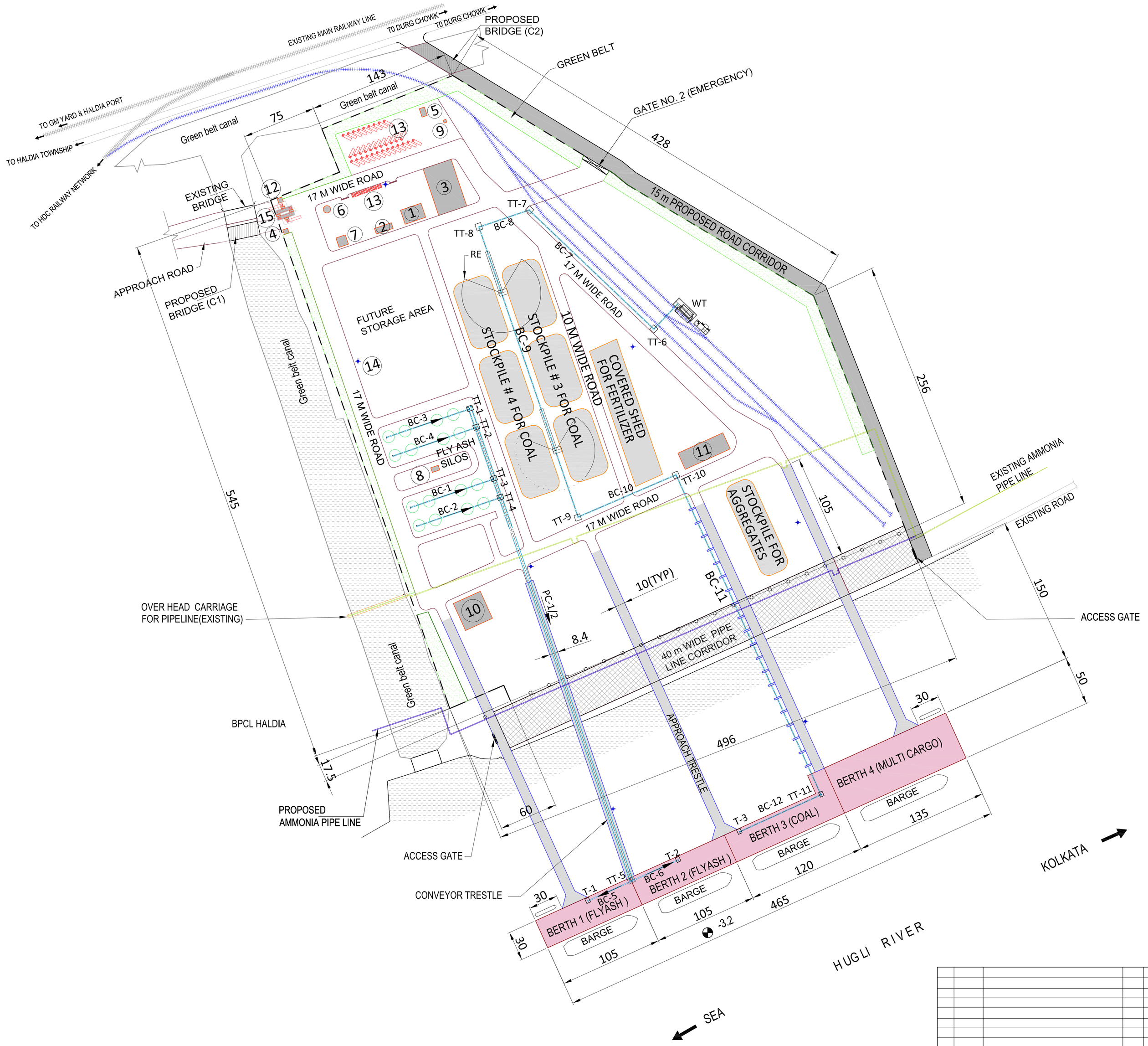
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA - LAYOUT PLAN OF TERMINAL FACILITIES AT HALDIA (ALTERNATIVE-1) RECOMMENDED LAYOUT

JOB. NO. I-525 | DRG. NO. HT-204

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:2000 | Size : A1 | REV. 0



LEGEND:

S.NO.	DESCRIPTION
1	TERMINAL ADMINISTRATION BUILDING
2	WORKER'S AMENITY BUILDING
3	FUEL BUNKER
4	SECURITY OFFICE
5	SEWAGE TREATMENT PLANT
6	OVERHEAD WATER TANK
7	UNDERGROUND RESERVOIR
8	RIO (REMOTE INPUT OUT PUT)/ COMPRESSOR ROOM FOR ASH HANDLING
9	WASTE COLLECTION CENTER
10	SETTLING POND
11	ELECTRICAL SUB STATION
12	WEIGH BRIDGE CONTROL ROOM
13	VEHICLE PARKING AREA
14	HIGHMAST LIGHTING TOWERS
15	GATE HOUSE COMPLEX

LEGEND:

SYMBOL	DESCRIPTION
TT	TRANSFER TOWER
T	TOWER
BC	BELT CONVEYORS
PC	PIPE CONVEYORS
RE	RECLAIMER
WT	WAGON TIPPLER

NOTES:

1. ALL DIMENSIONS ARE IN METER
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

ALTERNATIVE-2 FLYASH, COAL & AGGREGATES

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

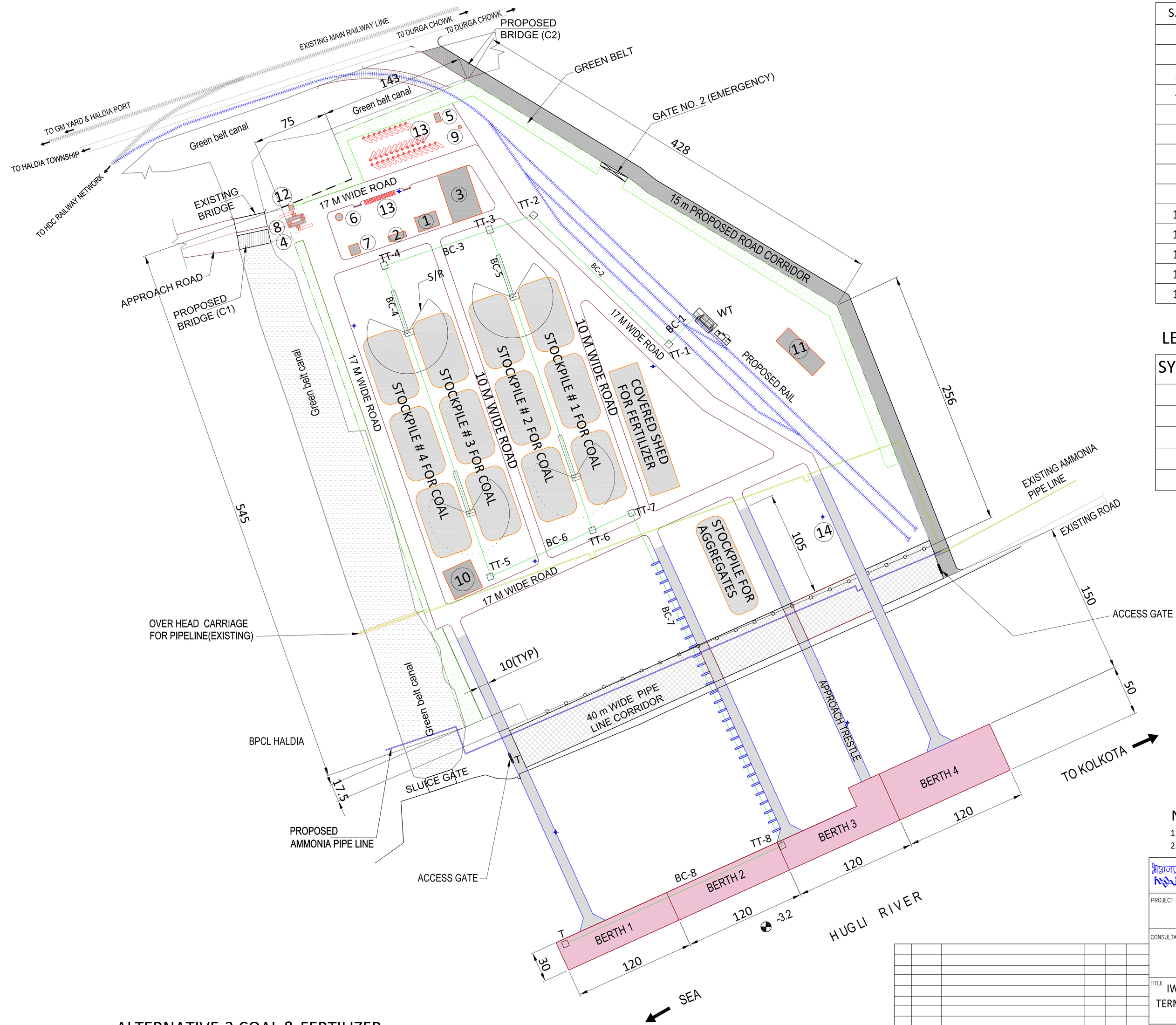
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA- LAYOUT PLAN OF TERMINAL FACILITIES AT HALDIA (ALTERNATIVE-2)

JOB. NO. I-525 | DRG. NO. HT-205

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:2000 | Size : A1 | REV. 0



ALTERNATIVE-3 COAL & FERTILIZER

N

LEGEND:

S.NO.	DESCRIPTION
1	TERMINAL ADMINISTRATION BUILDING
2	WORKER'S AMENITY BUILDING
3	FUEL BUNKER
4	SECURITY OFFICE
5	SEWAGE TREATMENT PLANT
6	OVERHEAD WATER TANK
7	UNDERGROUND RESERVOIR
8	GATE HOUSE COMPLEX
9	WASTE COLLECTION CENTER
10	SETTLING POND
11	ELECTRICAL SUB STATION
12	WEIGH BRIDGE CONTROL ROOM
13	VEHICLE PARKING AREA
14	HIGHMAST LIGHTING TOWERS

LEGEND:

SYMBOL	DESCRIPTION
TT	TRANSFER TOWER
T	TOWER
BC	BELT CONVEYORS
S/R	STACKER/RECLAMIER
WT	WAGON TIPPLER

NOTES:

1. ALL DIMENSIONS ARE IN METER
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

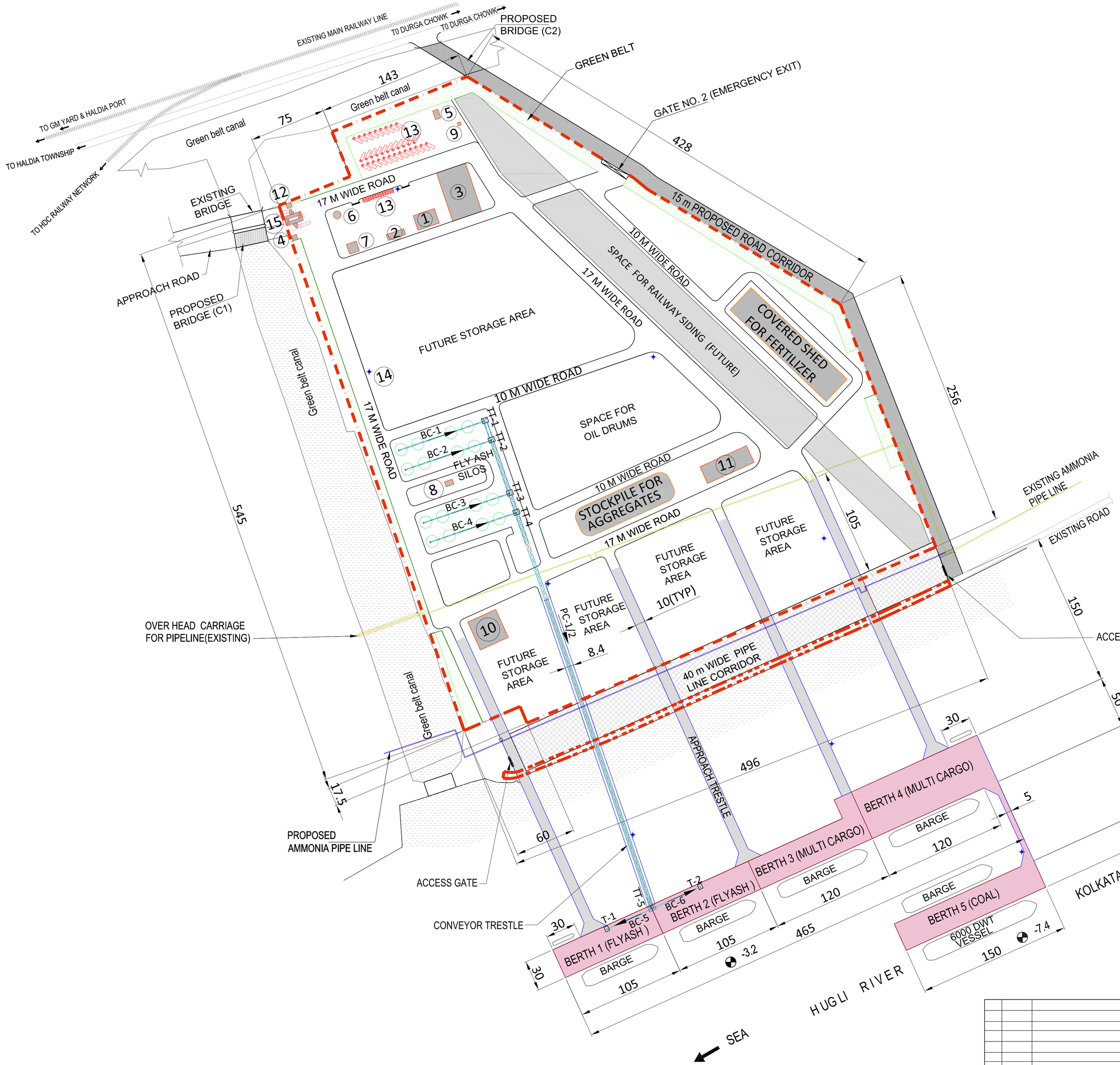
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA - LAYOUT PLAN OF TERMINAL FACILITIES AT HALDIA (ALTERNATIVE-3)

JOB. NO. I-525 | DRG. NO. HT-206

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:2000 | Size : A1 | REV. 0



LEGEND:

S.NO.	DESCRIPTION
1	TERMINAL ADMINISTRATION BUILDING
2	WORKER'S AMENITY BUILDING
3	FUEL BUNKER
4	SECURITY OFFICE
5	SEWAGE TREATMENT PLANT
6	OVERHEAD WATER TANK
7	UNDERGROUND RESERVOIR
8	RIO (REMOTE INPUT OUT PUT)/ COMPRESSOR ROOM FOR ASH HANDLING
9	WASTE COLLECTION CENTER
10	SETTLING POND
11	ELECTRICAL SUB STATION
12	WEIGH BRIDGE CONTROL ROOM
13	VEHICLE PARKING AREA (5030 sqm approx.)
14	HIGHMAST LIGHTING TOWERS
15	GATE HOUSE COMPLEX

LEGEND:

SYMBOL	DESCRIPTION
TT	TRANSFER TOWER
T	TOWER
BC	BELT CONVEYORS
PC	PIPE CONVEYORS

N

NOTES:

1. ALL DIMENSIONS ARE IN METER
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

ALTERNATIVE-4 FLYASH, AGGREGATES, FERTILIZER, PETROLEUM PRODUCTS, EDIBLE OIL & COAL TRANSHIPMENT

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

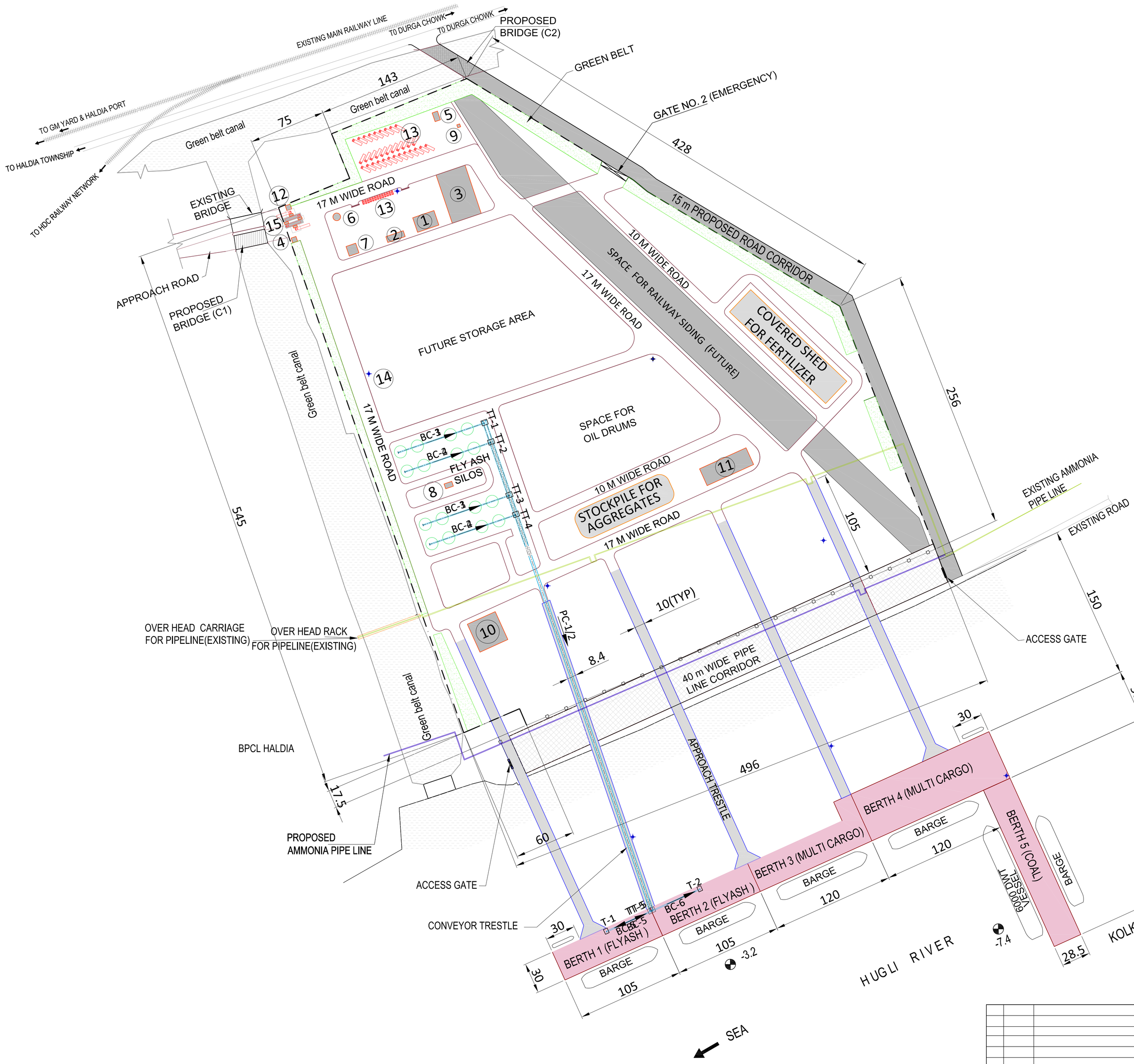
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA - LAYOUT PLAN OF TERMINAL FACILITIES AT HALDIA (ALTERNATIVE-4)

JOB. NO. I-525 | DRG. NO. HT-207

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:2000 | Size : A1 | REV. 0



LEGEND:

S.NO.	DESCRIPTION
1	TERMINAL ADMINISTRATION BUILDING
2	WORKER'S AMENITY BUILDING
3	FUEL BUNKER
4	SECURITY OFFICE
5	SEWAGE TREATMENT PLANT
6	OVERHEAD WATER TANK
7	UNDERGROUND RESERVOIR
8	RIO (REMOTE INPUT OUT PUT)/ COMPRESSOR ROOM FOR ASH HANDLING
9	WASTE COLLECTION CENTER
10	SETTLING POND
11	ELECTRICAL SUB STATION
12	WEIGH BRIDGE CONTROL ROOM
13	VEHICLE PARKING AREA
14	HIGHMAST LIGHTING TOWERS
15	GATE HOUSE COMPLEX

LEGEND:

SYMBOL	DESCRIPTION
TT	TRANSFER TOWER
T	TOWER
BC	BELT CONVEYORS
PC	PIPE CONVEYORS

NOTES:

1. ALL DIMENSIONS ARE IN METER
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

ALTERNATIVE-5 FLYASH, AGGREGATES, FERTILIZER, PETROLEUM PRODUCTS, EDIBLE OIL & COAL TRANSHIPMENT

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

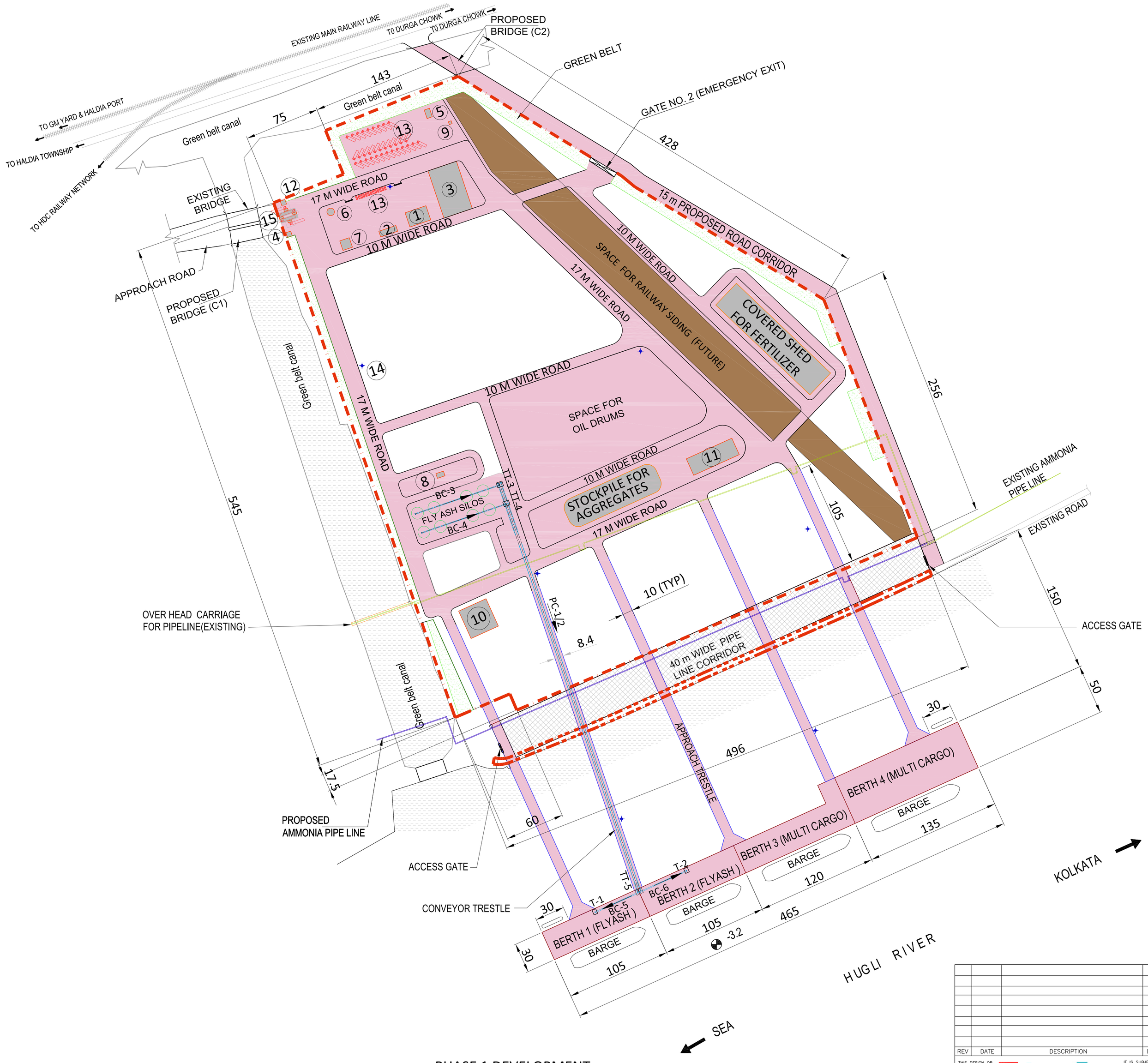
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA - LAYOUT PLAN OF TERMINAL FACILITIES AT HALDIA (ALTERNATIVE-5)

JOB. NO. I-525 | DRG. NO. HT-208

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:2000 | Size : A1 | REV. 0



PHASE 1 DEVELOPMENT

LEGEND:

S.NO.	DESCRIPTION
1	TERMINAL ADMINISTRATION BUILDING
2	WORKER'S AMENITY BUILDING
3	FUEL BUNKER
4	SECURITY OFFICE
5	SEWAGE TREATMENT PLANT
6	OVERHEAD WATER TANK
7	UNDERGROUND RESERVOIR
8	RIO (REMOTE INPUT OUT PUT)/ COMPRESSOR ROOM FOR ASH HANDLING
9	WASTE COLLECTION CENTER
10	SETTLING POND
11	ELECTRICAL SUB STATION
12	WEIGH BRIDGE CONTROL ROOM
13	VEHICLE PARKING AREA (5030 sqm approx.)
14	HIGHMAST LIGHTING TOWERS
15	GATE HOUSE COMPLEX

LEGEND:

SYMBOL	DESCRIPTION
TT	TRANSFER TOWER
T	TOWER
BC	BELT CONVEYORS
PC	PIPE CONVEYORS

PHASE - 1

TERMINAL BOUNDARY LIMIT

NOTES:

1. ALL DIMENSIONS ARE IN METER
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM
3. PROPOSED AMMONIA PIPE LINE IS TAKEN FROM DWG. NO. 85091-LAY-LD-001,REV1, PROPOSED MODIFICATION OF PIPING LAYOUT FOR 16'' & 4'' AMMONIA PIPE LINE

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

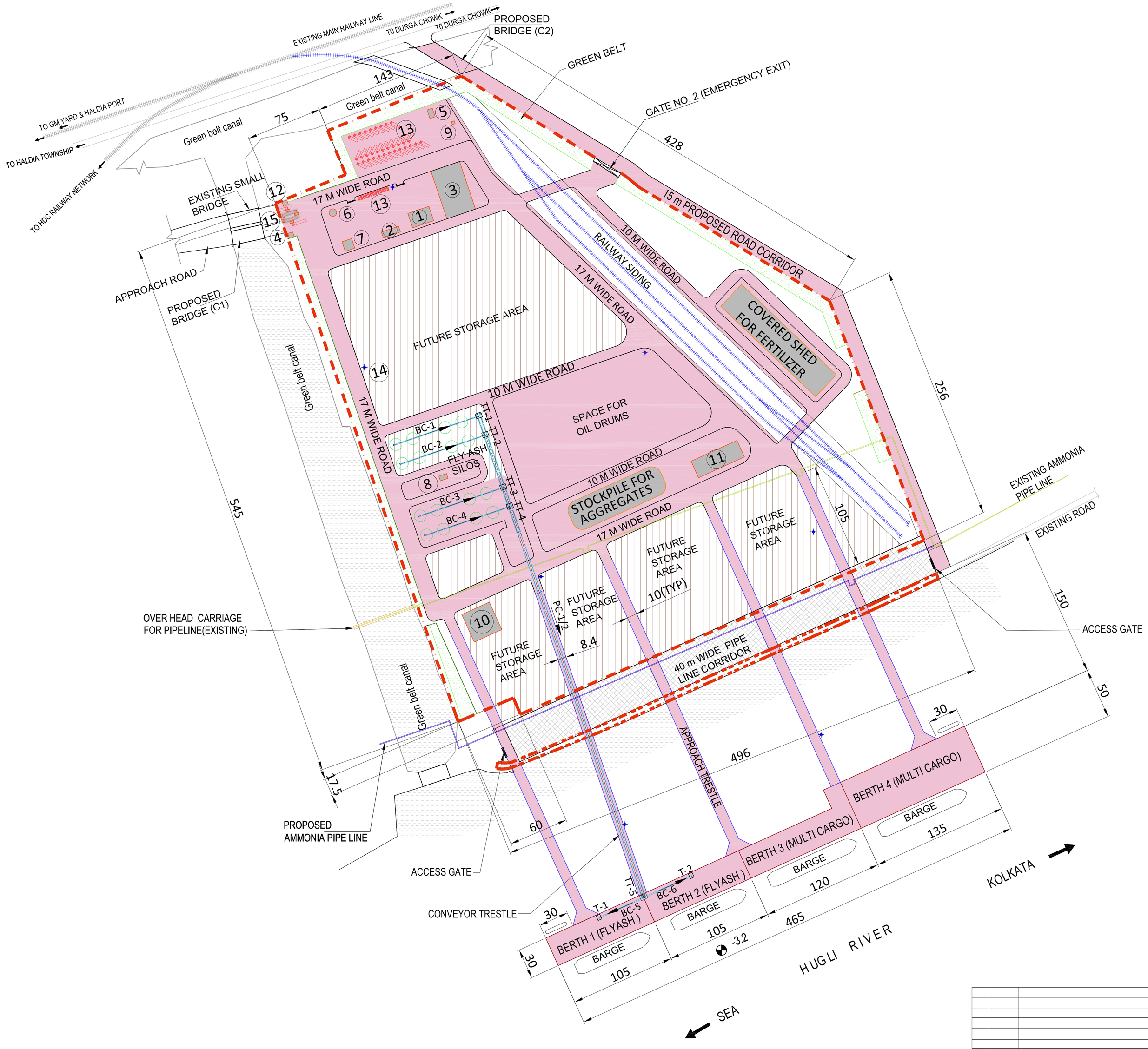
	NAME	SIGN	DATE
DRN	SKN		30–05–2016
CHD	HM/SKA		30–05–2016
APD	S DHAR		30–05–2016

TITLE: IWT TERMINAL AT HALDIA- LAYOUT PLAN OF TERMINAL FACILITIES AT HALDIA PHASE 1

JOB. NO. I-525 | DRG. NO. HT-209

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:2000 | Size : A1 | REV. 0



LEGEND:

S.NO.	DESCRIPTION
1	TERMINAL ADMINISTRATION BUILDING
2	WORKER'S AMENITY BUILDING
3	FUEL BUNKER
4	SECURITY OFFICE
5	SEWAGE TREATMENT PLANT
6	OVERHEAD WATER TANK
7	UNDERGROUND RESERVOIR
8	RIO (REMOTE INPUT OUT PUT)/ COMPRESSOR ROOM FOR ASH HANDLING
9	WASTE COLLECTION CENTER
10	SETTLING POND
11	ELECTRICAL SUB STATION
12	WEIGH BRIDGE CONTROL ROOM
13	VEHICLE PARKING AREA (5030 sqm approx.)
14	HIGHMAST LIGHTING TOWERS
15	GATE HOUSE COMPLEX

LEGEND:

SYMBOL	DESCRIPTION
TT	TRANSFER TOWER
T	TOWER
BC	BELT CONVEYORS
PC	PIPE CONVEYORS

PHASE - 1

PHASE - 2

TERMINAL BOUNDARY LIMIT

NOTES:

1. ALL DIMENSIONS ARE IN METER
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

PHASE 2 DEVELOPMENT

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

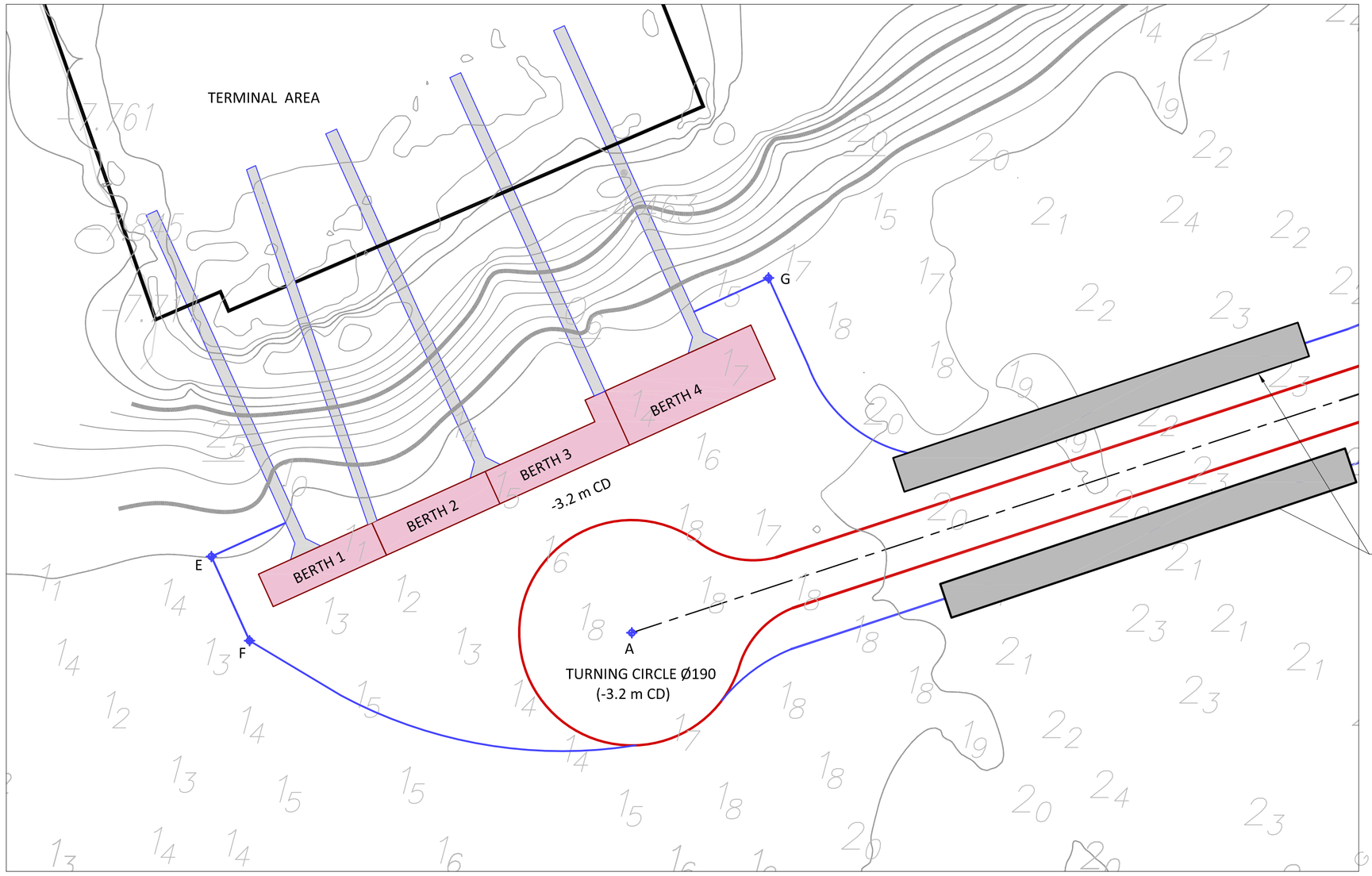
	NAME	SIGN	DATE
DRN	SKN		
CHD	HM/SKA		
APD	S DHAR		

TITLE: IWT TERMINAL AT HALDIA- LAYOUT PLAN OF TERMINAL FACILITIES AT HALDIA PHASE 2

JOB. NO. I-525 | DRG. NO. HT-210

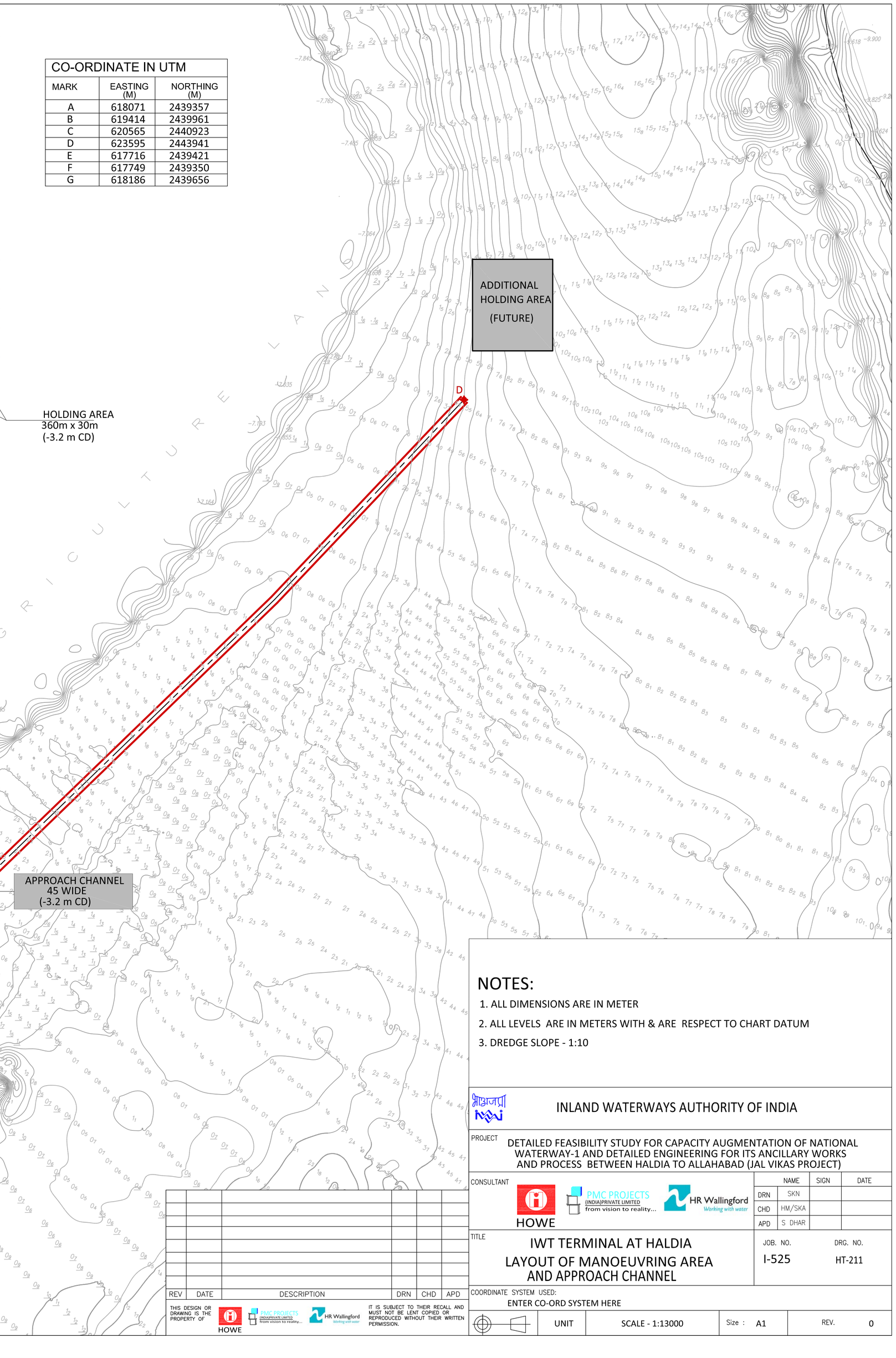
COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:2000 | Size : A1 | REV. 0



DETAIL -X
NTS

CO-ORDINATE IN UTM		
MARK	EASTING (M)	NORTHING (M)
A	618071	2439357
B	619414	2439961
C	620565	2440923
D	623595	2443941
E	617716	2439421
F	617749	2439350
G	618186	2439656



NOTES:

1. ALL DIMENSIONS ARE IN METER
2. ALL LEVELS ARE IN METERS WITH & ARE RESPECT TO CHART DATUM
3. DREDGE SLOPE - 1:10

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

	NAME	SIGN	DATE
DRN	SKN		
CHD	HM/SKA		
APD	S DHAR		

TITLE: IWT TERMINAL AT HALDIA
LAYOUT OF MANOEUVRING AREA AND APPROACH CHANNEL

JOB. NO. I-525 | DRG. NO. HT-211

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:13000 | Size : A1 | REV. 0

17 M WIDE ROAD

℄ OF APPROACH TRESTLE – 1 | ℄ OF APPROACH TRESTLE – 2 | ℄ OF APPROACH TRESTLE – 3 | ℄ OF APPROACH TRESTLE – 4

REINFORCED EARTH WALL

40 m WIDE PIPE LINE CORRIDOR

326025 APPROACH TRESTLE

APPROACH TRESTLE - 1 | CONVEYOR TRESTLE | APPROACH TRESTLE - 2 | APPROACH TRESTLE - 3 | APPROACH TRESTLE - 4

P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P13 P14 P15 P16 P17 P18 P19 P20 P21 P22 P23 P24 P25 P26 P27 P28 P29 P30 P31 P32 P33 P34 P35 P36 P37 P38

T5 T6 T7 T8 T9 T10 T11 T12 T13 T14

A B C D E F G H J K

44000 30000 115000 96000 44000 30000

1 11 17 26 33 42 43 49 56 64 67

2250 7000 7000 7000 6000 750 1250 50000

BOLLARD (TYP) FENDER (TYP) 7500 TYP. ℄ OF EXP. GAP X' 5000 TYP. SERVICE DUCT (W X H) (1000x600) 6250 TYP.

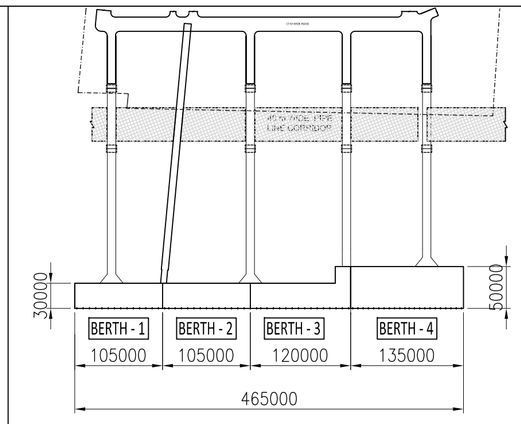
BERTH - 1 105000 | BERTH - 2 105000 | BERTH - 3 120000 | BERTH - 4 135000

110000 110000 110000 67500 67500

465000

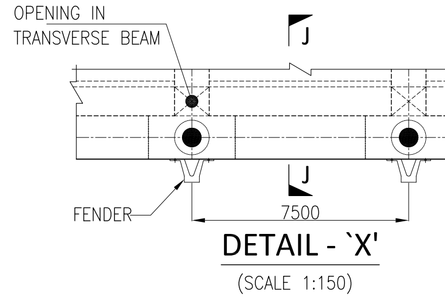
PLAN OF JETTY & APPROACH TRESTLE

(SCALE 1:800)



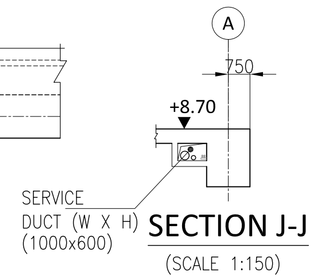
KEY PLAN

(SCALE 1:5000)



DETAIL - `X'

(SCALE 1:150)



SECTION J-J

(SCALE 1:150)

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM
3. SUBSTRUCTURE SHOULD BE AVOIDED IN '40m. PIPELINE CORRIDOR'
4. MS. LINER NOT SHOWN IN THE DRAWING FOR CLARITY.
   MS. LINER FOR PILES SHOULD BE PROVIED UP TO (–) 35m CD OR DEPTH WHERE SPT N–VALUE GREATER THAN OR EQUAL TO TEN (10) AND IN INCREASING ORDER, WHICHEVER IS MORE.
5. DURING PHASE 1A DEVELOPMENT, FENDERS & BOLLARDS SHALL BE PROVIDED IN GRIDS 65, 66 & 67

REV	DATE	DESCRIPTION	DRN	CHD	APD
R2	11.05.16	REMOVAL OF BERTH 5	SKN	KR	SD
R1	07.04.16	THE SERVICE TRENCH INCLUDED	SKN	AKM	SD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE | PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality... | HR Wallingford Working with water

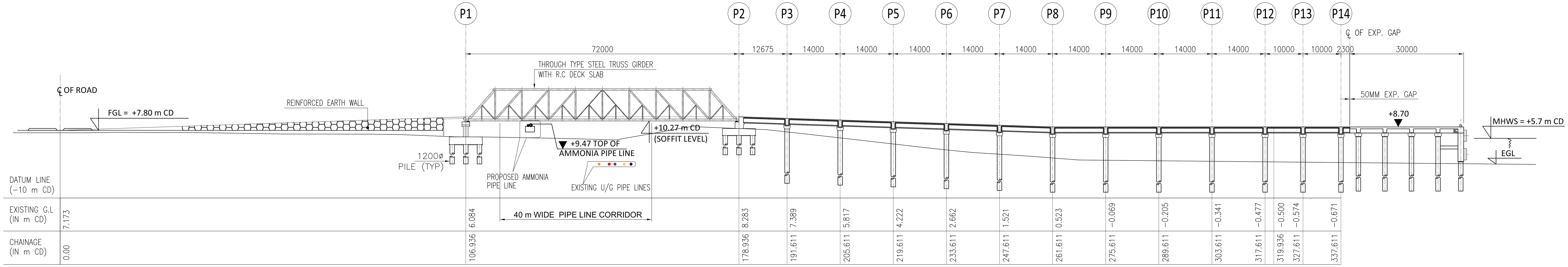
	NAME	SIGN	DATE
DRN	SKN/HY		30–05–2016
CHD	AKK/PKM		30–05–2016
APD	S DHAR		30–05–2016

TITLE: IWT TERMINAL AT HALDIA - GENERAL ARRANGEMENT OF JETTY AND APPROACH TRESTLE

JOB. NO. I-525 | DRG. NO. HT-212

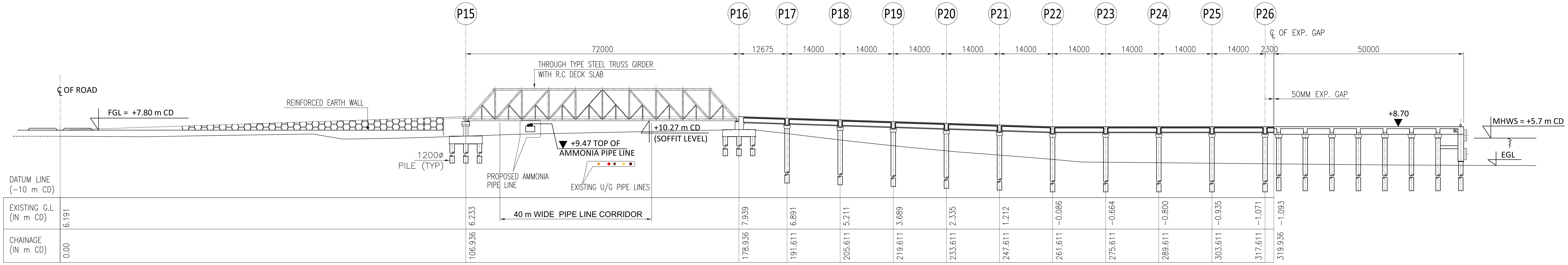
COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - AS SHOWN | Size : A1 | REV. 2



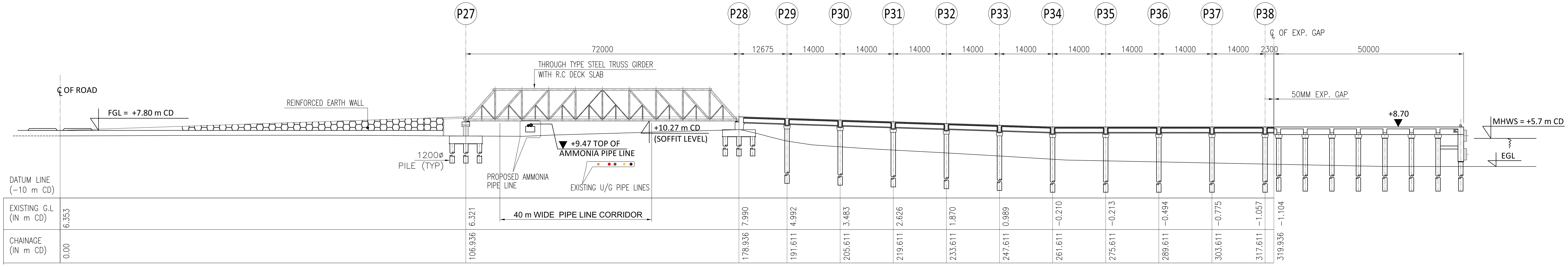
LONGITUDINAL ELEVATION OF APPROACH TRESTLE - 1 & 2

(SCALE 1:500)



LONGITUDINAL ELEVATION OF APPROACH TRESTLE - 3

(SCALE 1:500)



LONGITUDINAL ELEVATION OF APPROACH TRESTLE - 4

(SCALE 1:500)

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM
3. MINIMUM VERTICAL CLEARANCE ABOVE AMMONIA PIPE SHOULD BE 800mm.
4. ALL OTHER NOTES REFER TO DRAWING NO. HT-1005, SHEET-1
5. PROPOSED AMMONIA PIPE LINE IS TAKEN FROM DWG. NO. 85091-LAY-LD-001,REV1, PROPOSED MODIFICATION OF PIPING LAYOUT FOR 16" & 4" AMMONIA PIPE LINE
6. THE EXISTING UNDER GROUND PIPE LINE TAKEN FROM PXPL-54-01-5008-1/2 REV 02 2ND PXPL ALIGNMENT SHEET CHAINAGE 3849.65 TO 4626.00m

REV	DATE	DESCRIPTION	DRN	CHD	APD
R1	11.05.16	SHOWN IN 40M WIDE PIPE LINE CORRIDOR	SKN	KR	SD

THIS DESIGN OR DRAWING IS THE PROPERTY OF HOWE | PMC PROJECTS | HR Wallingford

IT IS SUBJECT TO THEIR RECALL AND MUST NOT BE LENT COPIED OR REPRODUCED WITHOUT THEIR WRITTEN PERMISSION.

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE | PMC PROJECTS (INDIA) PRIVATE LIMITED from vision to reality... | HR Wallingford Working with water

	NAME	SIGN	DATE
DRN	SKN/HY		30-05-2016
CHD	AKK/PKM		30-05-2016
APD	S DHAR		30-05-2016

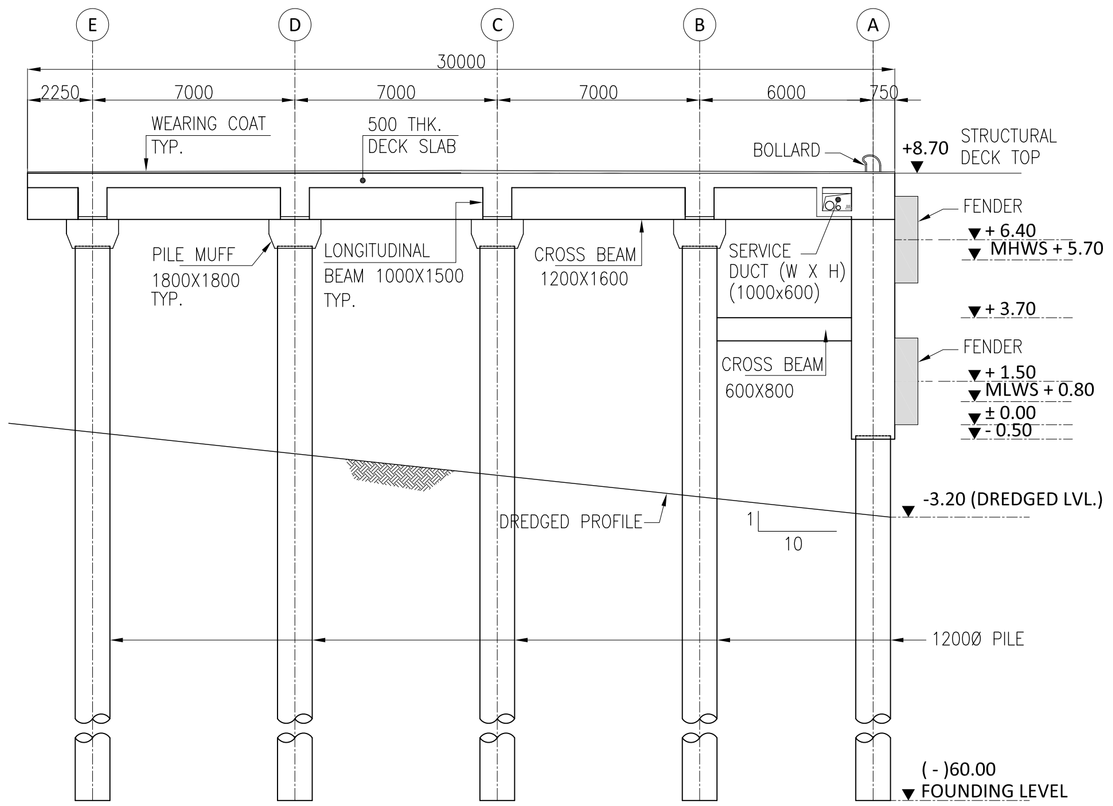
TITLE: IWT TERMINAL AT HALDIA - CROSS SECTION OF JETTY AND APPROACH TRESTLE

JOB. NO. I-525

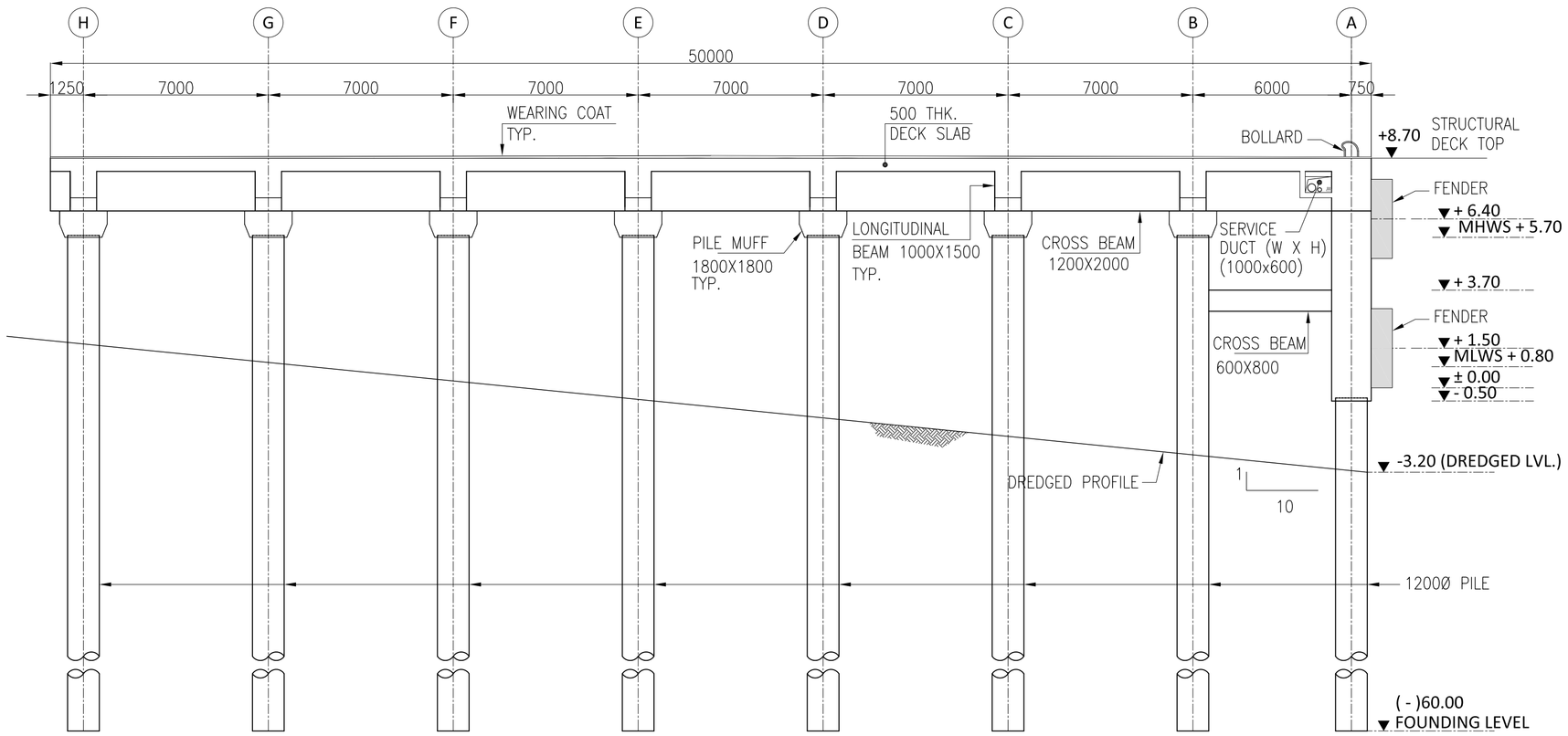
DRG. NO. HT-213 (SH.1 OF 2)

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

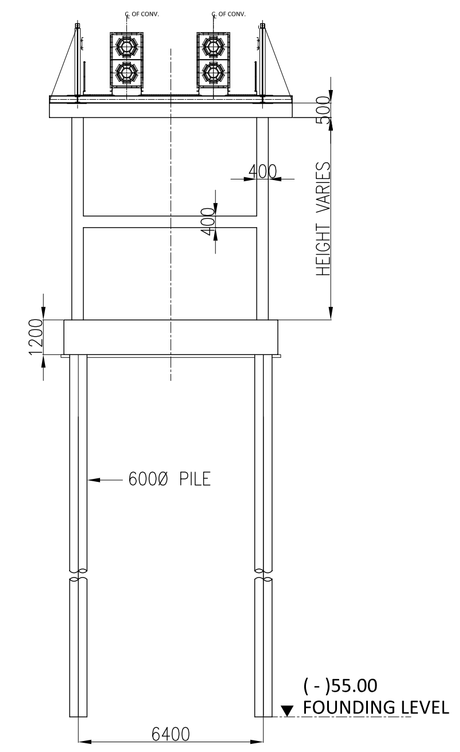
UNIT | SCALE - AS SHOWN | Size : A1 | REV. 1



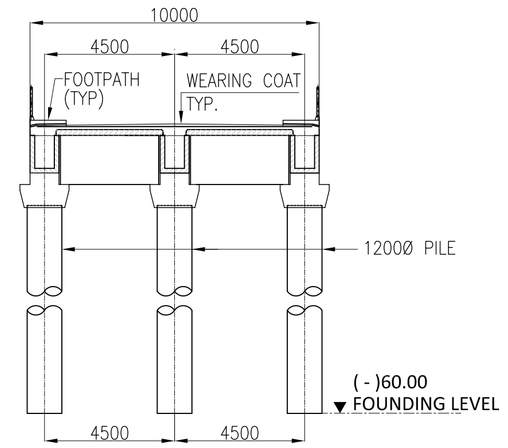
SECTION A-A
(SCALE 1:150)



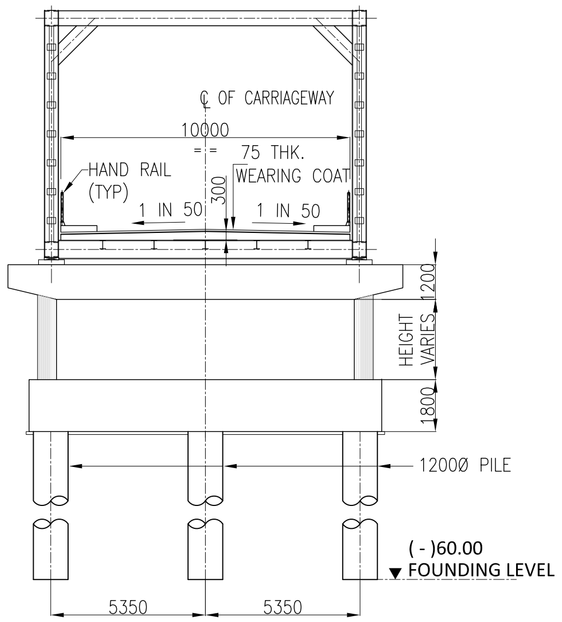
SECTION B-B
(SCALE 1:150)



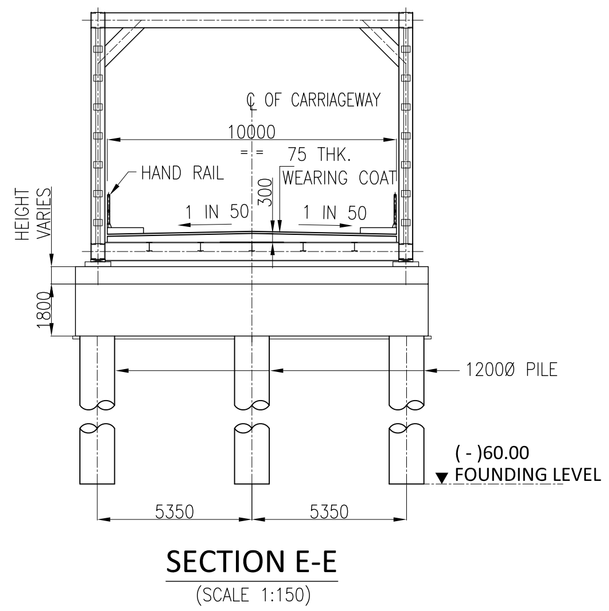
SECTION F-F
(SCALE 1:150)



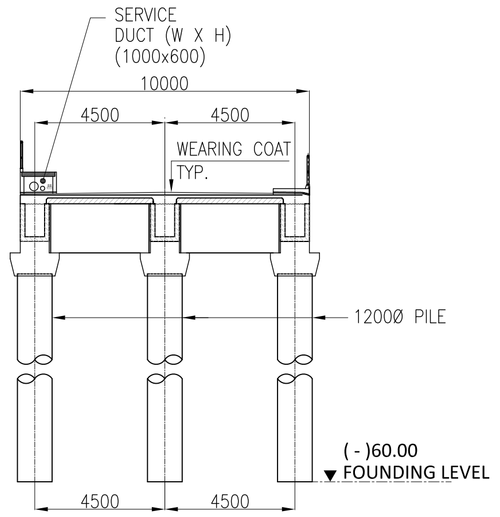
SECTION C-C
(SCALE 1:150)



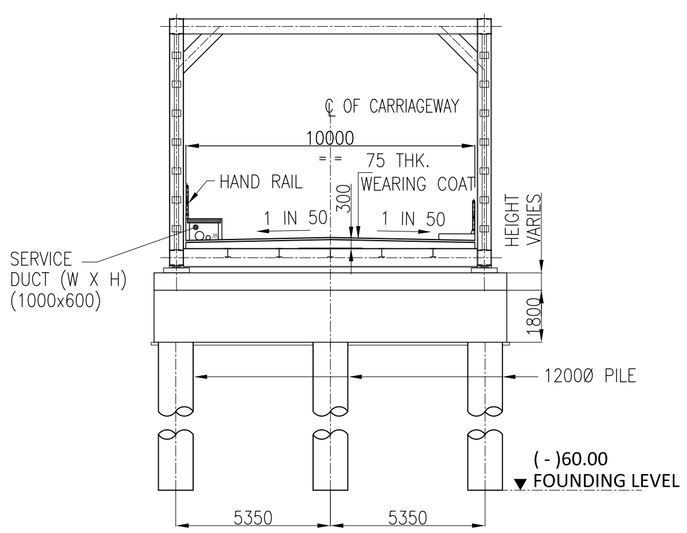
SECTION D-D
(SCALE 1:150)



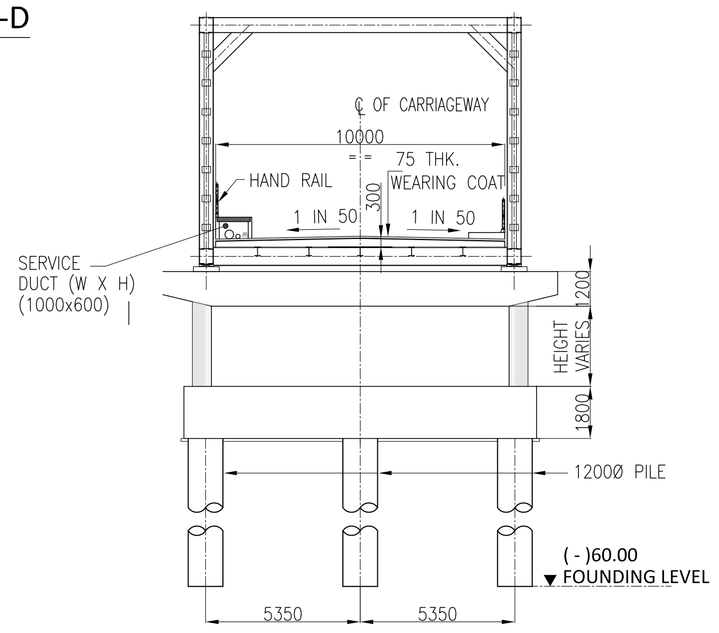
SECTION E-E
(SCALE 1:150)



SECTION G-G
(SCALE 1:150)



SECTION K-K
(SCALE 1:150)



SECTION H-H
(SCALE 1:150)

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS.
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM.
3. ALL FOUNDING LEVELS ARE TENTATIVE. ACTUAL FOUNDING LEVEL MAY VARY AS PER THE ACTUAL SOIL CONDITION AT SITE.
4. ALL OTHER NOTES REFER TO DRAWING NO. HT-1005, SHEET-1.

REV	DATE	DESCRIPTION	DRN	CHD	APD
R2	11.05.16	REMOVAL OF BERTH 5	SKN	KR	SD
R1	07.04.16	THE SERVICE TRENCH INCLUDED	SKN	AKM	SD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

	NAME	SIGN	DATE
DRN	SKN/HY		30-05-2016
CHD	AKK/PKM		30-05-2016
APD	S DHAR		30-05-2016

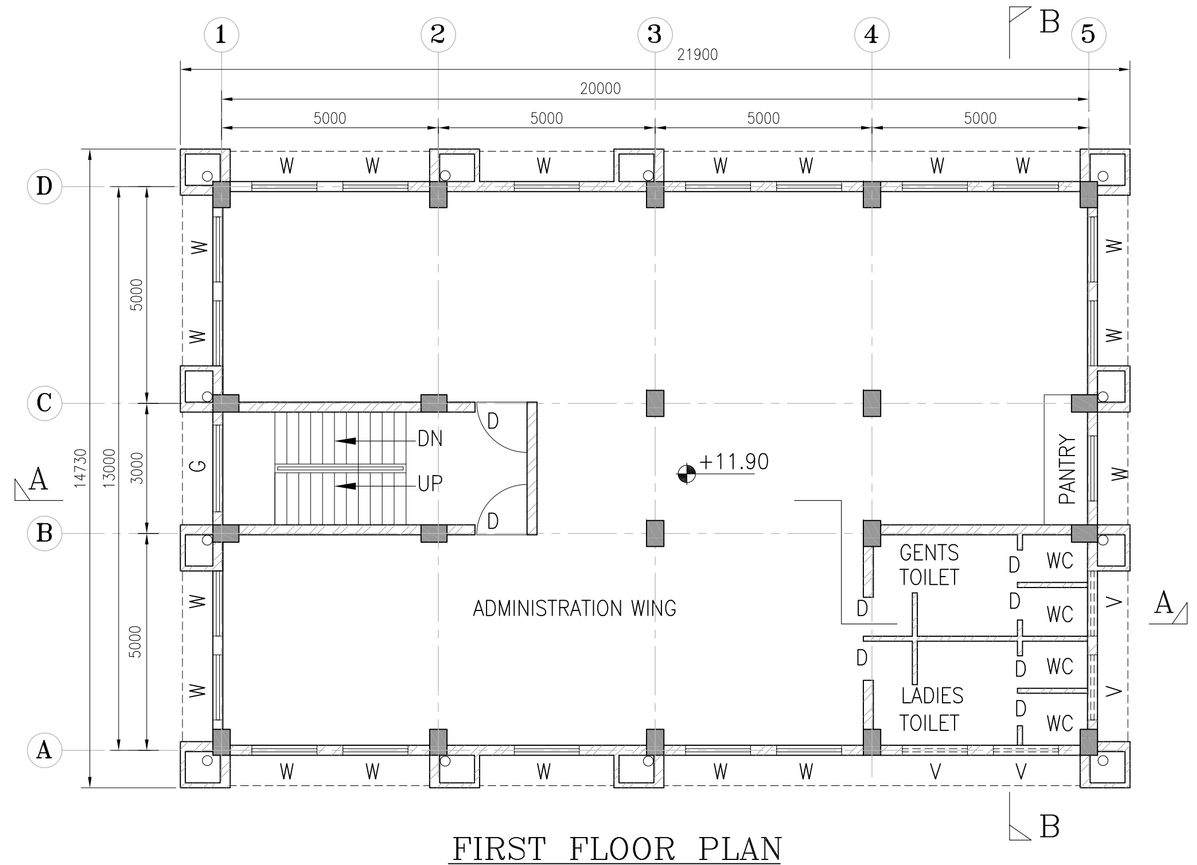
TITLE: IWT TERMINAL AT HALDIA - CROSS SECTION OF JETTY AND APPROACH TRESTLE

JOB. NO. I-525

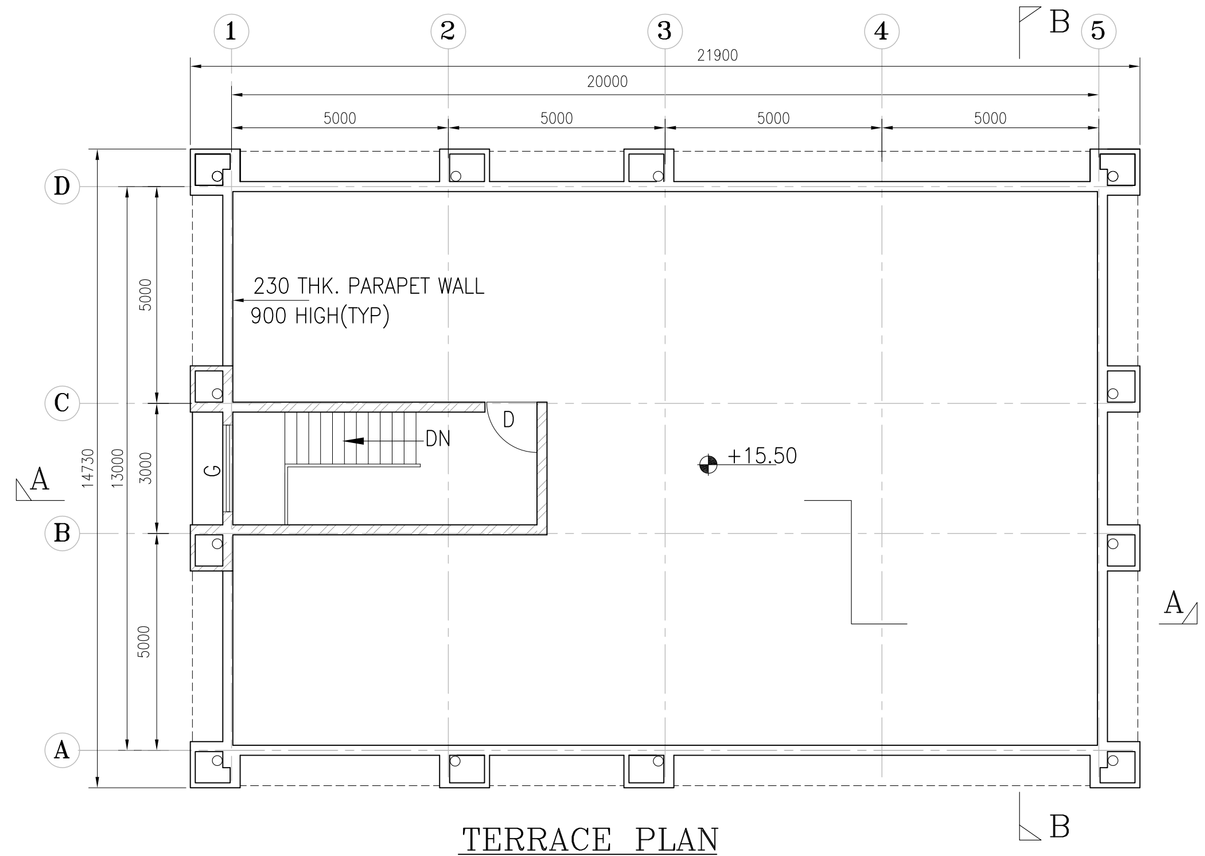
DRG. NO. HT-213 (SH.2 OF 2)

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

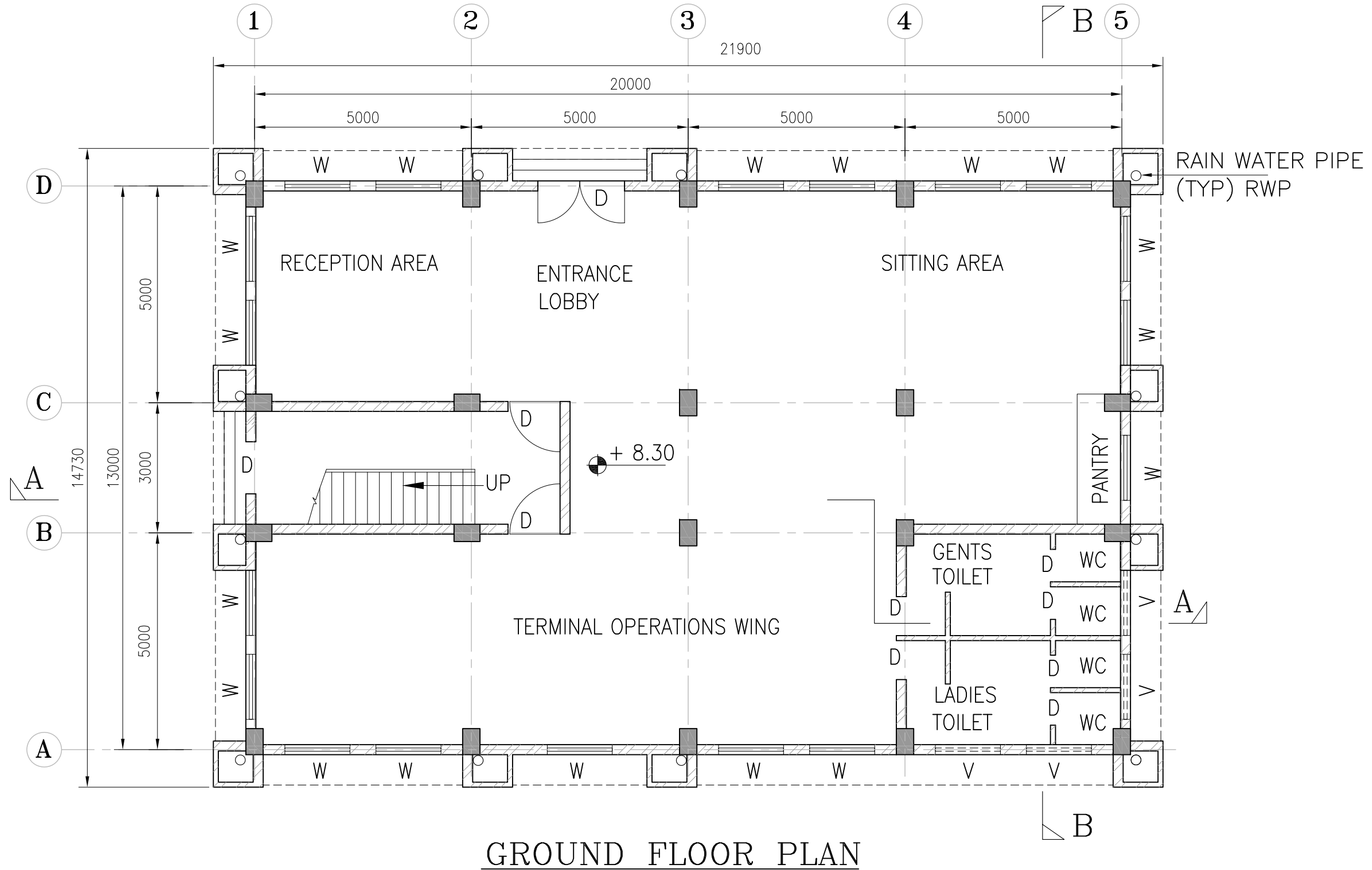
UNIT | SCALE - AS SHOWN | Size : A1 | REV. 2



FIRST FLOOR PLAN



TERRACE PLAN



GROUND FLOOR PLAN

SCHEDULE		
S.NO:	TYPE	DESCRIPTION
1.	D	DOOR
2.	W	WINDOW
3.	V	VENTILATOR
4.	G	GLASS WINDOW
5.	WC	WATER CLOSET

E.G.L.–EXISTING GROUND LEVEL
F.F.L.–FINISH FLOOR LEVEL

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

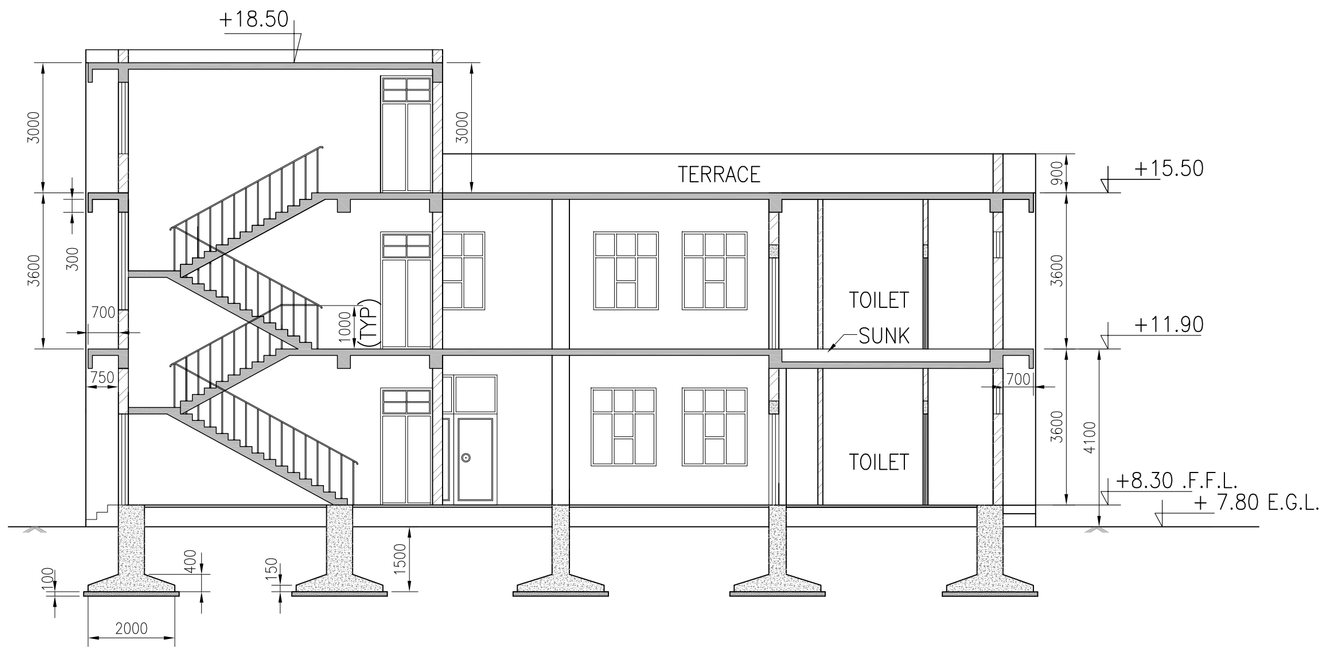
	NAME	SIGN	DATE
DRN	SKN		30–05–2016
CHD	HM/SKA		30–05–2016
APD	S DHAR		30–05–2016

TITLE: IWT TERMINAL AT HALDIA
TYPICAL LAYOUT OF TERMINAL ADMINISTRATION BUILDING

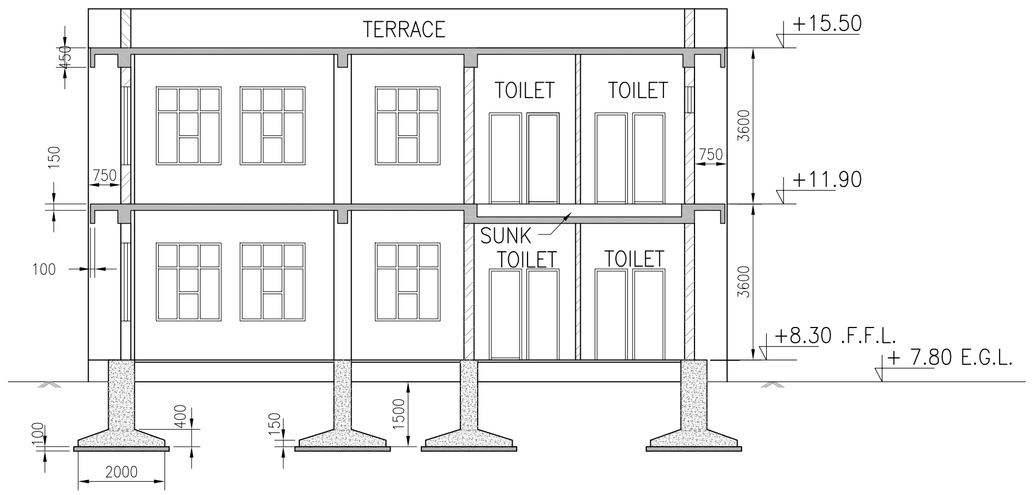
JOB. NO. I-525 | DRG. NO. HT-214

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

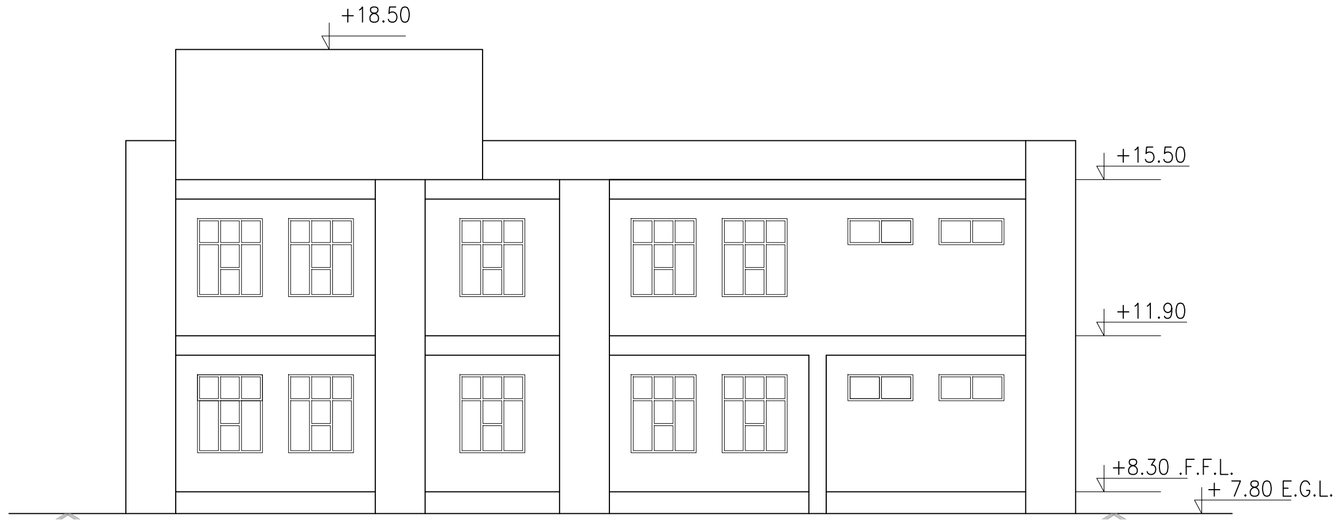
UNIT | SCALE - 1:100 | Size : A1 | REV. 0



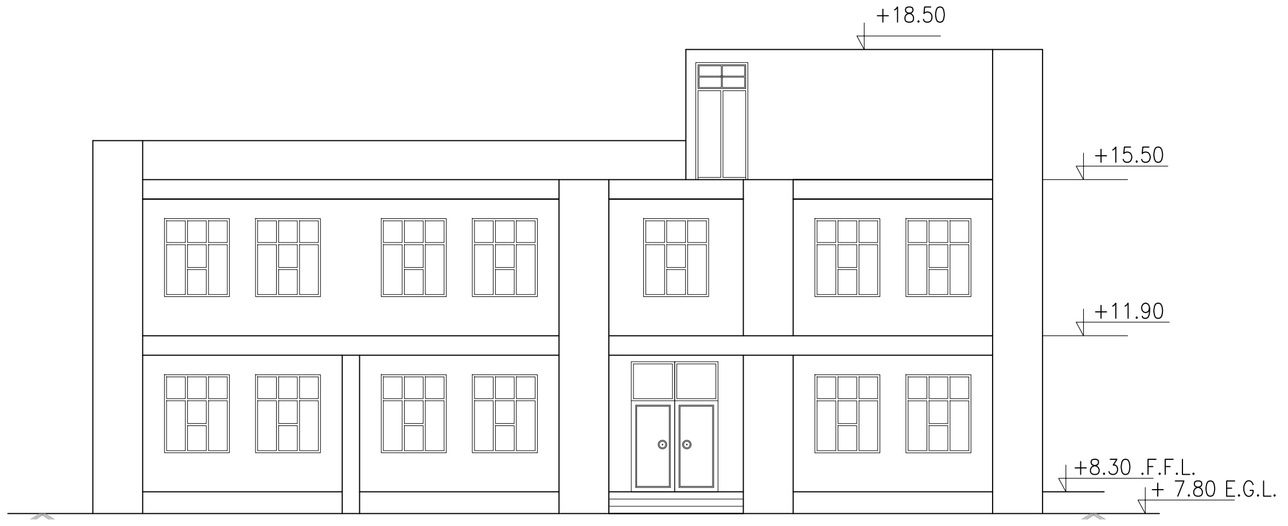
SECTION A–A



SECTION B–B



FRONT ELEVATION



REAR ELEVATION

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

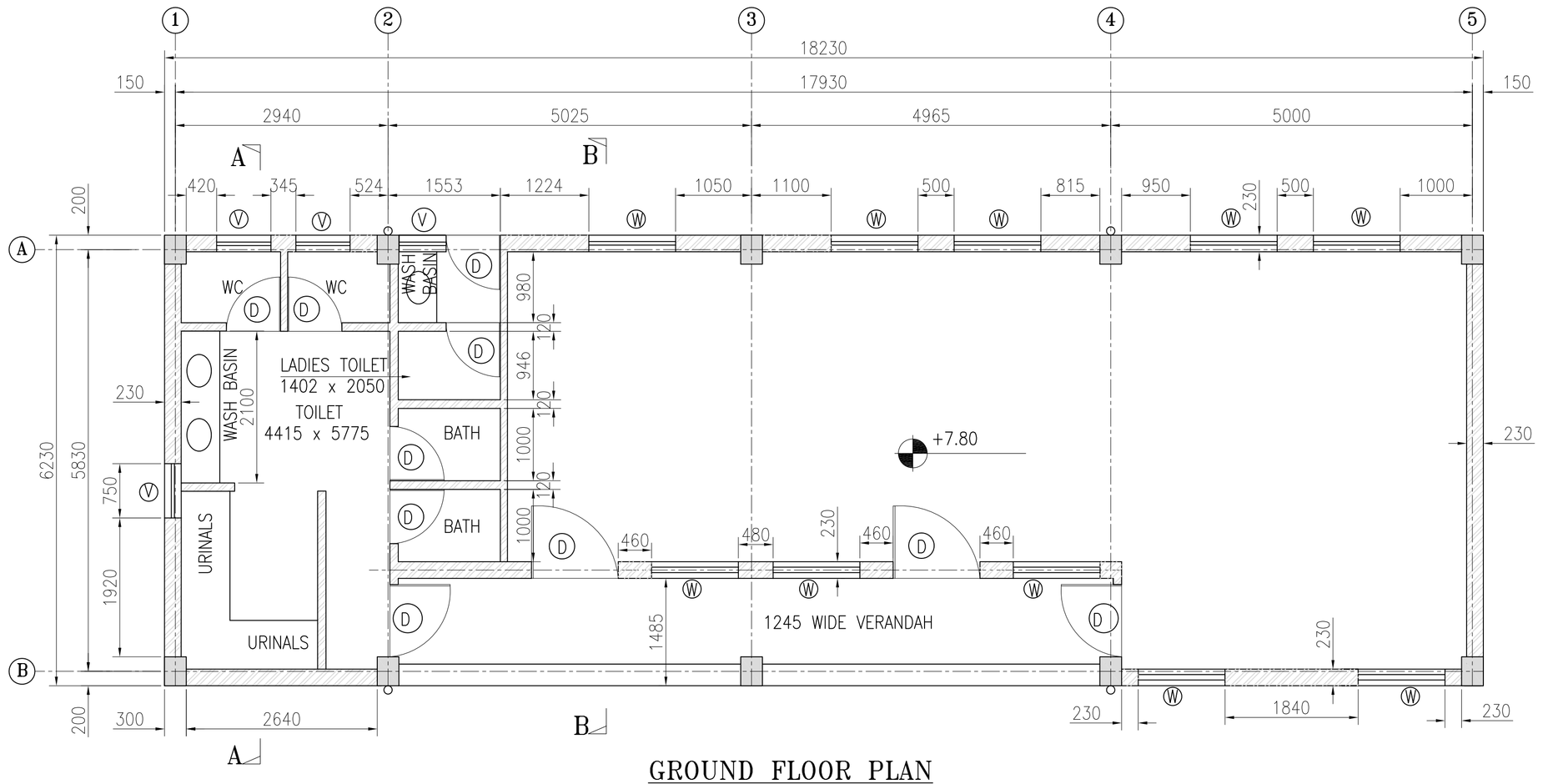
	NAME	SIGN	DATE
DRN	SKN		30–05–2016
CHD	HM/SKA		30–05–2016
APD	S DHAR		30–05–2016

TITLE: IWT TERMINAL AT HALDIA
ELEVATION OF TERMINAL ADMINISTRATION BUILDING

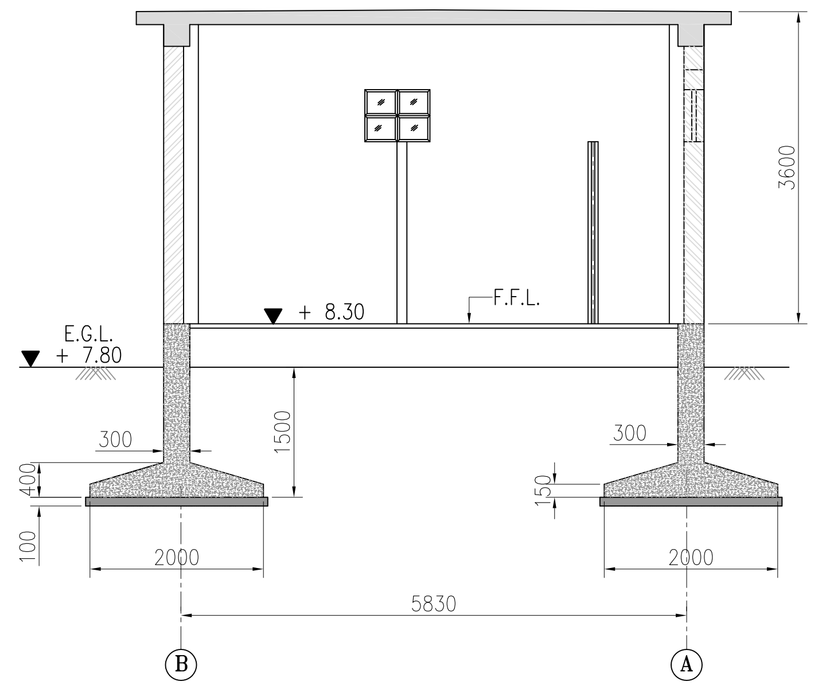
JOB. NO. I-525 | DRG. NO. HT-215

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

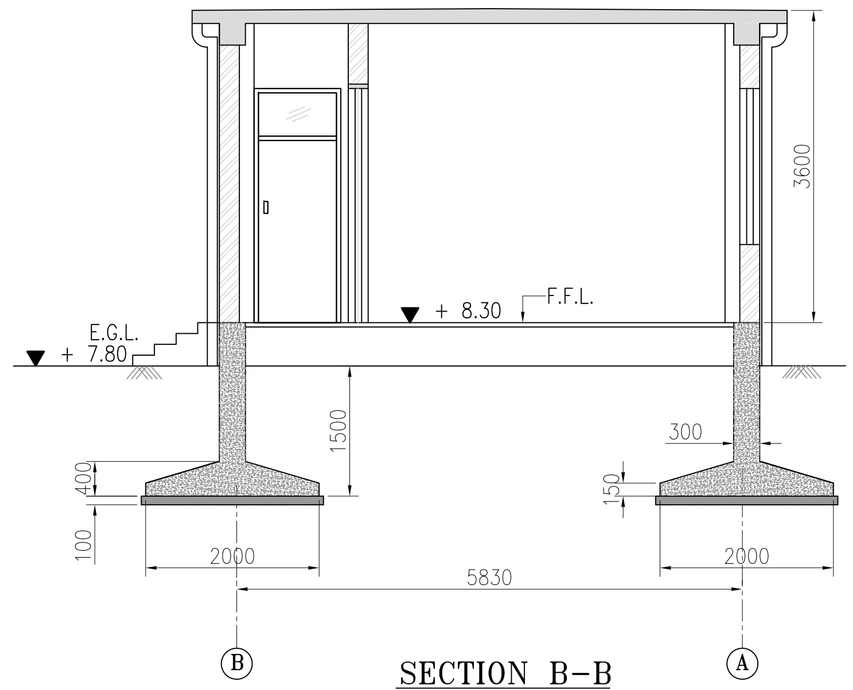
UNIT | SCALE - 1:100 | Size : A1 | REV. 0



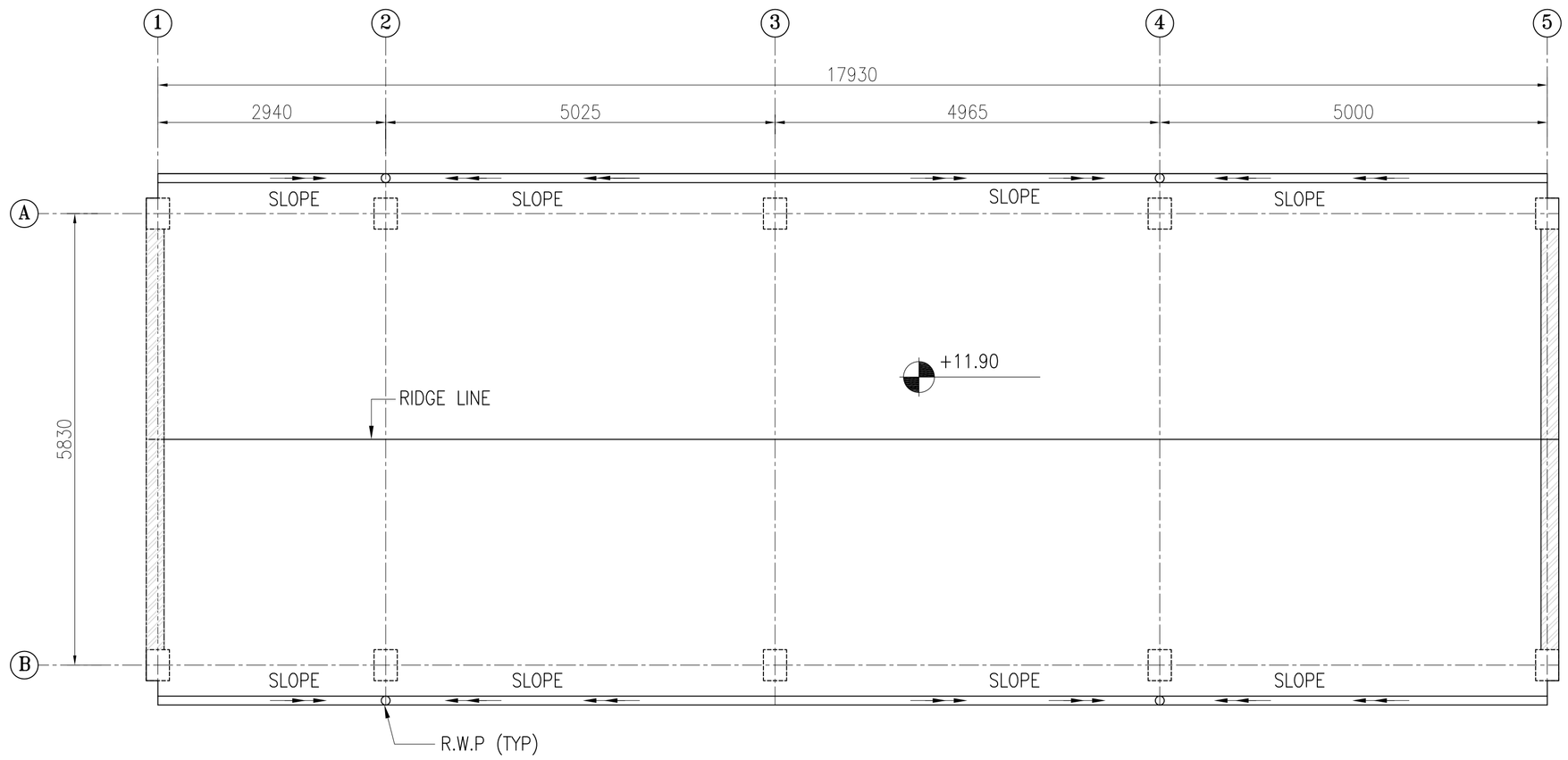
GROUND FLOOR PLAN



SECTION A–A



SECTION B–B



ROOF PLAN

SCHEDULE		
S.NO:	TYPE	DESCRIPTION
1.	D	DOOR
2.	W	WINDOW
3.	V	VENTILATOR
4.	WC	WATER CLOSET

E.G.L.–EXISTING GROUND LEVEL
F.F.L.–FINISH FLOOR LEVEL

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

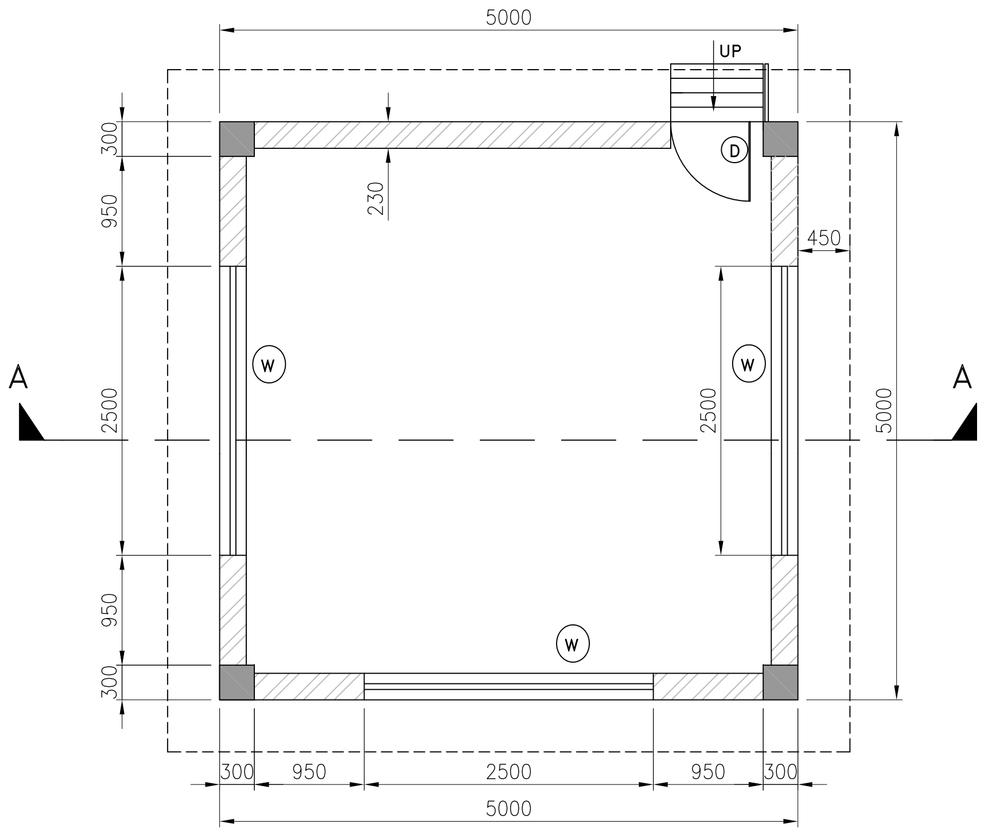
	NAME	SIGN	DATE
DRN	SKN		30–05–2016
CHD	HM/SKA		30–05–2016
APD	S DHAR		30–05–2016

TITLE: IWT TERMINAL AT HALDIA
TYPICAL LAYOUT & SECTION OF WORKER'S AMENITY BUILDING

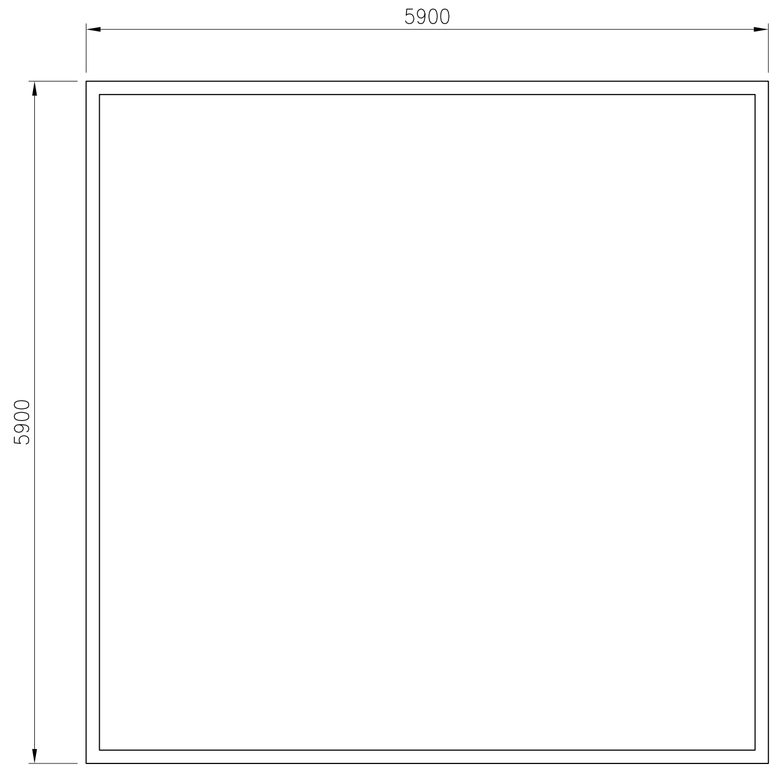
JOB. NO. I-525 | DRG. NO. HT-216

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

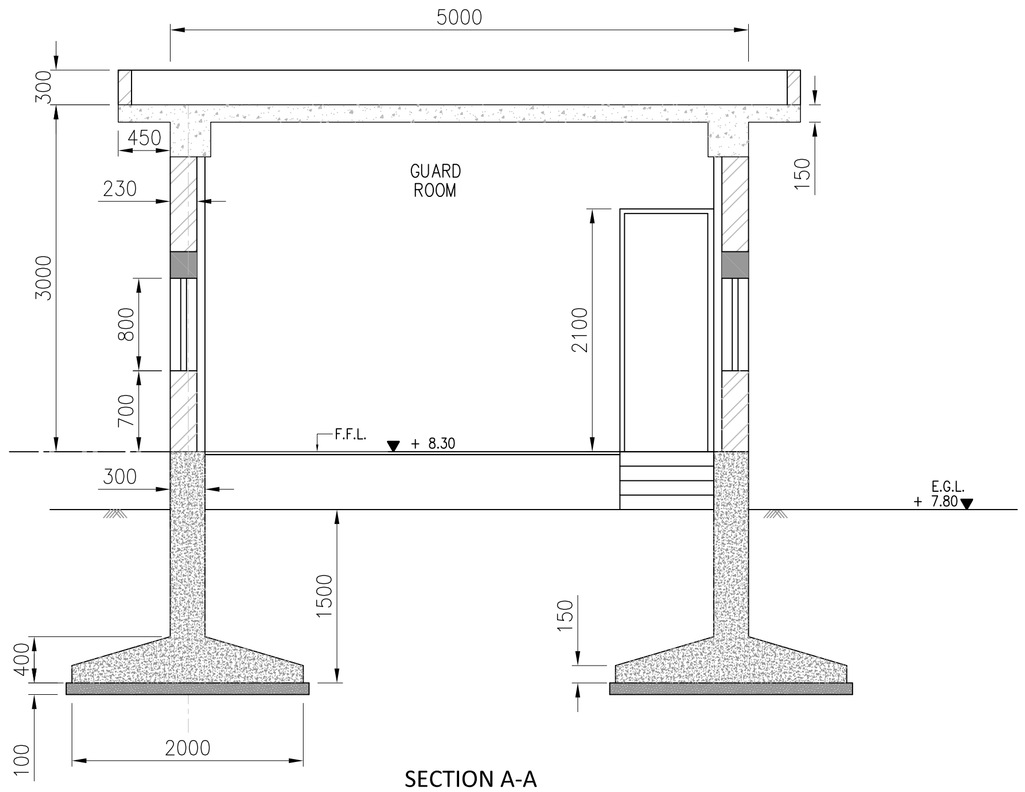
UNIT | SCALE - 1:50 | Size : A1 | REV. 0



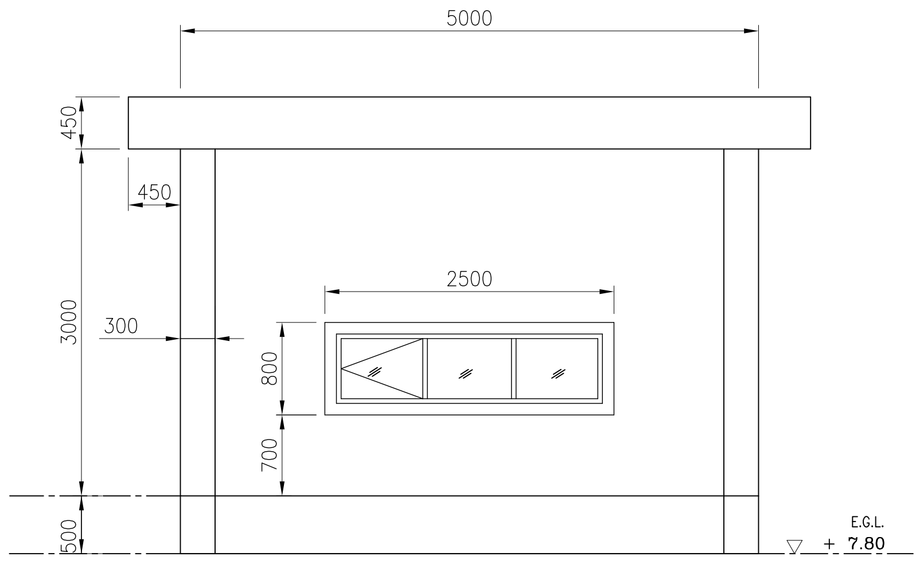
GROUND FLOOR PLAN



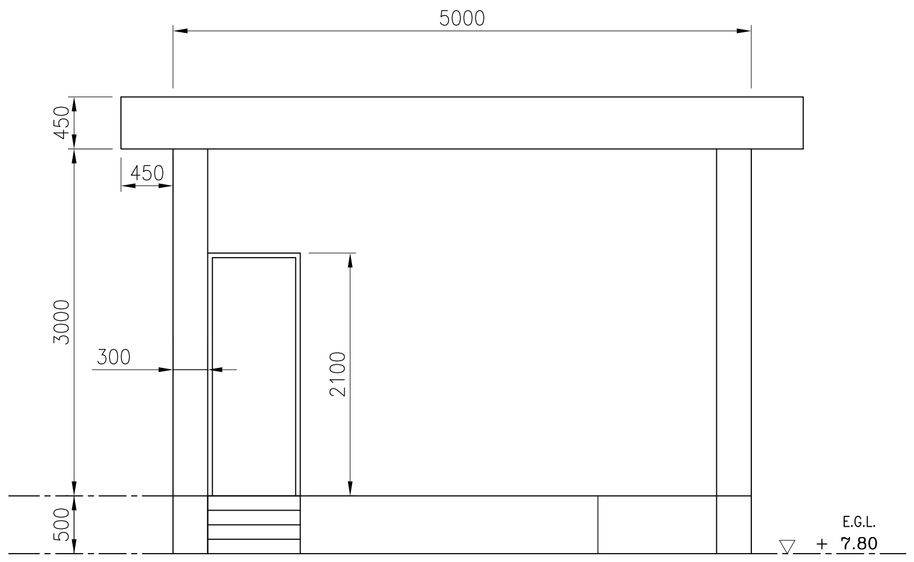
TERRACE PLAN



SECTION A-A



FRONT ELEVATION



REAR ELEVATION

SCHEDULE		
S.NO:	TYPE	DESCRIPTION
1.	D	DOOR
2.	W	WINDOW

E.G.L.–EXISTING GROUND LEVEL
F.F.L.–FINISH FLOOR LEVEL

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

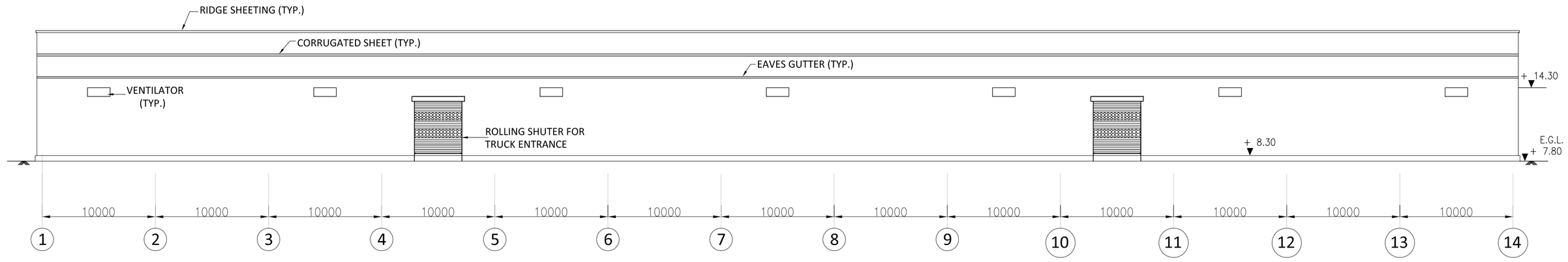
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA-TYPICAL LAYOUT AND ELEVATION OF SECURITY OFFICE & WEIGH BRIDGE CONTROL ROOM

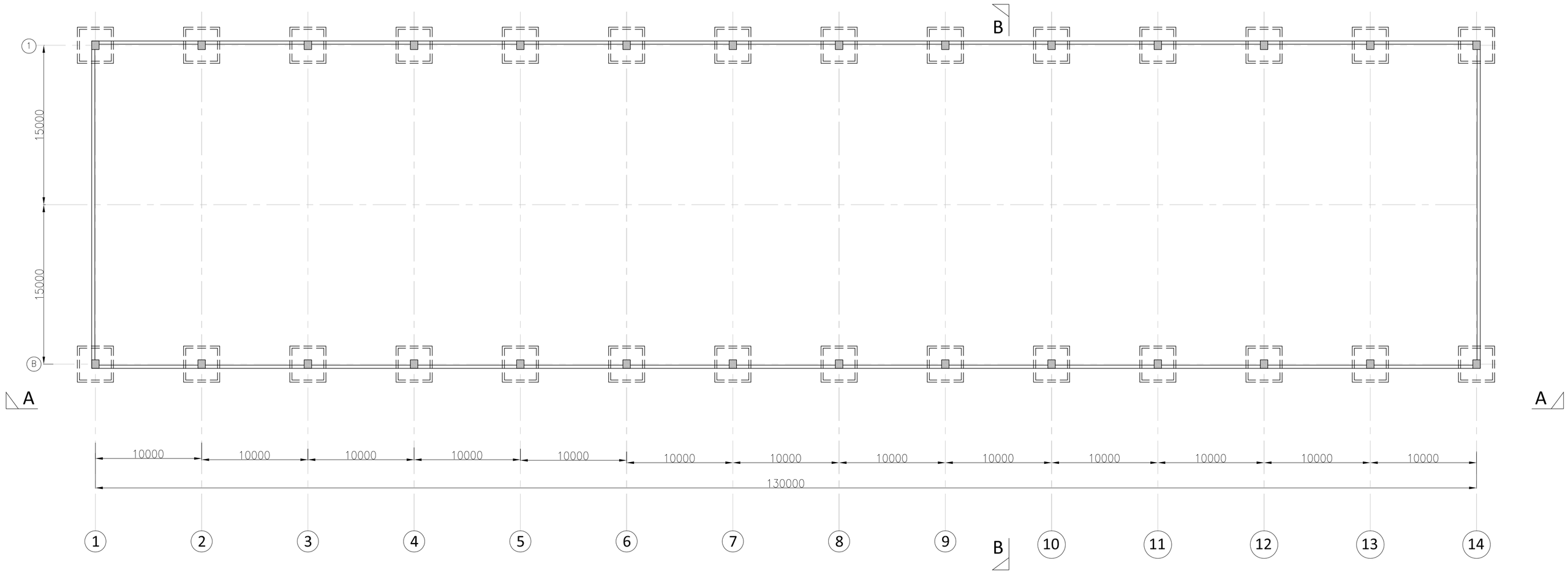
JOB. NO. I-525 | DRG. NO. HT-217

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

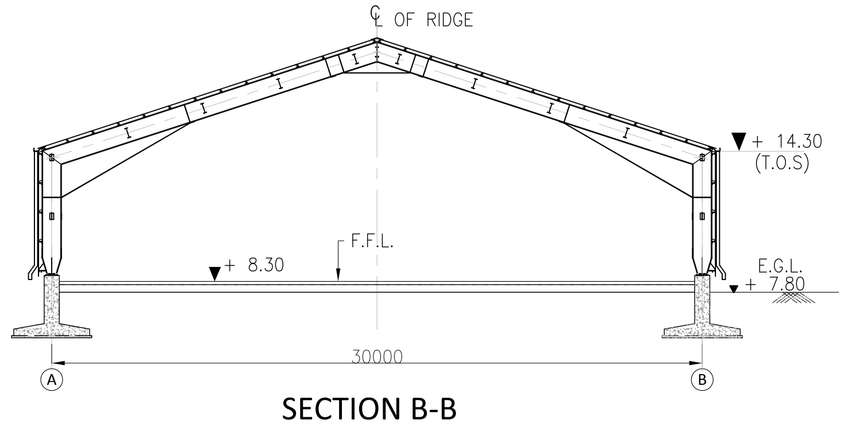
UNIT | SCALE - 1:75 | Size : A1 | REV. 0



VIEW A-A
SCALE 1:250



LAYOUT PLAN OF SHED
SCALE 1:200



SECTION B-B
SCALE 1:200

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

REV	DATE	DESCRIPTION	DRN	CHD	APD
1	31.5.16	VIEW A–A INCLUDED	SKN	HM	SD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

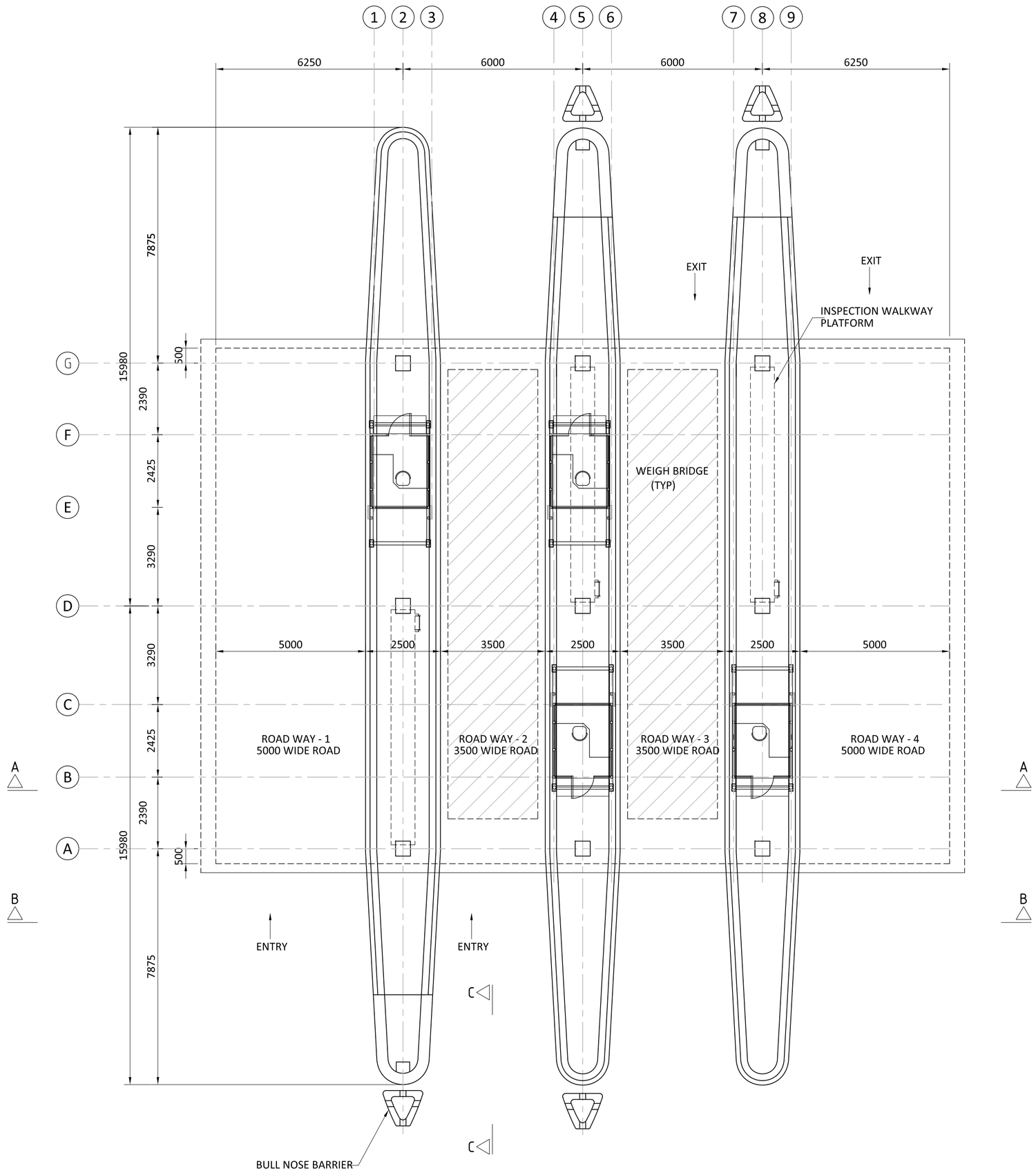
	NAME	SIGN	DATE
DRN	SKN		30–05–2016
CHD	HM/SKA		30–05–2016
APD	S DHAR		30–05–2016

TITLE: IWT TERMINAL AT HALDIA
GENERAL ARRANGEMENT OF COVERED STORAGE SHED

JOB. NO. I-525 | DRG. NO. HT-218

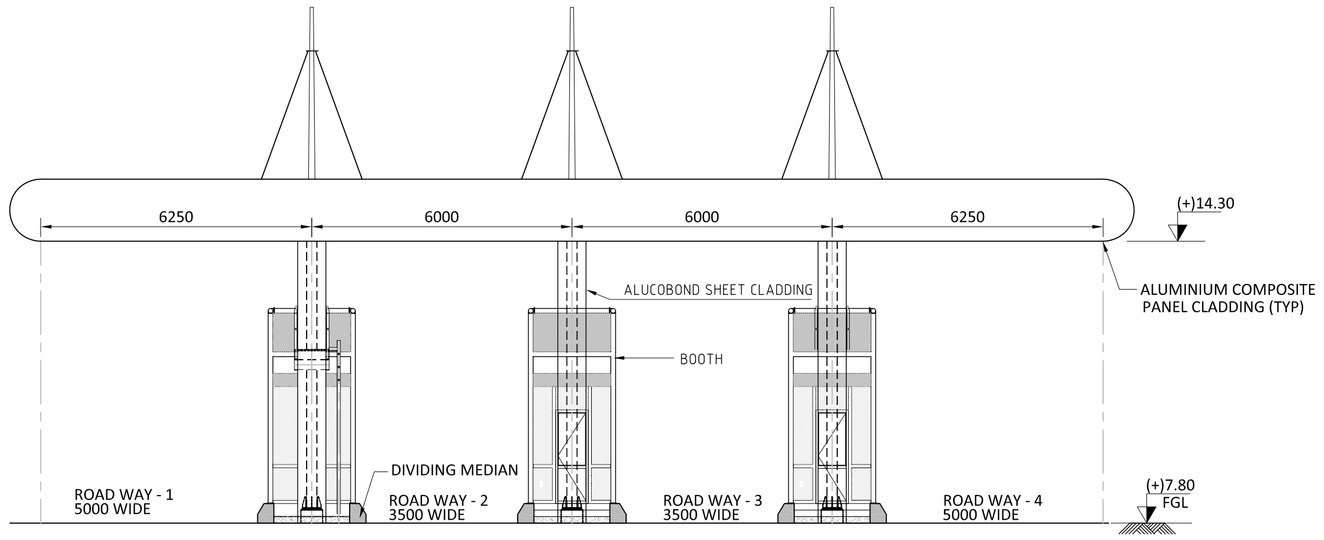
COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - AS SHOWN | Size : A1 | REV. 1



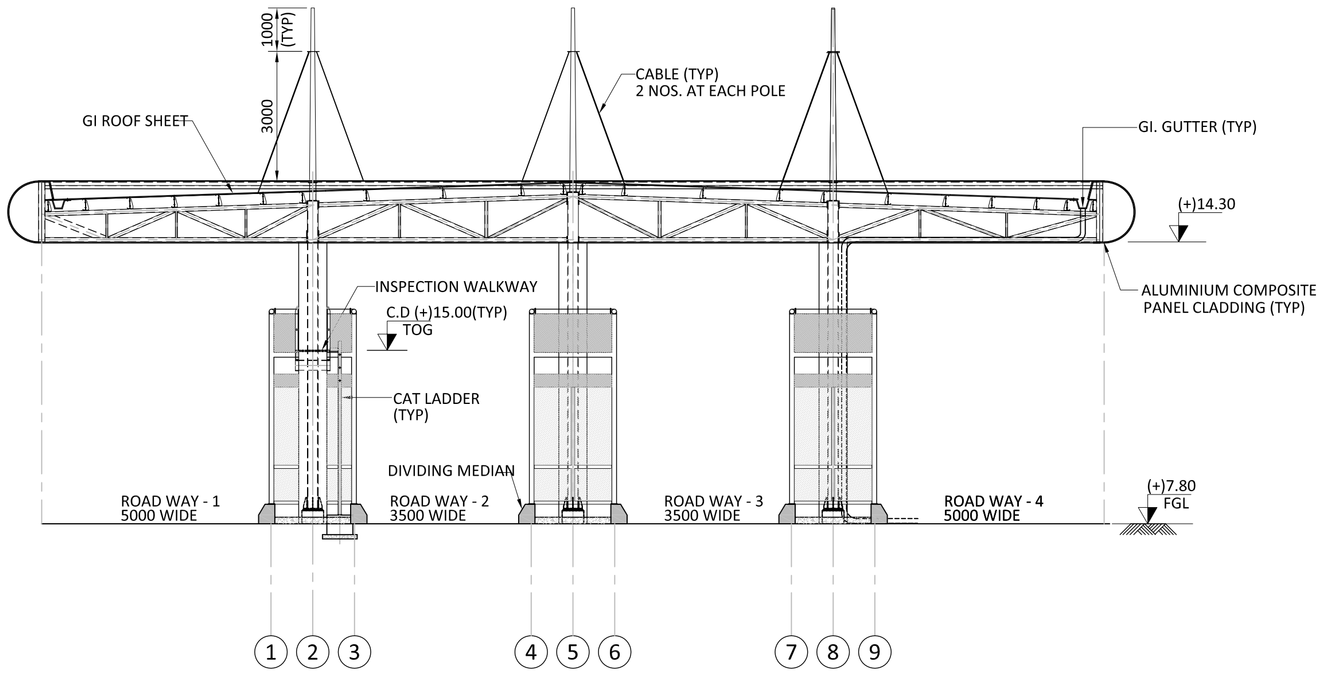
GATE COMPLEX ENTRY & EXIT PLAN

(SCALE 1:100)



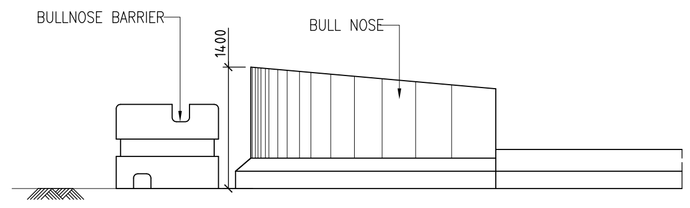
VIEW B-B

(SCALE 1:100)



SECTION A-A

(SCALE 1:100)



VIEW C-C

(SCALE 1:50)

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

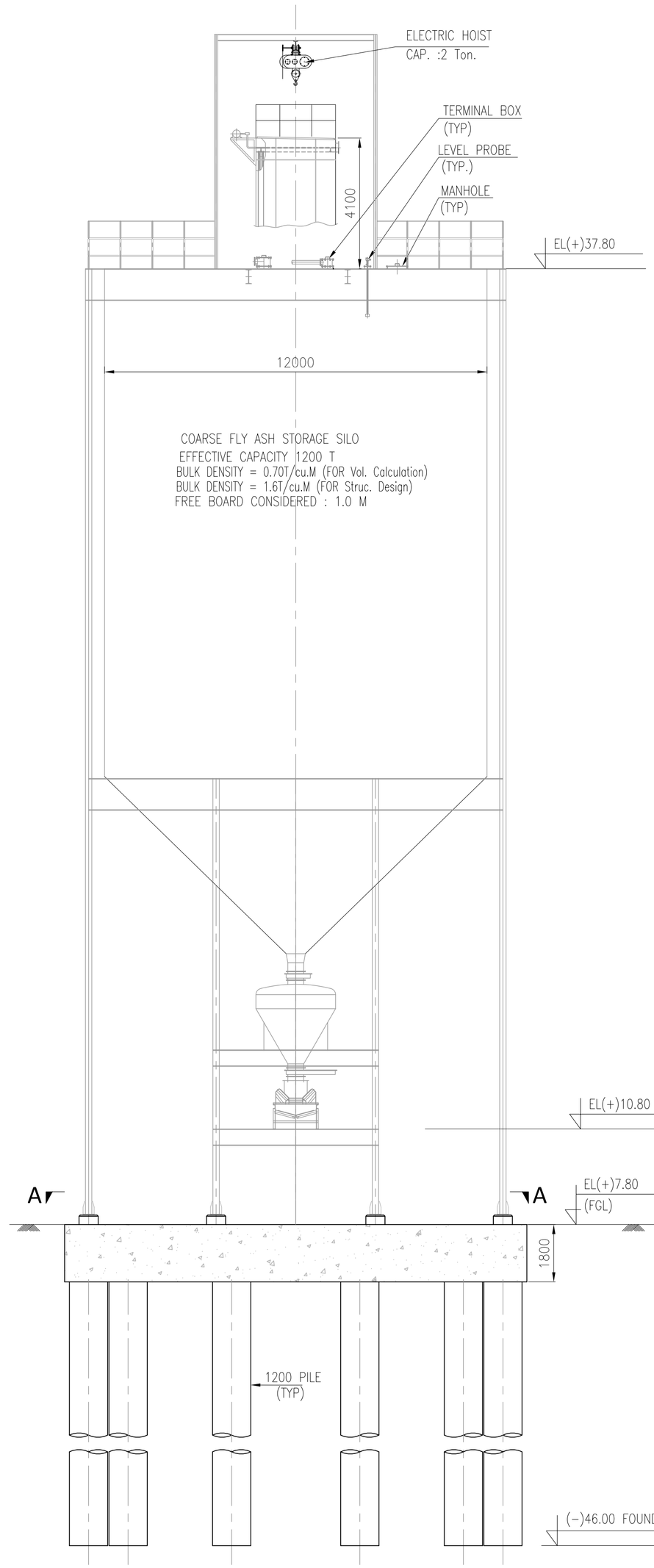
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA
GENERAL ARRANGEMENT OF GATE COMPLEX

JOB. NO. I-525 | DRG. NO. HT-219

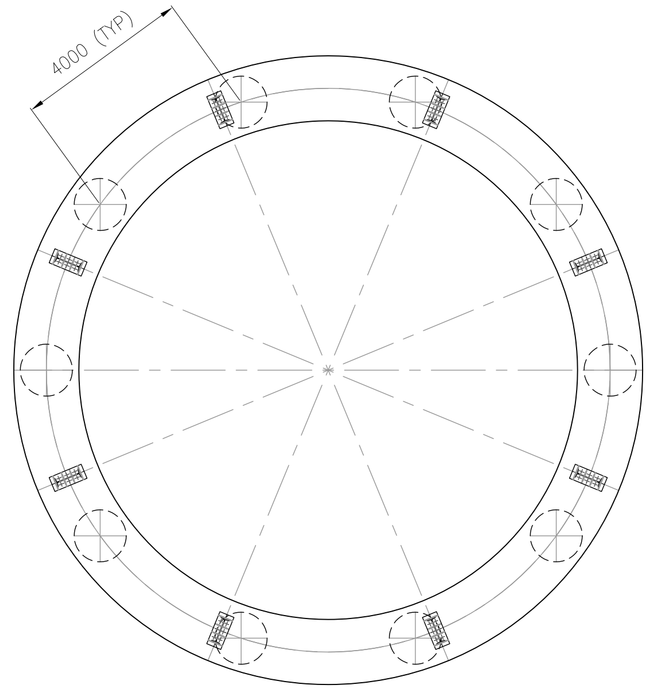
COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - AS SHOWN | Size : A1 | REV. 0



ELEVATION

SCALE– 1:100



PLAN A-A

SCALE– 1:100

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

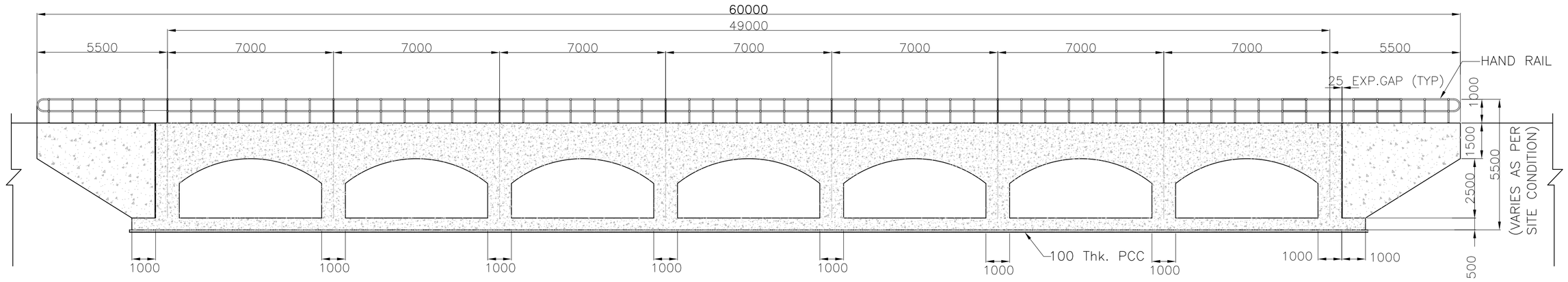
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	AK		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA
TYPICAL PLAN & ELEVATION DETAIL OF SILO

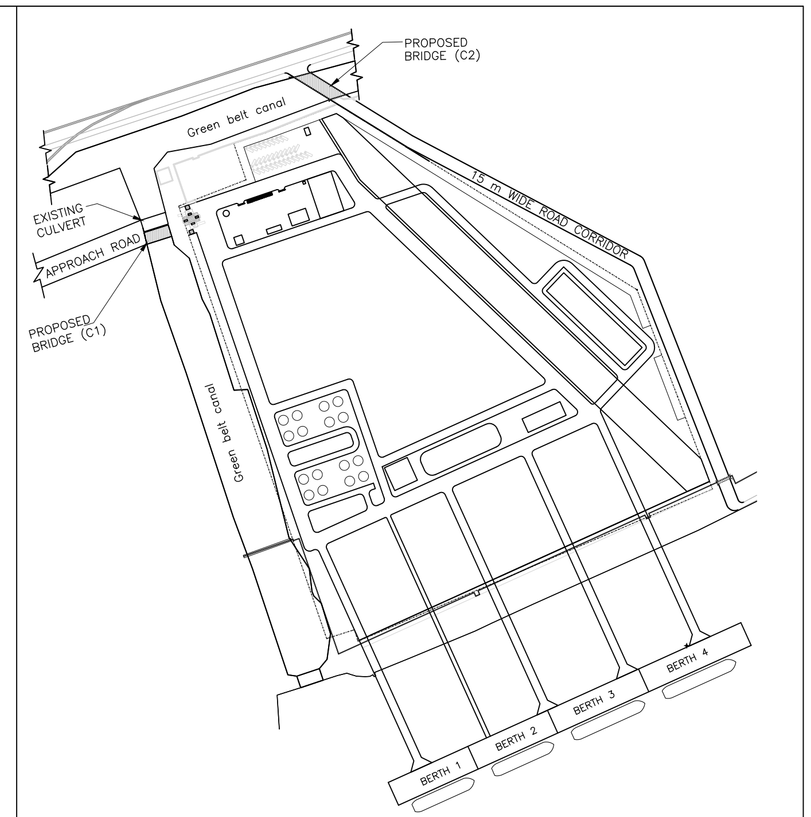
JOB. NO. I-525 | DRG. NO. HT-220

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - AS SHOWN | Size : A1 | REV. 0

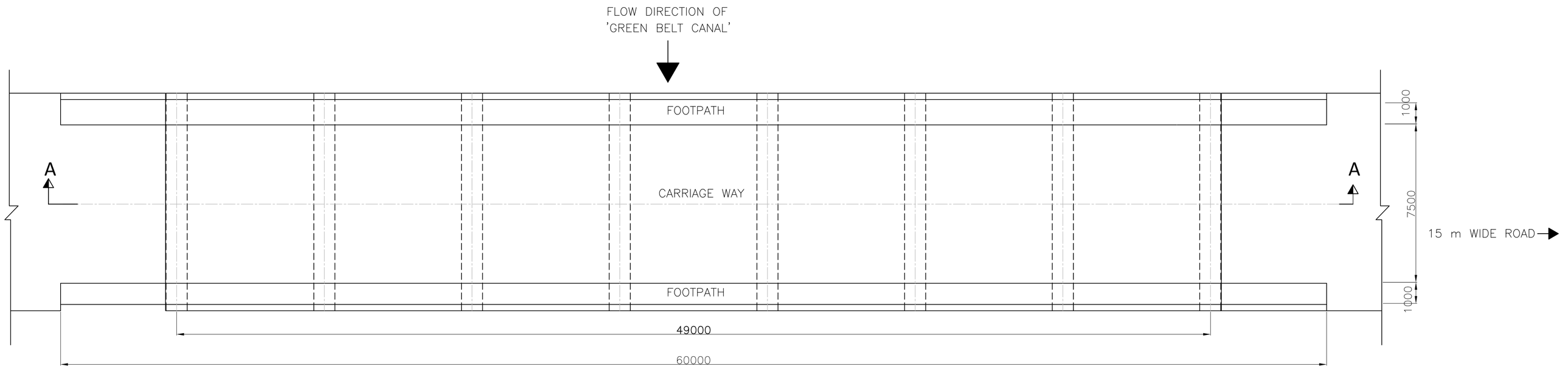


SECTION A-A



KEY PLAN

NTS



PLAN FOR

PROPOSED BRIDGE 'C2'

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS WITH & ARE RESPECT TO CHART DATUM
3. THE DIMENSIONS OF THE PROPOSED BRIDGE (C2) HAS TO BE CONSIDERED BASED ON THE ACTUAL DIMENSIONS OF 'GREEN BELT CANAL'

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

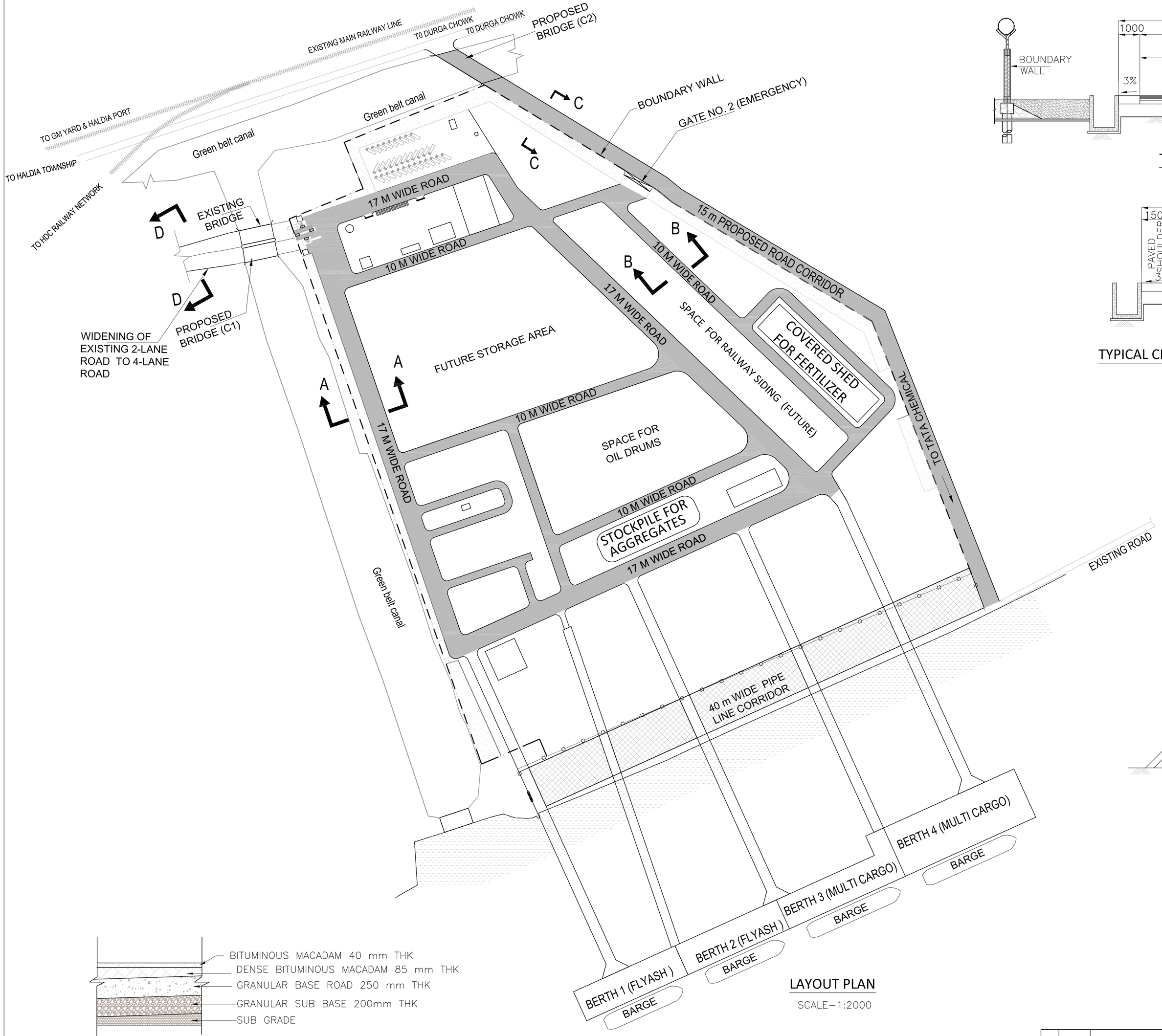
TITLE: IWT TERMINAL AT HALDIA - PLAN AND CROSS SECTION OF PROPOSED BRIDGE OVER 'GREEN BELT CANAL'

JOB. NO. I-525

DRG. NO. HT-222

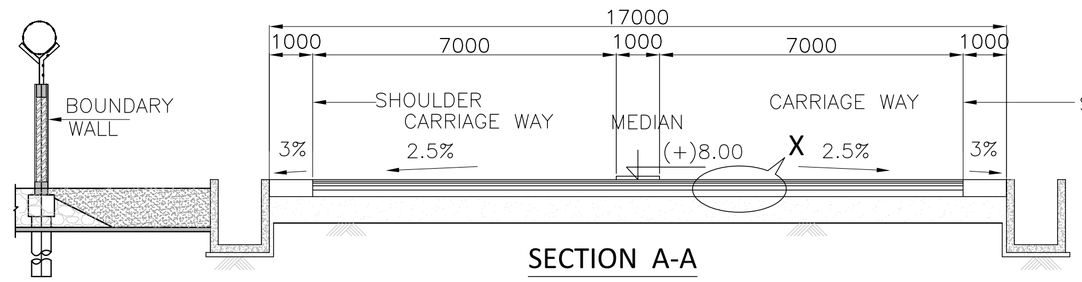
COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:125 | Size : A1 | REV. 0



LAYOUT PLAN

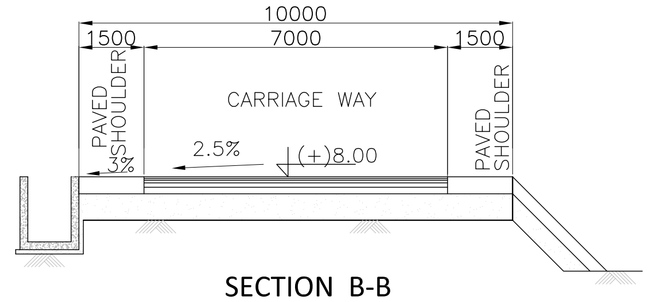
SCALE – 1:2000



SECTION A-A

TYPICAL CROSS SECTION OF 17 m WIDE ROAD

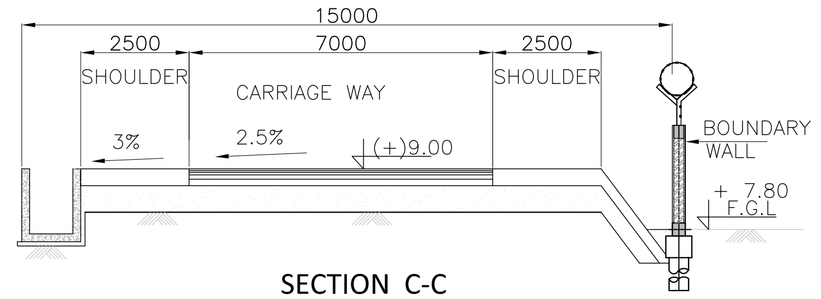
SCALE – 1:100



SECTION B-B

TYPICAL CROSS SECTION OF 10 m WIDE ROAD

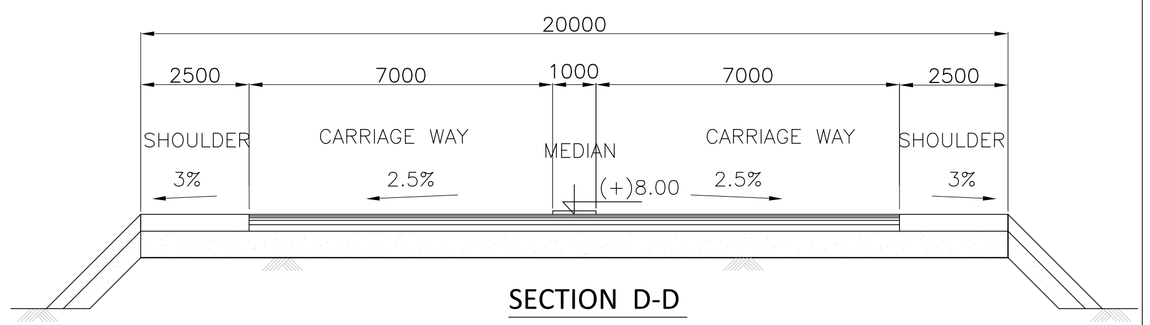
SCALE – 1:100



SECTION C-C

TYPICAL CROSS SECTION OF 15 m WIDE ROAD CORRIDOR

SCALE – 1:100



SECTION D-D

TYPICAL CROSS SECTION OF 20 m WIDE ROAD

SCALE – 1:100

TYPICAL PAVEMENT DETAIL -X

NTS

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETER
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM
3. THE LEVELS OF APPROACH ROAD & 'PROPOSED 15 m WIDE ROAD CORRIDOR' TO TATA CHEMICAL ARE INDICATIVE. THE LEVELS SHOULD BE PROVIDED INLINE WITH THE LEVELS OF THE EXISTING ROADS

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

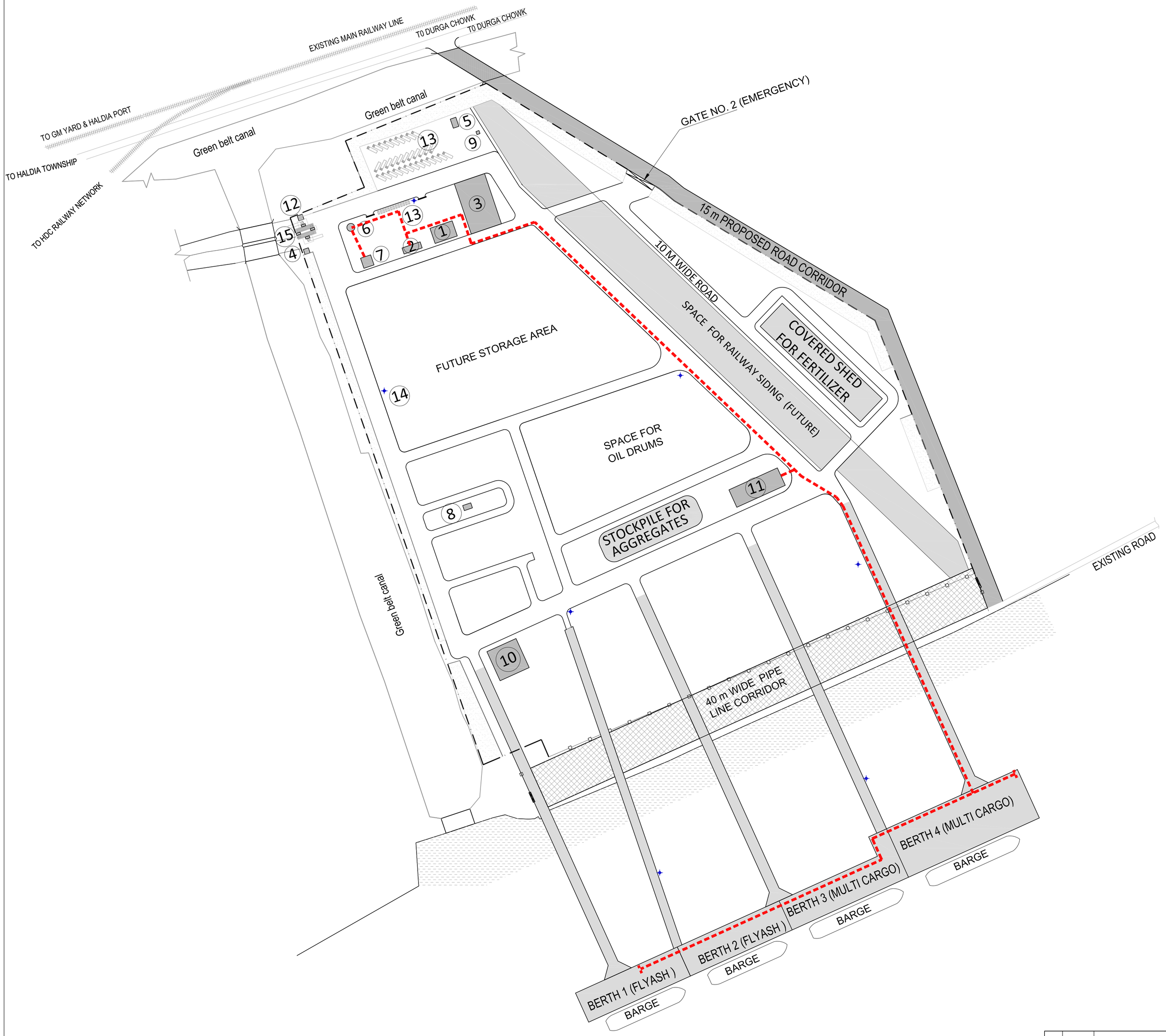
	NAME	SIGN	DATE
DRN	SKN		30–05–2016
CHD	HM/SKA		30–05–2016
APD	S DHAR		30–05–2016

TITLE: IWT TERMINAL AT HALDIA
TYPICAL CROSS SECTION OF ROADS

JOB. NO. I-525 | DRG. NO. HT-223

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - AS SHOWN | Size : A1 | REV. 0



LEGEND:

S.NO.	DESCRIPTION
1	TERMINAL ADMINISTRATION BUILDING
2	WORKER'S AMENITY BUILDING
3	FUEL BUNKER
4	SECURITY OFFICE
5	SEWAGE TREATMENT PLANT
6	OVERHEAD WATER TANK
7	UNDERGROUND RESERVOIR
8	RIO (REMOTE INPUT OUT PUT)/ COMPRESSOR ROOM FOR ASH HANDLING
9	WASTE COLLECTION CENTER
10	SETTLING POND
11	ELECTRICAL SUB STATION
12	WEIGH BRIDGE CONTROL ROOM
13	VEHICLE PARKING AREA
14	HIGHMAST LIGHTING TOWERS
15	GATE HOUSE COMPLEX

N

LEGEND:

POTABLE WATER PIPE LINE

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

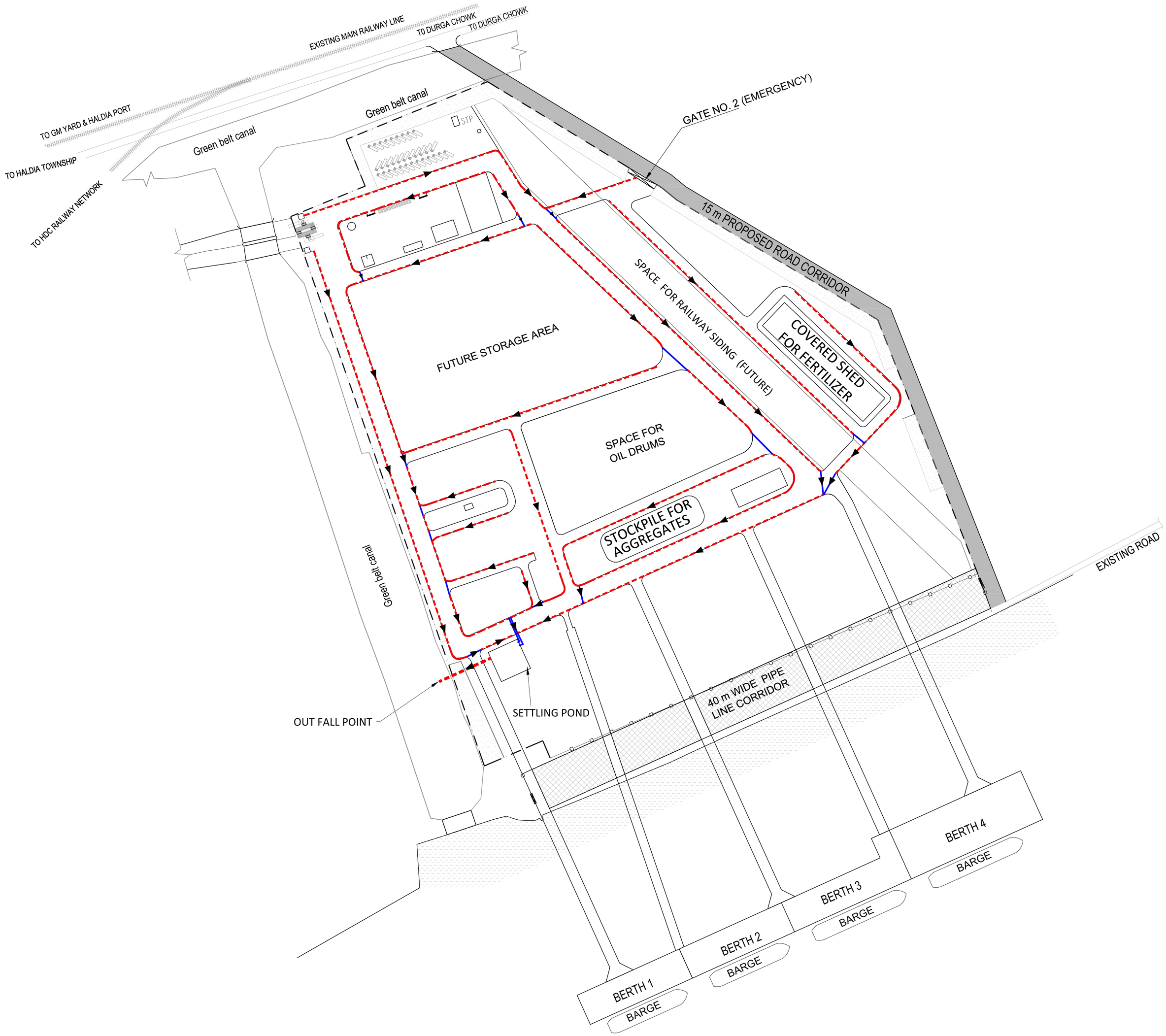
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA
SCHEMATIC LAYOUT OF WATER SUPPLY SYSTEM

JOB. NO. I-525 | DRG. NO. HT-224

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:2000 | Size : A1 | REV. 0



N

LEGEND:

COVERED RCC DRAIN

PIPE / CULVERT

NOTES:

1. PIPE DRAINS / CULVERT TO BE CONSIDERED AT ROAD CROSSING

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

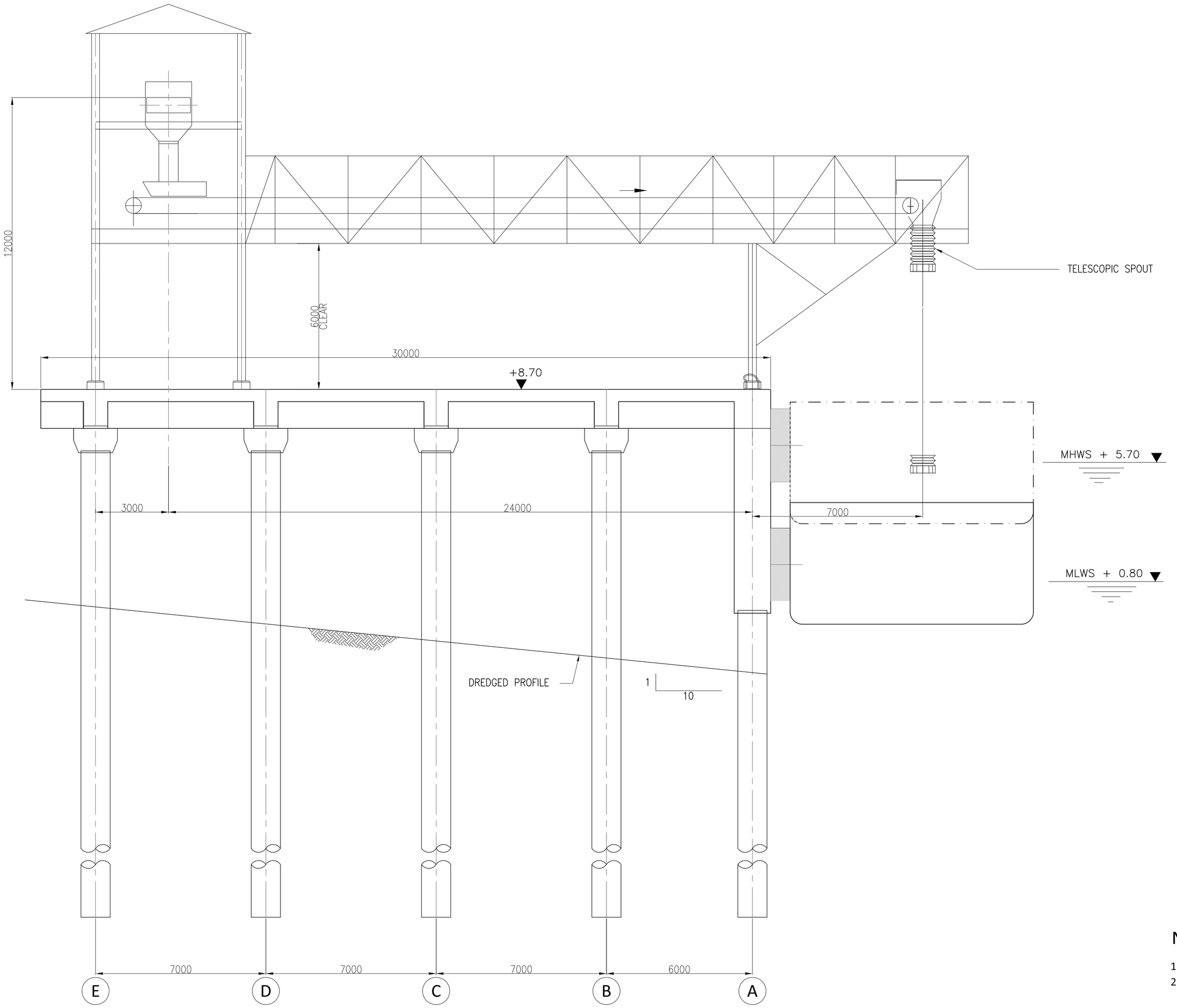
TITLE: IWT TERMINAL AT HALDIA
LAYOUT OF STORM WATER DRAINAGE

JOB. NO. I-525

DRG. NO. HT-225

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:2000 | Size : A1 | REV. 0



NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

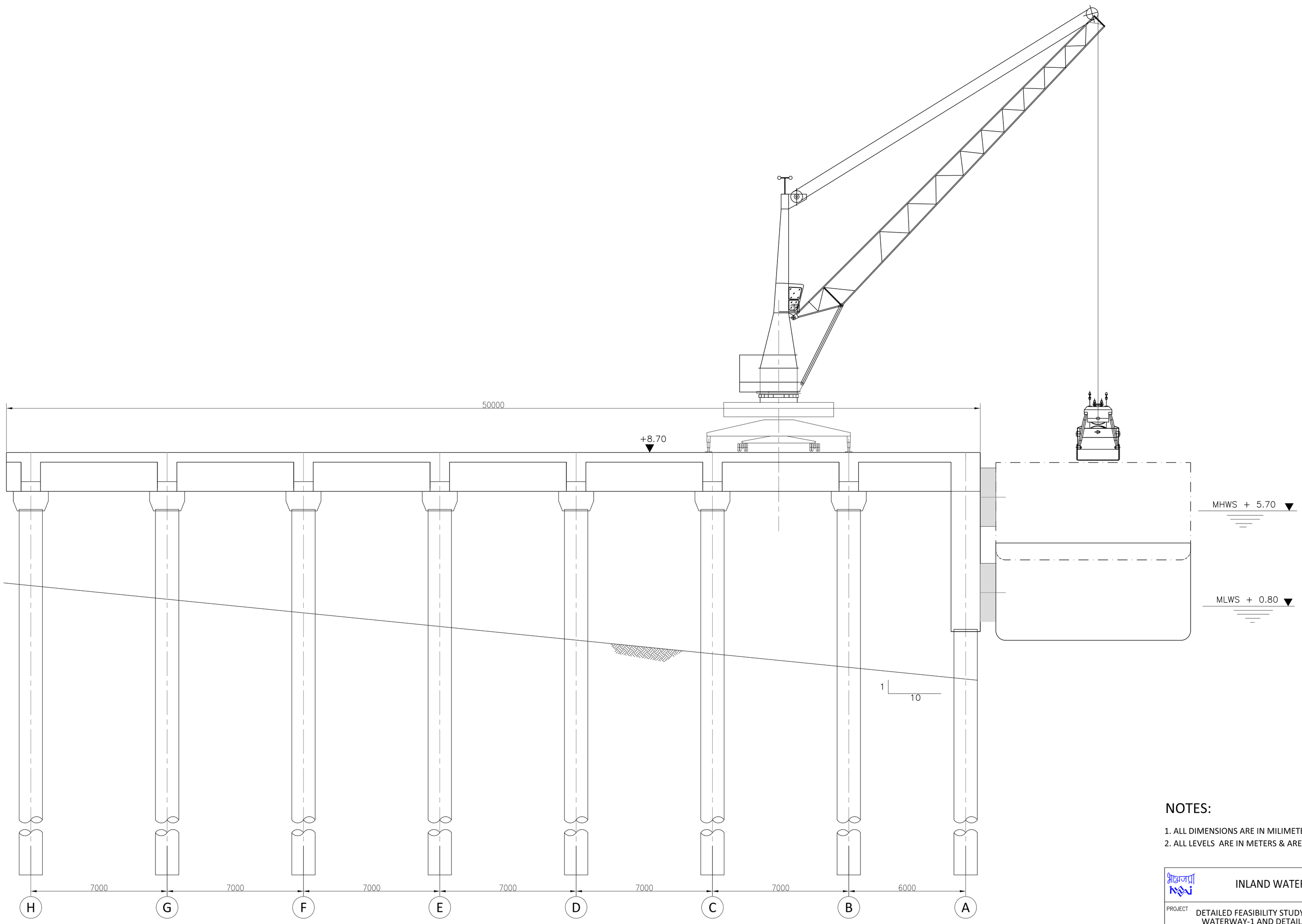
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA
CROSS SECTION OF FIXED TYPE BARGE LOADER

JOB. NO. I-525 | DRG. NO. HT-226

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:100 | Size : A1 | REV. 0



NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

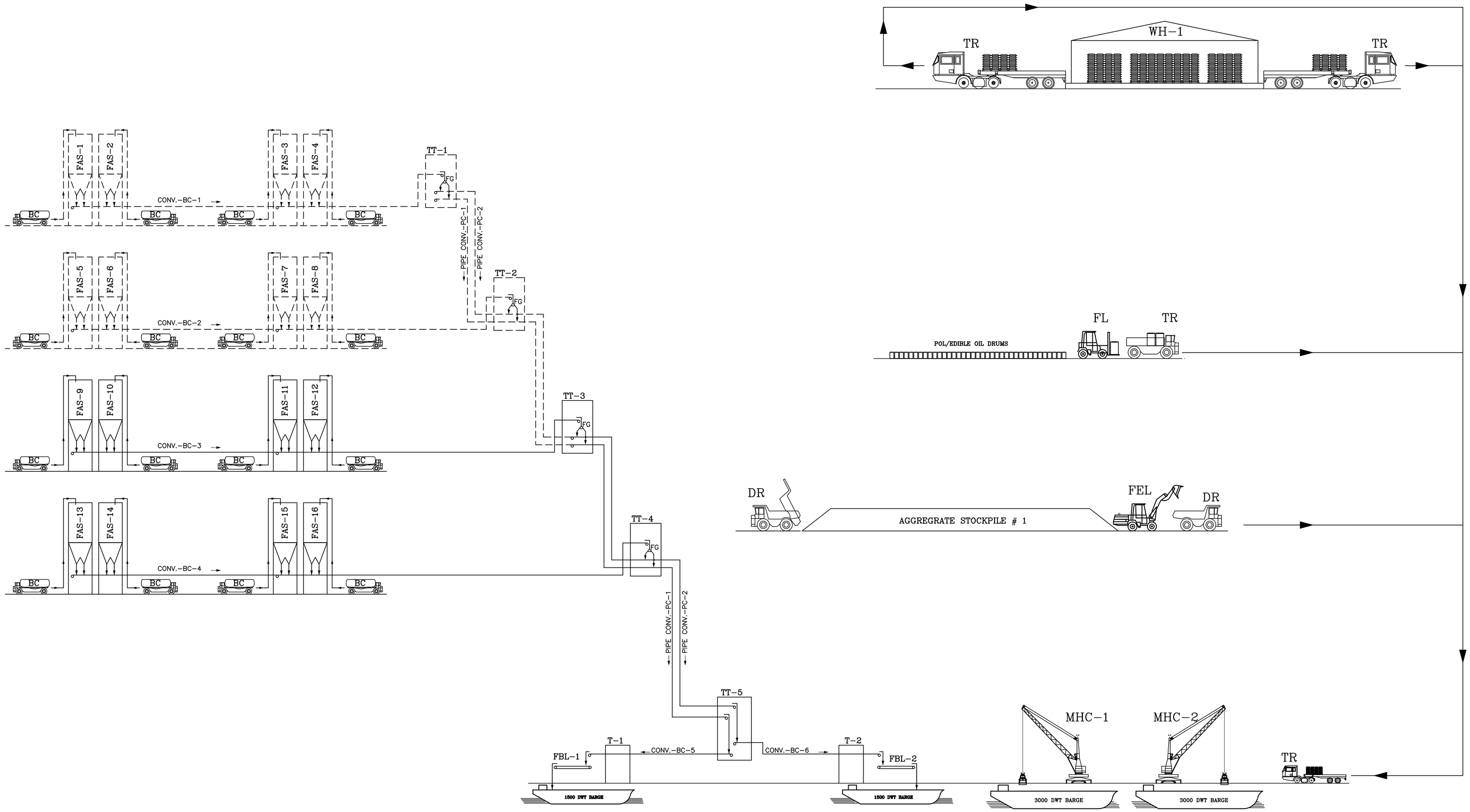
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA
CROSS SECTION OF MOBILE HARBOUR CRANE

JOB. NO. I-525 | DRG. NO. HT-227

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:100 | Size : A1 | REV. 0



SYM-BOL	DESCRIPTION	RATED CAP. TPH.	QTY.	REMARKS
FAS	FLY ASH SILO	1200 T	8 NO.S	8 NO.S (FUT.)
FBL	FIXED BARGE LOADER	–	2 NO.S	
MHC	MOBILE HARBOUR CRANE	–	2 NO.S	
BUL	BARGE UNLOADER	–	2 NO.S	
BC	BELT CONVEYOR	400	LOT	
PC	PIPE CONVEYOR	400	LOT	
FG	FLAP GATES	–	LOT	
TT	TRANSFER TOWER	–	LOT	
T	TOWER	–	LOT	
WH-1	WARE HOUSE FOR FERTILIZER FOR BAGGED CARGO	–	1 NO.	
BC	BULK CARRIER	–	LOT	BY OTHERS
DR	DUMPER TRUCKS	–	LOT	
FL	FORK LIFT TRUCK	–	LOT	
FEL	FRONT END LOADER	–	LOT	
TR	TRUCK	–	LOT	

LEGENDS:–

———— FACILITY IN PHASE – 1

– – – – – – – – FACILITY IN PHASE – 2

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA

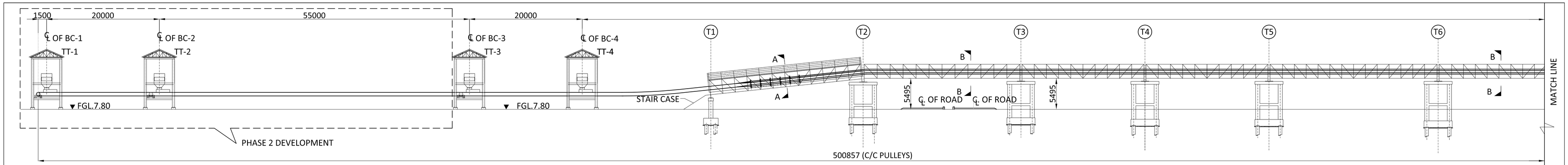
FLOW DIAGRAM FOR CARGO HANDLING SYSTEM

JOB. NO. I-525

DRG. NO. HT-228 (SH. 1 OF 2)

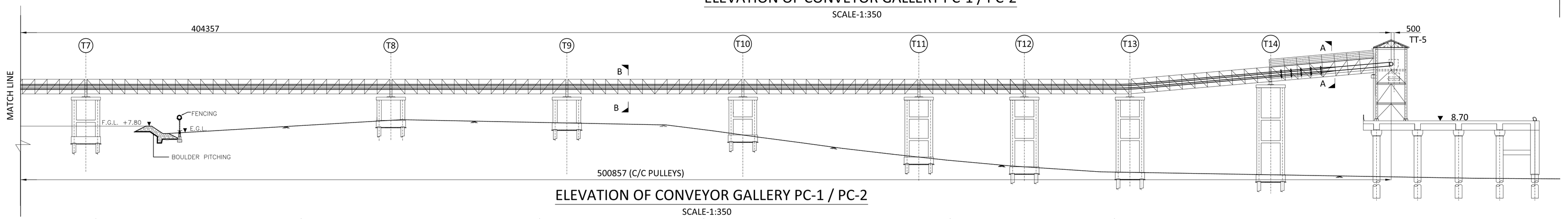
COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - NTS | Size : A1 | REV. 0



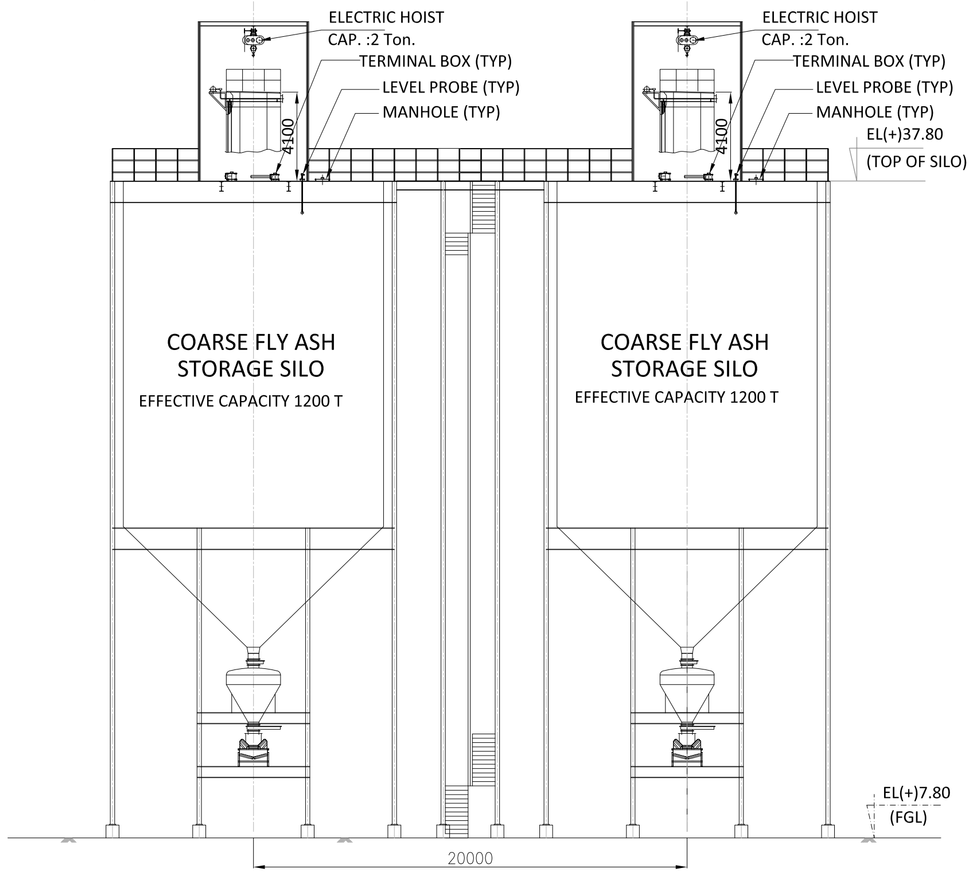
ELEVATION OF CONVEYOR GALLERY PC-1 / PC-2

SCALE-1:350



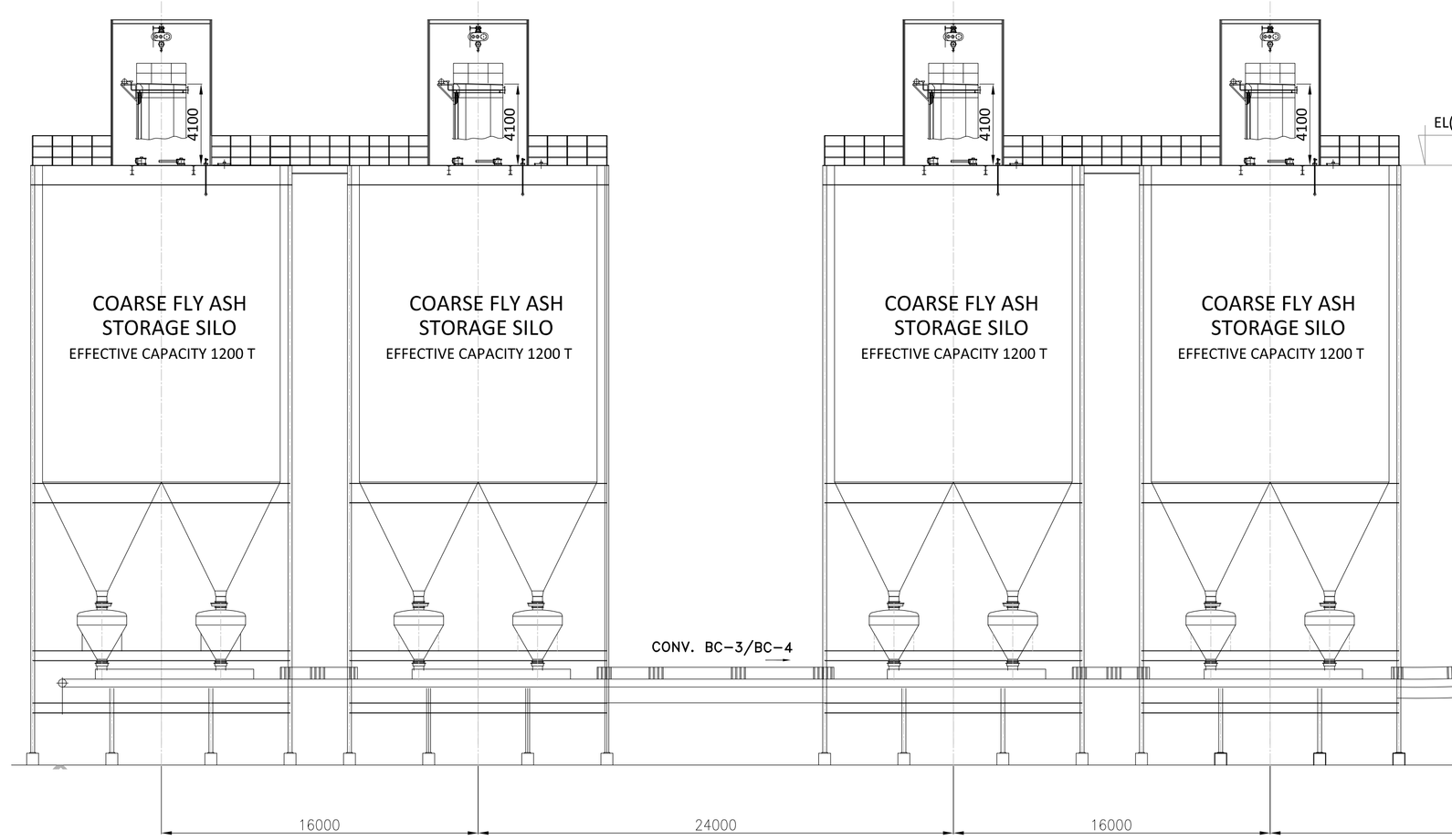
ELEVATION OF CONVEYOR GALLERY PC-1 / PC-2

SCALE-1:350



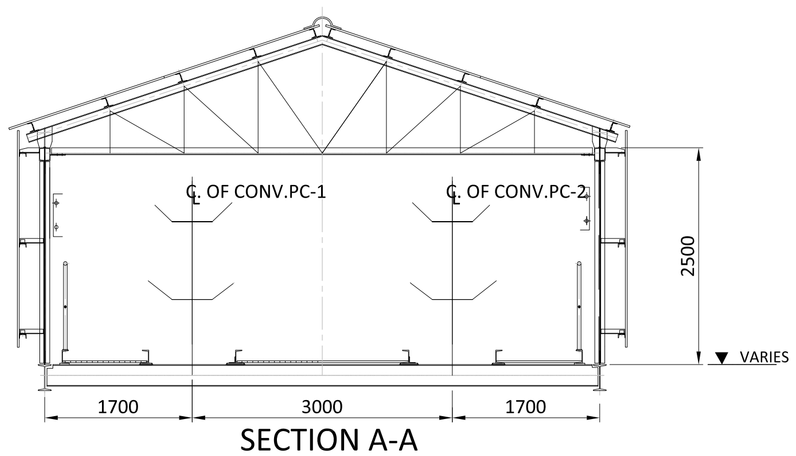
GENERAL ARRANGEMENT OF FLY ASH SILOS

SCALE-1:175



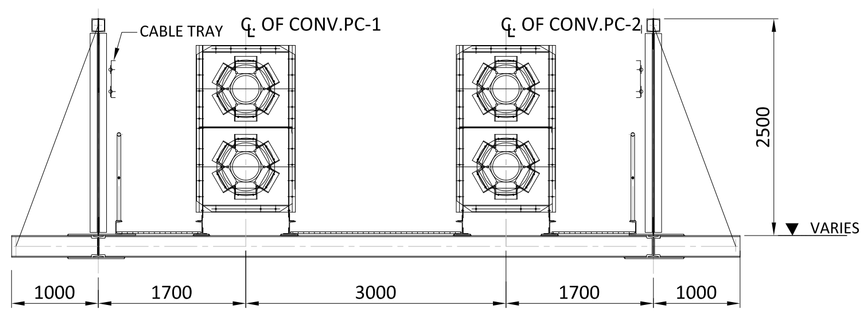
ELEVATION OF CONVEYOR BC-3/BC-4

SCALE-1:175



SECTION A-A

SCALE-1:50



SECTION B-B

SCALE-1:50

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETERS
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM
3. REFER DWG. NO. HT 213 FOR STRUCTURAL DETAILS

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	AKK/PKM		30-05-2016
APD	S DHAR		30-05-2016

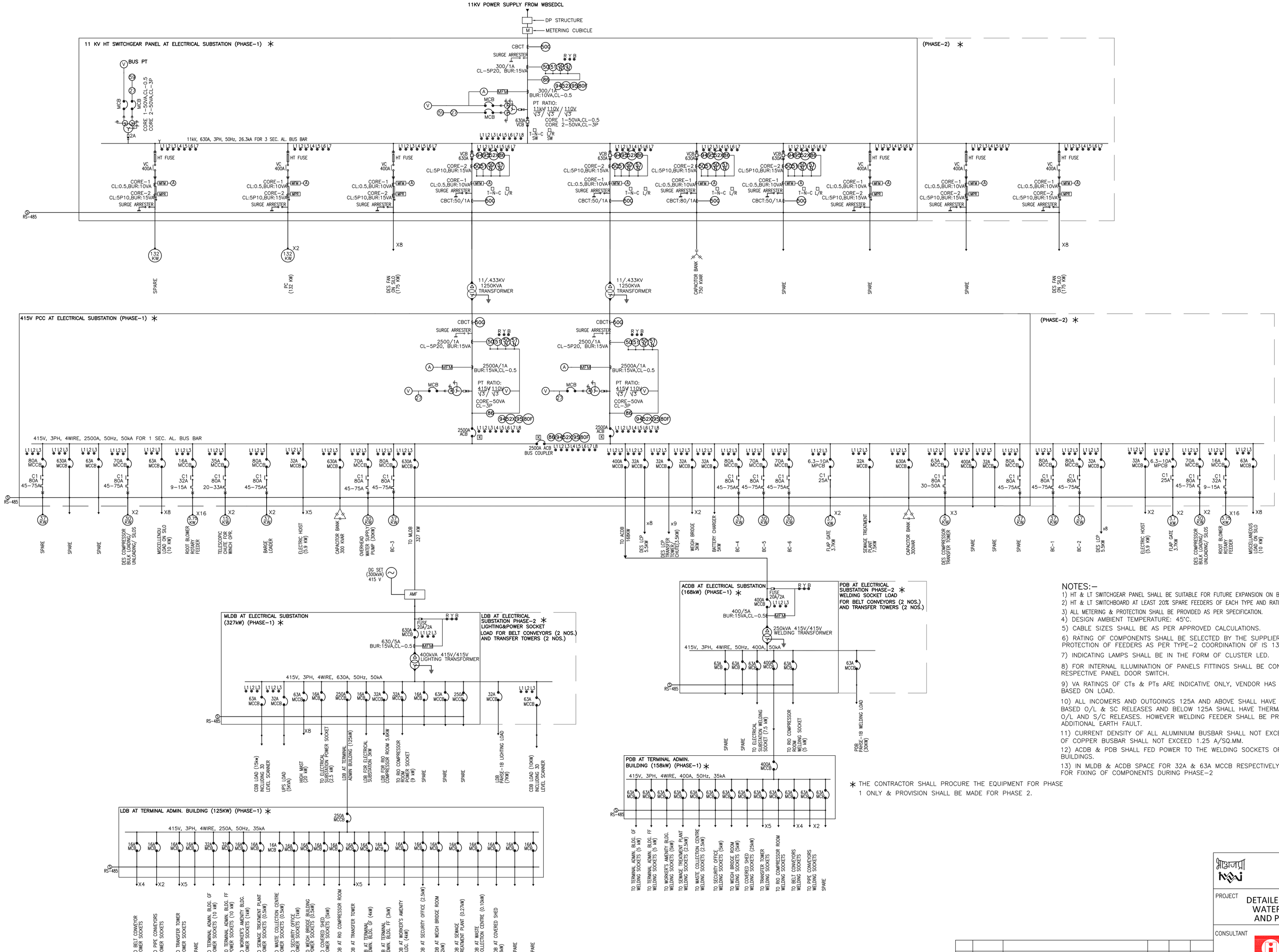
TITLE: IWT TERMINAL AT HALDIA - GENERAL ARRANGEMENT OF FLY ASH SILO &PROFILE OF PIPE CONVEYOR PC-1/PC-2

JOB. NO. I-525

DRG. NO. HT-228 (SH- 2 OF 2)

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - AS SHOWN | Size : A1 | REV. 0



SYMBOL	DESCRIPTION
	OVERLOAD RELAY
	FUSE
	CURRENT TRANSFORMER
	POTENTIAL TRANSFORMER
	MOULDED CASE CIRCUIT BREAKER
	INDICATION
	AIR CIRCUIT BREAKER
	SURGE ARRESTER
CBCT	CORE BALANCE CURRENT TRANSFORMER
27	UNDER VOLTAGE RELAY
50	INSTANTANEOUS OVER CURRENT RELAY
50N	INSTANTANEOUS EARTH FAULT RELAY
51	IDMT OVER CURRENT RELAY
51N	IDMT EARTH FAULT RELAY
59	OVER VOLTAGE RELAY
95	TRIP CIRCUIT SUP. RELAY
86	LOCK OUT RELAY
94	ANTI PUMPING RELAY
50G	INSTANTANEOUS GROUND FAULT RELAY
96F	DC FAIL RELAY
L1	BREAKER ON RED
L2	BREAKER OFF GREEN
L3	BREAKER TRIP AMBER
L4	SPRING CHARGED RED
L5	TRIP CIRCUIT HEALTHY
L6	BREAKER IN TEST POSITION
L7	BREAKER IN SERVICE POSITION
L8	DC FAIL
52Y	BREAKER CONTACT MULTIPLIER RELAY
TNC	TRIP NEUTRAL CLOSE SWITCH
L/R	LOCAL/REMOTE SELECTOR SWITCH
V	VOLTMETER
A	AMMETER
MFM	MULTI FUNCTION METER
	VACUUM CIRCUIT BREAKER
	ELECTRICAL & MECHANICAL INTERLOCK
	CONTACTOR
AMF	AUTO MAINS FAILURE WITH CHANGEOVER SWITCH
PCC	POWER CONTROL CENTER
MLDB	MAIN LIGHTING DISTRIBUTION BOARD
ACDB	AC DISTRIBUTION BOARD
LDB	LIGHTING DISTRIBUTION BOARD
PDB	POWER DISTRIBUTION BOARD
COB	CONTROL DISTRIBUTION BOARD
WBSEDCL	WEST BENGAL STATE ELECTRICITY DISTRIBUTION COMPANY LIMITED
PC	PIPE CONVEYOR

NOTES:–

1) HT & LT SWITCHGEAR PANEL SHALL BE SUITABLE FOR FUTURE EXPANSION ON BOTH SIDES.
2) HT & LT SWITCHBOARD AT LEAST 20% SPARE FEEDERS OF EACH TYPE AND RATING SHALL BE PROVIDED.
3) ALL METERING & PROTECTION SHALL BE PROVIDED AS PER SPECIFICATION.
4) DESIGN AMBIENT TEMPERATURE: 45°C.
5) CABLE SIZES SHALL BE AS PER APPROVED CALCULATIONS.
6) RATING OF COMPONENTS SHALL BE SELECTED BY THE SUPPLIER TO ENSURE PROTECTION OF FEEDERS AS PER TYPE–2 COORDINATION OF IS 13947.
7) INDICATING LAMPS SHALL BE IN THE FORM OF CLUSTER LED.
8) FOR INTERNAL ILLUMINATION OF PANELS FITTINGS SHALL BE CONTROLLED BY THE RESPECTIVE PANEL DOOR SWITCH.
9) VA RATINGS OF CTs & PTs ARE INDICATIVE ONLY, VENDOR HAS TO CHECK THE SAME BASED ON LOAD.
10) ALL INCOMERS AND OUTGOINGS 125A AND ABOVE SHALL HAVE MICROPROCESSOR BASED O/L & SC RELEASES AND BELOW 125A SHALL HAVE THERMAL MAGNETIC BASED O/L AND S/C RELEASES. HOWEVER WELDING FEEDER SHALL BE PROVIDED WITH AN ADDITIONAL EARTH FAULT.
11) CURRENT DENSITY OF ALL ALUMINIUM BUSBAR SHALL NOT EXCEED 1.0/SQ.MM AND OF COPPER BUSBAR SHALL NOT EXCEED 1.25 A/SQ.MM.
12) ACDB & PDB SHALL FED POWER TO THE WELDING SOCKETS OF RESPECTIVE BUILDINGS.
13) IN MLDB & ACDB SPACE FOR 32A & 63A MCCB RESPECTIVELY SHALL BE PROVIDED FOR FIXING OF COMPONENTS DURING PHASE–2

* THE CONTRACTOR SHALL PROCURE THE EQUIPMENT FOR PHASE 1 ONLY & PROVISION SHALL BE MADE FOR PHASE 2.

REV	DATE	DESCRIPTION	DRN	CHD	APD
R1	11.05.16	BASED ON REMOVAL OF BERTH 5	SKN	SS	SD

THIS DESIGN OR DRAWING IS THE PROPERTY OF HOWE, PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality..., HR Wallingford Working with water. IT IS SUBJECT TO THEIR RECALL AND MUST NOT BE LENT COPIED OR REPRODUCED WITHOUT THEIR WRITTEN PERMISSION.

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

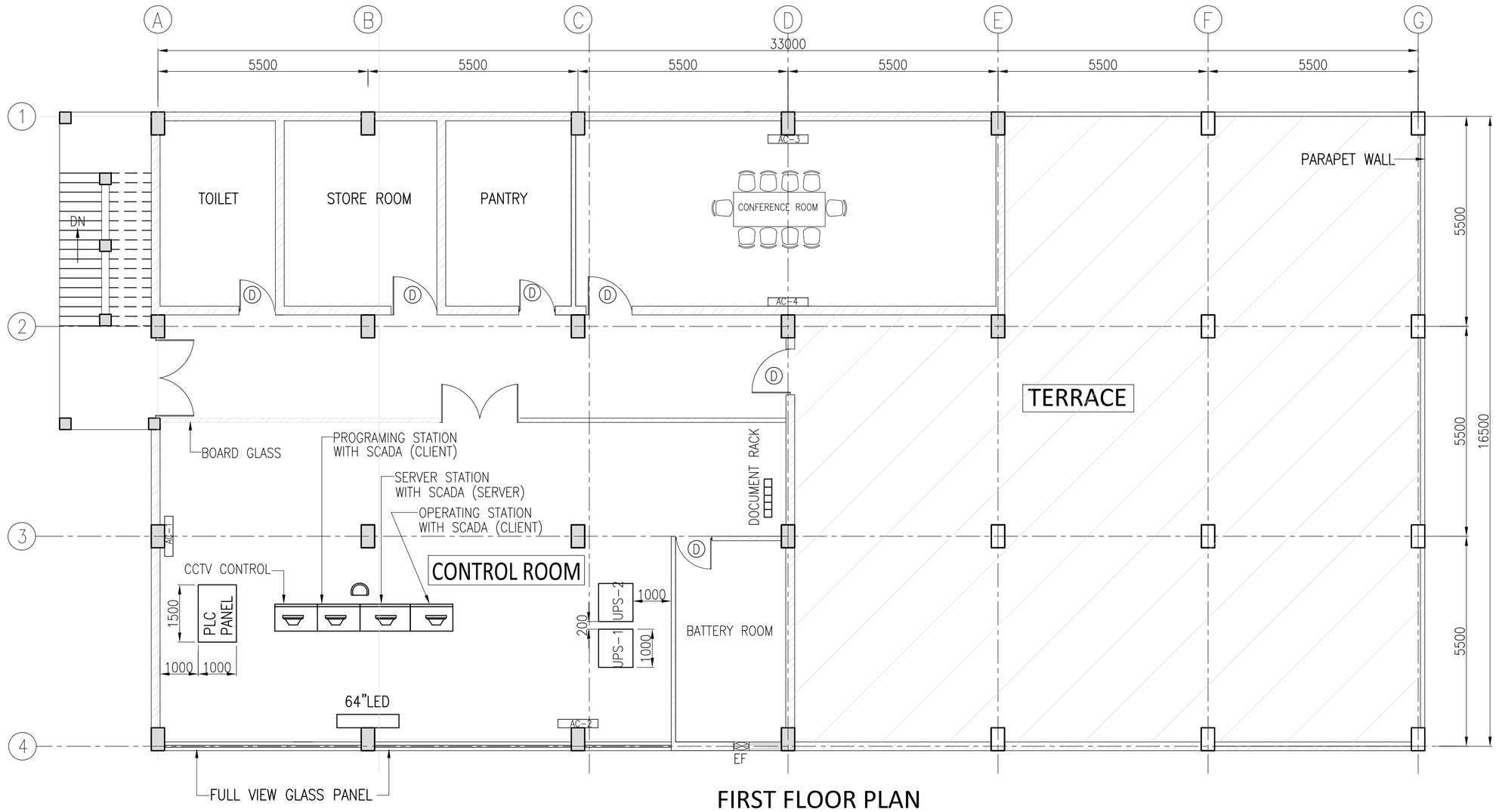
	NAME	SIGN	DATE
DRN	VS		30–05–2016
CHD	SS		30–05–2016
APD	SD		30–05–2016

TITLE: IWT TERMINAL AT HALDIA
POWER SINGLE LINE DIAGRAM

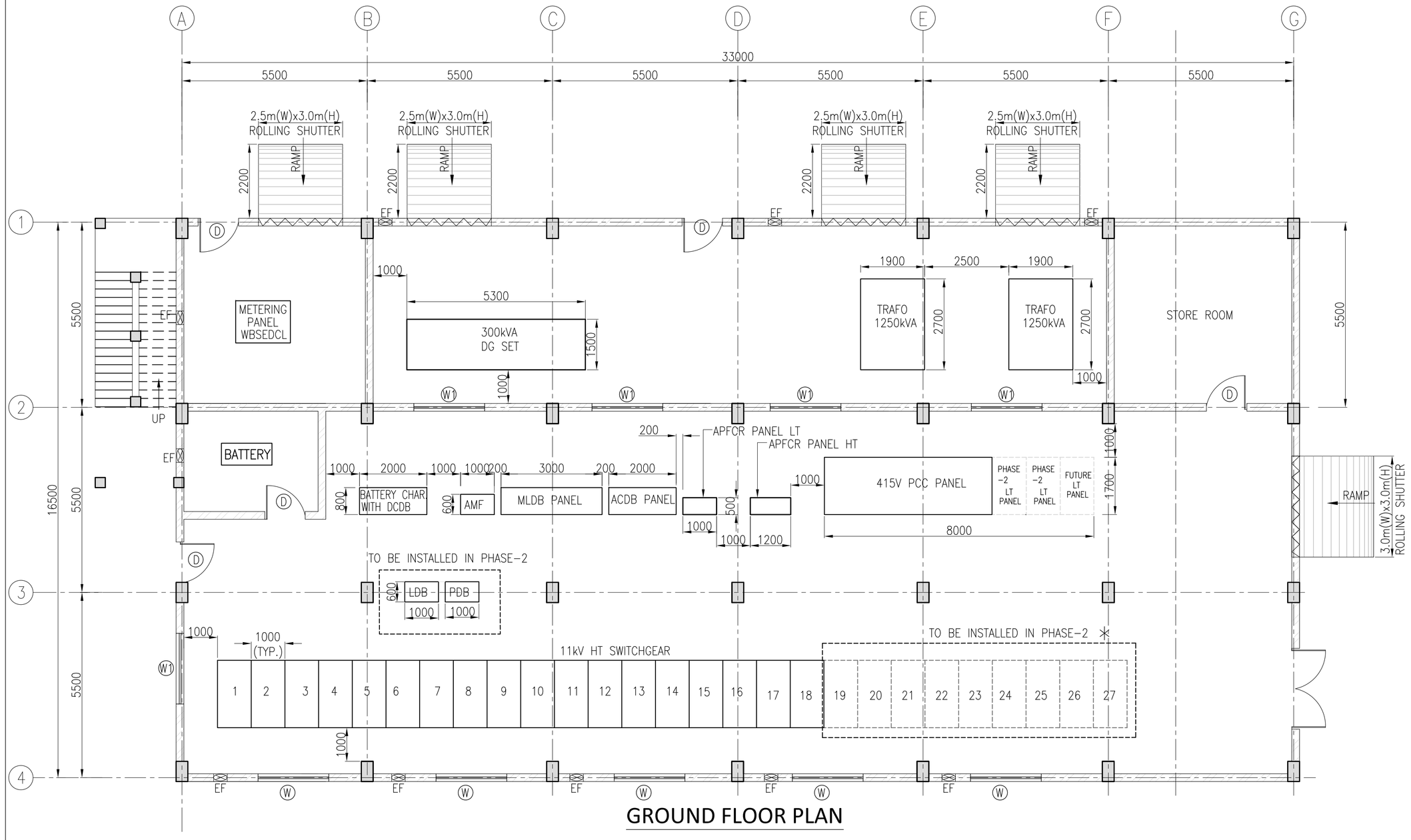
JOB. NO. I-525 | DRG. NO. HT-229

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE-NTS | Size : A1 | REV. 1



FIRST FLOOR PLAN



GROUND FLOOR PLAN

LEGEND :-

- (W) WINDOW (OPENABLE)
- (W1) FIXED GLASS WINDOW
- EXHAUST FAN
- (D) DOOR

NOTE :-

1. ALL DIMENSIONS ARE IN MM UNLESS OTHERWISE NOTED.

REV	DATE	DESCRIPTION	DRN	CHD	APD
R1	11.05.16	BASED ON REMOVAL OF BERTH 5	SKN	SS	SD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

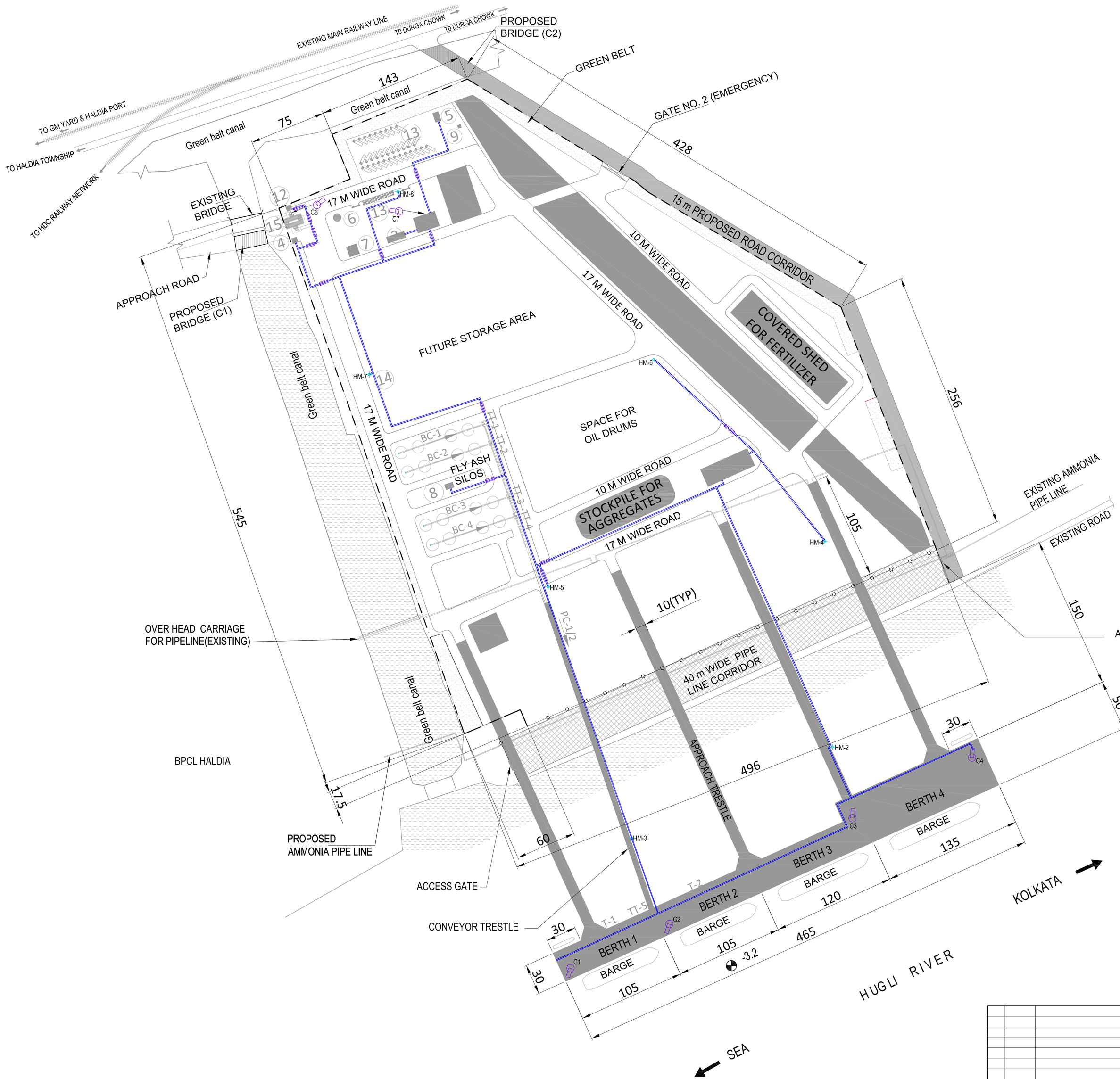
	NAME	SIGN	DATE
DRN	VS		30-05-2016
CHD	SS		30-05-2016
APD	SD		30-05-2016

TITLE: IWT TERMINAL AT HALDIA
SUBSTATION EQUIPMENT LAYOUT

JOB. NO. I-525 | DRG. NO. HT-230

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE-1:100 | Size : A1 | REV. 1



LEGEND:

S.NO.	DESCRIPTION
1	TERMINAL ADMINISTRATION BUILDING
2	WORKER'S AMENITY BUILDING
3	FUEL BUNKER
4	SECURITY OFFICE
5	SEWAGE TREATMENT PLANT
6	OVERHEAD WATER TANK
7	UNDERGROUND RESERVOIR
8	RIO (REMOTE INPUT OUT PUT)/ COMPRESSOR ROOM FOR ASH HANDLING
9	WASTE COLLECTION CENTER
10	SETTLING POND
11	ELECTRICAL SUB STATION
12	WEIGH BRIDGE CONTROL ROOM
13	VEHICLE PARKING AREA
14	HIGHMAST LIGHTING TOWERS
15	GATE HOUSE COMPLEX

LEGEND:

SYMBOL	DESCRIPTION
TT	TRANSFER TOWER
T	TOWER
BC	BELT CONVEYORS
PC	PIPE CONVEYORS
	HUME PIPE FOR CABLE ROAD CROSSING
	RCC CABLE TRENCH 1.0X1.0 m
	CCTV CAMERA
	HIGHMAST(HM)

NOTES:

1. ALL DIMENSIONS ARE IN METER

REV	DATE	DESCRIPTION	DRN	CHD	APD
R1	11.05.16	BASED ON REMOVAL OF BERTH 5	SKN	SS	SD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

	NAME	SIGN	DATE
DRN	VS		30-05-2016
CHD	SS		30-05-2016
APD	SD		30-05-2016

TITLE: IWT TERMINAL AT HALDIA
HIGH MAST & CABLE LAYOUT

JOB. NO. I-525 | DRG. NO. HT-231

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE:-NTS | Size : A1 | REV. 1

IN CONTROL ROOM

PC, SERVER, NETWORK SWITCH AND AUXILIARIES

CONTROL ROOM AT ELECTRICAL SUBSTATION

3D LEVEL SCANNER MODEM

USB CABLE

OPERATING STATION TERMINAL WITH SCADA CLIENT SIDE

SERVER STATION WITH SCADA SERVER SIDE

PROGRAMMING STATION WITH SCADA CLIENT SIDE

CCTV TERMINAL

COLOR LASER PRINTER (A3/ A4)

CPU

21" MONITOR

64" LED SCREEN

NVR SERVER

REDUNDANT UPS (5kVA)

ETHC

1P X 1.5 SQMM.

ETHSW (100 Mbps)

ETHSW (100 Mbps)

PROGRAMMABLE LOGIC CONTROLLER

INPUT OUTPUT MODULES

PLC

PWR | CPU | ETH | EXCH | LIU | DI | DI | DI | DI | DI | DI | DO | LIU | AO | AI | SPARE | SPARE

PWR | CPU | EXCH | ETH | PLC

FO

7P X 1.5 SQMM.

FO TO ETHERNET MEDIA CONVERTER

ETHERNET TO FO MEDIA CONVERTER

TO BE INSTALLED IN PHASE-2

BERTH-1 | BERTH-2 | BERTH-3 | BERTH-4 | BERTH-5 | MAIN GATE | TERMINAL ADMIN BLDG.

3D LEVEL SCANNERS (8 NOS.) ABOVE EACH SILO FOR PHASE-1 AND 8NOS. ABOVE EACH SILO FOR PHASE-2

PANEL-1

PANEL-2

PANEL-3

PANEL-4

3D LEVEL SCANNERS (4 NOS.)

3P X 1.0 SQMM.

JB

* PHASE-2

RIO PANEL, JUNCTION BOX AND FIELD DEVICES

BARGE LOADER-1 PLC

BARGE LOADER-2 PLC

WEIGH BRIDGE-1 PLC

WEIGH BRIDGE-2 PLC

MHC-1 PLC

MHC-2 PLC

LIU

SINGLE TO MULTI CHANNEL JB FOR FO AT BERTH

PHASE-2

PCS/ BSS ON BC-1 | PCS/ BSS ON BC-2 | PCS/ BSS ON BC-3 | PCS/ BSS ON BC-4 | PCS/ BSS ON BC-5 | PCS/ BSS ON BC-6

2P X 1.5 SQMM.

MU-1 | MU-2 | MU-3 | MU-4 | MU-5 | MU-6

3C X 2.5 SQMM.

MULTI CORE CABLES

RIO PANEL AT RIO/ COMPRESSOR ROOM

SILO DE LCP-1
SILO DE LCP-2
SILO DE LCP-3
SILO DE LCP-4
SILO DE LCP-5
SILO DE LCP-6
SILO DE LCP-7
SILO DE LCP-8

MULTI TERMINAL JB-1

SILO DE LCP-9
SILO DE LCP-10
SILO DE LCP-11
SILO DE LCP-12
SILO DE LCP-13
SILO DE LCP-14
SILO DE LCP-15
SILO DE LCP-16

MULTI TERMINAL JB-2

TRANSFER TOWER DE LCP-17
TRANSFER TOWER DE LCP-18
TRANSFER TOWER DE LCP-19

MULTI TERMINAL JB-4

BELT SCALE JB-1

BELT SCALE JB-2

BC-1 JB | BC-2 JB | BC-3 JB | BC-4 JB | BC-5 JB | BC-6 JB

3C X 2.5 SQMM.
ZSS
BTS

FLAP GATE JB-1 | FLAP GATE JB-2 | FLAP GATE JB-3 | FLAP GATE JB-4

PC-1 | PC-2

MU-7 | MU-8

PCS/ BSS ON PC-1

PCS/ BSS ON PC-2

STAND ALONE JB AT BERTH (IP-67)

LEGEND

MU	MASTER UNIT
PCS	PULL CORD SWITCH
BSS	BELT SWAY SWITCH
UPS	UNINTERRUPTED POWER SUPPLY
JB	JUNCTION BOX
ETHSW	ETHERNET SWITCH
PLC	PROGRAMMABLE LOGIC CONTROLLER
PWR	PLC POWER SUPPLY
CPU	PLC CENTRAL PROCESSING UNIT
EXCH	PLC MEMORY EXCHANGE WITH REDUNDANT PLC
ETH	PLC ETHERNET MODULE
DI	PLC DIGITAL INPUT MODULES
DO	PLC DIGITAL OUTPUT MODULE
SPARE	PLC SPARE I/O BASE
LIU	LIGHT INTERFACE UNIT
CPU	CENTRAL PROCESSING UNIT
DE LCP	DUST EXTRACTION LOCAL CONTROL PANEL
MHC	MOBILE HARBOR CRANE
BC	BELT CONVEYOR
RIO	REMOTE INPUT OUTPUT
PC	PIPE CONVEYOR
BTS	BELT TAKE UP SWITCH
ZSS	ZERO SPEED SWITCH

CABLE LEGEND

- FO — FIBRE OPTIC
- ETHERNET CABLE (Cat 5e)
- MULTICORE/ MULTIPAIR CABLES
- PAN TILT ZOOM CLOSED CIRCUIT TELEVISION CAMERAS

NOTE:-

1. NUMBER OF INPUT/ OUTPUTS FOR RIO PANEL AND PLC PANEL SHALL BE CONSIDERED WITH 20% SPARE,

2. ALL DUST EXTRACTION LOCAL CONTROL PANEL (DE LCP) SHALL BE LOCATED ON THE FIELD IN RESPECTIVE LOCATIONS NEAR DUST EXTARCTION SYSTEM. THESE PANELS WILL BE CONNECTED TO THE RIO PANEL VIA MULTICORE CABLES.

3. NUMBER OF INPUTS/ OUTPUTS FOR PHASE-2 SHALL BE CONSIDERED IN THE RESPECTIVE PHASE-2 WITH 20% SPARE CAPACITY

REV	DATE	DESCRIPTION	DRN	CHD	APD
R1	11.05.16	BASED ON REMOVAL OF BERTH 5	SKN	SS	SD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

	NAME	SIGN	DATE
DRN	AM		30-05-2016
CHD	SS		30-05-2016
APD	SD		30-05-2016

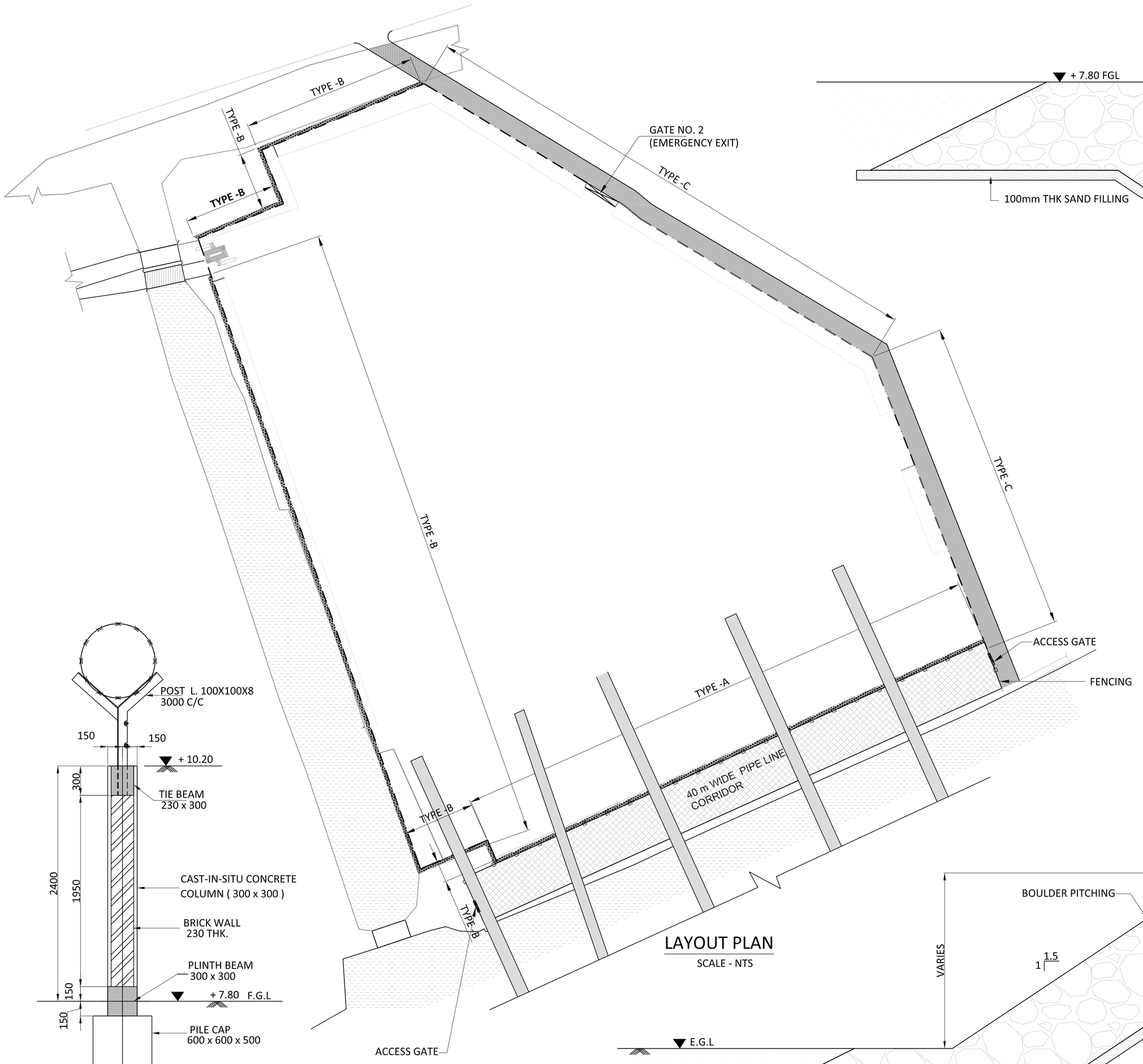
TITLE: IWT TERMINAL AT HALDIA CONTROL ARCHITECTURE

JOB. NO. I-525

DRG. NO. HT-232

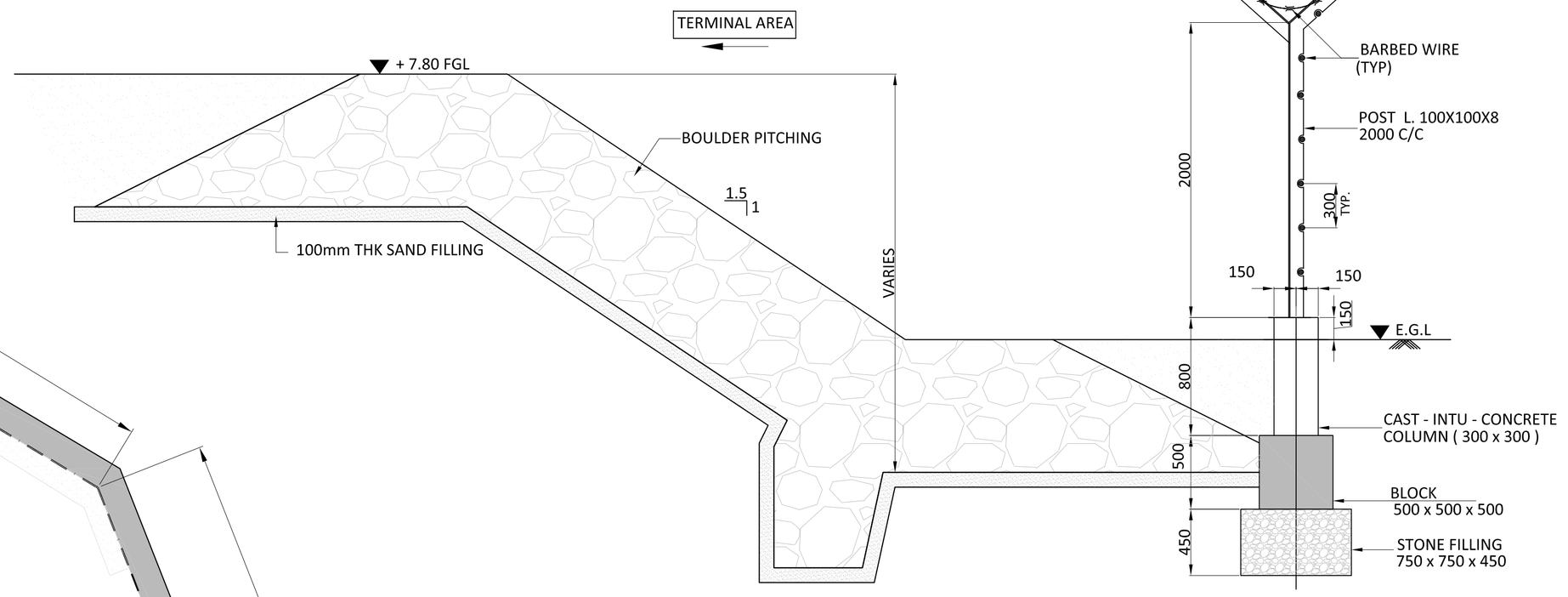
COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE-NTS | Size : A1 | REV. 1



LAYOUT PLAN

SCALE - NTS



TYPE A

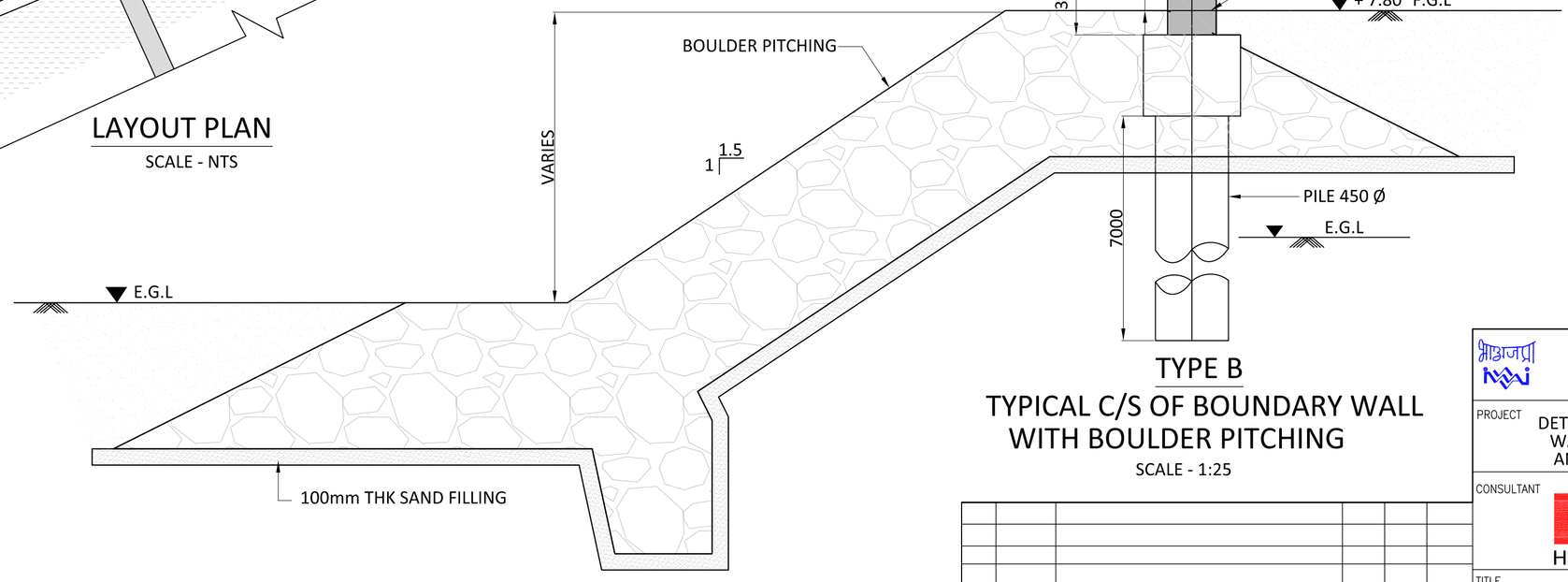
TYPICAL C/S OF FENCING WITH BOULDER PITCHING

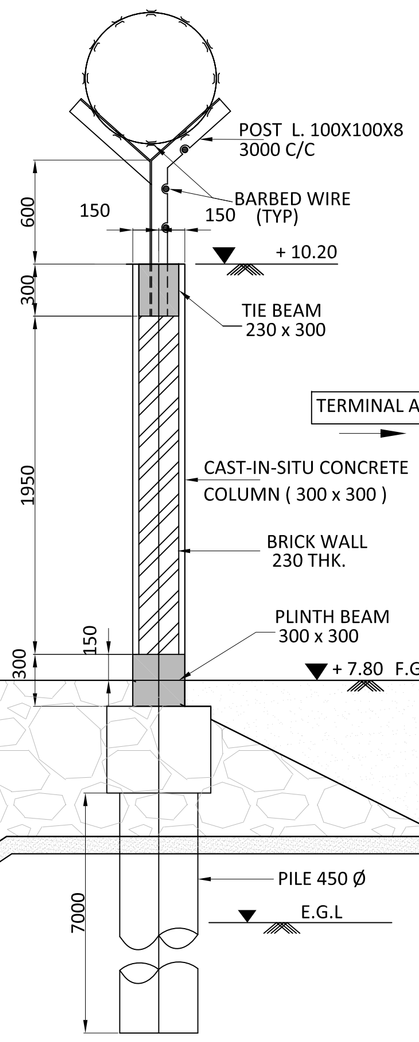
SCALE -1:25

TYPE C

TYPICAL C/S OF BOUNDARY WALL

SCALE - 1:25





TYPE B

TYPICAL C/S OF BOUNDARY WALL WITH BOULDER PITCHING

SCALE - 1:25

NOTES:

1. ALL DIMENSIONS ARE IN MILIMETER
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM
3. ALL FOUNDING LEVEL ARE TENTATIVE. ACTUAL FOUNDING LEVEL MAY VARY AS PER THE ACTUAL SOIL CONDITION AT SITE
4. ALL STRUCTURAL STEEL & BARBED WIRES HAS TO BE GALVANIZED

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

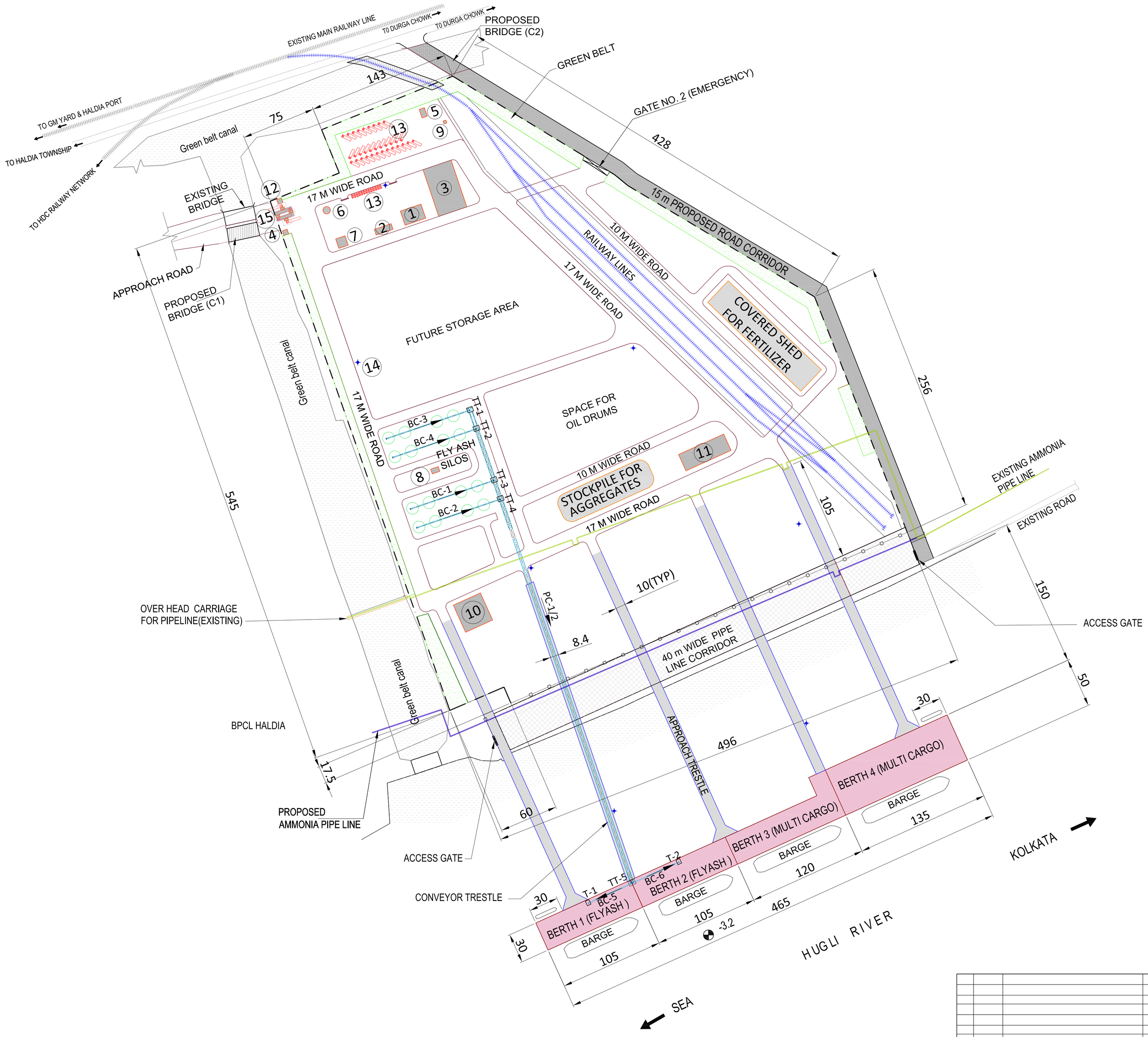
	NAME	SIGN	DATE
DRN	SKN		30-05-2016
CHD	HM/SKA		30-05-2016
APD	S DHAR		30-05-2016

TITLE: IWT TERMINAL AT HALDIA-TYPICAL DETAIL OF BOUNDARY WALL, FENCING & BOULDER PITCHING

JOB. NO. I-525 | DRG. NO. HT-233

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - AS SHOWN | Size : A1 | REV. 0



LEGEND:

S.NO.	DESCRIPTION
1	TERMINAL ADMINISTRATION BUILDING
2	WORKER'S AMENITY BUILDING
3	FUEL BUNKER
4	SECURITY OFFICE
5	SEWAGE TREATMENT PLANT
6	OVERHEAD WATER TANK
7	UNDERGROUND RESERVOIR
8	RIO (REMOTE INPUT OUT PUT)/ COMPRESSOR ROOM FOR ASH HANDLING
9	WASTE COLLECTION CENTER
10	SETTLING POND
11	ELECTRICAL SUB STATION
12	WEIGH BRIDGE CONTROL ROOM
13	VEHICLE PARKING AREA
14	HIGHMAST LIGHTING TOWERS
15	GATE HOUSE COMPLEX

LEGEND:

SYMBOL	DESCRIPTION
TT	TRANSFER TOWER
T	TOWER
BC	BELT CONVEYORS
PC	PIPE CONVEYORS

NOTES:

1. ALL DIMENSIONS ARE IN METER
2. ALL LEVELS ARE IN METERS & ARE WITH RESPECT TO CHART DATUM

REV	DATE	DESCRIPTION	DRN	CHD	APD

INLAND WATERWAYS AUTHORITY OF INDIA

PROJECT: DETAILED FEASIBILITY STUDY FOR CAPACITY AUGMENTATION OF NATIONAL WATERWAY-1 AND DETAILED ENGINEERING FOR ITS ANCILLARY WORKS AND PROCESS BETWEEN HALDIA TO ALLAHABAD (JAL VIKAS PROJECT)

CONSULTANT: HOWE; PMC PROJECTS (INDIA)PRIVATE LIMITED from vision to reality...; HR Wallingford Working with water

	NAME	SIGN	DATE
DRN	SKN		30–05–16
CHD	HM/SKA		30–05–16
APD	S DHAR		30–05–16

TITLE: IWT TERMINAL AT HALDIA
RAIL CONNECTIVITY

JOB. NO. I-525 | DRG. NO. HT-234

COORDINATE SYSTEM USED: ENTER CO-ORD SYSTEM HERE

UNIT | SCALE - 1:2000 | Size : A1 | REV. 0