CHAPTER

0

EXECUTIVE SUMMARY

0 Executive Summary

0.1 Introduction

This Chapter of the Report summarizes the findings of the Feasibility Study carried out for the Project. According to the study, Istaru-Booni Hydropower Project is marked to have an installed power generation capacity of 72 MW against 52 MW as originally estimated in the identification studies conducted earlier by GTZ. Accordingly, the Annual Energy is now estimated as 256 GWh. Salient Features of the Project are placed at the end of this Chapter.

All relevant desk and field studies including Field Investigations have been conducted during the course of Feasibility Study. Geological, Environmental and Seismic Studies have not indicated any major adversity that may challenge/threaten further development and construction of the Project.

The Feasibility Report has been prepared by a Joint Venture of three local Consultants including ACE, EGC and TEAM Consultants, ACE being the lead Consultant.

0.2 Project Location

Istaru Booni Hydropower Project is located in northern part of Chitral District of Khyber Pakhtunkhwa. Both weir and powerhouse sites are accessible from Booni Town by a jeepable road. Booni Town is located about 75 km from Chitral city and is connected to the latter through a metalled road. Chitral city is about 365 km from Peshawar and is connected from down country through Lowari Pass and Lowari Tunnel.

Istaru-Booni Hydropower Project (IB HPP) has its weir site located on Turkho River about 2 km downstream of Istaru Village. Turkho River is a right tributary of Mastuj River. It joins with Mastuj River about 10 km downstream of Booni Town. The powerhouse site is proposed on the right bank of Mastuj River near Booni Town.

0.3 Selection of Dam Site and Project Layout Studies

After an exhaustive study, the Dam Site has been selected near Istaru Village 1 Km upstream of GTZ's identified Dam axis. Better geological conditions at the selected Dam Site, availability of working space and better access to the Site have been the main factors for selection of this site.
Conventional open desanders were not found feasible due to the natural constraints imposed by narrow valley; hence barrel type desanders have been provided in the rock.

0.4 Geological and Geotechnical Studies

Studies and Investigations conducted so far reveal that the rocks at Dam site and Power House area are sound and massive. Limestone, Slates, Dolomites and at some places low grade Marble has been encountered during the investigations. Open joints resulting in high permeability will have to be treated properly. Bearing Capacity of the rocks will not pose any problem for the structures designed for Istaru-Booni Hydropower Project.

0.5 Seismic Hazard Analysis

Seismic Hazard evaluation has been carried out in accordance with the ICOLD Guidelines for selecting Seismic Parameters for large dams (1989, Revised 2010).
Recommended PGA value for Safety Evaluation Earthquake (SEE) is 0.40g which has a return period of 3,000 years. PGA of 0.18g having a return period of 145 years is recommended for Operating Basis Earthquake (OBE).

0.6 Optimization and Project Sizing

According to Optimization Studies, optimum value of Turkho River Discharge is derived as 94 m^3/sec, instead of 74m^3/sec as indicated earlier by GTZ. All other components of the scheme have been sized accordingly, resulting in an increased installed capacity of Power Plat from 52 MW to 72 MW with a Plant Factor of 40%.

0.7 Environmental and Social Impact Assessment

Surveys and Studies are indicative of Low-Adverse Impact resulting from implementation of Istaru-Booni Hydropower Project. All the impacts can be mitigated without difficulty.

0.8 Construction Planning

It is presumed that the construction of this Project shall be carried out as Engineering, Procurement & Construction (EPC) Package. At this stage, Consultants have carried out an exercise to establish broad outlines which identify the extent, viability and interdependence of various activities involved in construction as shown in the Project Construction Schedule given in Chapter-15 of this Report. The Project can be completed in a Period of 48 months, out of which 12 months will be required for pre-construction activities and 36 months for construction.

0.9 Cost Estimate

Cost estimates of the Project are prepared on the basis of Feasibility Level Designs and Drawings. Rates of various items used for cost estimation are derived from Composite Schedule of Rates. Rates have also been obtained from suppliers / manufacturers wherever needed. All rates pertain to the year 2013 price level.
Total Project cost has been worked out as US$ 260.30 million or 27,566.02 million Rs which includes US$ 36.99 million as Interest during construction (IDC) and includes US$ 171.71 million as Direct Cost and US$ 31.63 million as Indirect Cost. The indirect cost includes land acquisition and compensation, engineering cost, developer's expenses, taxes, duties and insurance. While working out the cost of each Project component, contingencies in case of Civil Works and E&M items have been included.

0.10 Economic and Financial Analyses

Economic viability of the Project has been determined using the “Alternative Cost” approach, wherein the investment of Istaru-Booni Hydropower Project is compared with the investment of alternative thermal Power plants.

EIRR in comparison with thermal Plant of equivalent capacity is 27.40% in case of furnace oil plant and 16.67% in case of gas operated plant. Benefit-Cost Ratio in each of the two cases is 2.01 and 1.27 respectively.

To test the robustness of the Economic appraisal of the Project, a sensitivity analysis has been carried out. This test has been performed only for the combined cycle plant (in case of furnace oil) as this alternative has been compared with the proposed Project.

The above mentioned analysis has been tested for its robustness by Cost increase and Benefit decrease of 10%. The cumulative effect of the above two conditions gives an EIRR of 21.55% and B.C Ratio as 1.64 Study of Certified Emission Rate (CER) indicates a saving of emission of 43,520 tons of CO_2 compared to furnace oil plants and 31,334 tons in case of gas plants.

Financial Analysis has indicated B.C Ratio greater than one (1). It is also seen from the Financial Analysis that repayment of the loan instalments will be easily manageable for the executing agency.

SALIENT FEATURES

ISTARU-BOONI HYDROPOWER PROJECT
SALIENT FEATURES

Location
2 km downstream of Istaru Village,
(District Chitral), Khyber Pakhtunkhwa,
Pakistan.

Organization
Pakhtunkhwa Hydel Development Organization
(PHYDO).

Hydrology

Catchment area (dam site)	3386 km^2
Mean Monthly Discharge (m^3/sec)	8.2 to 264.30
Design Flood	1085 m^3/sec

River Diversion

Design Flood (Q_{10} year)	504 m^3/sec
No of Diversion Tunnels	2 No's.
Shape	D-shaped
Size	6.00 m x 5.50 m

Dam & Appurtenant Structures

Spillway type	Ogee-crest with LLO, s
Design Discharge (spill portion)	542.5 m^3/sec.
Design Discharge (LLO's)	542.5 m^3/sec.
Dam Height (from Bed)	28 m.
No of Low level outlets (LLO's)	6 No's
Size of Low level outlets (W x H)	2.60 m x 2.00 m

Power Intake/ Connecting Tunnels

No of Intakes	2 No's.
Size of each intake opening	6.30 m x 3.00 m
Intake invert Level	2099.00 m.asl.
No of Intake Connecting tunnels	2 No's

Sand Trap / Flushing Tunnels

Type	Pressurized-D shape
No of chambers	2 No's
Length of Chamber	350 m.
Fall velocity	0.2 m /sec
Flushing Discharge	18.8 m^3 /sec.
No of Flushing Conduits	2 No's

Headrace Tunnel

Type	Horseshoe
Length	4024 m.
Diameter	6.30 m.

Surge Shaft

Height	30 m.
Diameter	12 m.

Concrete Lined Pressure Shaft

Length	53 m.
Diameter	5.0 m.

Steel Lined Penstock

Length	148 m.
Diameter	4.50 m.

Head

Gross head	96.60 m.
Head loss	11.00 m.
Net Head	85.60 m.

Discharge

Design Discharge	94 m^3/sec

Powerhouse

Type	Surface
Size (Lx WxH)	90x16.50 x 20.00

Tailrace Tunnel

Type	Trapezoidal
Total length	475 m.
Bed Width	30 m.

Hydro-Mechanical Equipment

Type of turbine	Francis
No of Units	4 No's
Discharge/ Unit	23.5 m^3/sec

Electrical Equipment

Generators	3 No's
Speed	333 rpm.

Installed Capacity

Plant Capacity	72 MW
Capacity/ unit	18 MW

Energy

Annual Energy	256 MW
Plant Factor	41 %

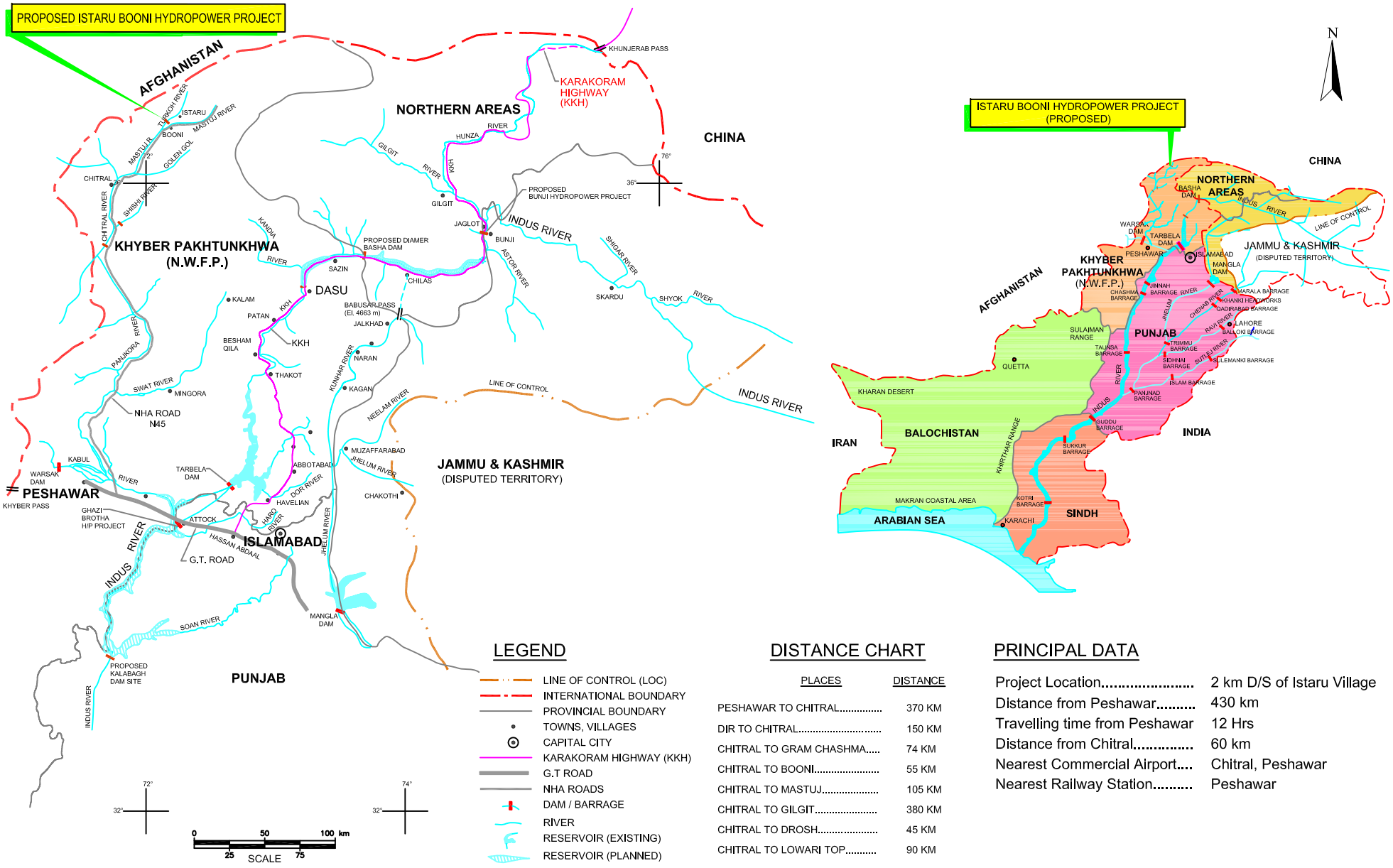
Project Cost (with transmission line)

Base Cost	21,532.93 M.Rs.
Total Project Cost	27,566.02 M.Rs.

Economic and Financial Analysis

B/C ratio	1.09:1
EIRR	27.40%
FIRR	13.03%
Cost/MW	3.58 M.US$
Construction time	36 months

FIGURE



LEGEND

- LINE OF CONTROL (LOC)
- INTERNATIONAL BOUNDARY
- PROVINCIAL BOUNDARY
- TOWNS, VILLAGES
- CAPITAL CITY
- KARAKORAM HIGHWAY (KKH)
- G.T ROAD
- NHA ROADS
- DAM / BARRAGE
- RIVER
- RESERVOIR (EXISTING)
- RESERVOIR (PLANNED)

DISTANCE CHART

PLACES	DISTANCE
PESHAWAR TO CHITRAL	370 KM
DIR TO CHITRAL	150 KM
CHITRAL TO GRAM CHASHMA	74 KM
CHITRAL TO BOONI	55 KM
CHITRAL TO MASTUJ	105 KM
CHITRAL TO GILGIT	380 KM
CHITRAL TO DROSH	45 KM
CHITRAL TO LOWARI TOP	90 KM

PRINCIPAL DATA

Project Location	2 km D/S of Istaru Village
Distance from Peshawar	430 km
Travelling time from Peshawar	12 Hrs
Distance from Chitral	60 km
Nearest Commercial Airport	Chitral, Peshawar
Nearest Railway Station	Peshawar

CONSULTANTS: ACE, EGC, TEAM
A Joint Venture of Associated Consulting Engineers - ACE (Pvt.) Ltd, EGC and TEAM

CLIENT:
ISLAMIC REPUBLIC OF PAKISTAN
GOVERNMENT OF KHYBER PAKHTUNKHWA,
PAKHTUNKHWA HYDEL DEVELOPMENT ORGANIZATION (PHYDO)

Designed By:	Checked By:
FAROOQ BHUTTA	—
Drawn By:	Approved By:
IMTIAZ KHAN	—

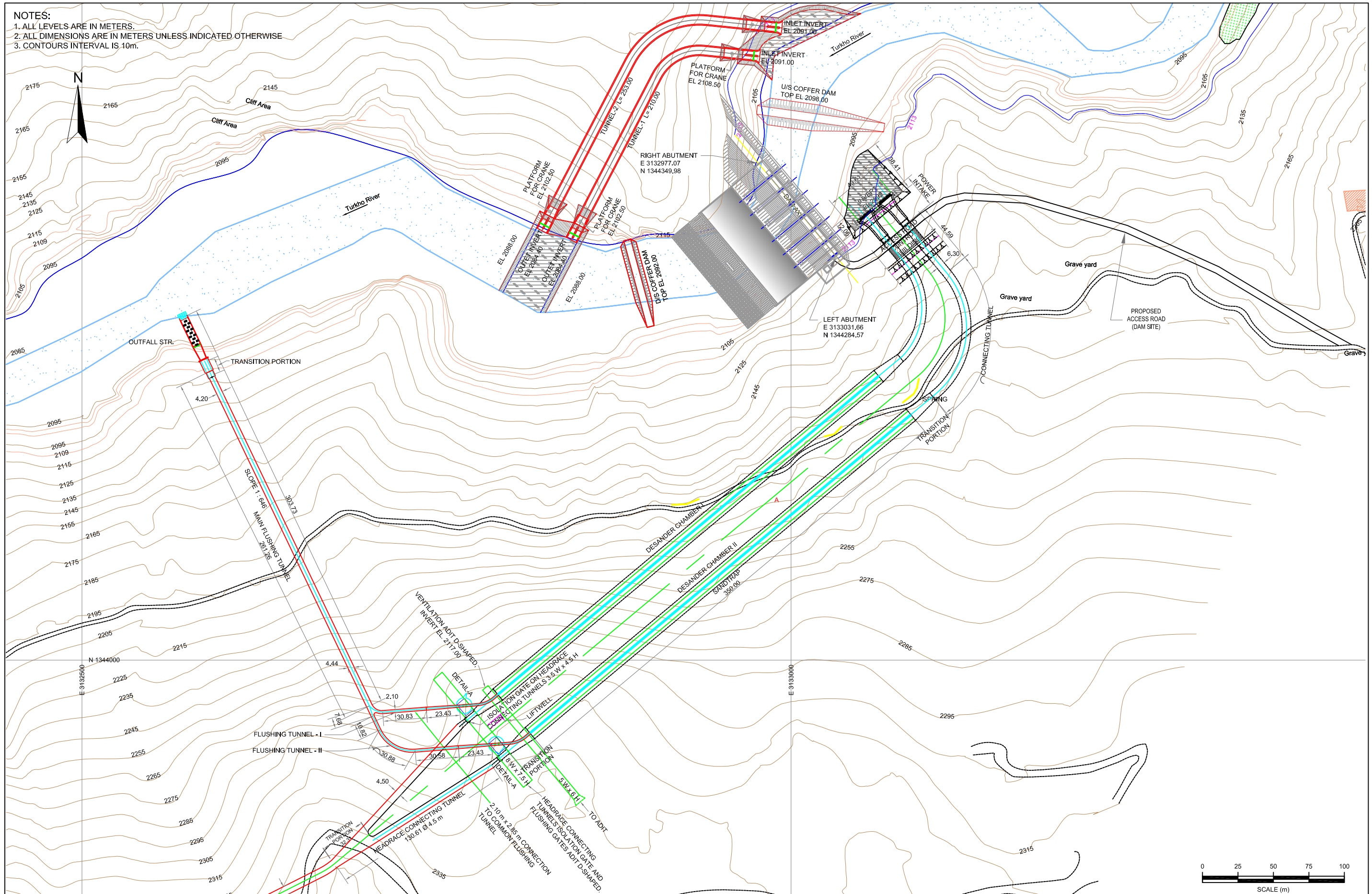
ISTARU BOONI HYDROPOWER PROJECT
FEASIBILITY STUDY

LOCATION PLAN

DATE:	DRAWING NO.	REV. NO.
SEPTEMBER, 2012	IB-01	00

Figure 1.1

NOTES:
1. ALL LEVELS ARE IN METERS.
2. ALL DIMENSIONS ARE IN METERS UNLESS INDICATED OTHERWISE
3. CONTOURS INTERVAL IS 10m.



CONSULTANTS: ACE / EGC / TEAM — A Joint Venture of Associated Consulting Engineers - ACE (Pvt.) Ltd, EGC and TEAM	CLIENT: ISLAMIC REPUBLIC OF PAKISTAN, GOVERNMENT OF KHYBER PAKHTUNKHWA, **PAKHTUNKHWA HYDEL DEVELOPMENT ORGANIZATION (PHYDO)**	Designed By: QURAT UL AIN	Checked By: M. IQBAL GILL	ISTARU BOONI HYDROPOWER PROJECT FEASIBILITY STUDY	
		Drawn By: SAMI	Approved By: –	SANDTRAP CHAMBERS LAYOUT	
				DATE: JANUARY, 2014	DRAWING NO. 8.26 / REV. NO. 00

NOTES:
1. ALL LEVELS ARE IN METERS.
2. ALL DIMENSIONS ARE IN METERS UNLESS INDICATED OTHERWISE.
3. CONTOURS INTERVAL IS 10m

N

PENSTOCK, Ø 4.5m
SLOPE; 3%
L = 149.50m

MANIFOLD
L= 91.00m

PROPOSED AREA
FOR SWITCH YARD
(5 KANALS)

PROPOSED AREA
FOR COLONY
(28 KANAL)

POWERHOUSE

UPGRADATION OF
EXISTING BOONI - MASTUJ
ROAD UPTO
POWERHOUSE

E 3129046.21
N 1341789.96

E 3129136.06
N 1341793.10

E 3129046.78
N 1341773.47

E 3129136.64
N 1341776.61

TAILWATER COLLECTION
CHAMBER (L 60, W 5)

OVERFLOW WEIR

BRIDGE FOR GATE CHAMBER

CEMENT GROUTED
STONE PITCHING

STOPLOG

30

TAILRACE CHANNEL W 30m
SLOPE: 1:800

PROPOSED AREA
CONTRACTOR'S CAMP
(15 KANAL)

TAILRACE
CHANNEL

EARTHEN CHANNEL
L = 406m, W = 30m

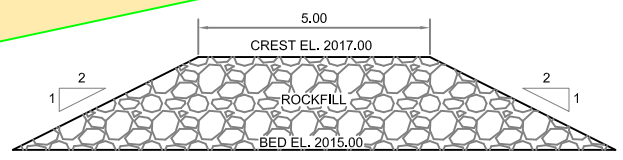
Cultivated Land

Jamwan Khan

Ali Bakhash House

PROPOSED FLOOD PROTECTION
BUND \ EMBANKMENT (WIDTH 5m)
CREST EL. 2017.00

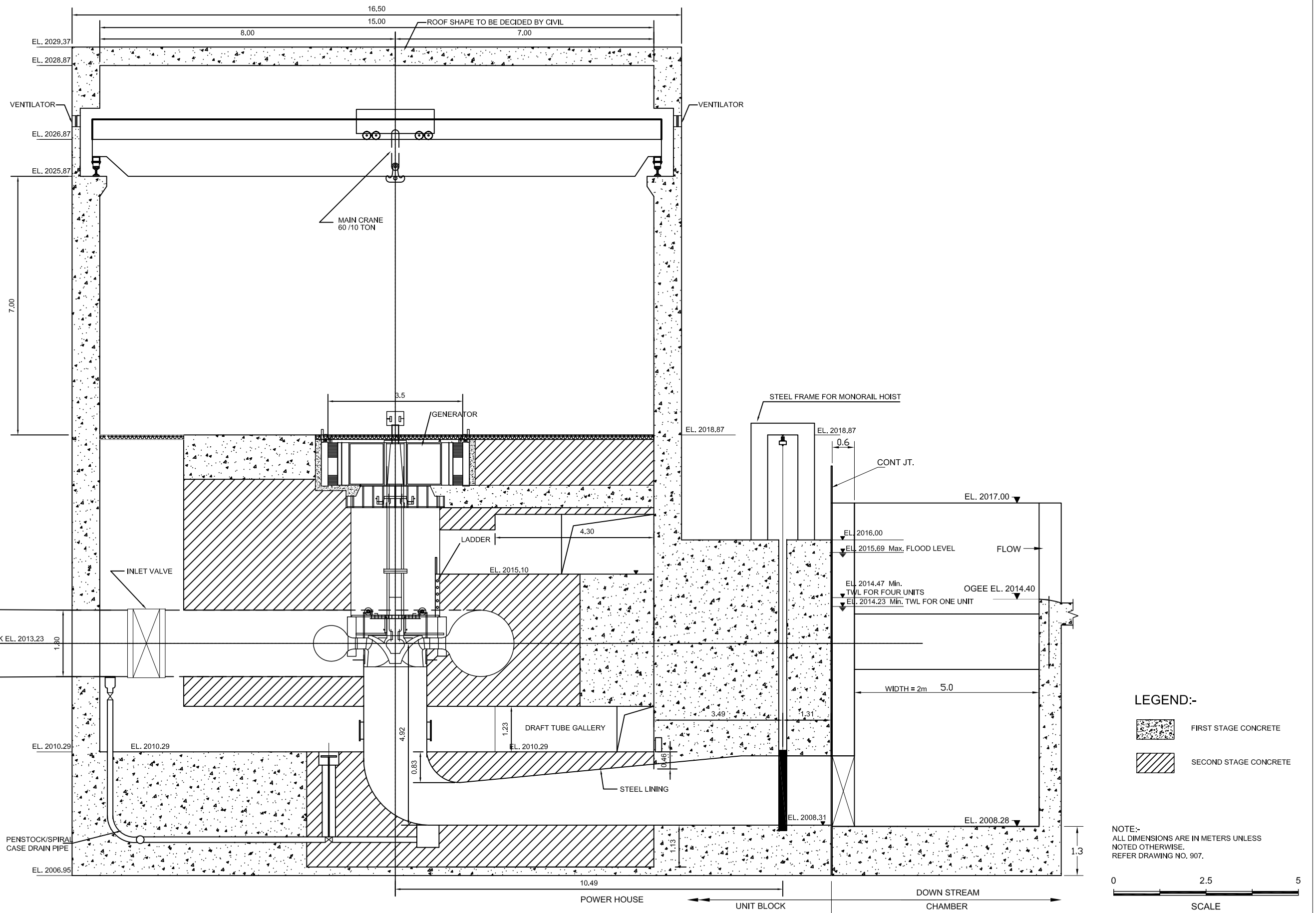
Cul



TYPICAL SECTION OF PROTECTION BUND / EMBANKMENT

0 10 20 30 40
SCALE (m)

CONSULTANTS: ACE / EGC / TEAM CONSULTANTS — A Joint Venture of Associated Consulting Engineers - ACE (Pvt.) Ltd, EGC and TEAM	CLIENT: ISLAMIC REPUBLIC OF PAKISTAN, GOVERNMENT OF KHYBER PAKHTUNKHWA, **PAKHTUNKHWA HYDEL DEVELOPMENT ORGANIZATION (PHYDO)**	Designed By: MUNEEB A. QURESHI	Checked By: M. IQBAL GILL	ISTARU BOONI HYDROPOWER PROJECT FEASIBILITY STUDY — POWERHOUSE (ZOOM VIEW)	
		Drawn By: IMTIAZ KHAN	Approved By: –	DATE: JANUARY, 2014	DRAWING NO. 8.31 / REV. NO. 00



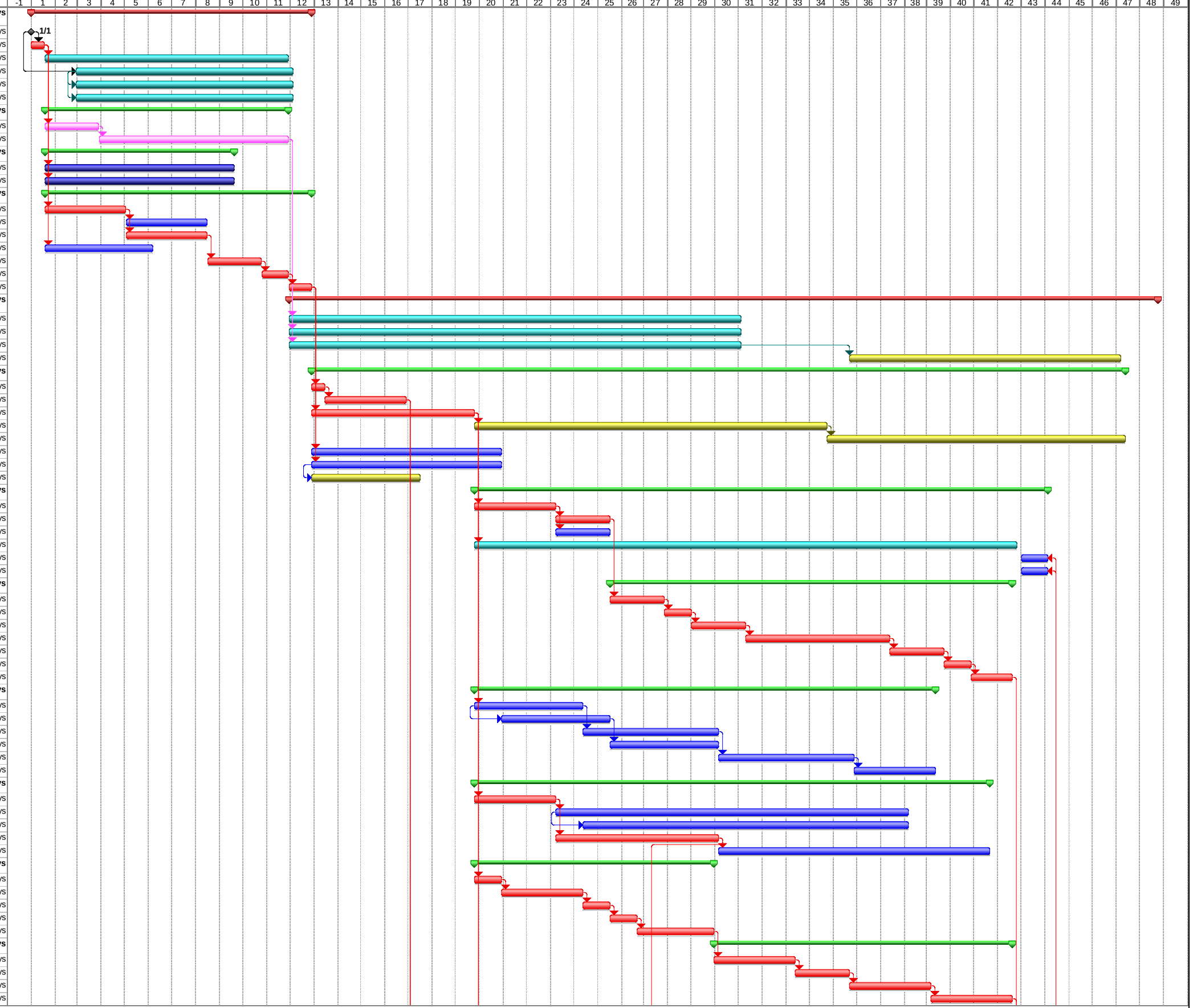
CONSULTANTS: ACE, EGC, TEAM CONSULTANTS — A Joint Venture of Associated Consulting Engineers - ACE (Pvt.) Ltd, EGC and TEAM	CLIENT: ISLAMIC REPUBLIC OF PAKISTAN, GOVERNMENT OF KHYBER PAKHTUNKHWA, **PAKHTUNKHWA HYDEL DEVELOPMENT ORGANIZATION (PHYDO)**	Designed By: G. ARIF	Checked By: F.B.	ISTARU BOONI HYDROPOWER PROJECT FEASIBILITY STUDY POWER HOUSE SECTION B-B	
		Drawn By: I.K.	Approved By: --	DATE: JANUARY, 2014	DRAWING NO. 10.5 / REV. NO. 00

ISTARU BOONI HYDROPOWER PROJECT

Overall Implimentation Programme Including Construction Schedule

Figure - 15.1

ID	Task Name	Duration
1	**Pre-Construction Stage**	**310 days**
2	**Feasibility Study**	0 days
3	**PC - I**	15 days
4	**Tariff, Power Sales Terms & NEPRA Approval**	270 days
5	**Other Misc. Legal Issues and Approvals**	240 days
6	**Power Purchase Agreement**	240 days
7	**Water Use Agreement**	240 days
8	**Land Acquisition**	**270 days**
9	Program Set-up	60 days
10	Land Acquisition	210 days
11	**Permits and Approvals**	**210 days**
12	Environmental Clearance	210 days
13	Generation License	210 days
14	**Consultancy and Tendering**	**295 days**
15	Appointment of Consultant	90 days
16	Additional Investigations and Surveys	90 days
17	Tender Design and Tender Documents	90 days
18	Prequalification of EPC Contractor	120 days
19	Tendering and Receiving Bids	60 days
20	Tender Evaluation and Selection of Contractor	30 days
21	Negotiation and Awards	25 days
22	**Construction Stage**	**961 days**
23	**Financing Institution Reporting Requirement**	500 days
24	**Environmental Mitigation and Monitoring**	500 days
25	**Compensations**	500 days
26	**Staffing and Training for Operation**	300 days
27	**Preparatory Works**	**900 days**
28	Notice to Proceed + Mobilization	15 days
29	Final Plant Size and Layout	90 days
30	Basic Design (Level-01)	180 days
31	Detail Design of Civil and other Works (Level-02)	390 days
32	As Built Drawings and Project Completion Report	330 days
33	Offices, Camps, Colony and Other Site Facilities	210 days
34	Access Road and other Related works	210 days
35	Concrete Plant and Equipment	120 days
36	**River Diversion**	**635 days**
37	Construction of Diversion Tunnels	90 days
38	Construction of Upstream Cofferdam	60 days
39	Construction of Downstream Cofferdam	60 days
40	Care and Handling of Water	600 days
41	Closure of Diversion Tunnels	30 days
42	Removal of D/S Cofferdam	30 days
43	**DAM and Intake**	**445 days**
44	Dam Excavation	60 days
45	Foundation Treatment	30 days
46	Excavation for Intake Structure	60 days
47	Reinforced Concrete in Dam	160 days
48	Reinforced Concrete in Intake Structure	60 days
49	Installations of Trash racks	30 days
50	Installations of Control and Flushing Gates	45 days
51	**Sand Trap**	**510 days**
52	Excavation for Sandtrap Chambers	120 days
53	Excavation for Flushing Tunnels	120 days
54	Reinforced Concrete in Sand Trap Chambers	150 days
55	Reinforced Concrete in Flushing Tunnels	120 days
56	Installations of Mechanical Embedded Parts	150 days
57	Installations of Control Gates & other related Equipment	90 days
58	**Power Tunnel**	**570 days**
59	Portal Excavations	90 days
60	Underground Excavations	390 days
61	Concreting and Rock Bolting	360 days
62	Reinforced Concrete in Inlet and Outlet Structures	180 days
63	Reinforced Concrete in Power Tunnel Lining	300 days
64	**Surge Shaft**	**265 days**
65	Portal Excavations	30 days
66	Underground Excavations	90 days
67	Concreting and Rock Bolting	30 days
68	Reinforced Concrete in Portals	30 days
69	Reinforced Concrete in Surge Shaft Lining	85 days
70	**Pressure Shaft**	**330 days**
71	Underground Excavations	90 days
72	Concreting and Rock Bolting	60 days
73	Reinforced Concrete in Surge Shaft Lining	90 days
74	Erection of Steel Liner	90 days



Project: IB HPP
Date: Tue 10/29/13

Task
Project Guide: Critical Task
Split
Progress
Milestone
Summary
Project Summary
Project Guide: Critical Task
Split
Progress
Milestone
Summary

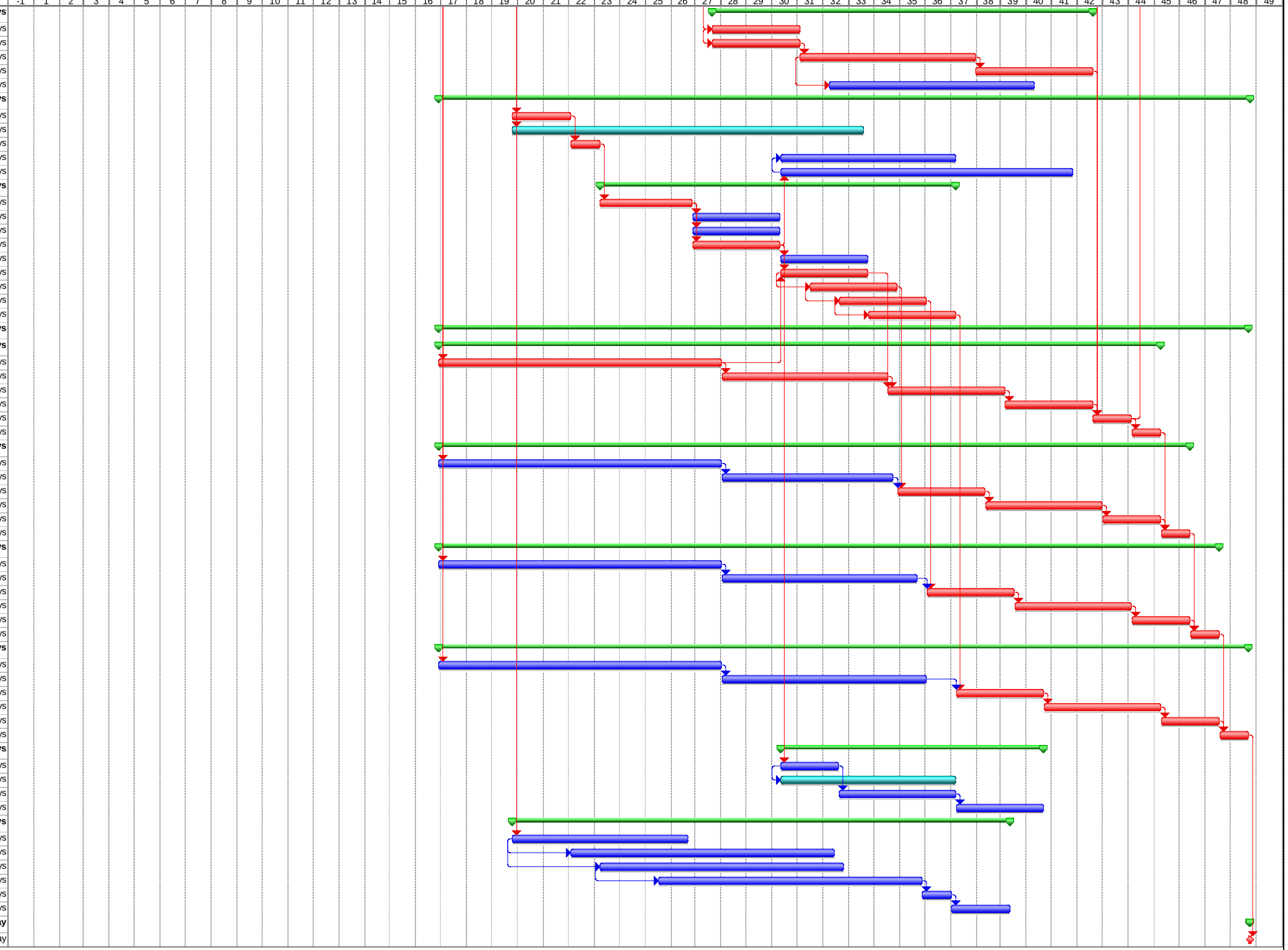
Farooq Bhutta

ISTARU BOONI HYDROPOWER PROJECT

Overall Implimentation Programme Including Construction Schedule

Figure - 15.1

ID	Task Name	Duration
75	**Penstock**	**390 days**
76	Alignment for Penstock	90 days
77	Excavations	90 days
78	Fabrication of Steel Liner	180 days
79	Erection of Steel Liner	120 days
80	Reinforced Concrete in Anchor Blocks for Penstock	210 days
81	**Power House**	**831 days**
82	Excavation	60 days
83	Dewatering	360 days
84	Foundation Treatment	30 days
85	Fabrication and Fixing of Doors & Windows	180 days
86	Architectural Works	300 days
87	**Concrete**	**365 days**
88	Concrete in Foundations	95 days
89	Reinforced Concrete in Draft tubes	90 days
90	Reinforced Concrete in Turbine Floor and Walls	90 days
91	Reinforced Concrete in Superstructure	90 days
92	Powerhouse 2nd Stage Concrete	90 days
93	Installation of Embedded Parts of Unit -1	90 days
94	Installation of Embedded Parts of Unit -2	90 days
95	Installation of Embedded Parts of Unit -3	90 days
96	Installation of Embedded Parts of Unit -4	90 days
97	**Electrical and Mechanical Works**	**830 days**
98	**Unit-1**	**740 days**
99	Fabrication and Delivery of Embedded Parts	290 days
100	Manufacturing and Transport of Equipment	170 days
101	Erection of Turbine and other Equipment	120 days
102	Erection of Generator and other Equipment	90 days
103	Dry Testing	40 days
104	Wet testing and Commissioning	30 days
105	**Unit-2**	**770 days**
106	Fabrication and Delivery of Embedded Parts	290 days
107	Manufacturing and Transport of Equipment	175 days
108	Erection of Turbine and other Equipment	90 days
109	Erection of Generator and other Equipment	120 days
110	Dry Testing	60 days
111	Wet testing and Commissioning	30 days
112	**Unit-3**	**800 days**
113	Fabrication and Delivery of Embedded Parts	290 days
114	Manufacturing and Transport of Equipment	200 days
115	Erection of Turbine and other Equipment	90 days
116	Erection of Generator and other Equipment	120 days
117	Dry Testing	60 days
118	Wet testing and Commissioning	30 days
119	**Unit-4**	**830 days**
120	Fabrication and Delivery of Embedded Parts	290 days
121	Manufacturing and Transport of Equipment	210 days
122	Erection of Turbine and other Equipment	90 days
123	Erection of Generator and other Equipment	120 days
124	Dry Testing	60 days
125	Wet testing and Commissioning	30 days
126	**Tailrace**	**270 days**
127	Excavation	60 days
128	Dewatering	180 days
129	Reinforced Concrete in Tailrace	120 days
130	Installations of Mechanical Embedded Parts and Gates	90 days
131	**Transmission Interconnection**	**510 days**
132	Construction of Powerhouse Switchyard	180 days
133	Installations of Switchyard Equipment	270 days
134	Construction of Transmission Line	250 days
135	Installations of Transmission Line Equipment	270 days
136	Inter Connection with National Grid	30 days
137	Testing and Commissioning of Transmission Line	60 days
138	**Start of Commercial Operation**	**1 day**
139	Taking over Certificate	1 day



Project: IB HPP
Date: Tue 10/29/13

Task | Split | Milestone | Project Summary | Split | Milestone
Project Guide: Critical Task | Progress | Summary | Project Guide: Critical Task | Progress | Summary

Farooq Bhutta