



CHILIME JALAVIDHYUT COMPANY LIMITED



BUDHI GANDAKI PROK HYDROELECTRIC PROJECT

Location: DoED OFFICE

Date: 2021

BUDHI GANDAKI PROK HYDROELECTRIC PROJECT

Project Name : Budhi Gandaki Prok Hydroelectric Project

License Number : वि. वि. वि. ०७४/७५ वि. उ. स. १०२

License issued date : Issued on 2074-06-01 as per decision of GoN dated 2074-05-26

Location of Project : Gandaki Province, Gorkha District

Name of Promoter : Chilime Jalavidhyut Company Limited

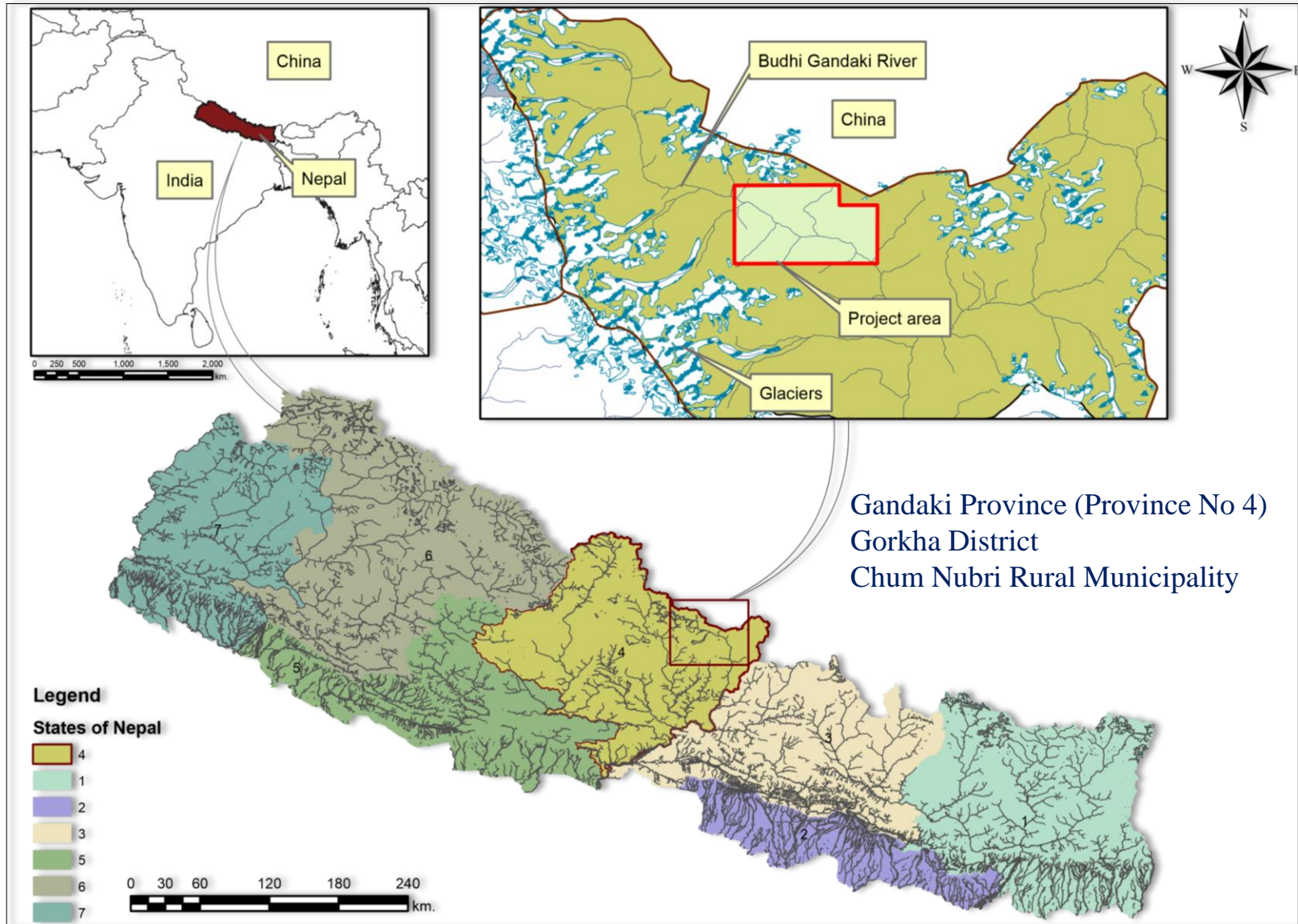
Name of Consulting Firm : Chilime Engineering and Services Co. Ltd

1.0 PROJECT BACKGROUND

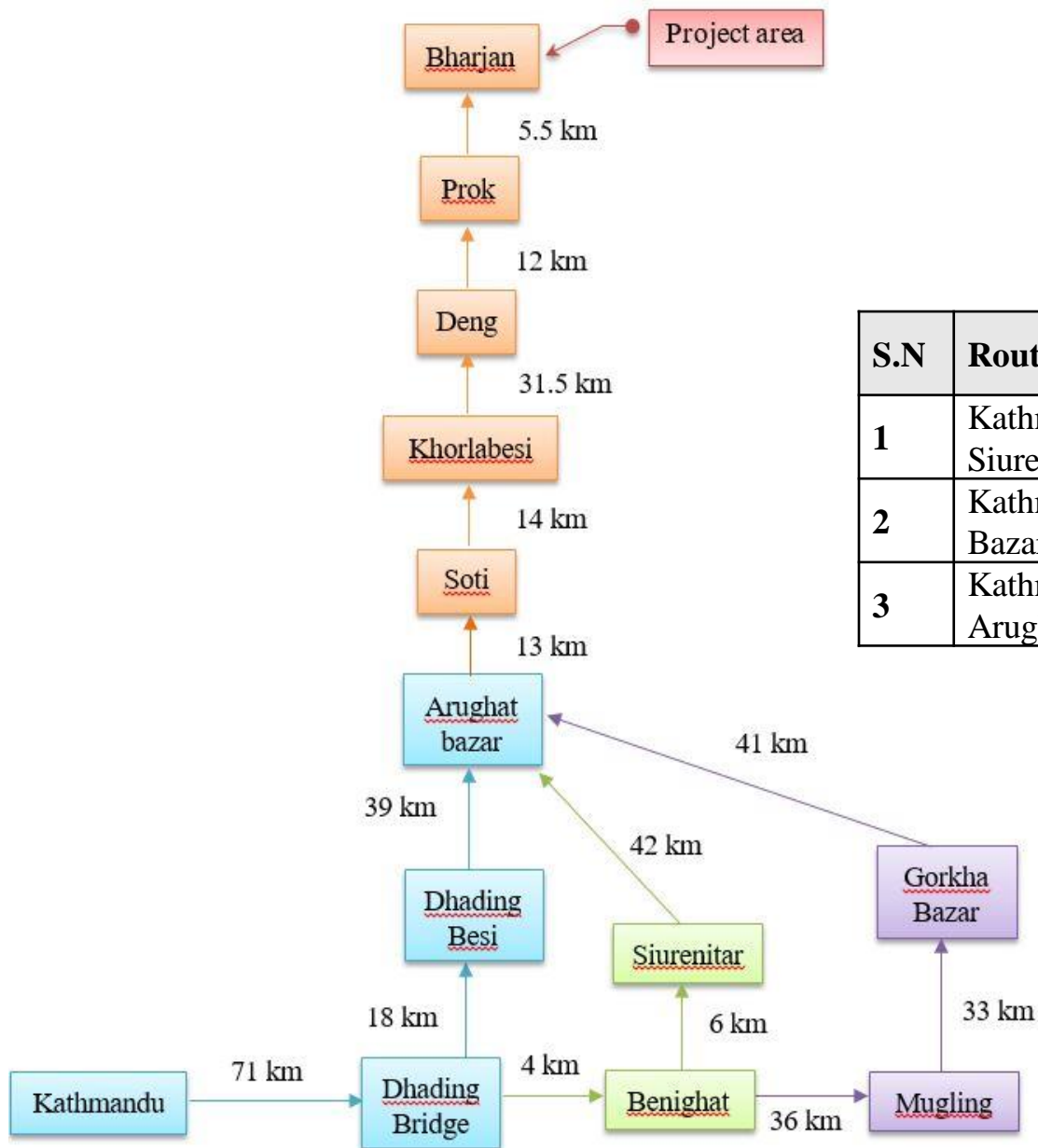
- Chilime Jalavidhyut Company Limited (CJCL) Prepared a Desk Study Report and applied for Survey License of Budhi Gandaki Prok Hydroelectric Project on 2074-03-06 B.S.
- Survey license was awarded on 2074-06-01 as per decision of GoN, Ministry of Energy dated 2074-05-26 B.S. (License Number वि. वि. वि. ०७४/७५ वि. उ. स. ९०२)
- Project lies in ChumNubri Rural Municipality of Gorkha district of Western Nepal.

	Coordinates	
East (Max)	84° 52' 00" E	Easting
East	84° 50' 00" E	Easting
West	84° 45' 00" E	Easting
North (Max)	28° 35' 00" N	Northing
North	28° 34' 03" N	Northing
South	28° 30' 38" N	Northing

2.0 PROJECT LOCATION

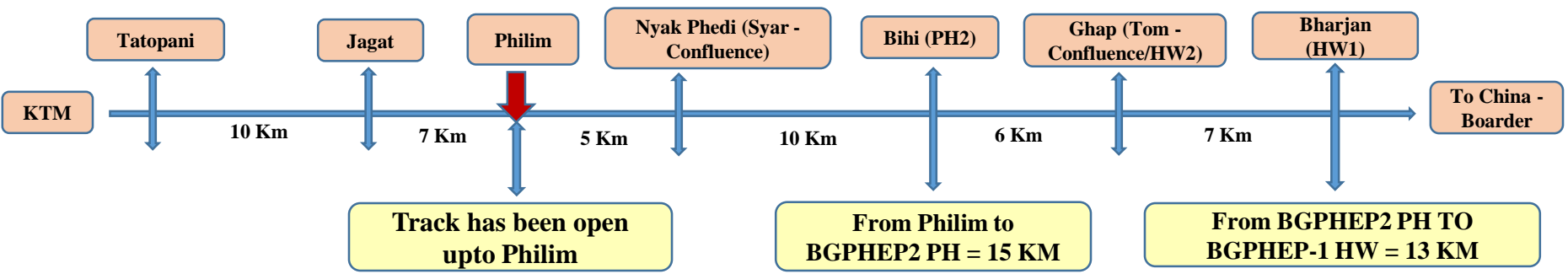
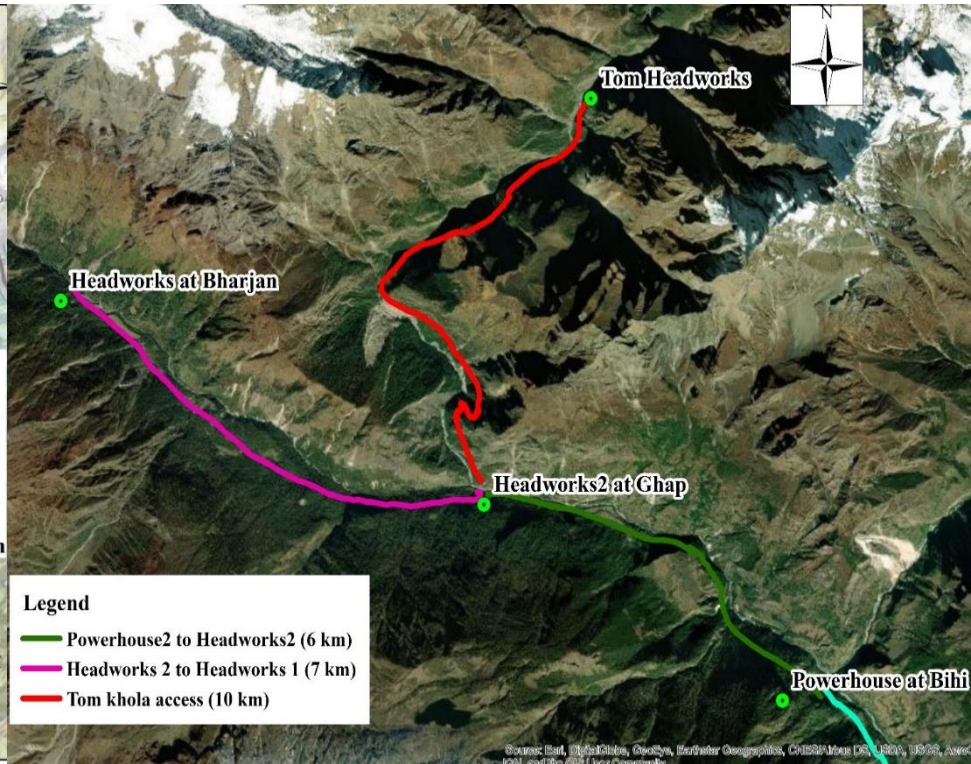
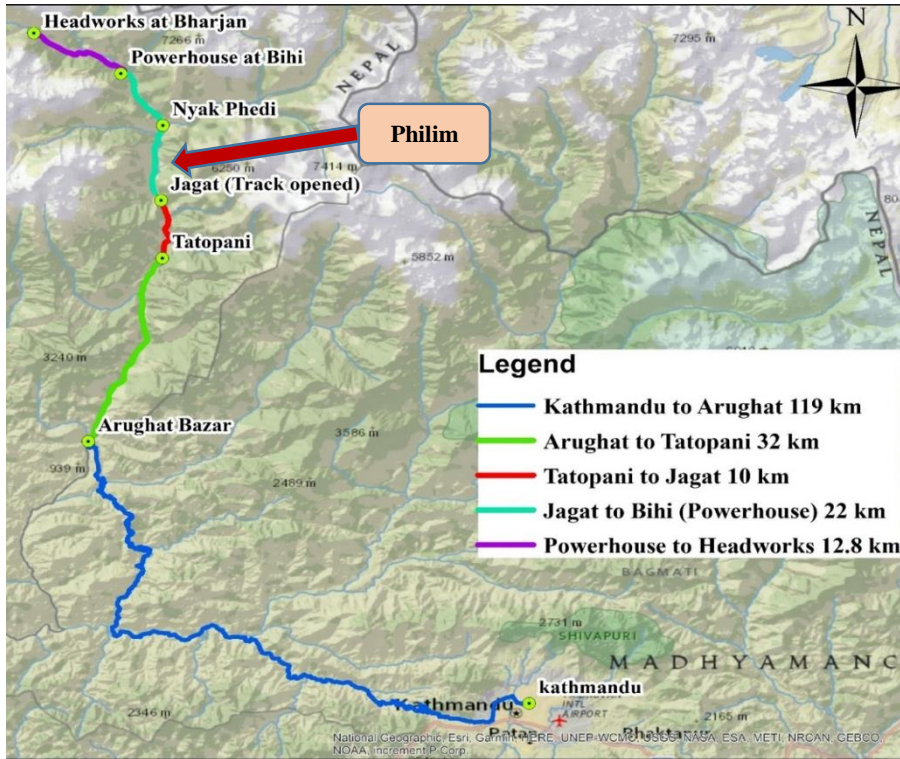


2.0 ACCESSIBILITY



S.N	Route	Total Length
1	Kathmandu – Dhading - Benighat- Siurenitar - Arughat Bazar- Bharjan	199 km
2	Kathmandu-Dhading besi-Arughat Bazar - Bharjan	204 km
3	Kathmandu-Mugling-Gorkha Bazar- Arughat Bazar-Bharjan	261 km

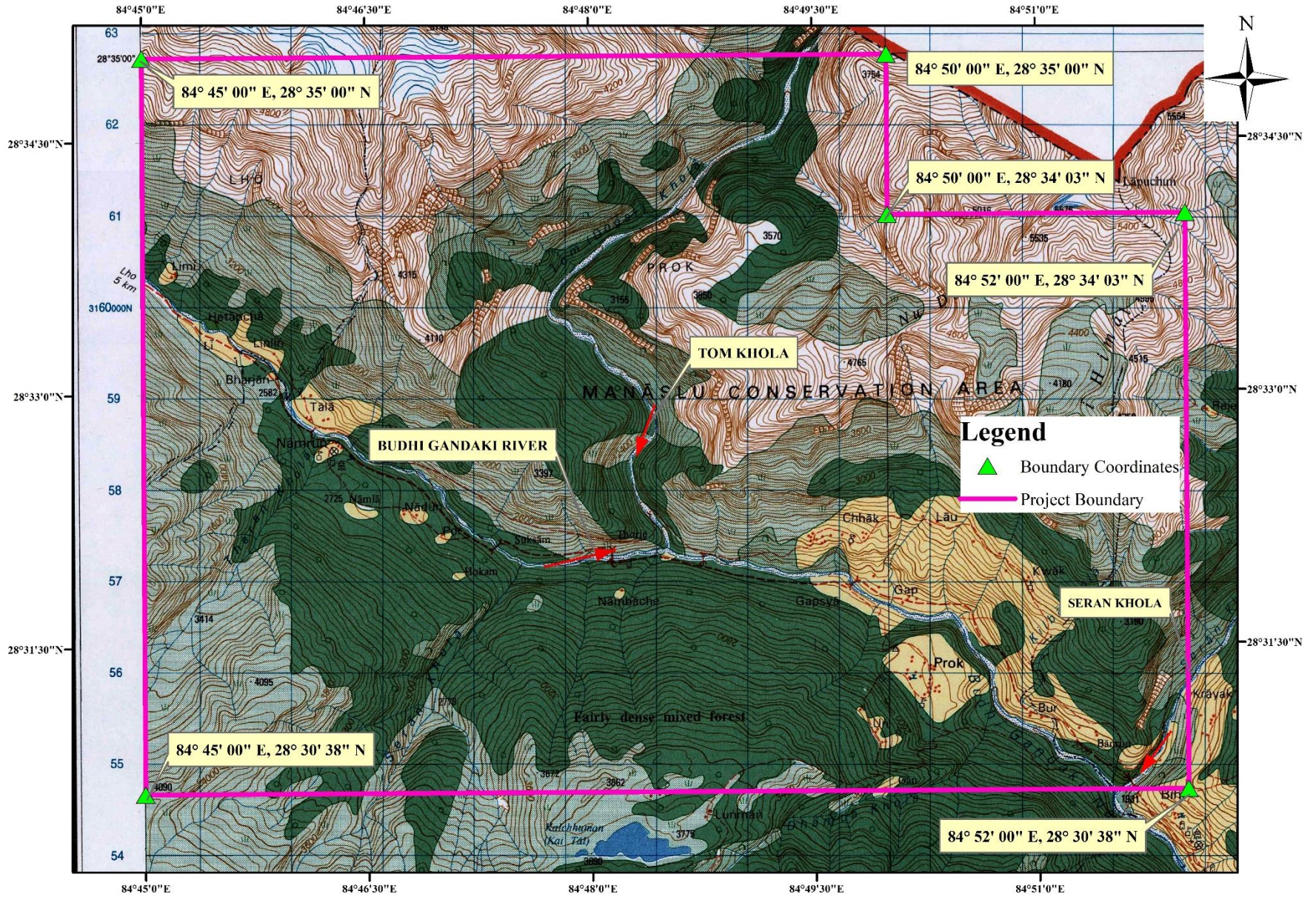
2.1 ACCESSIBILITY (Contd.)



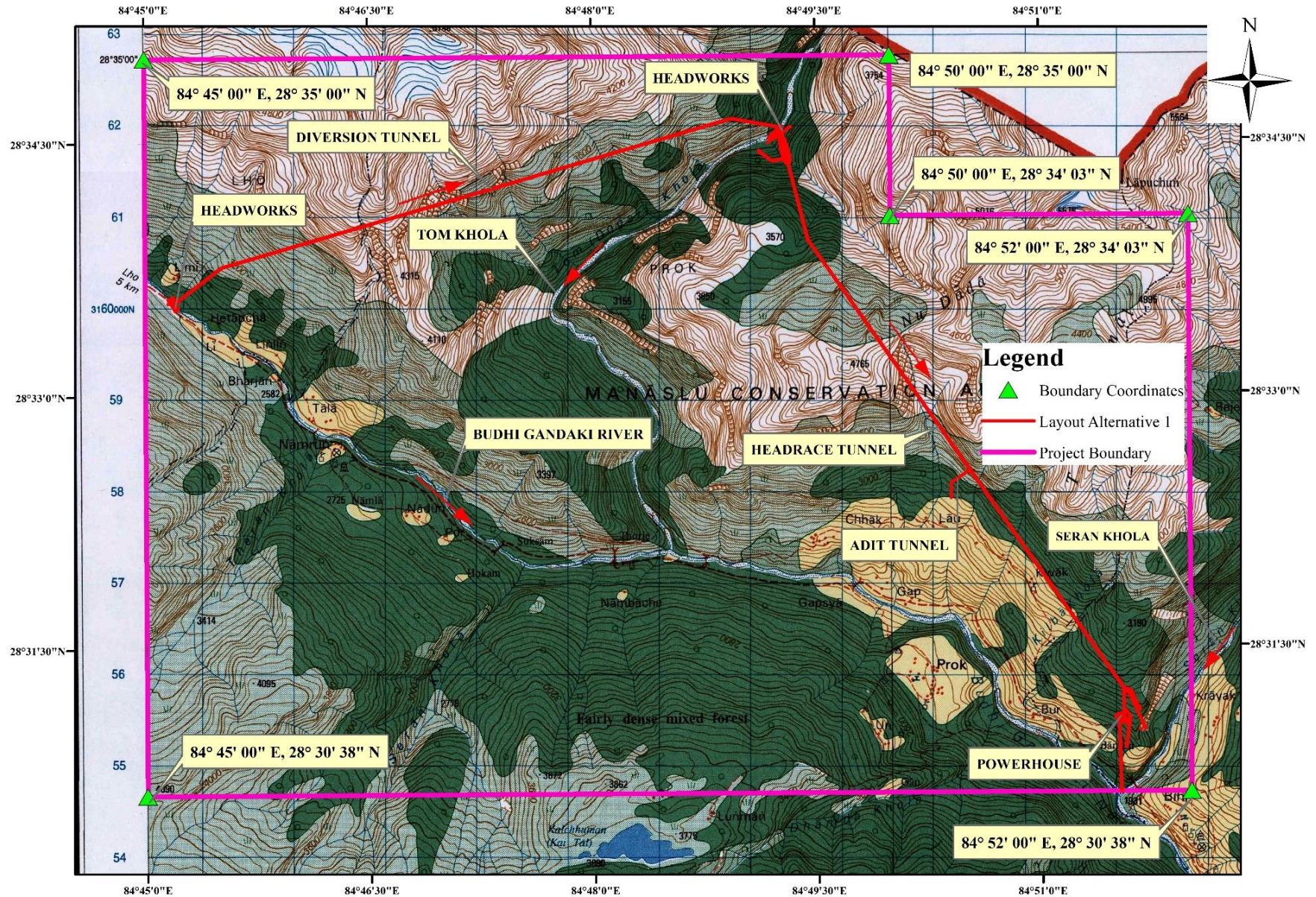
2.2 ACCESSIBILITY (Contd.)



3.0 MAP OF PROJECT AREA



4.0 PROJECT LAYOUT



5.0 PROJECT SALIENT FEATURES

1 Project Location

Development Region	: Western
Province	: Province No 4 (Gandaki)
District	: Gorkha

2 General

Name of River	: Budhi Gandaki River/ Tom Khola
Type of Scheme	: Run-of-River
Gross Head	: 660 m
Net Head	: 645 m
Average annual energy	: 2395.54 GWh

3 Hydrology

Catchment Area	: 533.8 km ² for Budhi Gandaki Intake and : 1393.33 km ² for Tom Khola Intake
Mean Annual Discharge	: 105.5 m ³ /s
Design Discharge	: 50.68 m ³ /s
Design Flood Discharge (100 Yr. flood)	: 1579.97 m ³ /s

4 Power and Energy

Average annual Energy	: 1436.21 Gwh
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6.0 PROJECT SALIENT FEATURES (Contd.)

5 Headworks

Diversion Structure	: 8 m high Concrete Weir
Intake	: 3 Nos of 5.5 X 3.75 m size Side intake with vertical lift gates in Budhi Gandaki and River and Tom khola
Undersluice	: 4.0 m X 4.0 m Radial Gate on both Budhi Gandaki River Intake and Tom khola Intake

6 Settling Basin

Type	: Underground
Dimension	: 130 m X 15.0 m X 10.0 m

7 Tunnel

Type	: D shaped
Diameter	: 4.40 m for diversion tunnel and 5.6 m for Headrace Tunnel
Length	: 6.5 km diversion Tunnel and 8.0 km headrace Tunnel

8 Surge Shaft

Diameter	: 14 m
Height	: 57 m

9 Pressure Shaft

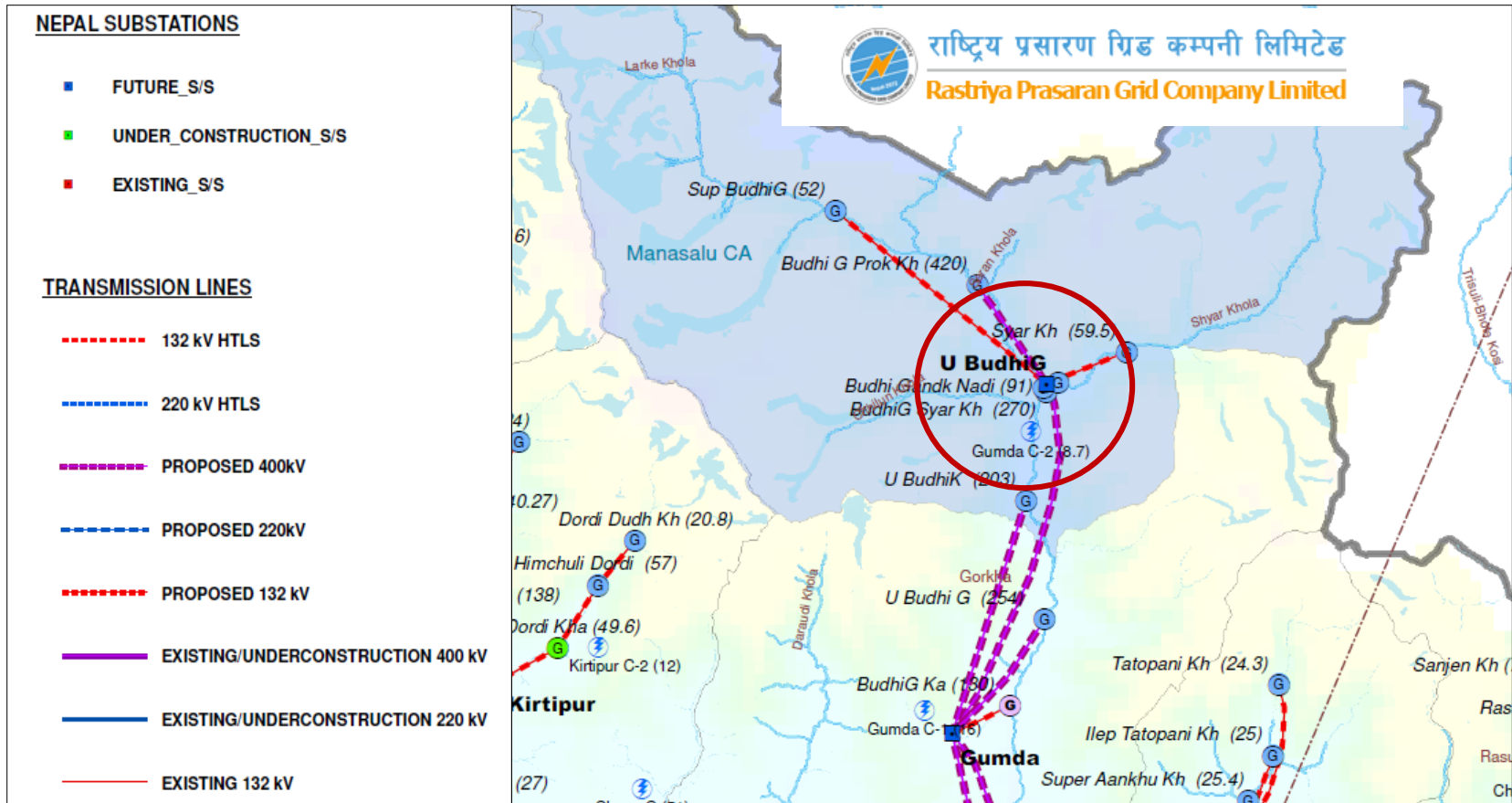
Diameter	: 4.0 m
Length	: 850 m

10 Powerhouse

Type	: Underground
Size	: 60 m X 18 m X 28.50 m

7.0 POWER EVACUATION ARRANGEMENTS

Nearest Sub Station	: Proposed Future S/S at the Confluence of Syar Khola and Budhi Gandaki River
Transmission Line Length	: 15 km
Capacity of Transmission Line	: 220 KV double circuit



8.0 ENVIRONMENTAL STUDIES

BACKGROUND

- According to Environment Protection Rules (EPR) 2057 Schedule 2- Rule 3, EIA needs to be conducted for Project
- Project lies in Manaslu Conservation Area. So, Approval of MCAP to conduct EIA is required, prior to Preparing Scoping and TOR document

STATUS

- Agreement with Chilime Engineering and Services Co. Ltd to conduct EIA on May 6, 2018
- Application submitted to MCAP to provide approval to conduct EIA on June 7, 2018
- Conducted meetings with official of MCAP on May 11, 2019
- Literature review and collection of Preliminary data on existing physical, Biological and Socio- Economic data of Project area

9.0 MAJOR STUDIES COMPLETED

- Establishments of Control Points, DGPS survey, Detailed Topographical survey and Mapping of Headworks and Powerhouse.
- Establishments of gauging stations, Discharge Measurement, Flood analysis and Bucket Method for sampling of sediment .
- Surface Geological Survey and Mapping, Preparation of Geological Map of Project area, Field data collection for discontinuity survey and Rock Mass Classification.
- ERT survey and interpretation of Resistivity Tomogram.
- Project Optimization Studies of all alternatives
- Hydraulic design of all water conveyance system including Electromechanical and Hydro-Mechanical
- Structure Stability Analysis and Rate Analysis
- Construction Schedule and Financial Analysis
- Power Evacuation Studies

10.0 STUDIES CARRIED OUT IN FIELD

Time Frame	Activities
12 th Nov 2017 to 27 th Jan, 2018	Site visit for Site selection and field Survey planning
11 th May, 2018 to 5 th July, 2018	Detailed Topographical Survey including establishment of Control Points and DGPS Survey, Installation of Staff gauge at Headworks and Powerhouse area.
28 th Nov-28 to Dec, 2018	Detailed Topographical Survey, Surface Geological Mapping of Project area, Discharge Measurement
22 nd April- 23 rd to June, 2019	Topographic Survey, 2-D ERT survey, Discharge Measurement, Sediment Sampling (Bucket Method)

10.1 TOPOGRAPHICAL SURVEY AND MAPPING

- Total 23 Number of Control Points were established at Headworks, adit and Powerhouse Location
- Control Points were monumented by making concrete pillars or by stone carving
- Control Survey using DGPS was conducted to find Coordinates of established control points
- Detailed Topographic survey was conducted at Headworks and Powerhouse location including Adit Tunnel inlet portal.
- Data from survey was plotted to produce a Topographical Map with contour interval of 1 m.

10.3 TOPOGRAPHICAL SURVEY AND MAPPING



Geomatics Engineer with local People after Locating Geodetic Point No 1077 of Survey department at Chhak Village



Monumentation of Control Point near Powerhouse location at Bihi

11.0 HYDROLOGICAL STUDIES

A. STAFF GAUGE INSTALLATION

- Staff gauge is installed at Budhi Gandaki River u/s and d/s of confluence Tom khola with Budhi Gandaki River
- A gauge reader has been appointed and water level is being recorded 3 times a day since 26th May, 2018

B. DISCHARGE MEASUREMENT

- Discharge measurement of Budhi Gandaki River is done at various intervals and different locations within the project area.

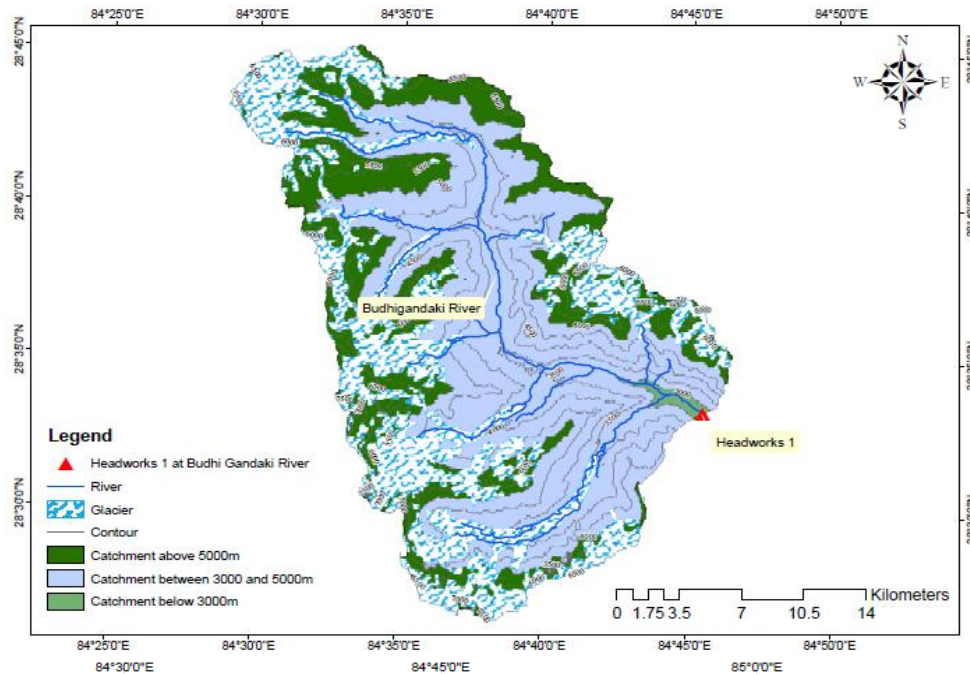
C. HYDROLOGICAL ANALYSIS

- Computation of Mean Monthly flow, flow duration curves, resulting in the estimation of design discharge and design flood, using different methods of hydrological analysis.

11.1 HYDROLOGICAL STUDIES

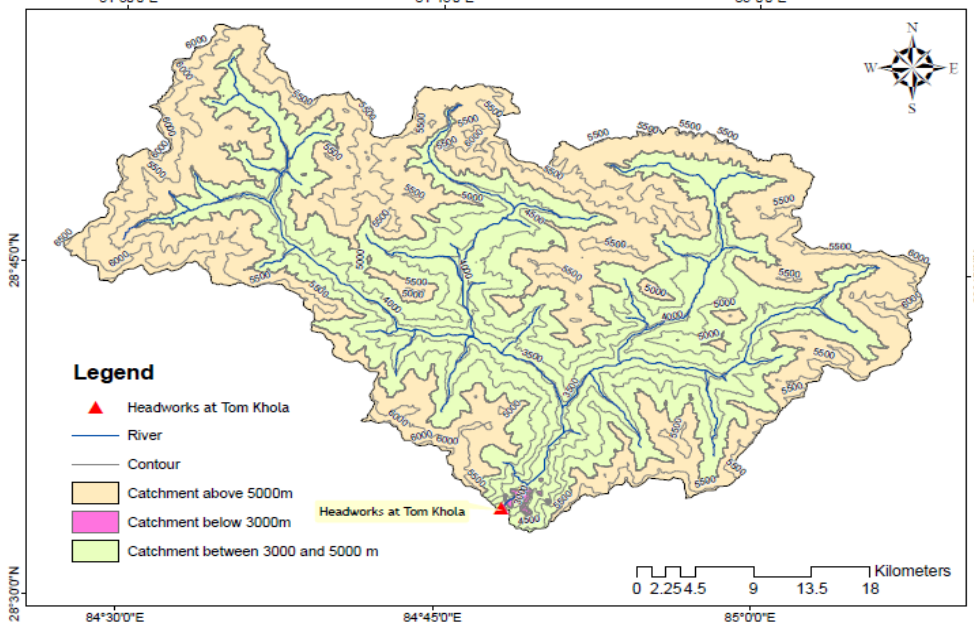
Watershed area at Budhi Gandaki Headwork

Total Catchment area = 533.8 sq. km

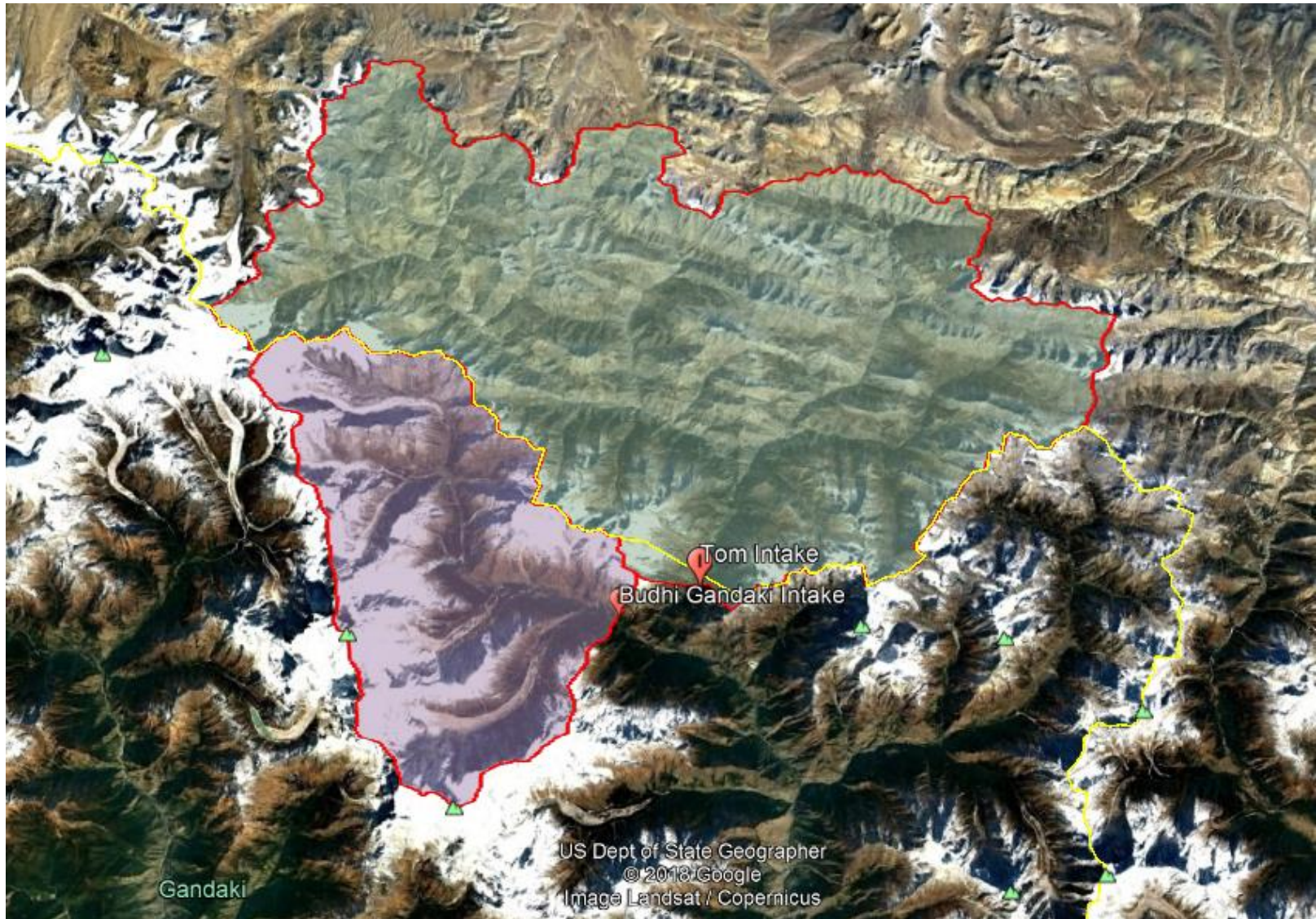


Watershed area at Tom intake

Total Catchment area = 1393.33 sq. km



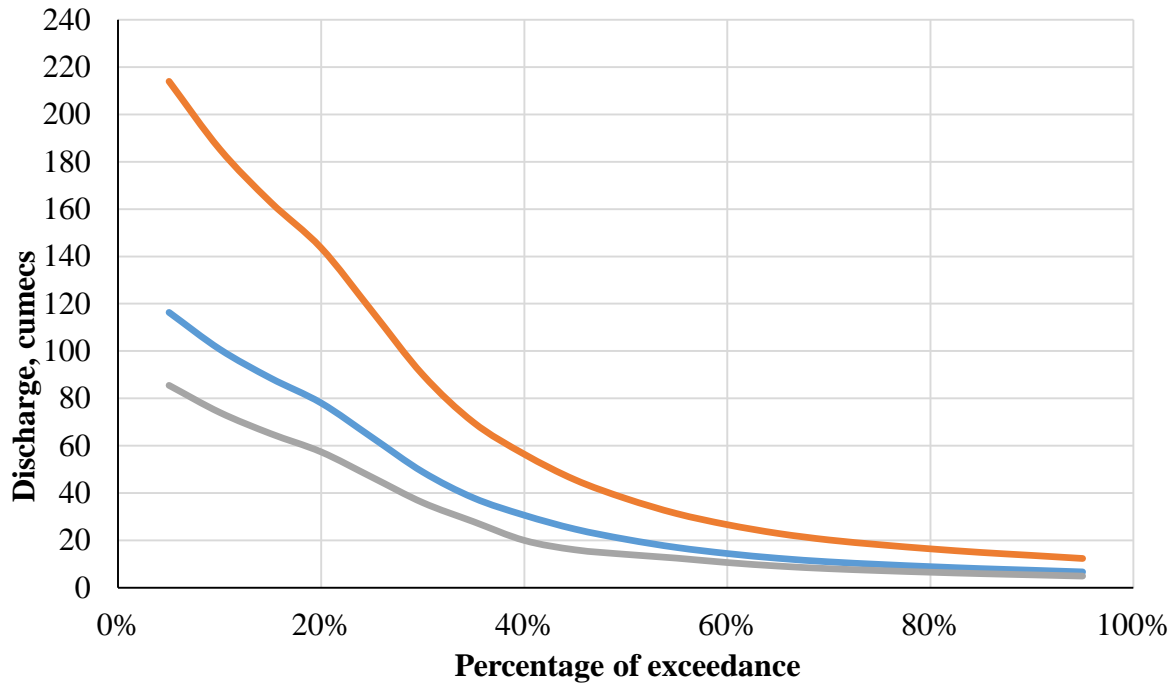
11.2 HYDROLOGICAL STUDIES



Catchment area at intake of Budhi Gandaki River and Tom khola (Source: Google Earth)

11.3 HYDROLOGICAL STUDIES

Flow Duration Curve



— Budhi Gandaki Intake 1 — Budhi Gandaki Intake 2 — Tom Intake

Flow Duration Curve of Tom khola and Budhi Gandaki River headworks area

Q_{40} for Budhi Gandaki Intake1 = 30.68 m³/s

Q_{40} for Budhi Gandaki Intake2 = 56.43m³/s

Q_{40} for Tom Khola Intake = 20 m³/s

11.4 HYDROLOGICAL STUDIES

Mean monthly flows for Budhi Gandaki River For Intake 1

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Flow m ³ /s	8.60	7.35	8.55	13.74	25.08	54.59	99.67	105.94	76.83	36.81	18.91	11.78

Flow Duration Curve of Budhi Gandaki River headworks area for Intake 1

Percentile	5%	10%	15%	20%	25%	30%	35%	40%	45%	
Discharge m ³ /s	116.4	100.81	88.64	78.07	63.56	48.95	37.99	30.68	24.8	
Percentile	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
Discharge m ³ /s	20.5	17.05	14.49	12.48	10.98	9.89	8.94	8.11	7.43	6.72

Downstream release 25% of the natural flow in monthly flows for Budhi Gandaki River for Intake 1

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Flow m ³ /s	2.15	1.84	2.14	3.44	6.27	13.65	24.92	26.49	19.21	9.20	4.73	2.95

Design Flood at Headworks and Powerhouse by using modified CAR method

Return Period	BGPHEP-I _H	Tailrace Outlet
10	431	792
20	521	958
50	637	1172
100	725	1333
200	812	1493
500	927	1704
1000	1013	1863
5000	1215	2234
10000	1301	2393

11.5 HYDROLOGICAL STUDIES

Mean monthly flows for Budhi Gandaki River For Intake 2

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Flow m ³ /s	15.81	13.53	15.71	25.26	46.13	100.39	183.29	194.82	141.29	67.70	34.78	21.67

Flow Duration Curve of Budhi Gandaki River headworks area for Intake 2

Percentile	5%	10%	15%	20%	25%	30%	35%	40%	45%	
Discharge m ³ /s	214.06	185.40	163.01	143.57	116.88	90.01	69.86	56.43	45.61	
Percentile	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%
Discharge m ³ /s	37.71	31.35	26.65	22.95	20.20	18.18	16.44	14.91	13.66	12.36

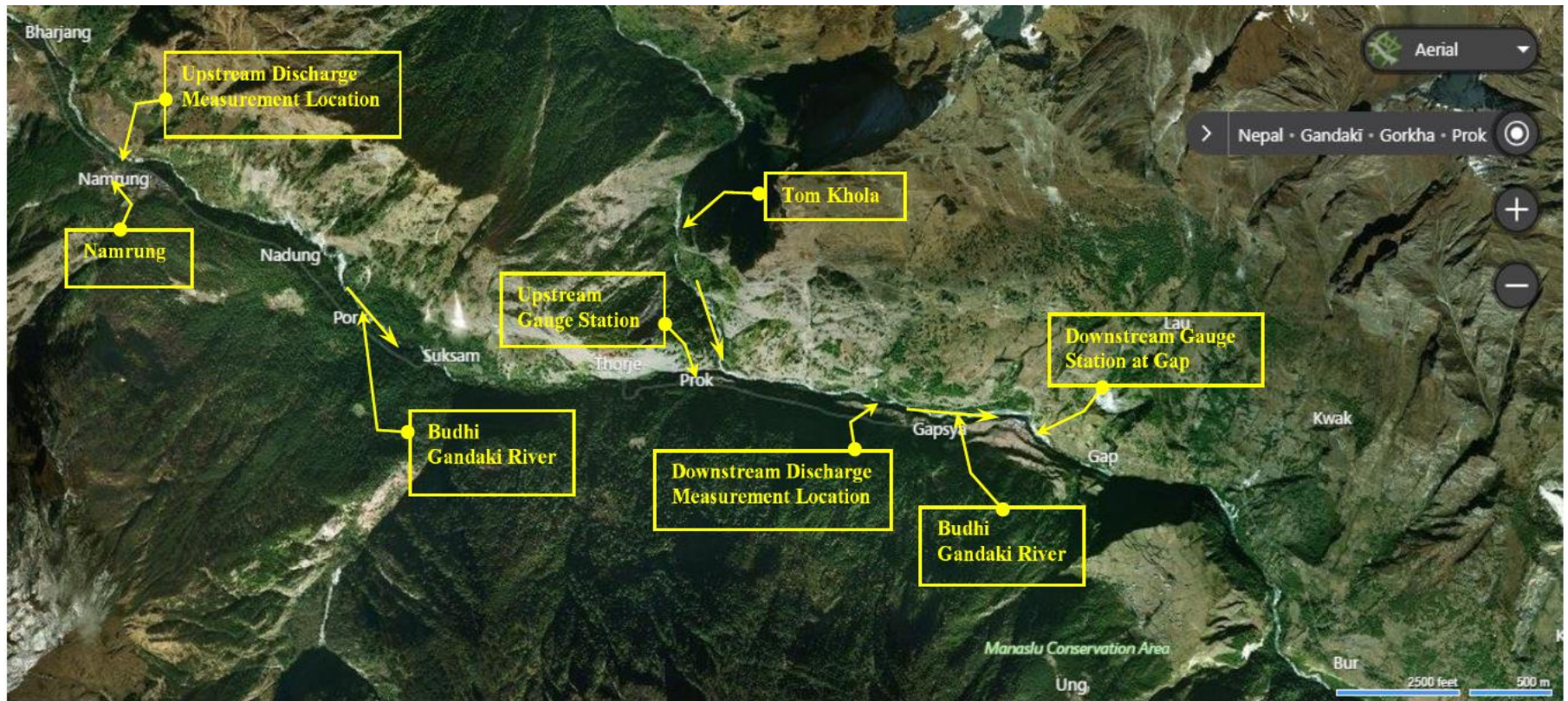
Downstream release 25% of the natural flow in monthly flows for Budhi Gandaki River for Intake 2

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Flow m ³ /s	3.95	3.38	3.93	6.32	11.53	25.10	45.82	48.71	35.32	16.92	8.70	5.42

Design Flood at Headworks and Powerhouse by using modified CAR method

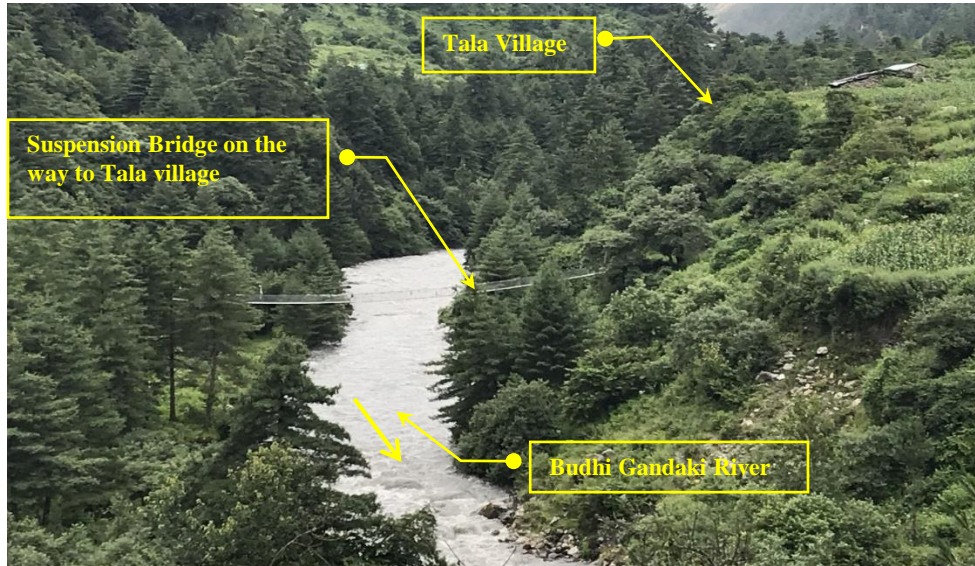
Return Period	BGPHEP-II _H	Tailrace Outlet
10	792	806
20	958	974
50	1172	1192
100	1333	1355
200	1493	1518
500	1704	1733
1000	1863	1895
5000	2234	2272
10000	2393	2434

11.6 HYDROLOGICAL STUDIES



Satellite map showing discharge measurement locations

11.7 HYDROLOGICAL STUDIES



Discharge Measurement location at Namrung



Discharge Measurement location at Ghap

11.8 HYDROLOGICAL STUDIES



Installation of staff gauge u/s of Confluence of Budhi Gandaki River and Tom khola



Installed gauge installation at Upstream of confluence (Budhi Gandaki River and Tom khola)

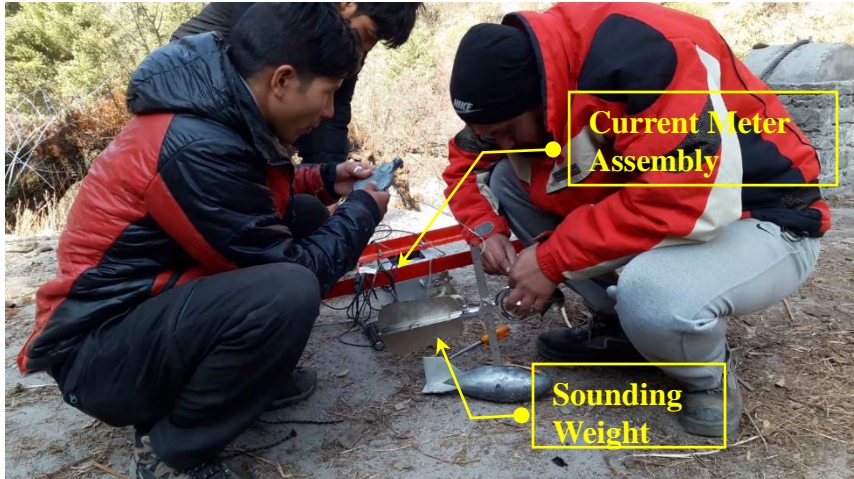


Installed gauge installation at downstream of confluence (Budhi Gandaki Rier and Tom khola



Training to Gauge Reader about reading a water level and maintaining data in sheet

11.9 HYDROLOGICAL STUDIES



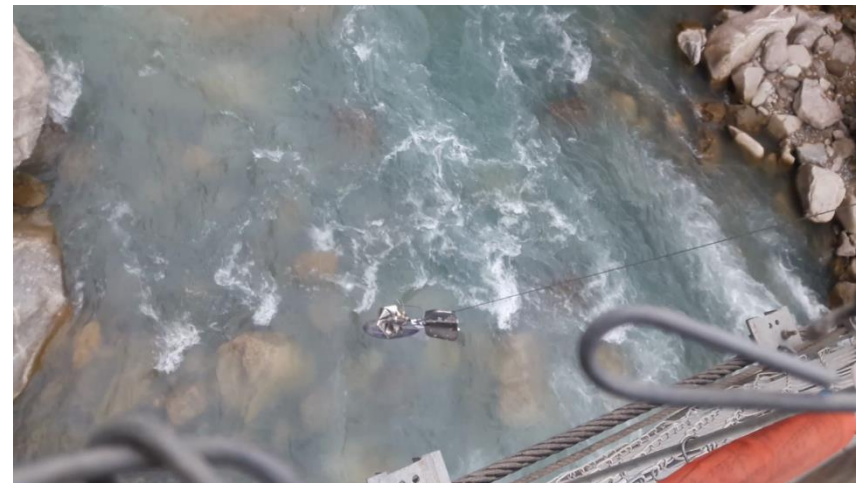
Setup of current meter for discharge measurement



Discharge Measurement of Budhi Gandaki River at headworks



Setup of current meter for discharge measurement



Lowering of current meter propeller from suspension bridge using sounding reel

12.0 SEDIMENT STUDIES



Satellite map showing sediment measurement locations

A. Sediment Sampling

- Sediment sampling using method of bucket sampling is being done in Budhi Gandaki River.

B. Sediment Yield Estimation

- Himalayan Sediment yield method
 - Budhi Gandaki Intake = $2405.41 \text{ t/km}^2/\text{yr}$
 - Tom khola Intake = $2450 \text{ t/km}^2/\text{yr}$
- Similarly using other empirical relation of Indian Catchment method sediment yield was computed.

12.1 SEDIMENT STUDIES



Photograph showing sediment sampling from a bridge



Training to gauge reader about sediment Sampling by bucket method



Sediment Sampling of Budhi Gandaki River



Sediment Samples for Concentration analysis

12.2 SEDIMENT STUDIES

RESULT SHEET OF LABORATORY ANALYSES

Client:	Chilime Engineering & Services Co. Ltd.		
Project:	Budhi Gandaki Prok Hydroelectric Project		
Sampling location:	Headworks site		
Sample provided by:	Client		
Reporting date:	25 December 2019	Report no.:	235-54.L1

Type of analyses

A. Suspended sediment concentration	✓	B. Particle size distribution (PSD)	✓
C. Mineral content	✓	D. Organic matters content	✓

B. Results of Particle Size Distribution (PSD)

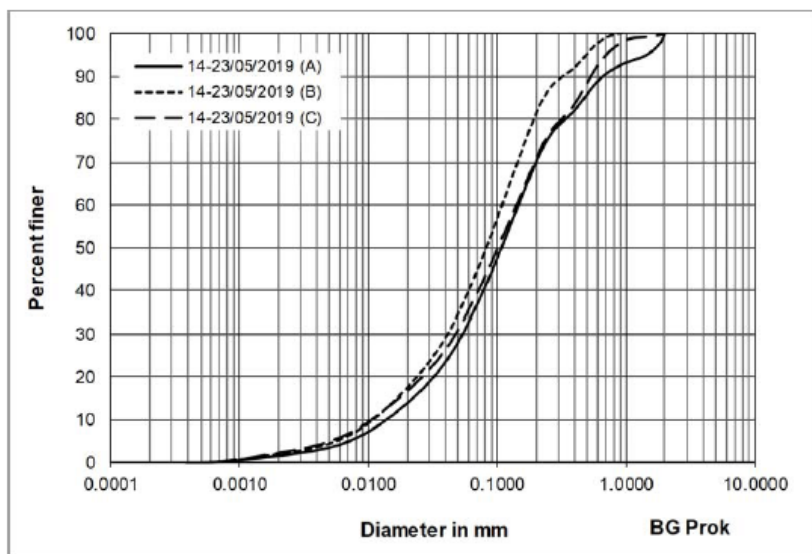


Figure B- 1: PSD curves of mixed sample of 14 to 23 May 2019

C. Results of Mineral Content

Table C-1: 14-23.05.2019 [SN 1(A)]

Minerals	Sample (%)			Average	Hardness (Moh's scale)
	1	2	3	(%)	
Quartz	53	56	53	54	7
Feldspar	4	5	6	5	6
Mica	10	13	16	13	2-3
Other	A	1	1	1	≥ 5
	B	32	25	24	27

Table C-2: 14-23.05.2019 [SN 1(B)]

Minerals	Sample (%)			Average	Hardness (Moh's scale)
	1	2	3	(%)	
Quartz	46	57	59	54	7
Feldspar	4	6	5	5	6
Mica	11	11	11	11	2-3
Other	A	2	2	2	≥ 5
	B	37	24	23	28

Table C-3: 14-23.05.2019 [SN 1(C)]

Minerals	Sample (%)			Average	Hardness (Moh's scale)
	1	2	3	(%)	
Quartz	56	49	54	53	7
Feldspar	2	1	3	2	6
Mica	10	10	13	11	2-3
Other	A	1	1	1	≥ 5
	B	31	39	29	33

Table C-4: 24.05-02.06.2019 [SN 2(A)]

Minerals	Sample (%)			Average	Hardness (Moh's scale)	
	1	2	3	(%)		
Quartz	41	46	45	44	7	
Feldspar	10	12	8	10	6	
Mica	13	14	21	16	2-3	
Other	A	3	2	1	2	≥ 5
	B	33	26	25	28	< 5

Table 4-37: Adopted suspended sediment concentration values (ppm) at headworks location of BGPHEP-1

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average Annual
Suspended Sediment Concentration (ppm)	BG PH EP- I _H	228.9	197	226.3	364.7	668.2	1453.6	2654.2	2819.3	2044.6	979.7	503.2	314.1	1037.8

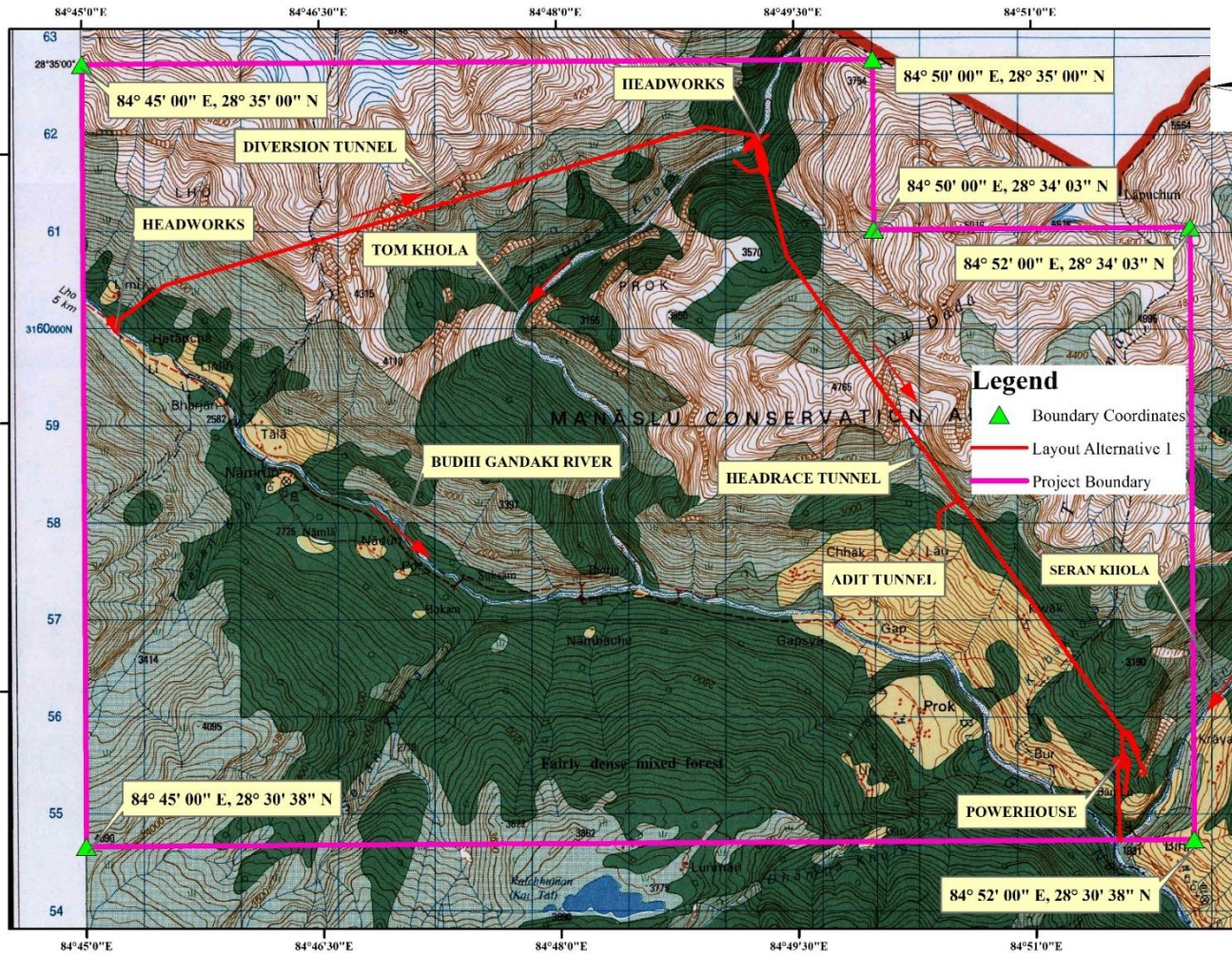
Table 4-39: Adopted suspended sediment concentration values (ppm) at headworks location of BGPHEP-2

Month		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average Annual
Suspended Sediment Concentration (ppm)	BGPHEP- II _H	198.5	169.9	197.2	317.1	579.1	1260.3	2301	2445.8	1773.8	849.9	436.6	272	900.1

Results of Laboratory analysis of Sediment studies

13.0 PROJECT OPTIMIZATION STUDY

Alternative 1



Desk Study

Design $Q_{40} = 76.00 \text{ m}^3/\text{s}$
 Net Head = 650 m
 Diversion Tunnel = 6.5 Km
 Headrace Tunnel = 8 Km
Power = 420 MW

But Actual (Desk Study Real Scenario)

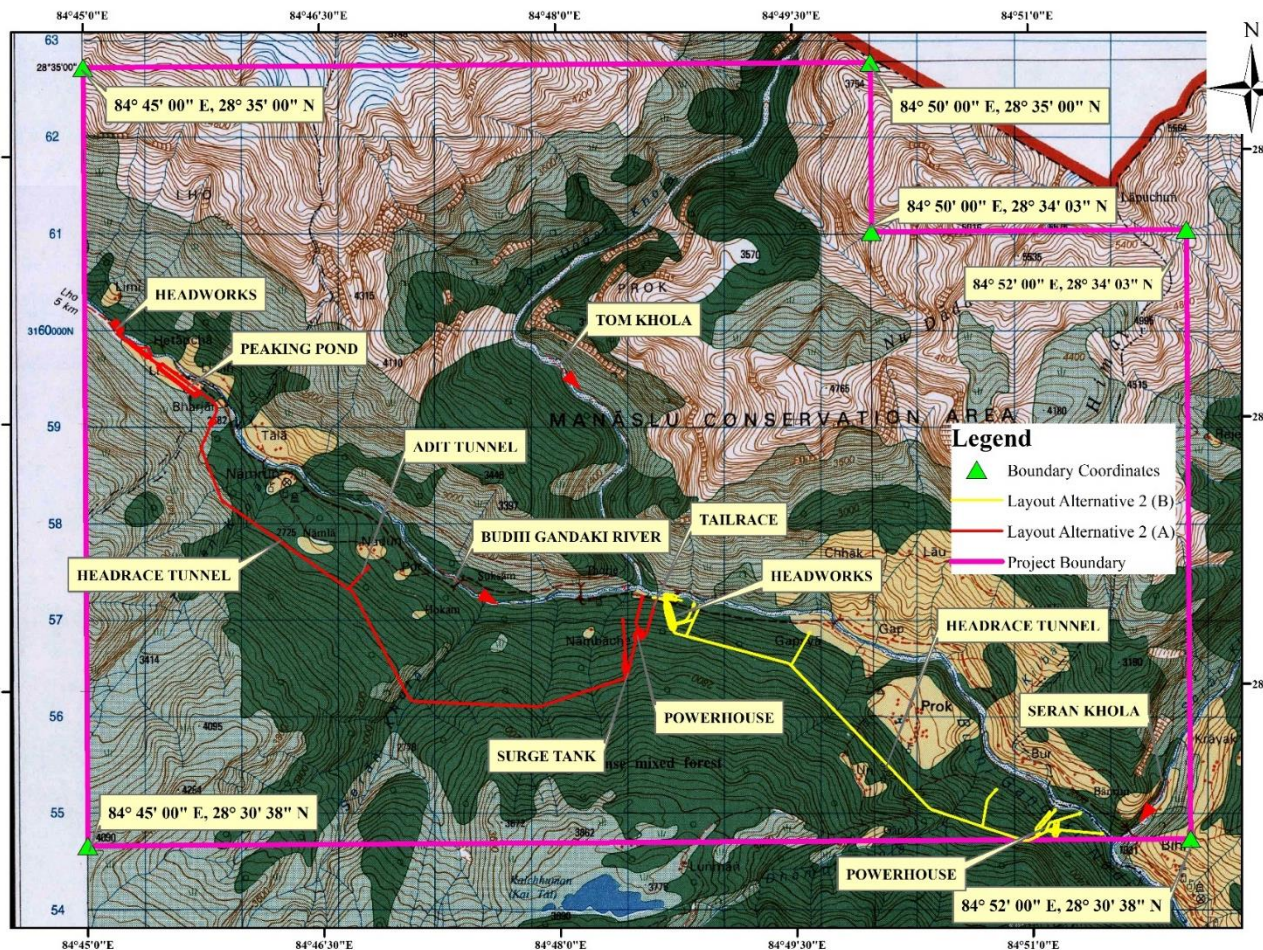
Downstream flow: 25% natural flow

Design $Q_{48.5} = 37.07 \text{ m}^3/\text{s}$
 Gross head = 703.5 m
 Net Head = 679.95 m
 Diversion Tunnel = 6.5 Km
 Headrace Tunnel = 8 Km
Power = 216 MW

Total Energy = 1204.56 GWhr
 Wet Energy = 835.67 Gwhr
 Dry Peaking = 45.28 Gwhr
 Dry Off peaking = 323.61 Gwhr
 Dry Energy % = 30.62 %

13.1 PROJECT OPTIMIZATION STUDY

Alternative 2



BGPHEP-1 [UPSTREAM PROJECT]

Design $Q_{46.5}$ = 23.51 m³/s [25% natural flow]
 Gross Head = 473 m
Power = 93.0 MW
 Total Energy = 522.42 GWhr

BGPHEP-2 [DOWNSTREAM PROJECT]

Design Q_{46} = 44.03 m³/s
 Gross Head = 214.24 m
Power = 81 MW
 Total Energy = 447.03 GWhr

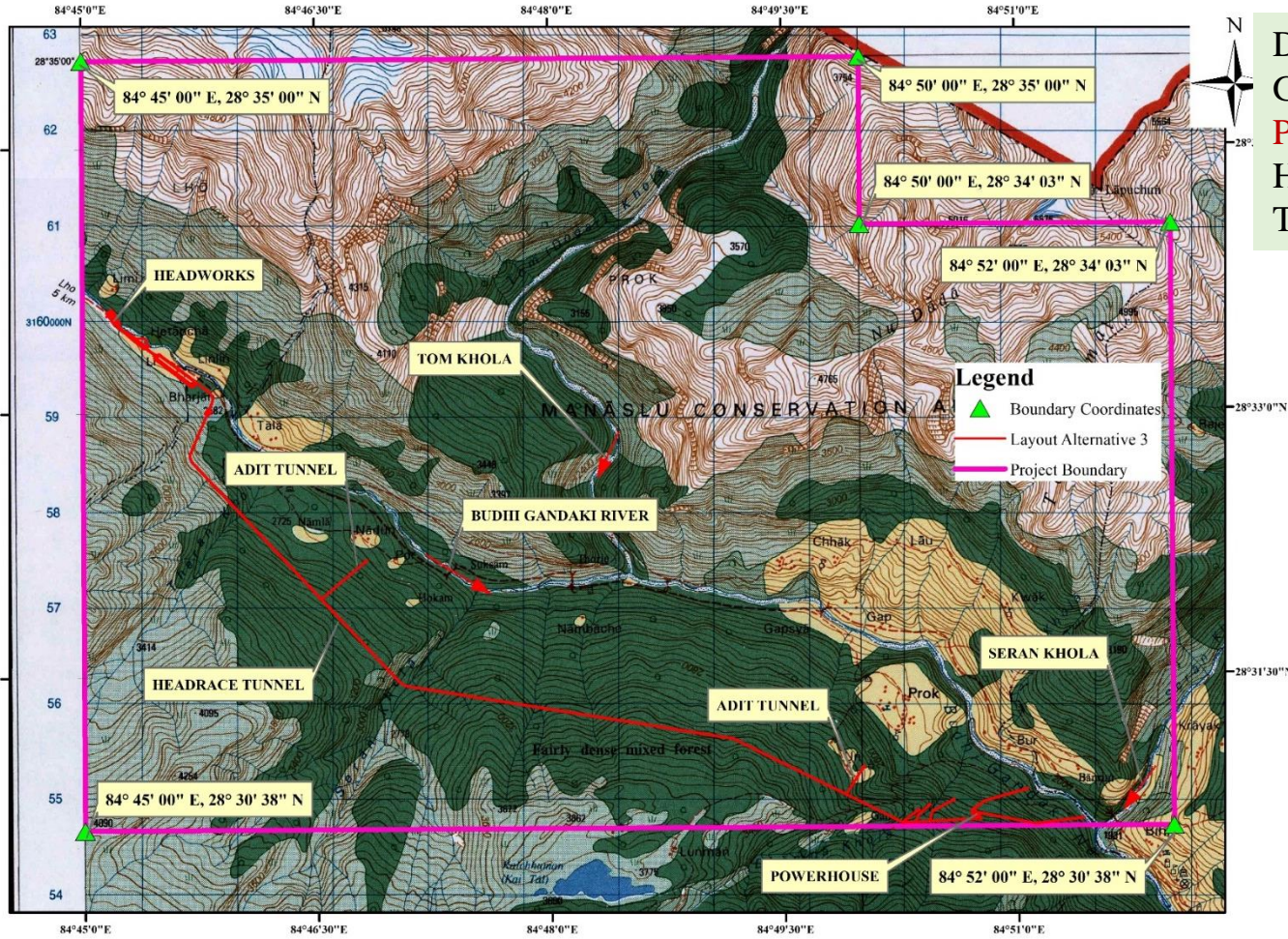
TOM KHOLA HEP

Design Q_{45} = 18.23 m³/s
 Gross Head = 473 m
 Headrace Tunnel = 4.5 Km
Power = 73.5 MW
 Total Energy = 389.09 GWhr

Total Power = 247.50 MW
Total Energy = 1258.54 GWhr

13.2 PROJECT OPTIMIZATION STUDY

Alternative 3



Design $Q_{46.5} = 23.51 \text{ m}^3/\text{s}$
Gross Head = 695 m
Power = 136 MW
Headrace Tunnel = 11.4 Km
Total Energy = 761.44 Gwhr

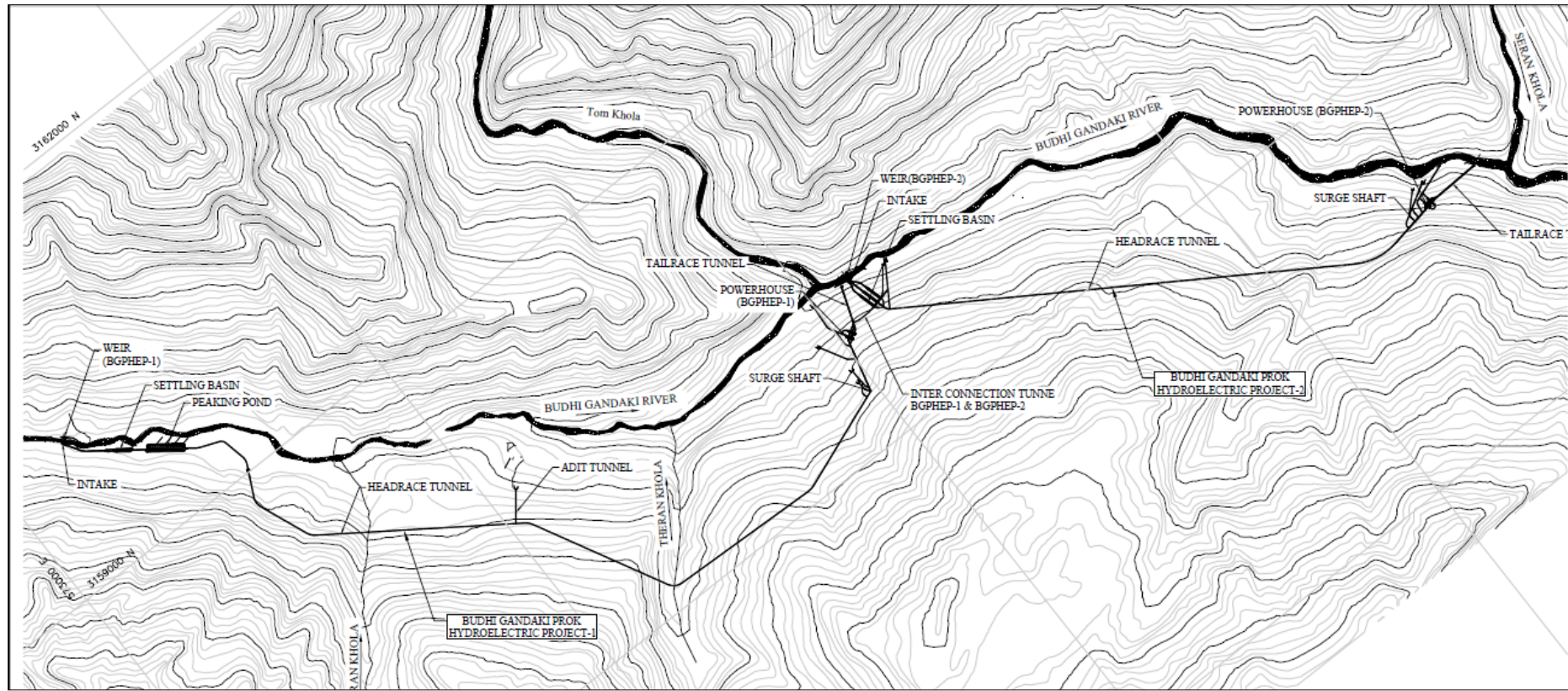
13.3 PROJECT OPTIMIZATION STUDY

		Alternative 1	Alternative 2			Alternative 3
S.N	Description	Desk Study, Q ₄₉	BGPHEP-1, Q _{46.5}	BGPHEP-2, Q ₄₆	Tom Khola HEP, Q ₄₅	BGHEP Single Project, Q _{46.5}
1	Discharge, m ³ /s Q	37.07	23.51	44.03	18.23	23.51
2	Weir Crest Level, m amsl	FSL: 2635 MWL : 2628	2635	2150	FSL: 2635 MWL : 2628	2639
3	Weir Height , m	Gated weir 10 * 11 m of 4 no.s	8	9	Gated weir 10 * 11 m of 4 no.s	9
4	Length of Weir, m	40	30	35	40	30
5	Stilling basin length, m	48	38	48	48	48
6	Flood 1000 years	850.17	1013.29	1863.46	850.17	1013.29
7	Flood 500 years	777.36	926.52	1703.88	777.36	926.52
8	Flood 100 years	608.01	724.68	1332.69	608.01	724.68
9	Undersluice	1 no.s	4 x 5 of 2 nos.	5 x 6 m, 2 no.s	1 no.s	4 x 5 of 2 nos.
10	Intake	2 no.s [3.5 x 5.5 m]	2 no.s [3.0 x 6.5 m]	3 no.s [3 x 8 m]	2 no.s [3.5 x 5.5 m]	3 no.s [2.5 x 5.5 m]
11	Gravel trap	5 mm settle down [6 x 20 m]	5 mm settle down [10 x 15 m]		5 mm settle down [6 x 20 m]	5 mm settle down [6 x 20 m]
12	Settling basin	2 nos 0.15 mm settle down 95 % efficiency 13 x 105 m [W X L]	2 nos 0.15 mm settle down 95 % efficiency 13 x 100 m [W X L]	3 nos 0.15 mm settle down 95 % efficiency 14 x 120 m [W X L]	2 no.s 0.15 mm settle down 95 % efficiency 13 x 95 m [W X L]	2 no.s 0.15 mm settle down 95 % efficiency 13 x 105 m [W X L]

13.4 PROJECT OPTIMIZATION STUDY

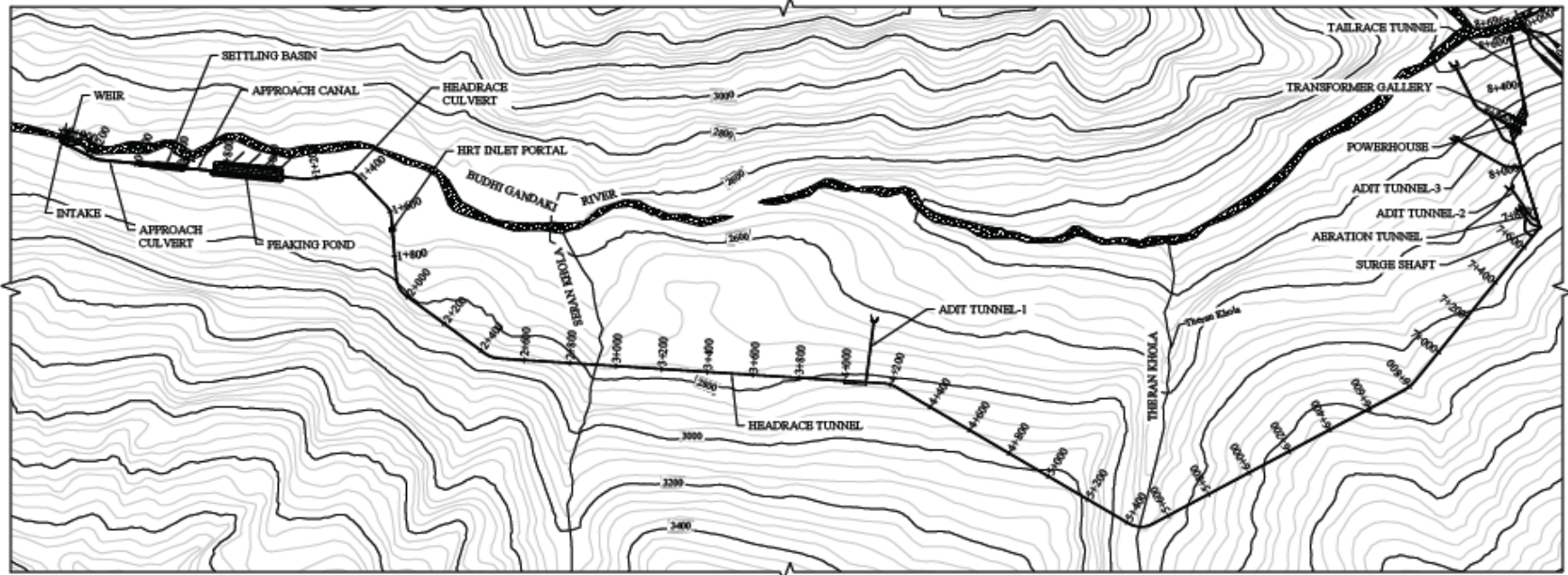
		Alternative 1	Alternative 2			Alternative 3
S.N	Description	Desk Study, Q ₄₉	BGPHEP-1, Q _{46.5}	BGPHEP-2, Q ₄₆	Tom Khola HEP, Q ₄₅	BGHEP Single Project, Q _{46.5}
14	HRT	4.4 x 4.4 m [8 km length] Diversion 6.5 km	4.2 x 4.2 m [6028 m length]	5.6 x 5.6 m [4365 m length]	4.0 x 4.0 m [4360 m length]	4.2 x 4.2 m [11400 m length]
15	Adit		277 m	337 m, 4 x 4 m dia D shaped	300	Adit1 397m Adit 2 486 m
16	Surge tank	Restricted orifice Height 85 m 12 m dia.	Restricted orifice Height 51 m 10 m dia.	Restricted orifice Height 48 m 12 m dia.	Restricted orifice Height 47 m 10 m dia.	Restricted orifice Height 85 m 12 m dia.
17	Pressure Shaft	320 m [3.2 m diameter]	769.20m [2.5 m diameter]	261 m [3.5 m diameter]	850 m [2.6 m diameter]	1170 m [2.5 m diameter]
18	Turbine C.L/ TWL, amsl	1940	2162	1934.5	2162	1940
19	Gross Head, m	703.5	473	214.24	473	695
20	Net Head, m	679.95	454.71	206.5	451.27	679.95
21	Peaking Hours	1.2 hours	1.5 hours	RoR+Cascade	1.5 hours	1.5 hours
22	Installed capacity (MW)	216	93	81	73	136
23	Powerhouse size	18 x 80 x 31 [W X L X H]	15 x 74 x 31 [W X L X H]	14.5 x 65 x 31 [W X L X H]	15 x 65 x 31 [W X L X H]	18 x 78 x 31 [W X L X H]
24	Number of unit	3 vertical axis Pelton turbine	3 vertical axis Pelton turbine	3 vertical axis Francis turbine	3 vertical axis pelton turbine	3 vertical axis pelton turbine
25	Total net Energy, GWh	1204.56	522.42	447.03	389.09	761.44
26	Dry Peak Energy GWh	45.28	48.29	-	14.47	28.72
27	Dry Off Peak Energy GWh	323.61	109.97	134.6	105.15	202.72
28	Wet Energy GWh	835.67	364.16	312.43	269.47	530.01
29	Dry Energy, %	30.62%	30.29%	30.11%	30.75%	30.39%
	Selected Option		Selected			

13.5 PROJECT OPTIMIZATION STUDY

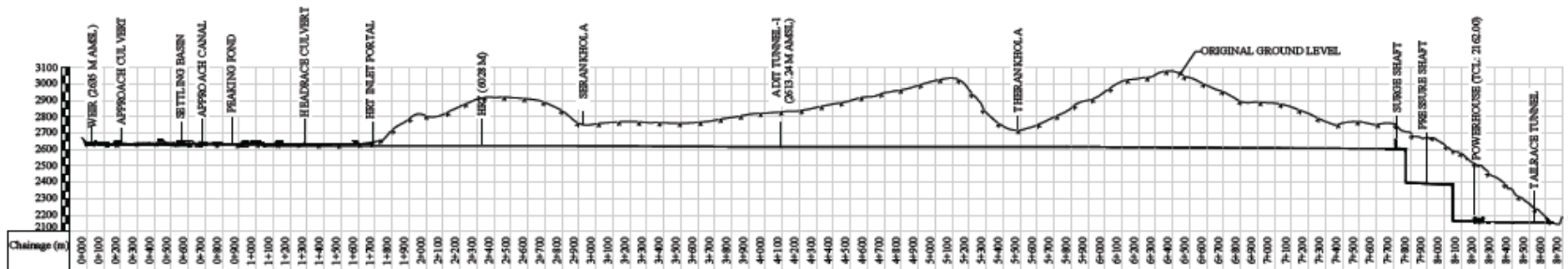


BUDHI GANDAKI PROK HEP LAYOUT (UPSTREAM AND DOWNSTREAM PROJECT)

13.6 PROJECT OPTIMIZATION STUDY



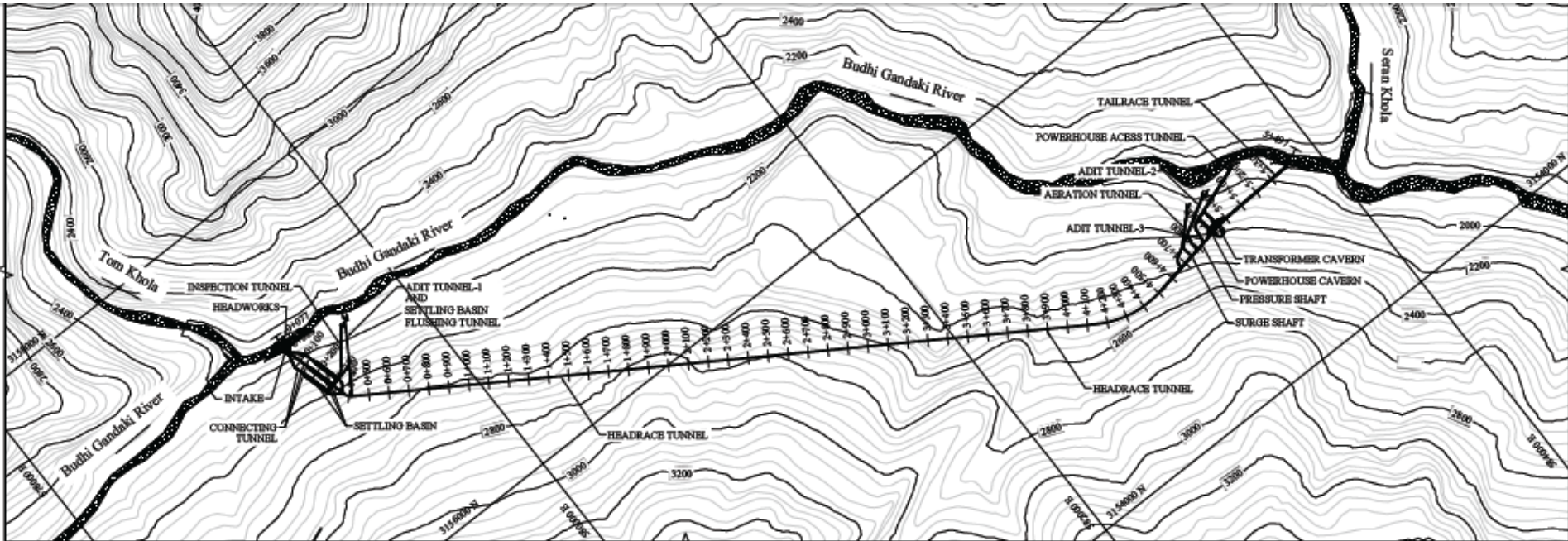
GENERAL LAYOUT
SCALE 1:20,000



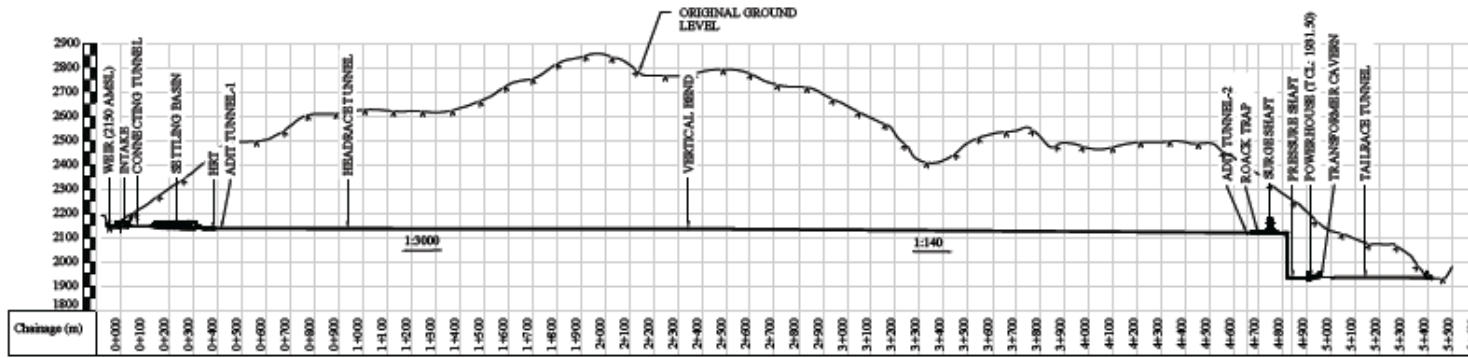
LONGITUDINAL PROFILE

BUDHI GANDAKI PROK HEP-1 LAYOUT (UPSTREAM PROJECT)

13.7 PROJECT OPTIMIZATION STUDY



GENERAL LAYOUT
SCALE 1:20,000



LONGITUDINAL PROFILE

NOTES:

1. ALL DIMENSIONS ARE IN METER AND LEVELS ARE IN METER AMSLL UNLESS OTHERWISE MENTIONED.
2. STRUCTURAL CONCRETE SHALL BE M25 UNLESS MENTIONED OTHERWISE.



BUDHI GANDAKI PROK HEP-2 LAYOUT (DOWNSTREAM PROJECT)

14.0 SURFACE GEOLOGICAL MAPPING

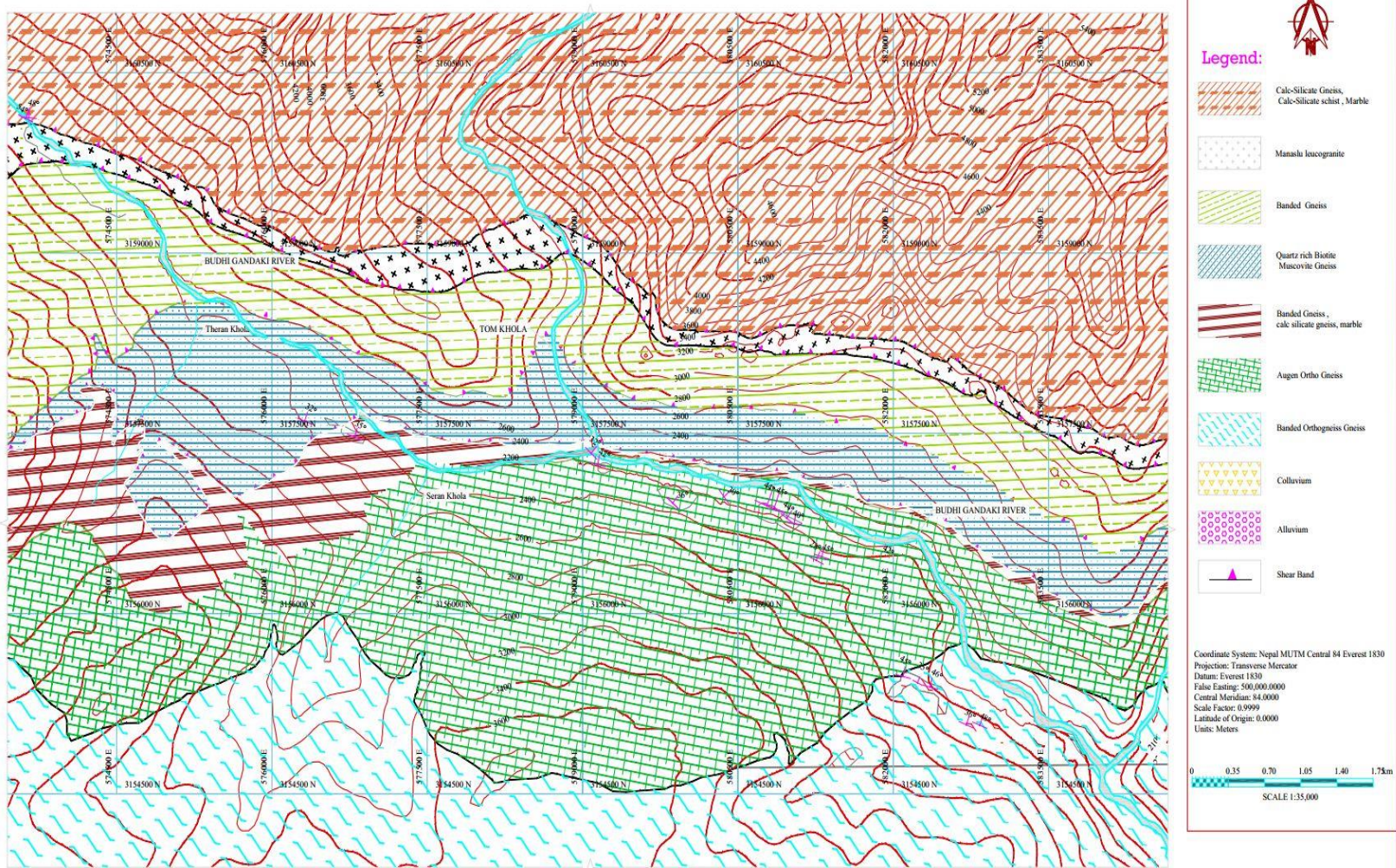
1. GEOLOGICAL MAPPING

- Project area lies in South Tibetan Detachment System of Greater Himalayan Sequence
- Geological route traverse in project area was done to find rock type and its orientation
- Discontinuity survey was conducted to find bedding/ foliation plane, lithological contact and faults
- Major Rock units found at site were Calc- Silicate Gneiss, Calc Silicate Schist, marble, Manaslu Leucogranite, Banded Gneiss, Quartz rich Biotite, Muscovite Gneiss, Augen Orthogneiss and Banded Orthogneiss

2. Geophysical Survey (2-D ERT)

- 6400 m length of ERT survey and Interpretation of Resistivity Tomogram has been completed at Major structure location.

14.1 SURFACE GEOLOGICAL MAPPING



Surface Geological Map of Budhi Gandaki Prok Hydroelectric Project

14.2 SURFACE GEOLOGICAL MAPPING



Rock outcrop of calc-silicate schist, calc-silicate gneiss, marble unit on left bank of Budhi Gandaki River at about 100 m upstream from weir axis of BGPHEP

14.3 SURFACE GEOLOGICAL MAPPING



Rock outcrop of Banded gneiss in area of headrace inlet portal (Alternative 2(A), 3)



Rock exposure of Quartz rich Biotite muscovite Gneiss at Adit portal 1 at near Nadun Village (Alternative 2(A))



Rock outcrop of calc-silicate gneiss at tributary area on the way from Gap to Namrun



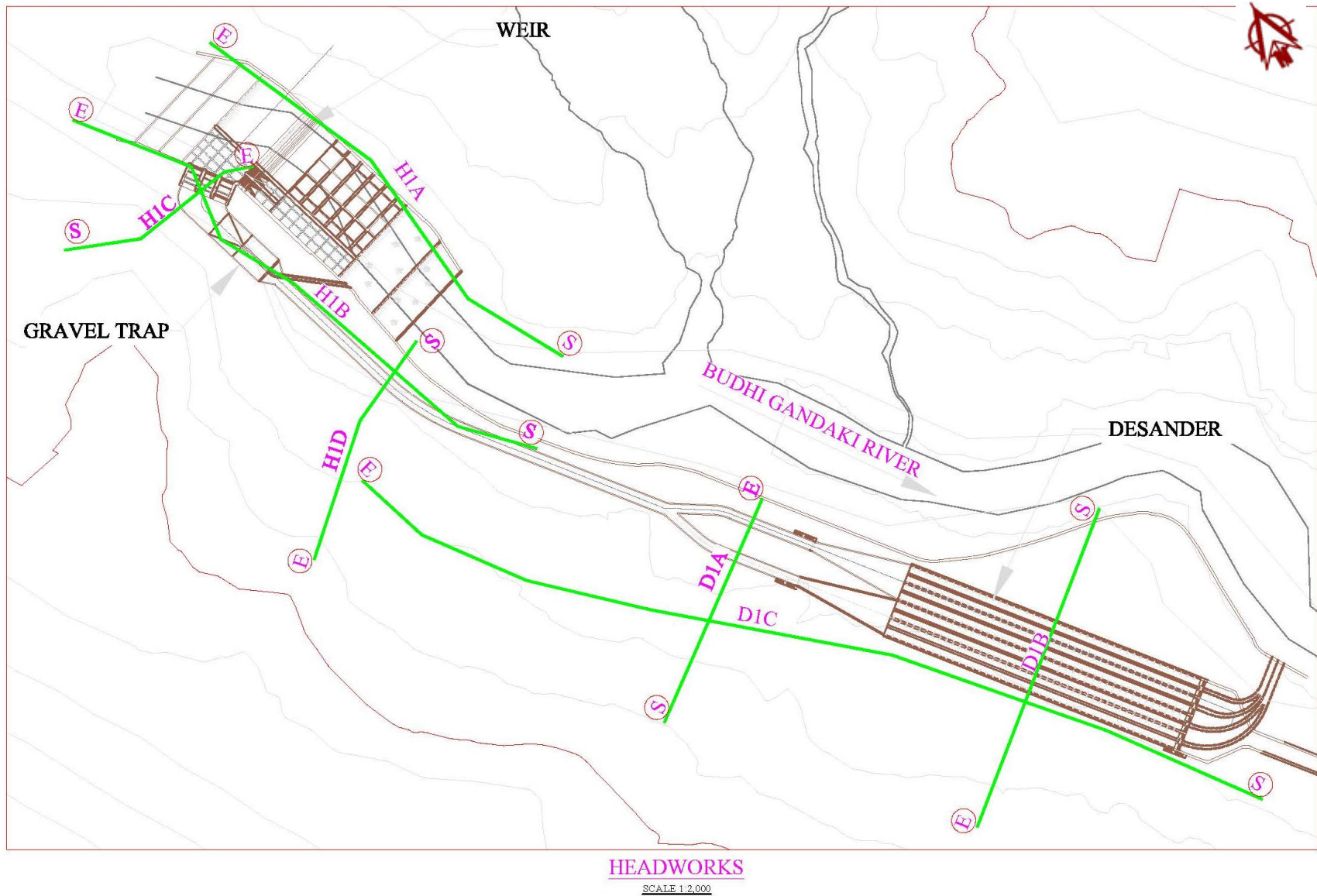
Rock outcrop of augen orthogneiss at Gapsya in Adit Portal⁴³ area

14.4 SURFACE GEOLOGICAL MAPPING



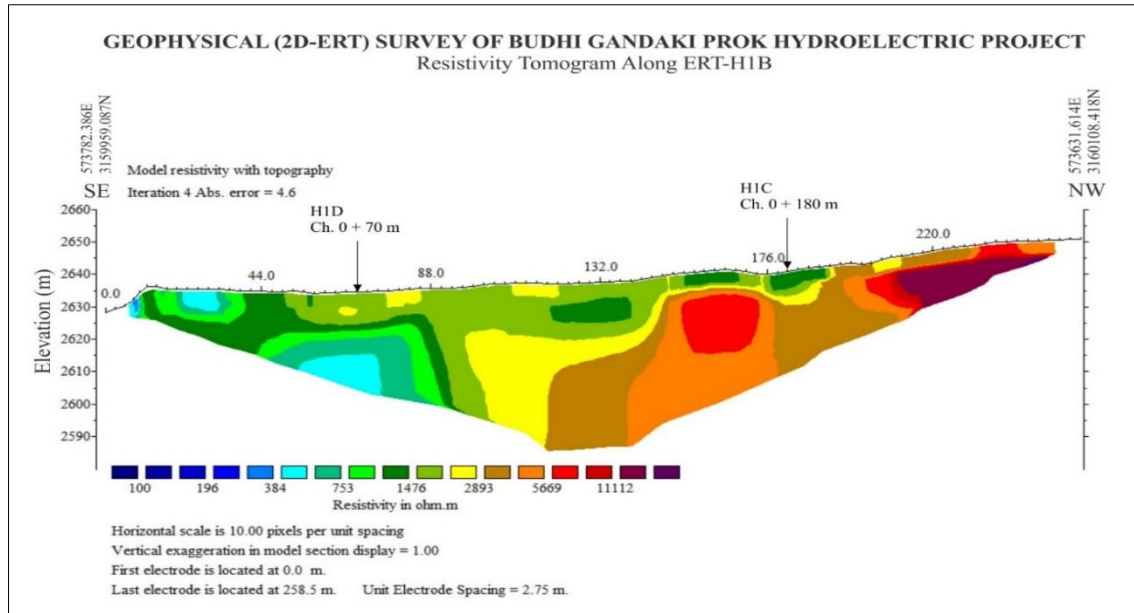
Laying of electrodes and acquisition of data during ERT survey

14.5 SURFACE GEOLOGICAL MAPPING

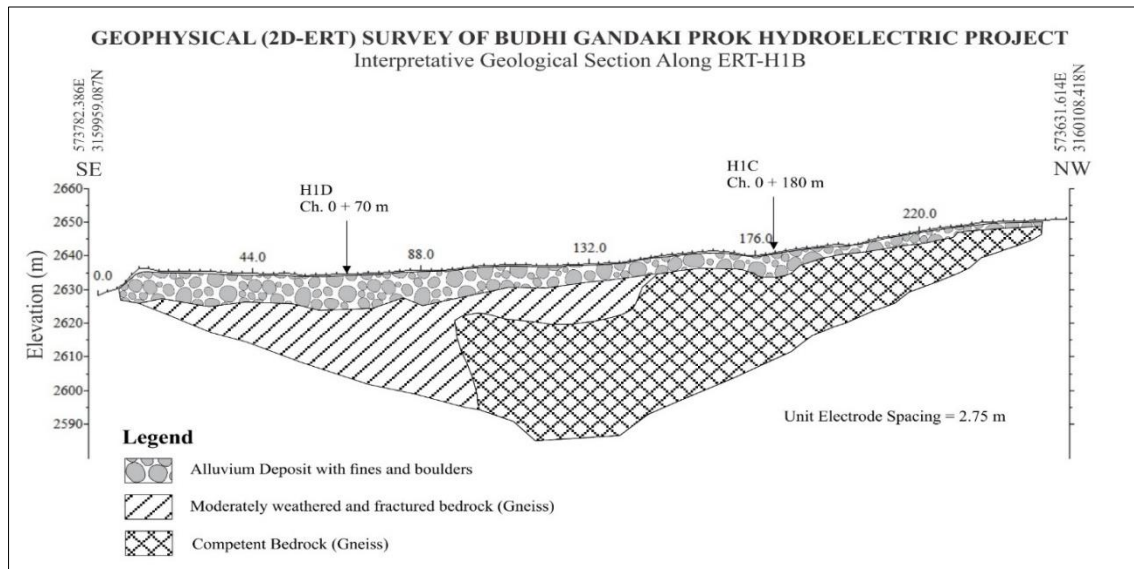


Location map showing ERT lines along with different components (Headworks area)

14.6 SURFACE GEOLOGICAL MAPPING

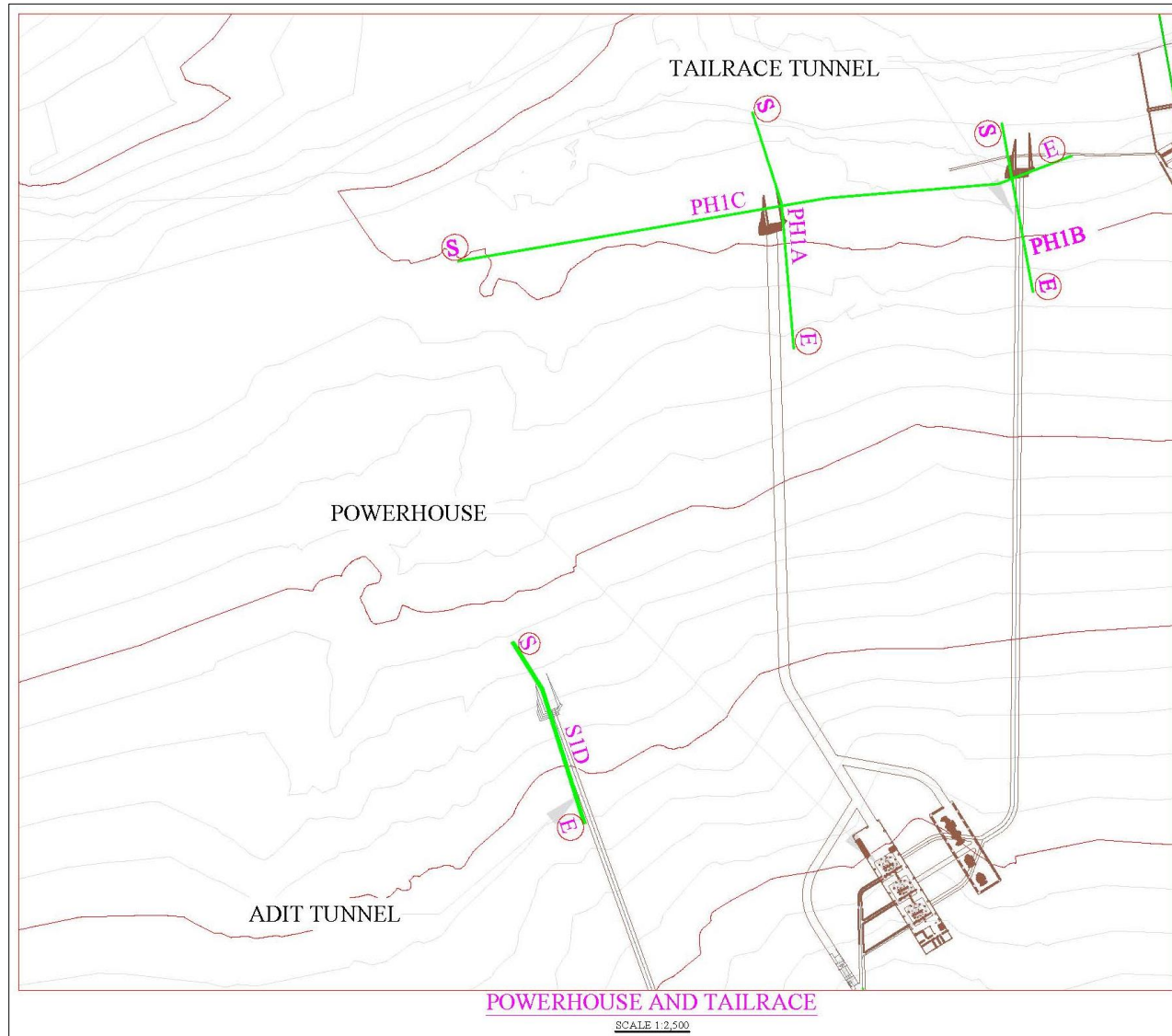


Resistivity Tomogram along H1B (Intake and Gravel trap) at Right bank of River at Headworks



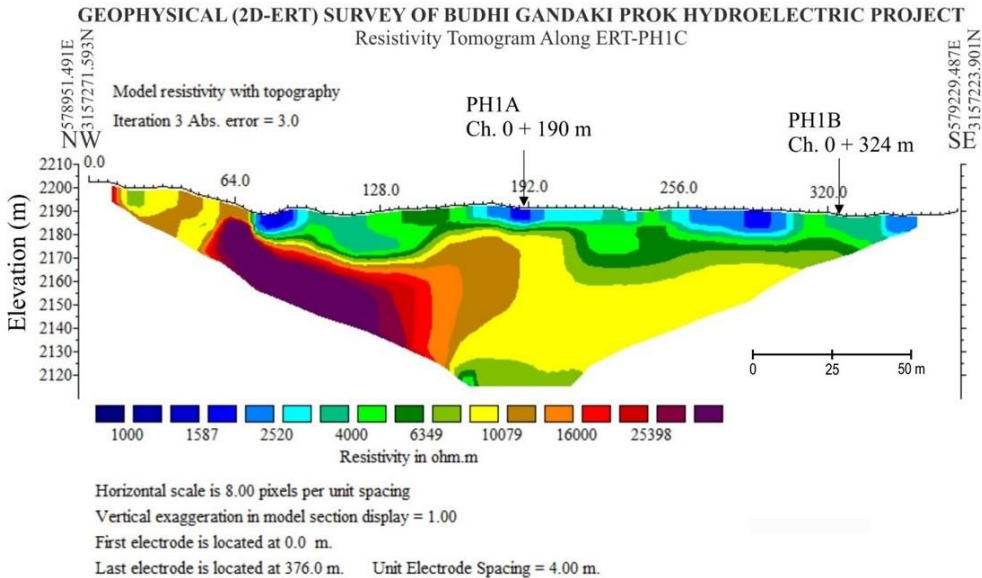
Interpretative Geological section along H1B (Intake and Gravel trap) at Right bank of River at Headworks

14.7 SURFACE GEOLOGICAL MAPPING

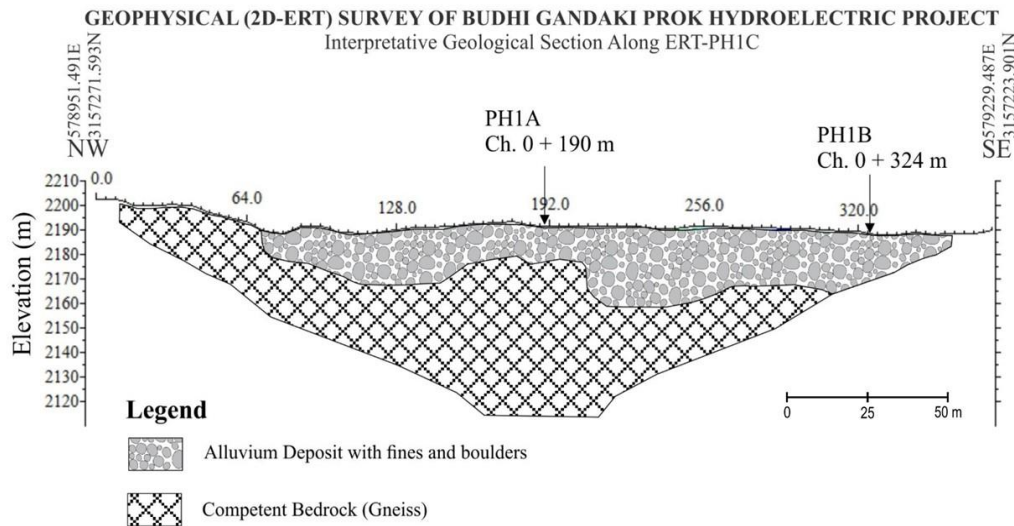


Location map showing ERT lines along with different components of BGPHEP-Alternative 2A (Powerhouse and Tailrace Area))

14.8 SURFACE GEOLOGICAL MAPPING



Resistivity Tomogram along PH1C (Powerhouse) at Right bank of River at Powerhouse area



Interpretative Geological section along PH1C (Powerhouse) at Right bank of River at Powerhouse area

15.0 GEOTECHNICAL INVESTIGATION

➤ Planning and Preparation is going on to carry out drilling work

SN	DH No.	Structure	Coordinates		Elevation (m)	Estimated/ Completed Drilling Depth (m)	Remarks
			Easting (m)	Northing (m)			
1	BGPHEP1-DH-1	Weir axis - Center line	573661.482	3160121.525	2630	30	
2	BGPHEP1-DH-2	Undersluice gate	573644.18	3160099.298	2633	30	
3	BGPHEP1-DH-3	Stilling Basin	573669.037	3160072.858	2632	30	
4	BGPHEP1-DH-4	Intake	573626.508	3160102.063	2641	40	
5	BGPHEP1-DH-5	Settling basin inlet	573927	3159785.886	2639	30	
6	BGPHEP1-DH-6	Settling basin Outlet	574009.688	3159724.092	2635	40	
7	BGPHEP1-DH-7	Peaking pond inlet	574141.757	3159641.858	2632	20	
8	BGPHEP1-DH-8	Peaking pond outlet	574318.936	3159511.343	2631.5	20	
9	BGPHEP1-DH-9	HRT inlet portal	574658.256	3159026.559	2641.5	30	
10	BGPHEP1-DH-10	Surge Shaft	578938.016	3156435.226	2760	150	
11	BGPHEP1-DH-11	Powerhouse	579055.961	3156903.394	2522	300	Drilling challenge to due to high overburden
12	BGPHEP1-DH-12	Tailrace	579269.128	3157230.306	2175	35	
				Total completed drilling depth		755	m

15.1 GEOTECHNICAL INVESTIGATION

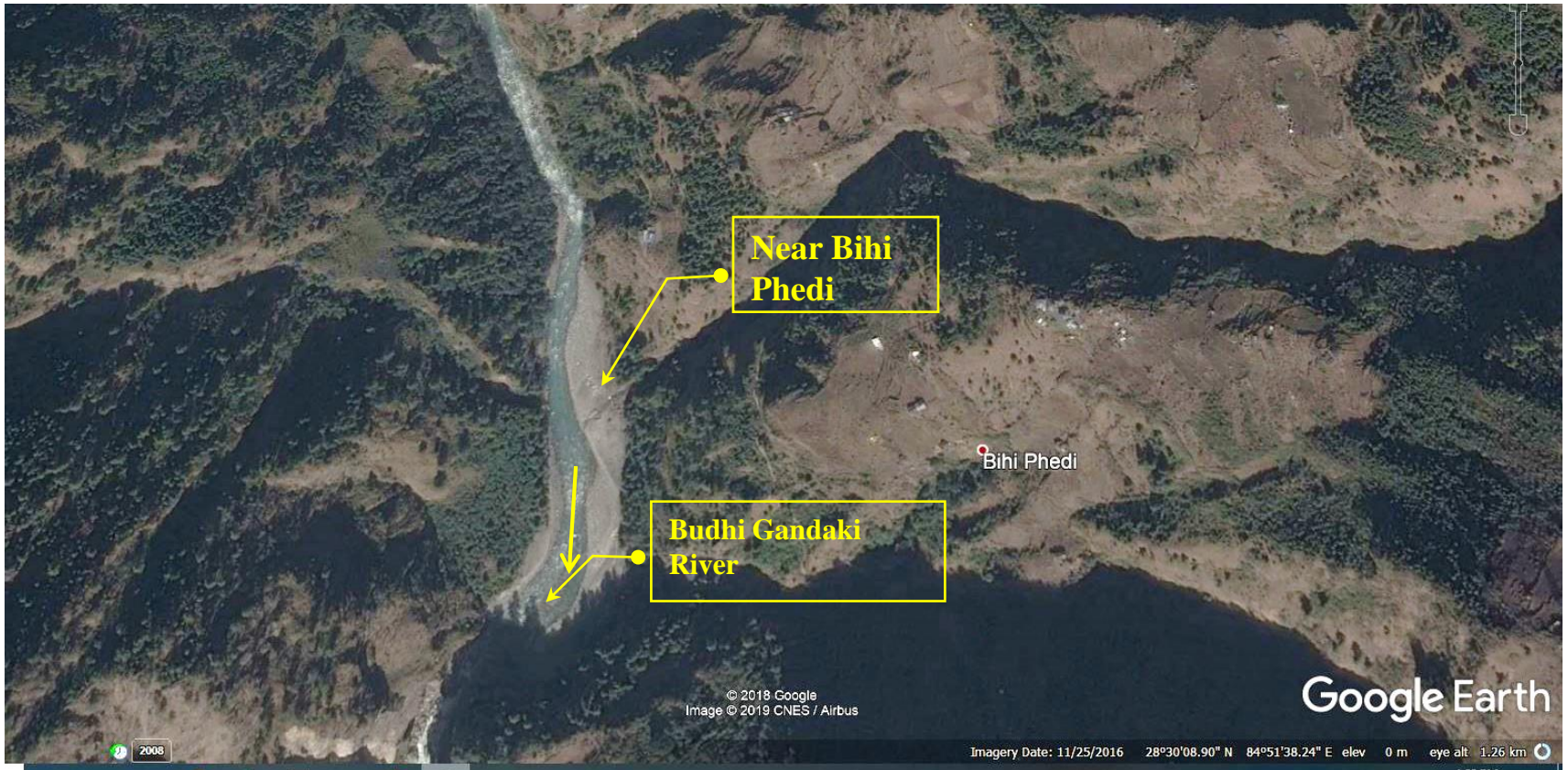
➤ Planning and Preparation is going on to carry out drilling work

SN	DH No.	Structure	Coordinates		Elevation (m)	Estimated/ Completed Drilling Depth (m)	Remarks
			Easting (m)	Northing (m)			
1	BGPHEP2-DH-1	Weir axis - Center line	579362.127	3157272.615	2145	50	
2	BGPHEP2-DH-2	Stilling Basin	579430.738	3157253.212	2145	25	
3	BGPHEP2-DH-3	Intake	579344.234	3157233.649	2175	50	
4	BGPHEP2-DH-4	Settling basin inlet	579424.012	3157093.095	2257	120	
5	BGPHEP2-DH-5	Adit 1	579664.293	3157168.96	2177	40	
6	BGPHEP2-DH-6	Surge Shaft	583180.59	3154808.607	2370	210	
7	BGPHEP2-DH-7	Powerhouse	583334.099	3154860.045	2250	310	
				Total completed drilling depth		805	m

16.0 CONSTRUCTION MATERIAL STUDY

- Preliminary location of quarry site
 - For sand nearest available location is at Bihi (2 km d/s of Powerhouse site) and Philim (15 km d/s of Proposed Powerhouse at Bihi)
 - Further Budhi Gandaki River bank at Yaru Bagar and Jagat (22 km d/s of Powerhouse) has been located for sand
 - Alluvium deposit at Peaking Pond near Bharjan will be further investigated for construction materials.
- Planning for field work for construction material study

16.1 CONSTRUCTION MATERIAL STUDY



Located site for sand at near Bihi 2 km downstream of Project site

17.0 OTHER STUDIES

Task	BGPHEP Status
Topographic Survey and Mapping	Completed
Hydrology and Sediment Study	Completed
Geological Surface Mapping	Completed
Layout Finalization	Completed
Construction Material	Under Progress
Project Design (Hydraulics)	Completed
ERT	Completed
Geotechnical Study (Drilling)	Under Progress
Structural Stability and Design	Completed
Seismic Hazard Study	Under Progress
Quantity Estimation and Rate Analysis/ Cost Estimate	Completed
Environment Impact Assessment	Remaining
Feasibility Report [Draft]	Completed

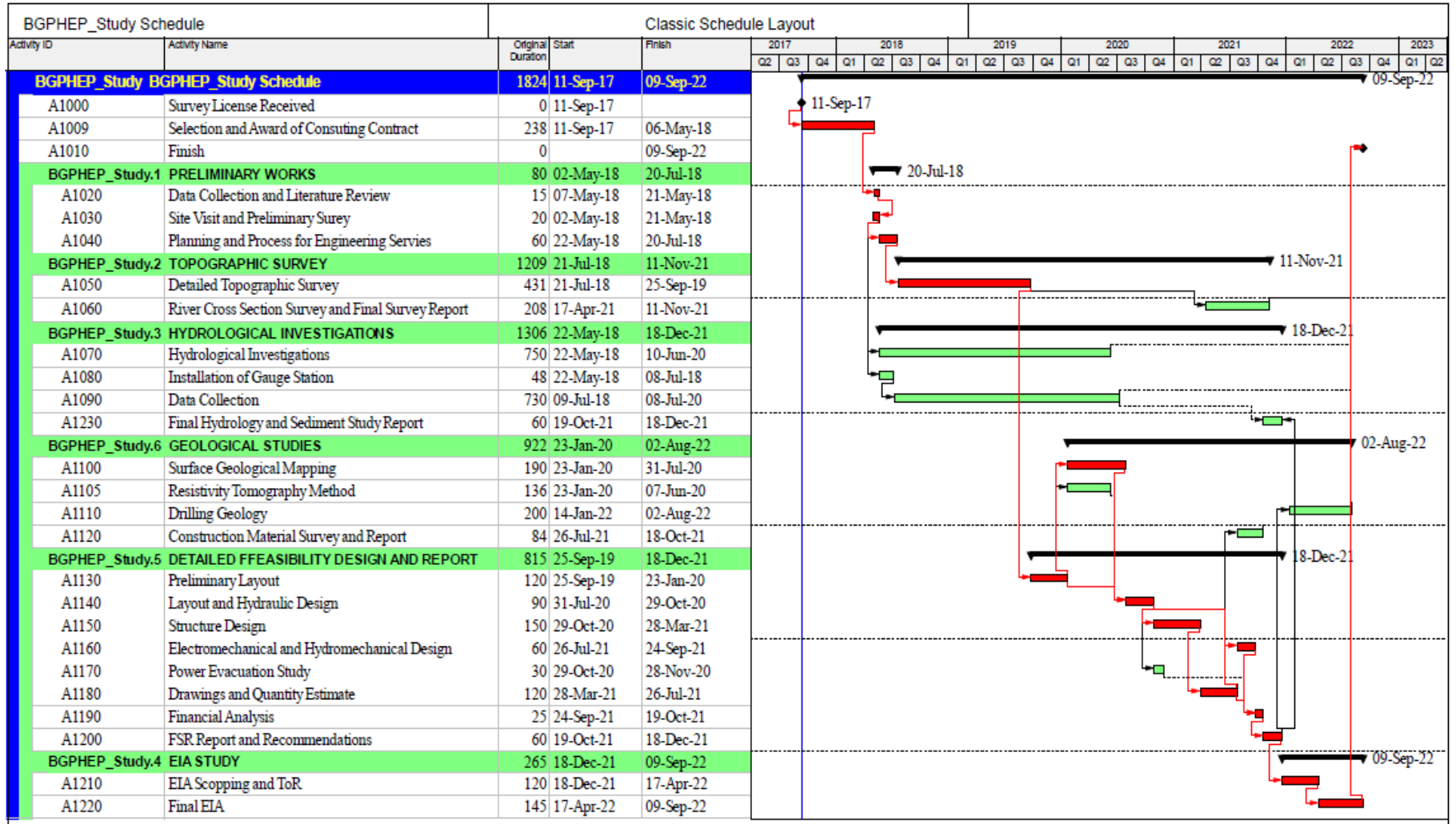
18.0 PROBLEMS OBSERVED THROUGH ENVIRONMENTAL STUDIES / LOCAL PROBLEMS

- Project Area lies on Manaslu Conservation Area.
- About 30 houses need relocation and about 5 ha of cultivable land need to be acquired if peaking pond is to be constructed after Settling basin.

19.0 FUTURE PROGRAMME IN FEASIBILITY STUDY

- Topographic survey at Tom Khola headworks, River Cross Section
Survey and strip survey for Tunnel Alignment
- Construction Material
- Seismological Study
- Drilling
- Prepare Final EIA report.

20.0 WORK SCHEDULE FOR NEXT YEAR



21.0 PROBLEM ENCOUNTERED AND CAUSES OF DELAY

1. Accessibility

- No motorable access is available up to Project site (Headworks and Powerhouse) site. It needs to be accessed by 3 days of walking along Manaslu Trekking Route and Difficult topography in Tom Khola.

2. Project at Conservation Area

1. Referring the Minister Level decision of dated 2074/10/09, consent for feasibility study shall have to be given by the Department of National Park and Wildlife Department for the Project located in the National Park, Conservation area or its buffer zone. The project Budhi Gandaki Prok HEP is located in Manaslu Conservation Area Project (MCAP) and necessary consent has not been obtained from the concerned authorities till date. This has affected the field data collection works for Feasibility study.

3. Topography

- Very steep and difficult Topography at Surge Shaft and Powerhouse Area. So, the field work on Topographic survey, Geological survey, ERT and hydrology took more time than expected
- Drilling work was affected due to access difficulty
- Headworks of Tom khola could not be accessed because of lack of availability of foot trail along Tom khola.

4. COVID-19

21.1 PROBLEM ENCOUNTERED AND CAUSES OF DELAY



Access to Tom Khola



22.0 RELEVANT COMMENTS

- The discharge $76.0 \text{ m}^3/\text{s}$ proposed in desk study is not actually available. The detailed hydrological analysis shows discharge available at $Q46 = 44.03 \text{ m}^3/\text{s}$ with downstream release of 25% of the natural flow.
- Topographic Survey at Tom Khola Headworks could not be carried out because of lack of foot trail available up to the headworks site.
- Consultant is working at analyzing different alternatives and selecting a best one that utilizes the flow of Budhi Gandaki River in most efficient way
- The Consultant is fully committed and shall use its best possible effort to complete the remaining works of feasibility study within the time period of Next one year.

THANK YOU