‘Preparation of Development Plan for Fourteen Upazilas’
Package-2

Presentation on

Geological Works at

Ishwarganj, Raipura and Shibpur Upazila

(Survey Report)

Presented by
Mohammed Jamal Uddin,
Consultant Geologist
&
Fansab Mustahid
Associate Consultant Geologist

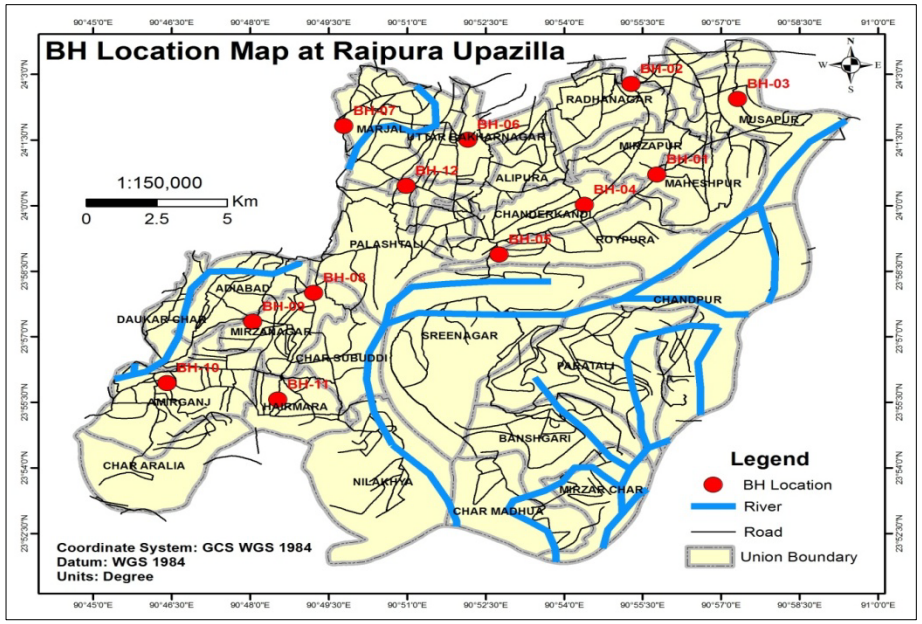
To ensure the sustainable development, the prime objectives of this work is to determine subsurface soil condition of the project area and evaluating of natural geological and hydro-meteorological hazards such as earthquake, landslide and ground failure and integrate the consequence into the design of the infrastructure.

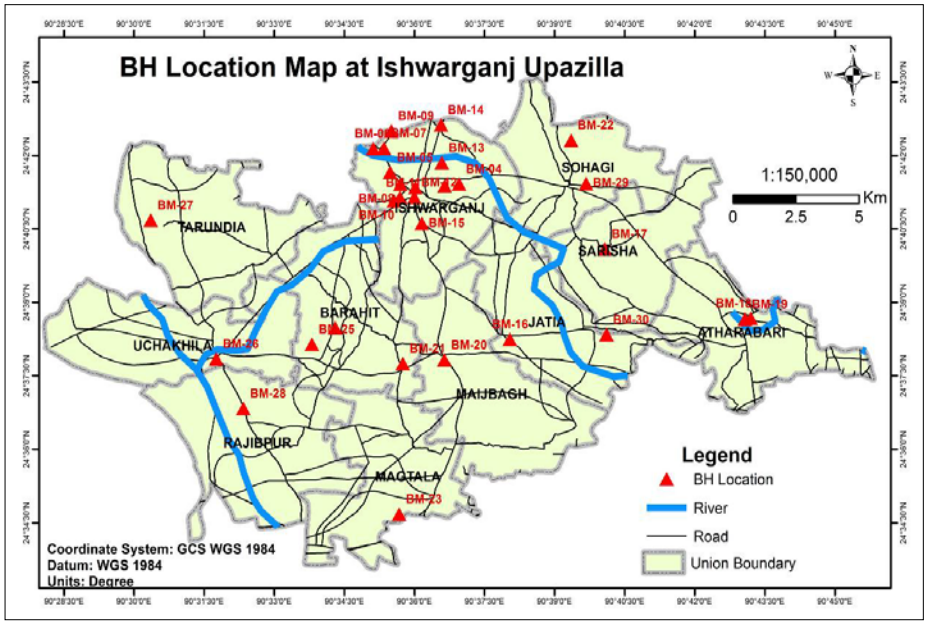
- Geomorphologic field study
- Drilling of boreholes and preparation of borehole logs;
- Collection of undisturbed and disturbed soil sample as per standard guide line;
- Conducting standard penetration tests (SPTs);
- Drilling of boreholes and casing by PVC pipe for conducting PS logging test
- Conducting Down-hole Seismic Test (PS Logging) and
- Conducting Multi-Channel Analysis of Surface Wave (MASW).

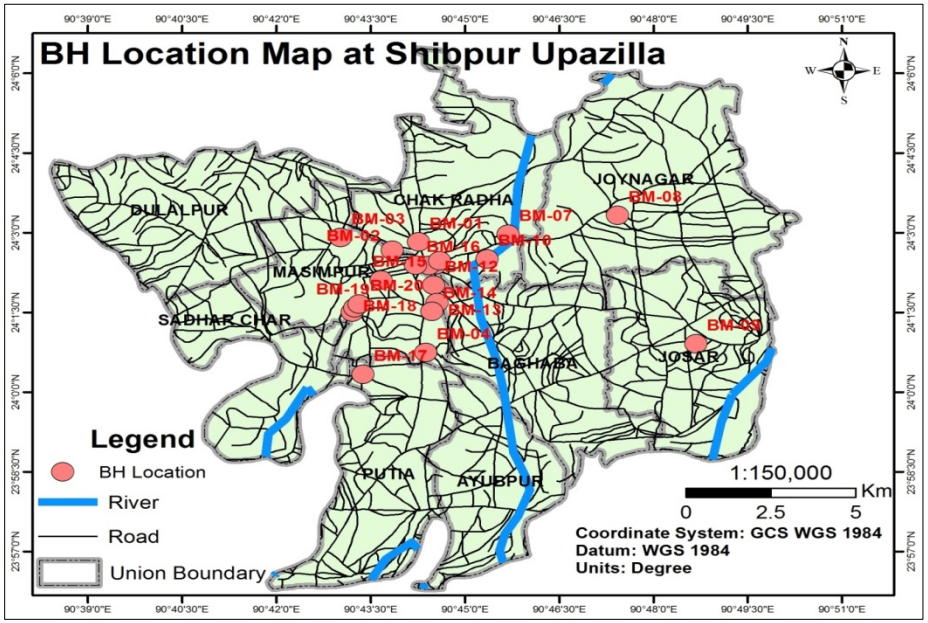
Test Number

Upazila Name	Borehole (SPT)	Downhole Seismic Test (PS Logging)	MASW Test
Raipura	12	3	5
Shibpur	20	3	5
Ishwarganj	30	4	5

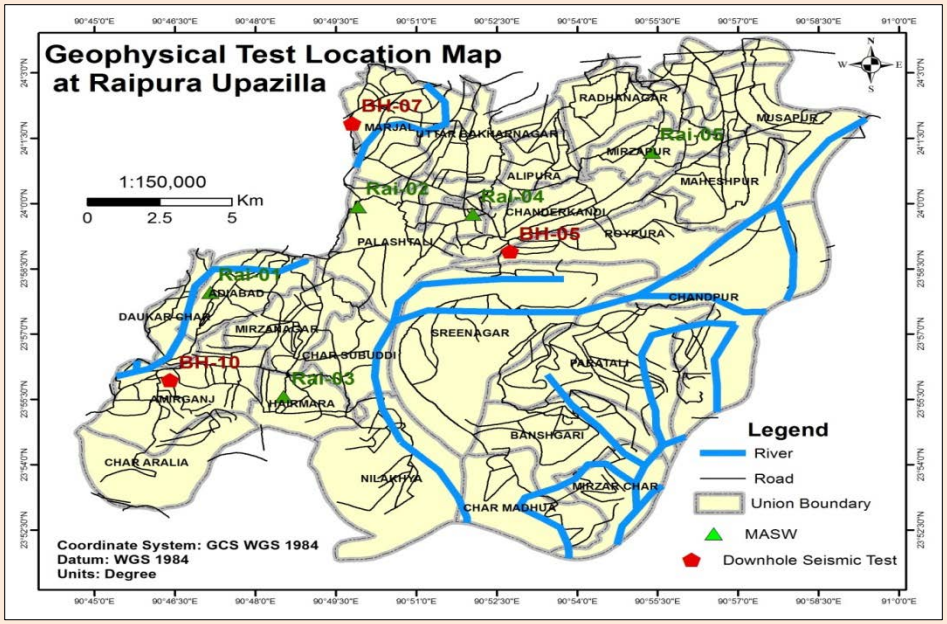
Drilling Locations for SPT Test

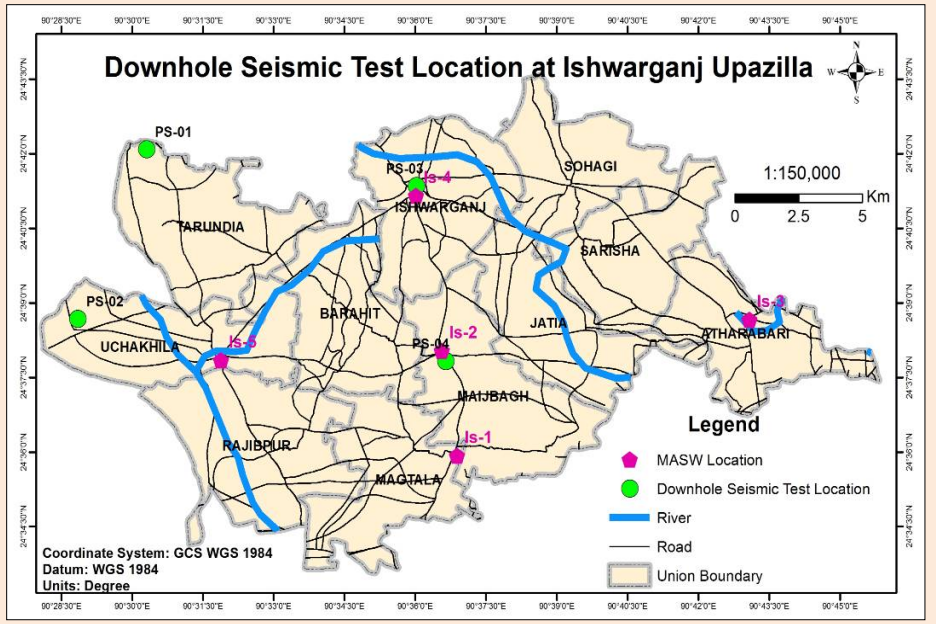


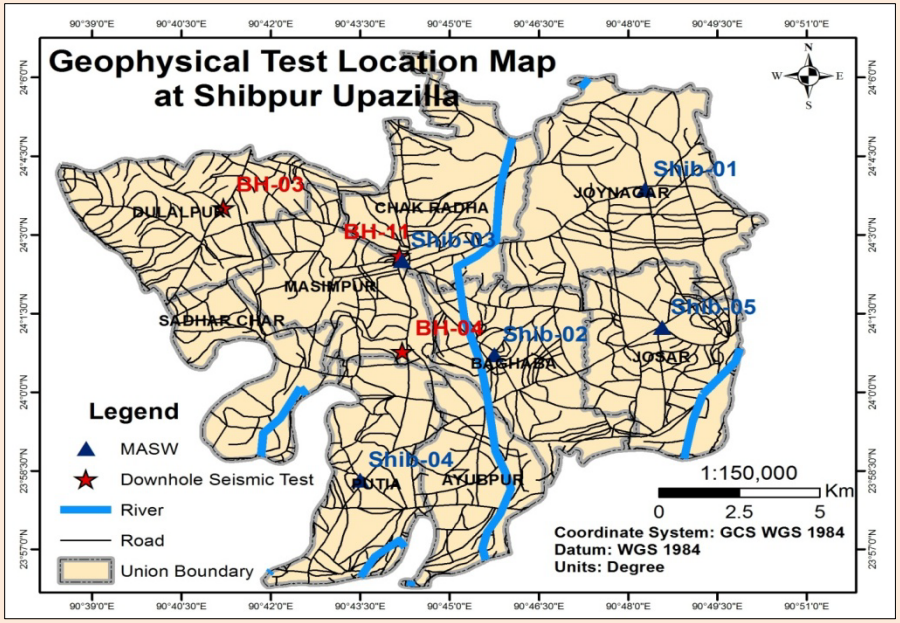




PS Logging and MASW Test Locations







PS logging Data Acquisitions at Raipura Upazila

BH-10, Hasnabad high school, Amirganj Union

BH-07, MarjalMadrasha, Marjal Union

PS logging Data Acquisitions at Iswarganj Upazila

BH-03, Near Maijbagh Union Porishod, Maijbagh Union

BH-20, ChorNiclauchhoBiddaloy, IshwarganjSadar

PS logging Data Acquisitions at Shibpur Upazila

BH-11, Shibpur ideal school and college, ShibpurSadar

BH-04, Near Dulalpur Union porishod, Dulalpur Union

Down-Hole Seismic (PS Logging) Test Result

- **Down-Hole Seismic (PS Logging) Test** data acquisition has been completed at three Upazilla in different locations on date 26th August 2016.

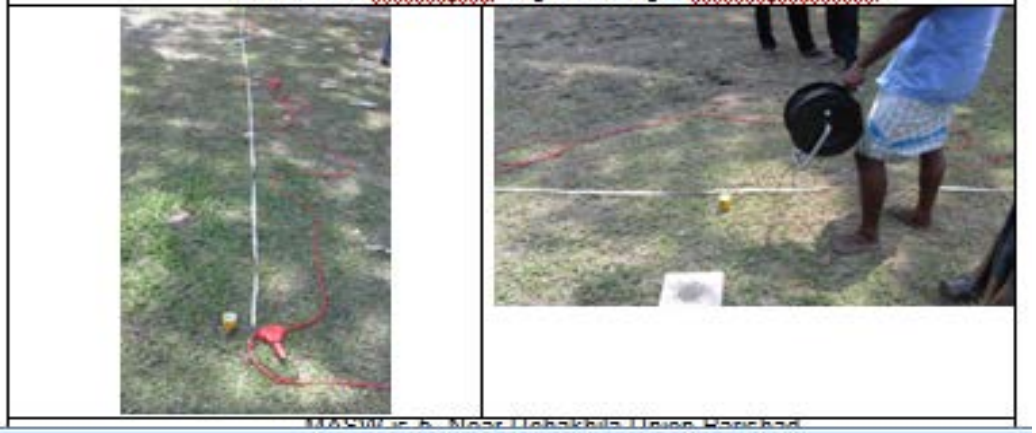
- Depth of observations was up to 30 meter for each hole

- Field raw data will be processed and interpreted very soon and result shall be included into final survey report.

MASW Survey at Raipura

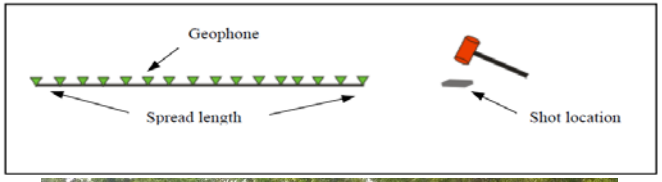
MASW is 3, Atharobari Girls High School, Atharbari Union

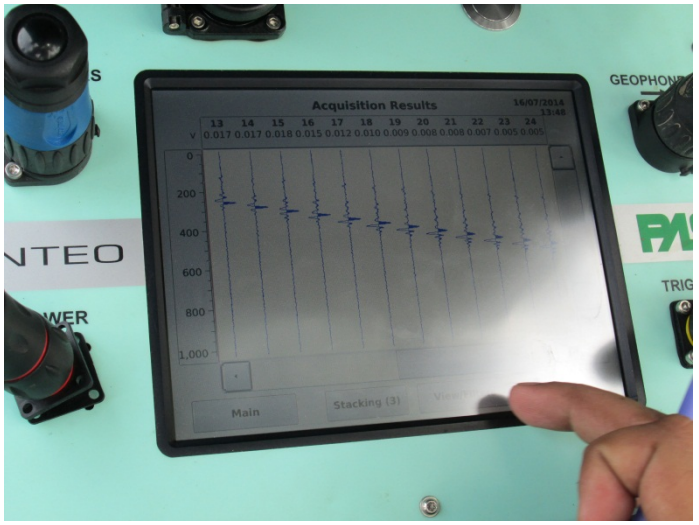
MASW is 4, Ishwarganj Degree College, IshwarganjSadar

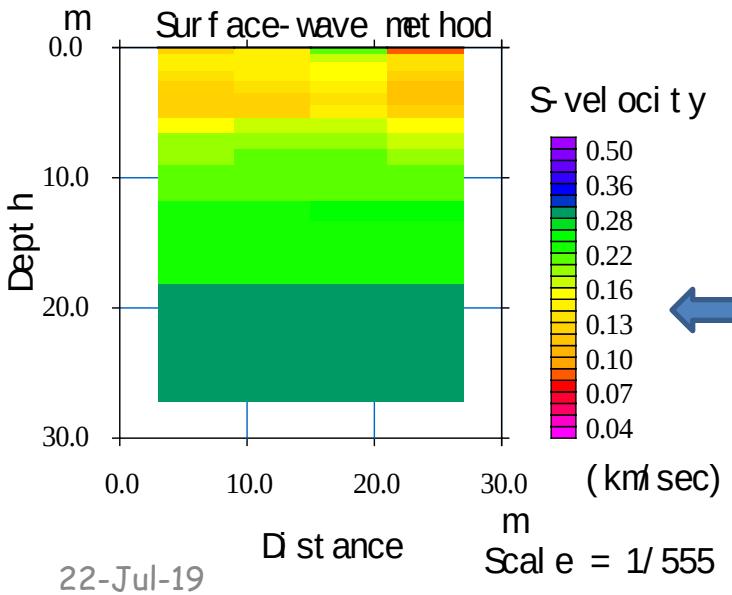


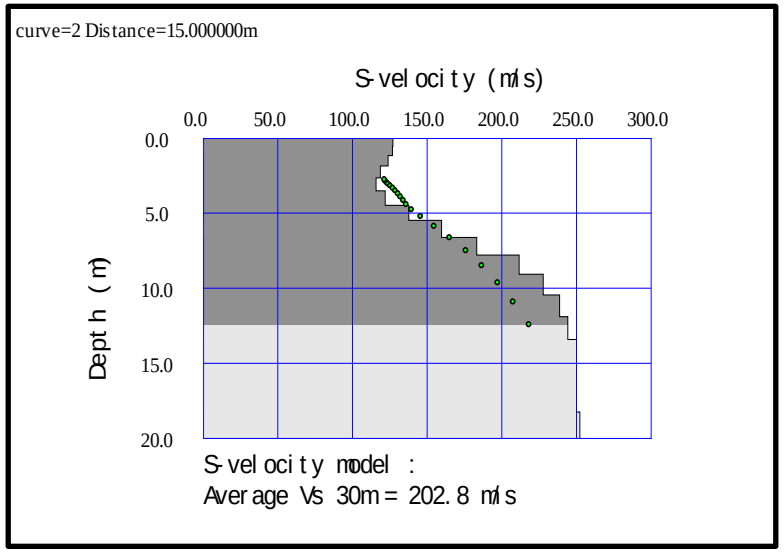
MASW-Rai 4, Raipura College, Polastoli Union

MASW-Rai 5, Piriikandi high School, Mirzapur Union

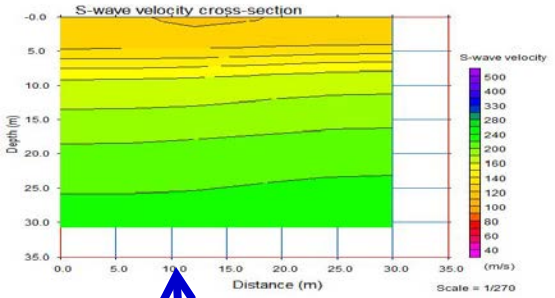

Geophone
Spread length
Shot location


Acquisition Results
Main
Stacking (3)

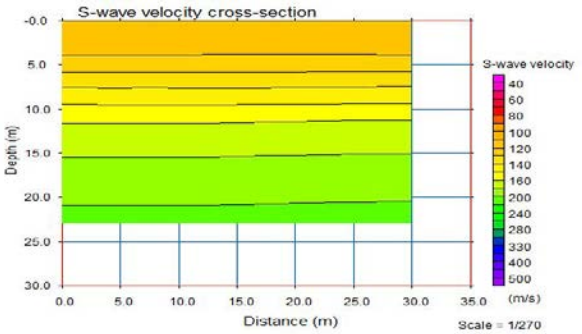

Surface-wave method
m
0.0
10.0
20.0
30.0
Depth
0.0
10.0
20.0
30.0
Distance
m
Scale = 1/555
S-velocity
0.50
0.36
0.28
0.22
0.16
0.13
0.10
0.07
0.04
(km/sec)


curve=2 Distance=15.000000m
S-velocity (m/s)
0.0
50.0
100.0
150.0
200.0
250.0
300.0
Depth (m)
0.0
5.0
10.0
15.0
20.0
S-velocity model :
Average Vs 30m = 202.8 m/s

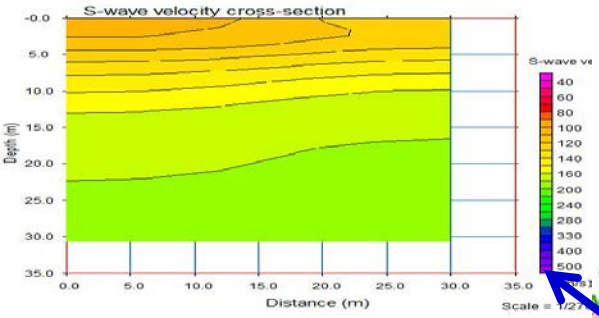
MASW Survey Result at Raipura Upazila



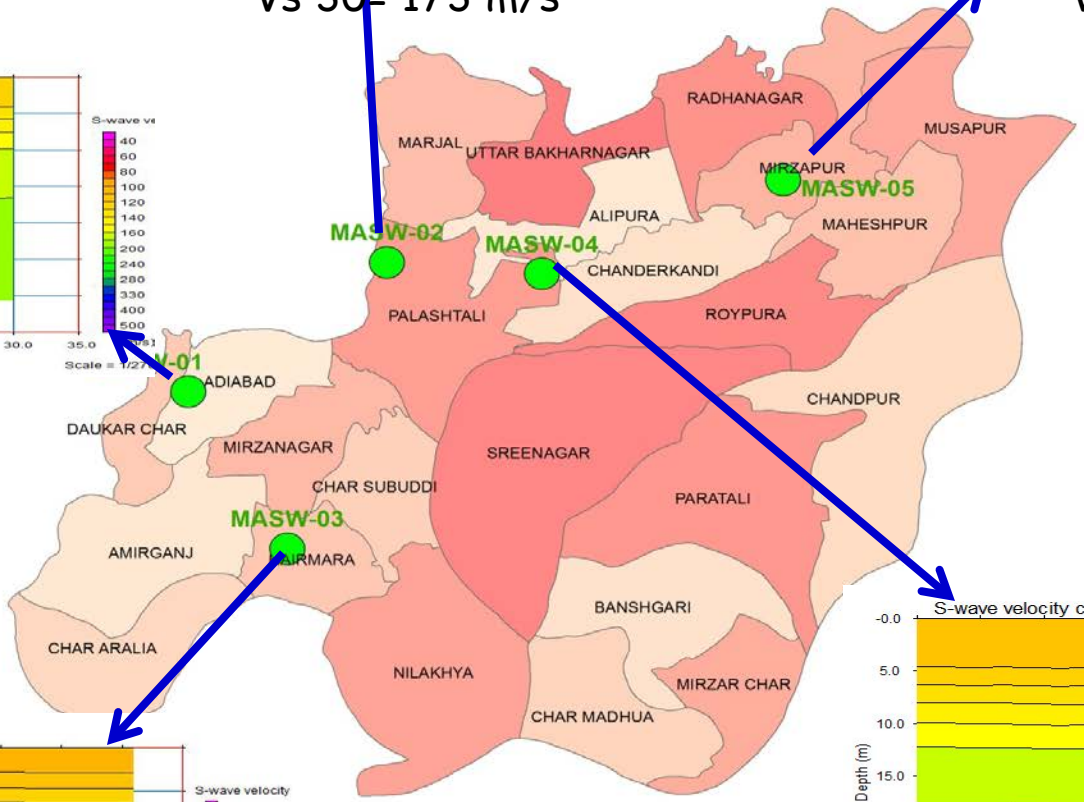
Vs 30= 173 m/s

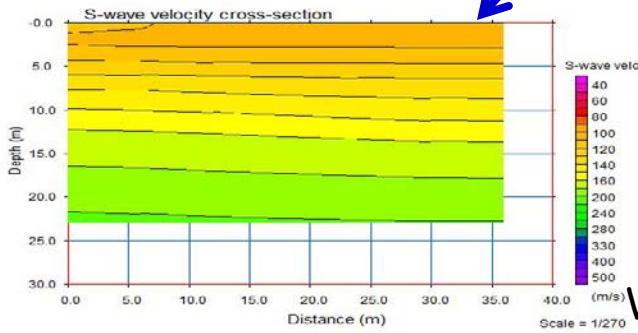


Vs 30= 163 m/s

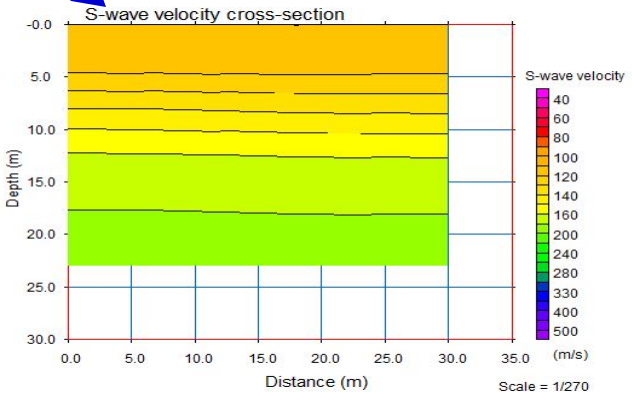


Vs 30= 163m/s





Vs 30= 160 m/s



Vs 30= 155m/s

Summary of MASW Test Results of Raipura

MASW ID	Average Shear Wave Velocity (Vs 30)
MASW Rai 1	163.0 m/s
MASW Rai 2	172.7 m/s
MASW Rai 3	159.8 m/s
MASW Rai 4	155.2 m/s
MASW Rai 5	162.9 m/s

Source: Field survey, 201

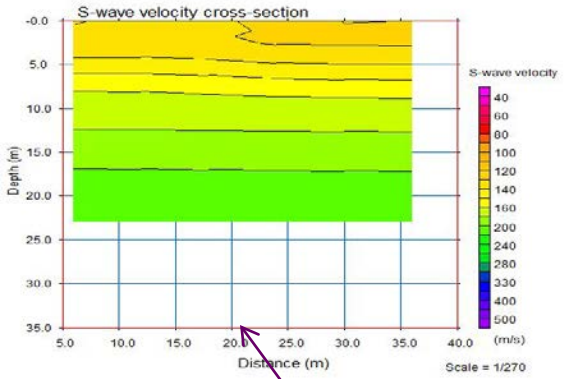
- According to MASW test result, the average shear wave velocities at all location are less than 180 m/s.

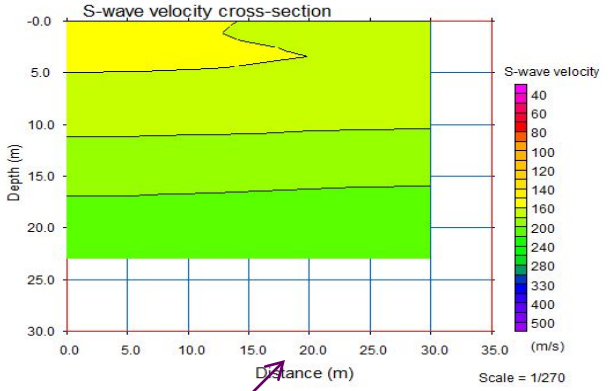
- Shear wave velocity of the project area is showing soft to moderate soil condition for foundation.

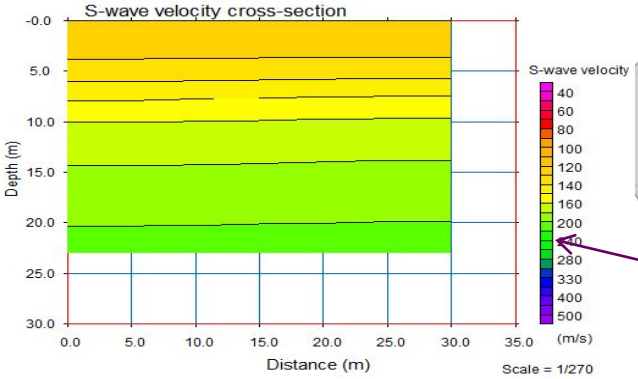
- The shear wave velocities at soil layer shows gradually increase from 110m/s to 230m/s.

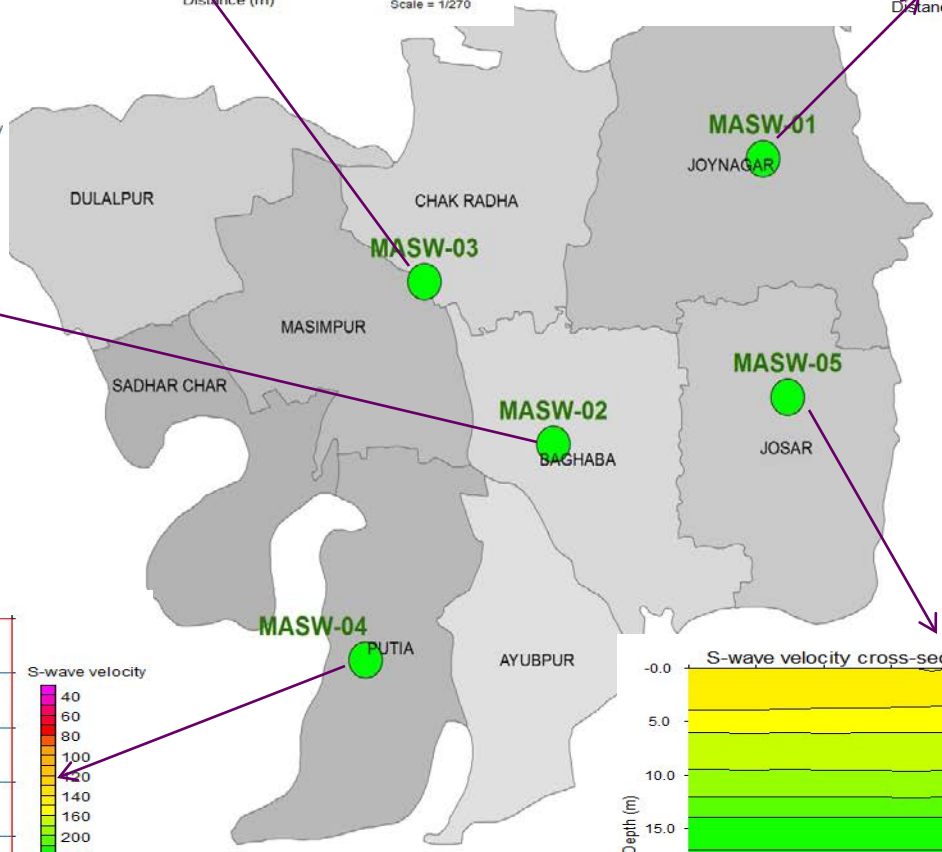
- From those soil velocities, it can be saying the upper soils (depth around 15m) are soft soil and soil hardness gradually increases by increasing depth.

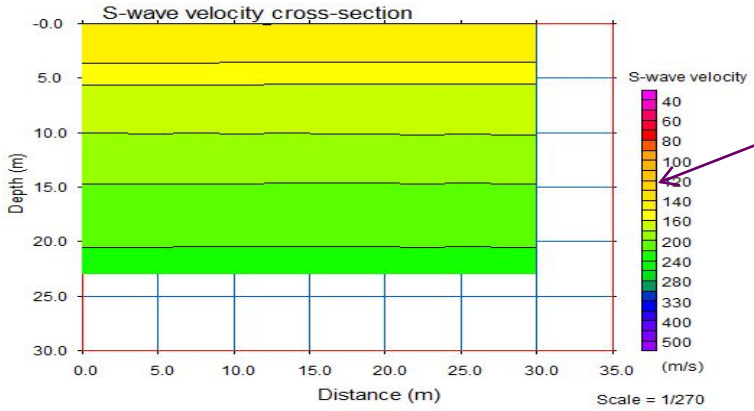
MASW Survey Result at Shibpur Upazila

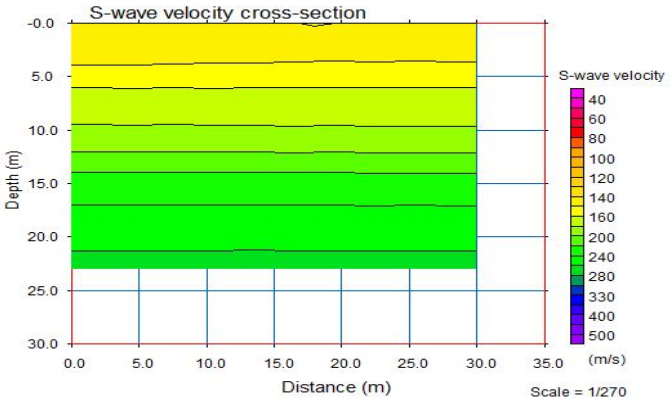












Summary of MASW Test Results of Shibpur

MASW ID	Average Shear Wave Velocity (Vs 30)
MASW Shib 1	188.9 m/s
MASW Shib 2	170.9 m/s
MASW Shib 3	178.4 m/s
MASW Shib 4	190.3 m/s
MASW Shib 5	205.3 m/s

Source: Field survey, 201

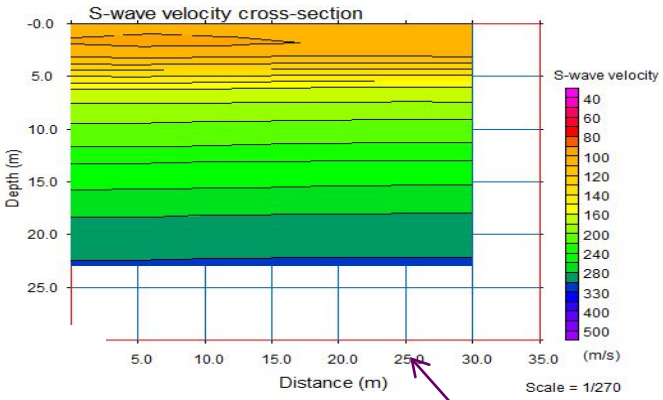
- According to MASW test result, shear wave velocity of the project area is showing soft to moderate soil condition for foundation.

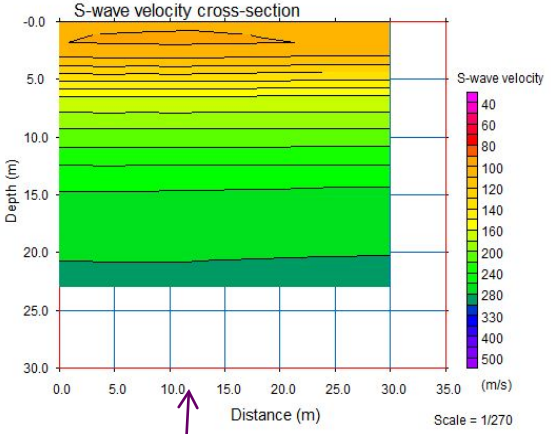
- MASW-01, MASW-04 and MASW -05 test results are showing more than 180 m/s but others two locations the average velocity is bellow 180m/s.

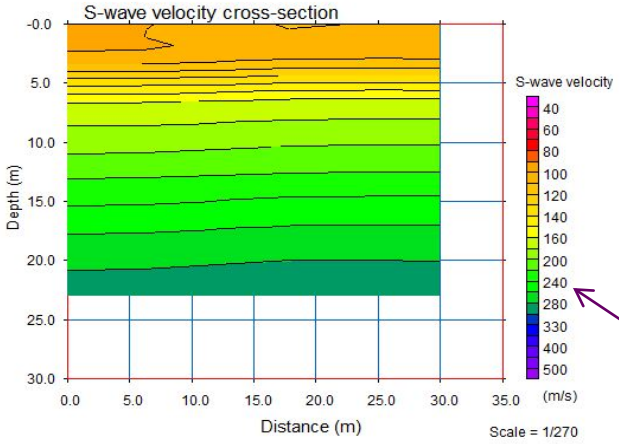
- The shear wave velocities at soil layer shows gradually increase from 110m/s to 230m/s.

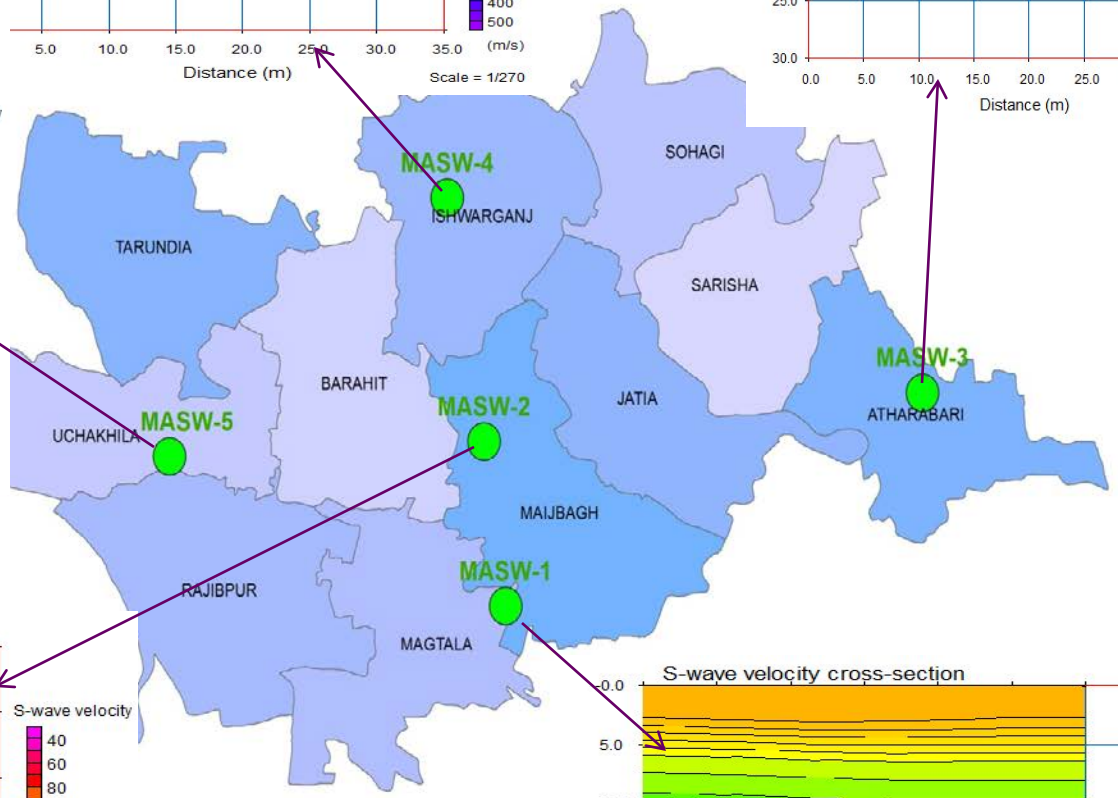
- From those soil velocities, it can be saying the upper soils (depth around 15m) are soft soil and soil strength gradually increases by increasing depth.

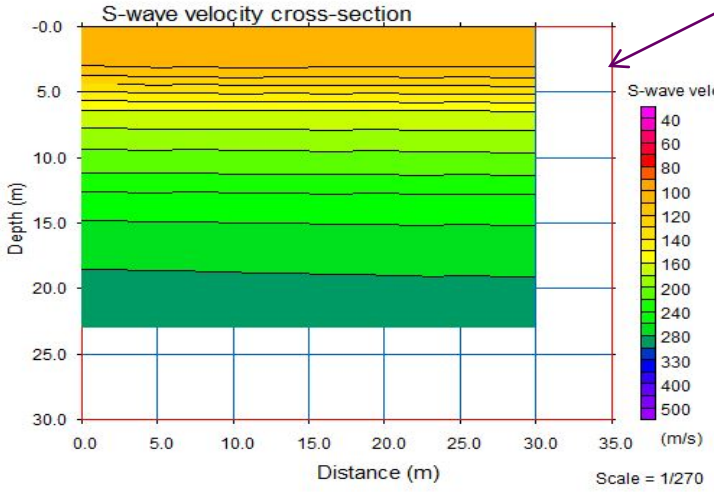
MASW Survey Result at Ishwarganj Upazila

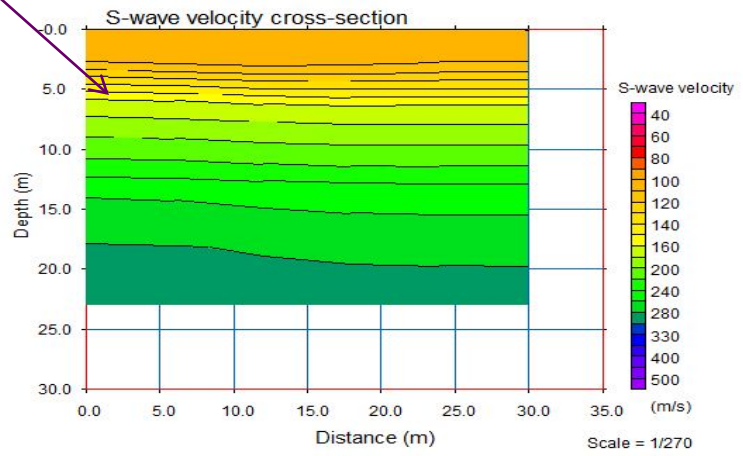












Summary of MASW Test Results of Ishwarganj

MASW ID	Average Shear Wave Velocity (Vs 30)
MASW Shib 1	207.1 m/s
MASW Shib 2	203.4 m/s
MASW Shib 3	201.4 m/s
MASW Shib 4	204.2 m/s
MASW Shib 5	199.7 m/s

Source: Field survey, 201

- According to MASW test result, average shear wave velocity at all locations are above 180 m/s.

- From those shear wave velocity, it can be saying, the project area is showing moderate soil condition for foundation.

- The shear wave velocities at soil layer shows gradually increase from 110m/s to 300m/s.

- From those soil velocities, it can be saying the upper soils (depth around 15m) are soft soil and soil hardness gradually increases by increasing depth.

- For geotechnical investigations , 30, 12 and 20 boreholes has been conducted at Ishwarganj, Raipura and Shibpur Upazila respectively

- The borings with SPT were carried out at all numbers of borehole in the respective Upazilas.

- Undisturbed samples and disturbed soil sample has been collected for further lab test. All samples are clearly labeled to show the project name, date, location, borehole number, depth and method of sampling; in addition, each sample should be given a serial number. Special care has been taken in the handling, transportation and storage of samples (particularly undisturbed samples) prior to testing.

- Investigation borings with standard penetration test were conducted in order to know vertical geological conditions.

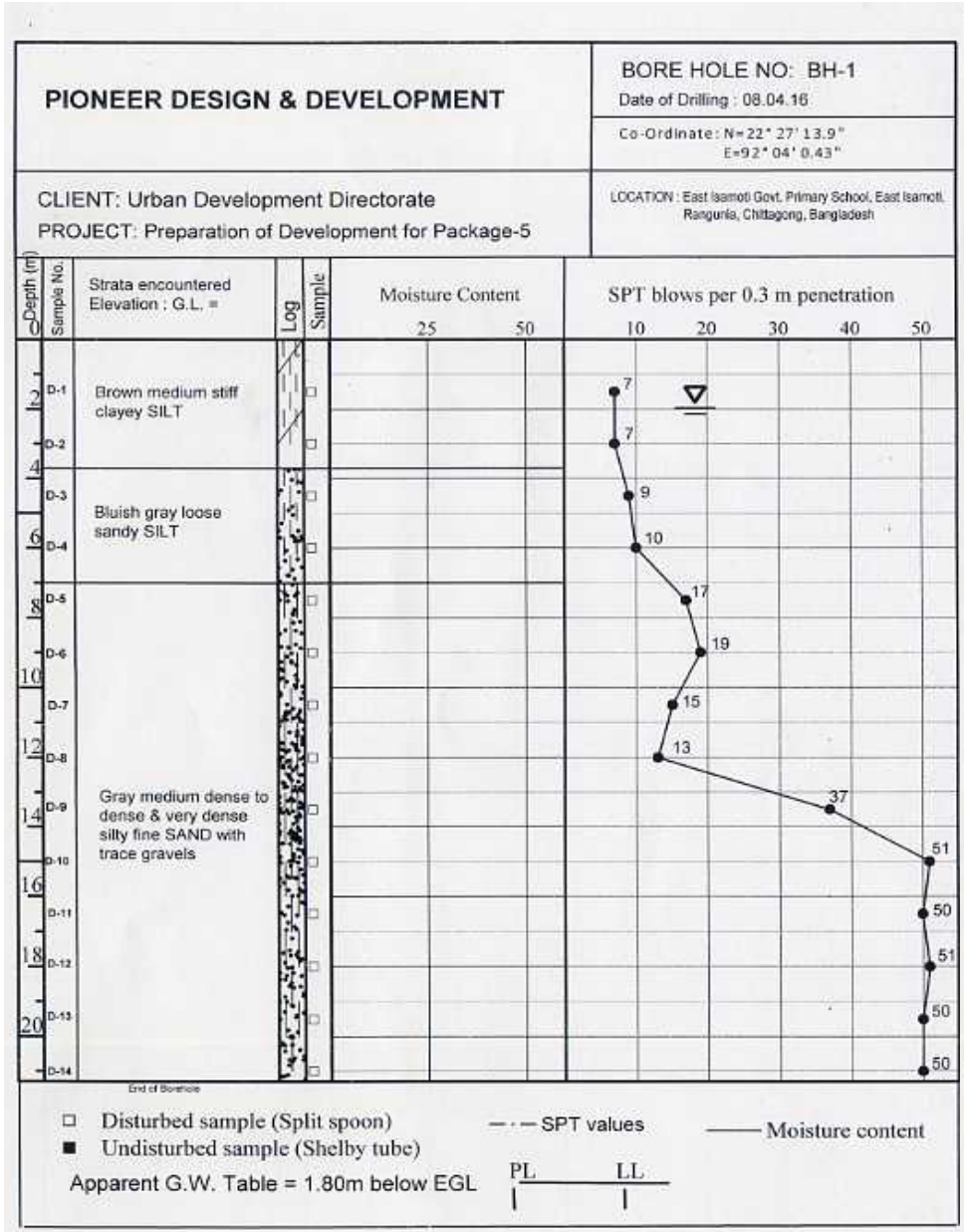
Preparing borehole for Standard Penetration Test

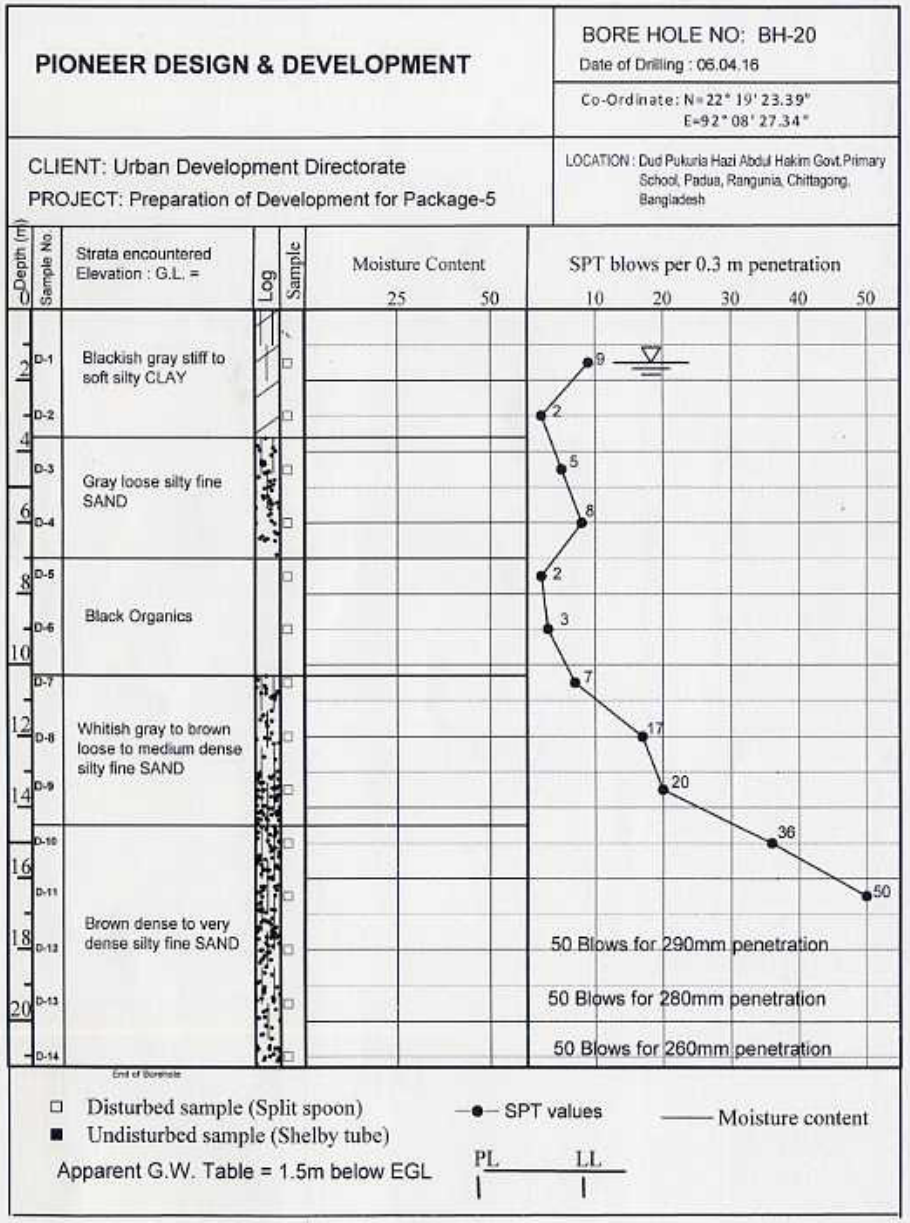
Drilling in the borehole

Blowing with hammer for calculating Standard Penetration resistance

Soil sample in split spoon

Engineering Geotechnical Logs





- Preparation of geological and geomorphologic map preparation of the study area from satellite image .
- Regional morph-tectonic and neo-tectonic mapping for potential earthquake source area identification.
- Preparation of sub-surface litho-logical 3D model of different layers through geo- technical investigation
- Foundation layer map which showing the depth of the foundation from existing ground level for footing.
- Preparation of engineering geological mapping based on AVS30
- Preparation of Seismic Hazard Assessment Map
- Peak Ground Acceleration (PGA) and Peak Ground Velocity (PGV) map.
- Recommended building height maps for both high rise building and low rise building
- Finally intensity map is prepared for high rise and low rise building

- All kind of field survey data(geological, geotechnical and geophysical) acquisition has been completed.

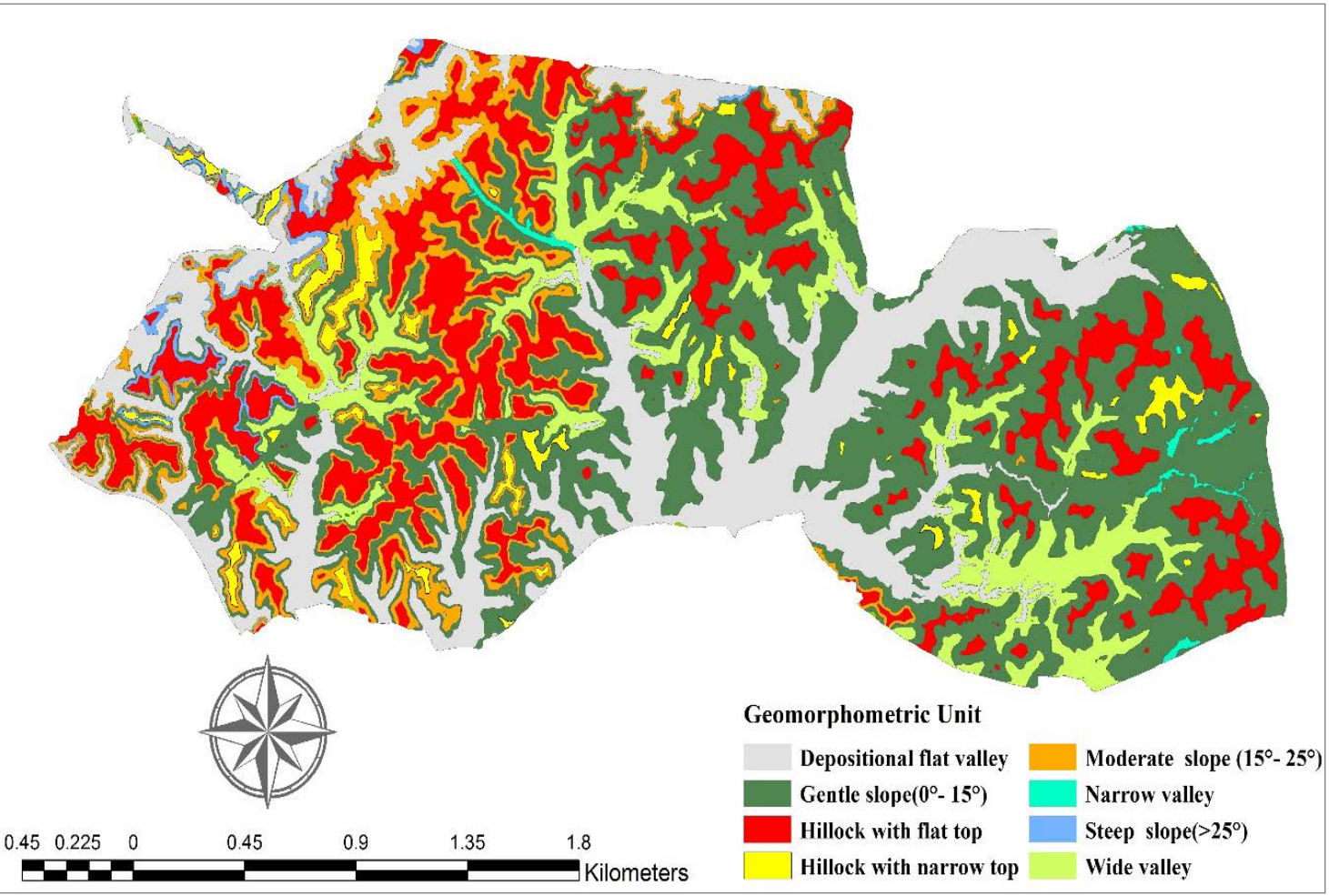
- The above mention data would give a clear idea about the geo-hazard status of particular landscape where newly urban developing activities or any other mega infrastructure project is going on and this mentioned investigation also gives idea about the vulnerability of existing build up infrastructure of a particular area.

- Based on these results, proper management techniques as well as other necessary adaptation process could be addressed before or after the development activities in the studied area. It is to be mentioned that the long-term maintenance cost will be reduced and the developed structure will withstand against the potential natural hazards if the infrastructures are built following the risk informed physical land-use plan.


THANK YOU
ALL

Some example of Final outcomes

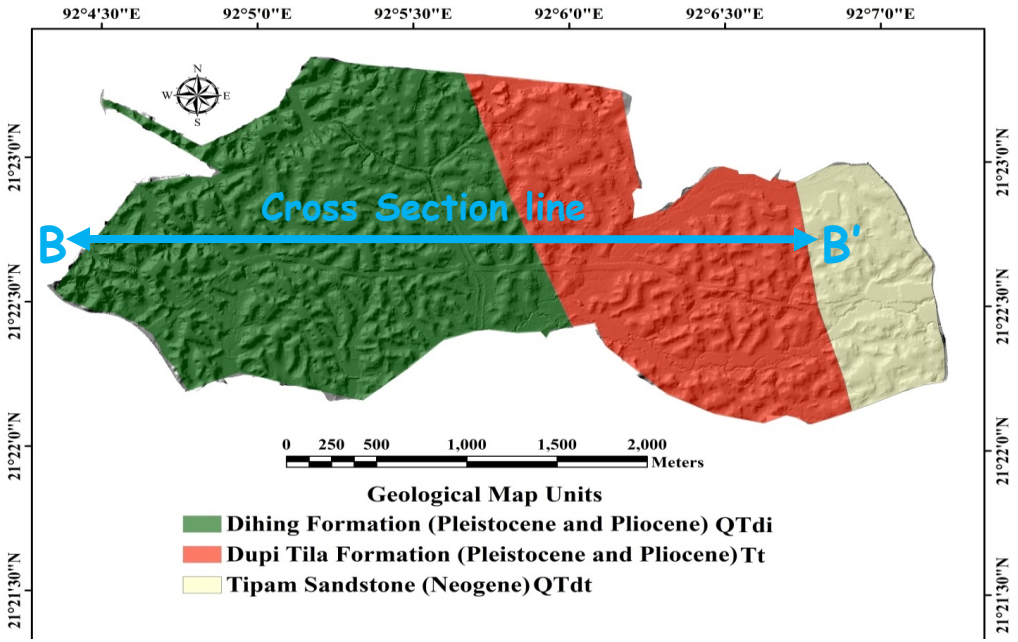
Geomorphology map



Preparation of geomorphologic-al maps using satellite images, borehole information and DEM

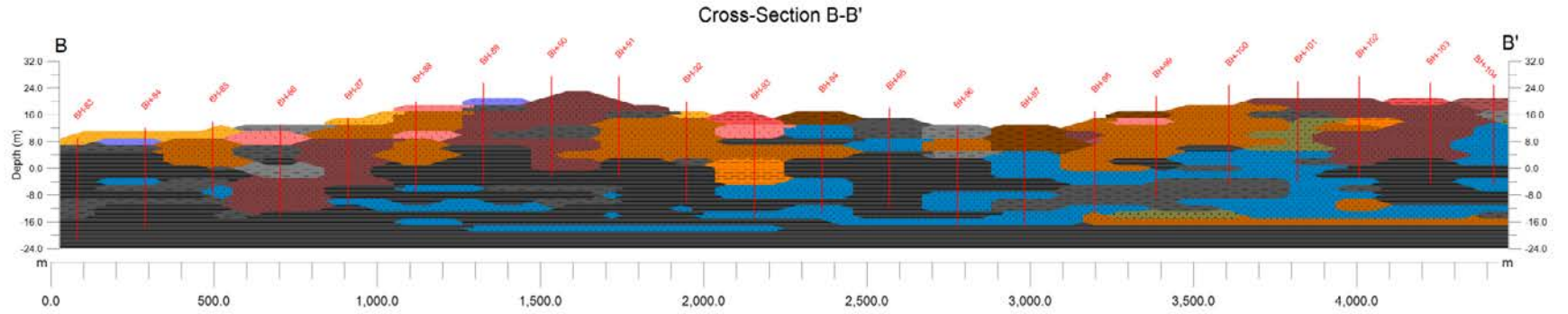
- **Valleys**
  - Depositional flat valley
  - Wide valley
  - Narrow valley
- **Slopes**
  - Gentle slope(0-15º)
  - Moderate slope(15º-25º)
  - Steep slope(>25º)
- **Hillocks**
  - Hillock with flat top
  - Hillock with narrow top

Engineering Geology Map



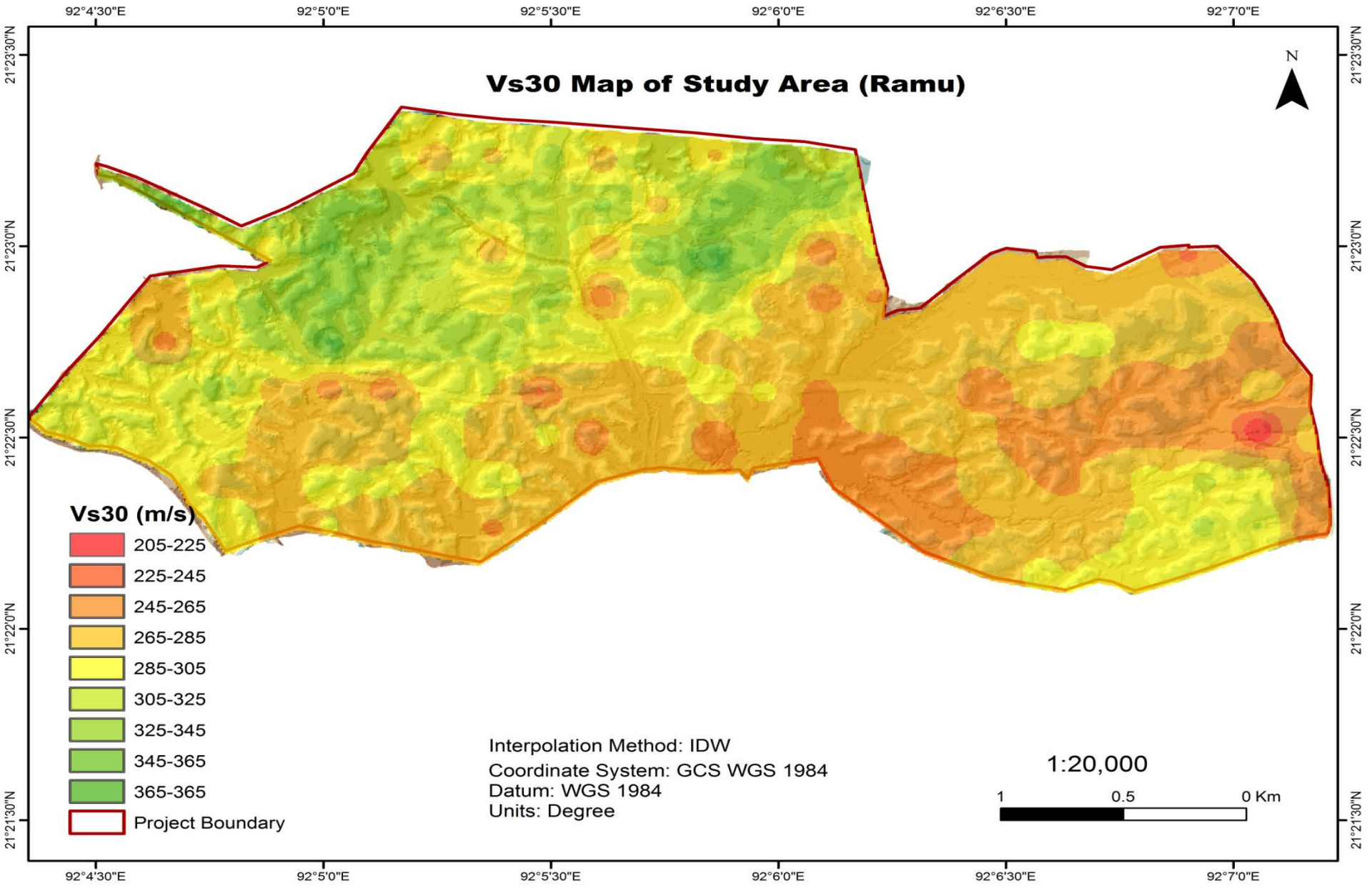
Geological formation

- Clay dominated sequence -Dihing Formation upper part of the Dupi Tila Formation
- Silt and silty clay dominated sequence- The middle or lower part of the Dupi Tila Formation
- Sand dominated sequence- Tipam Formation

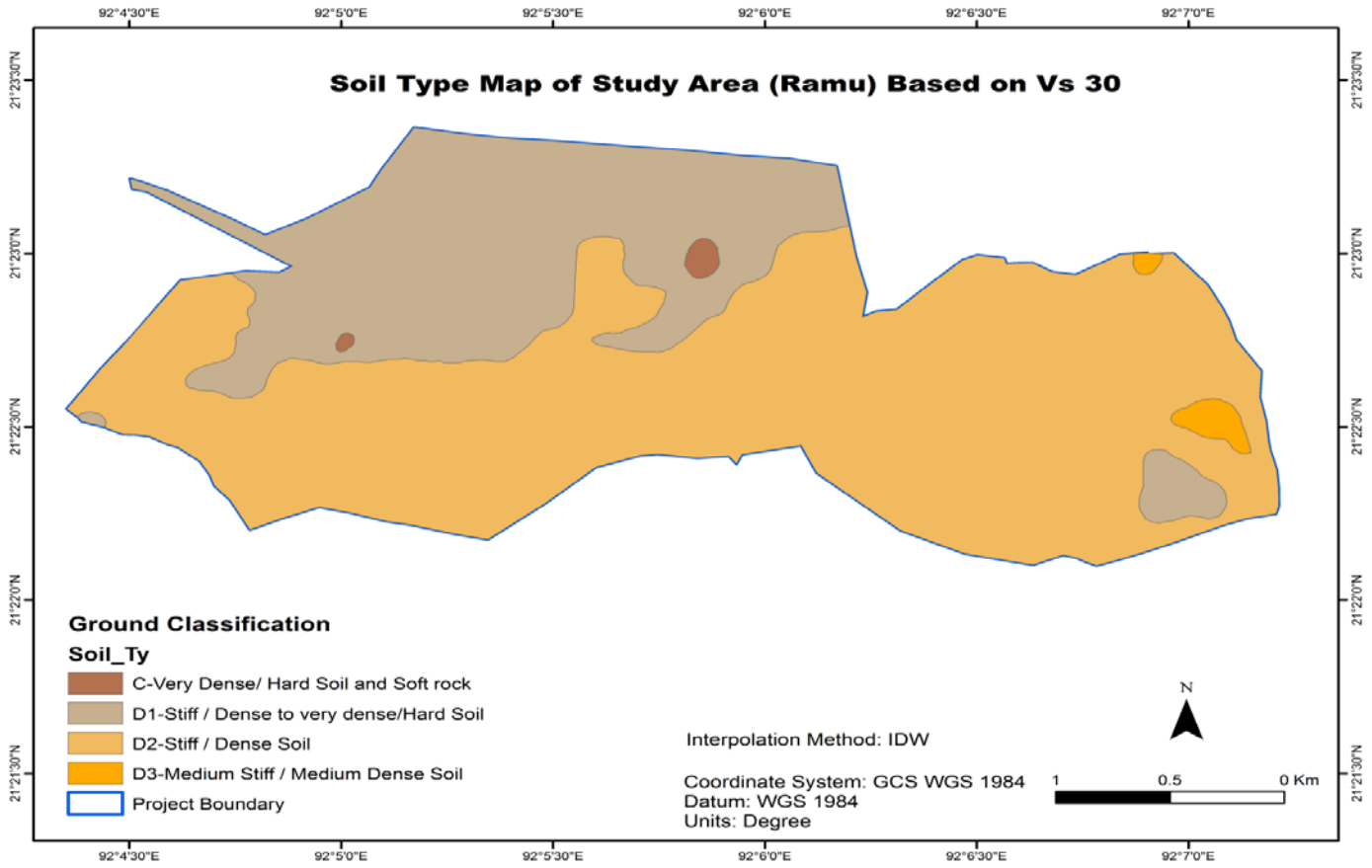


- Raddish brown soft CLAY -L 1
- Raddish brown stiff to hard SILT and silty clay -L 2
- Raddish brown Loose to medium dense SAND with silt -L 3
- Yellowish brown soft CLAY with silt -L 4
- Yellowish brown stiff SILT with clay -L 5
- Yellowish brown loose SAND -L 6
- Raddish brown dense to very dense SAND -L 7
- Yellowish brown dense to very dense SAND -L 8
- Gray soft CLAY with trace silt -L 9
- Gray stiff Silt with clay -L 10
- Gray loose to medium dense SAND -L 11
- Gray dense to very dense SAND -L 12
- Gray very hard silty Clay -L 13
- Brown very dense SAND -L 14

Engineering geological mapping based on AVS30

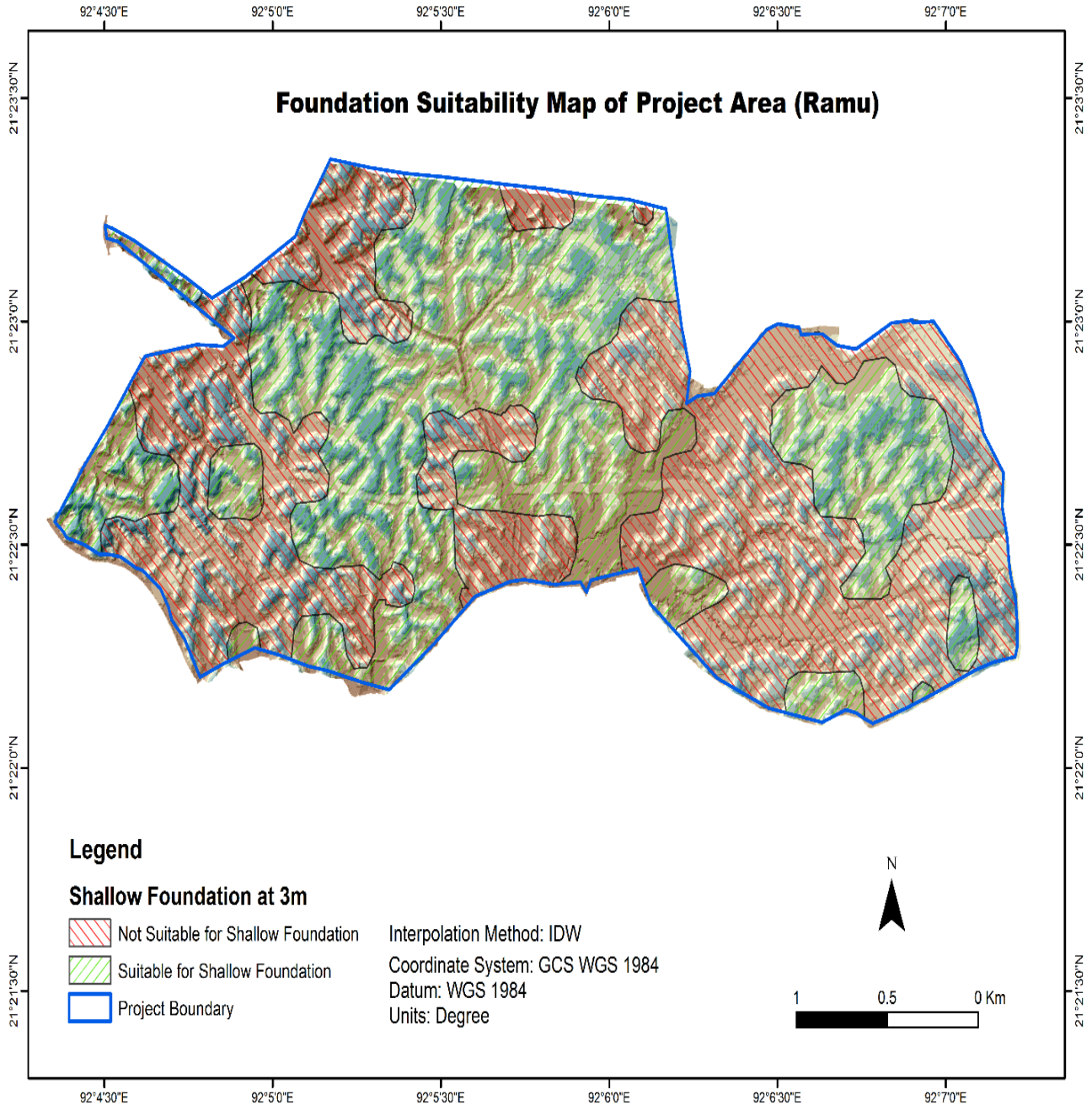


Soil Type



Ground Class	V_{s30}	Soil Type	Relative Quality
C	360 - 760 m/sec	Very Dense/ Hard Soil and Soft rock	Very Good Soil
D1	300 - 360 m/sec	Stiff / Dense to very dense/Hard Soil	Moderately good soil
D2	250 - 300 m/sec	Stiff / Dense Soil	Relatively Good soil
D3	220 - 250 m/sec	Medium Stiff / Medium Dense Soil	Good soil

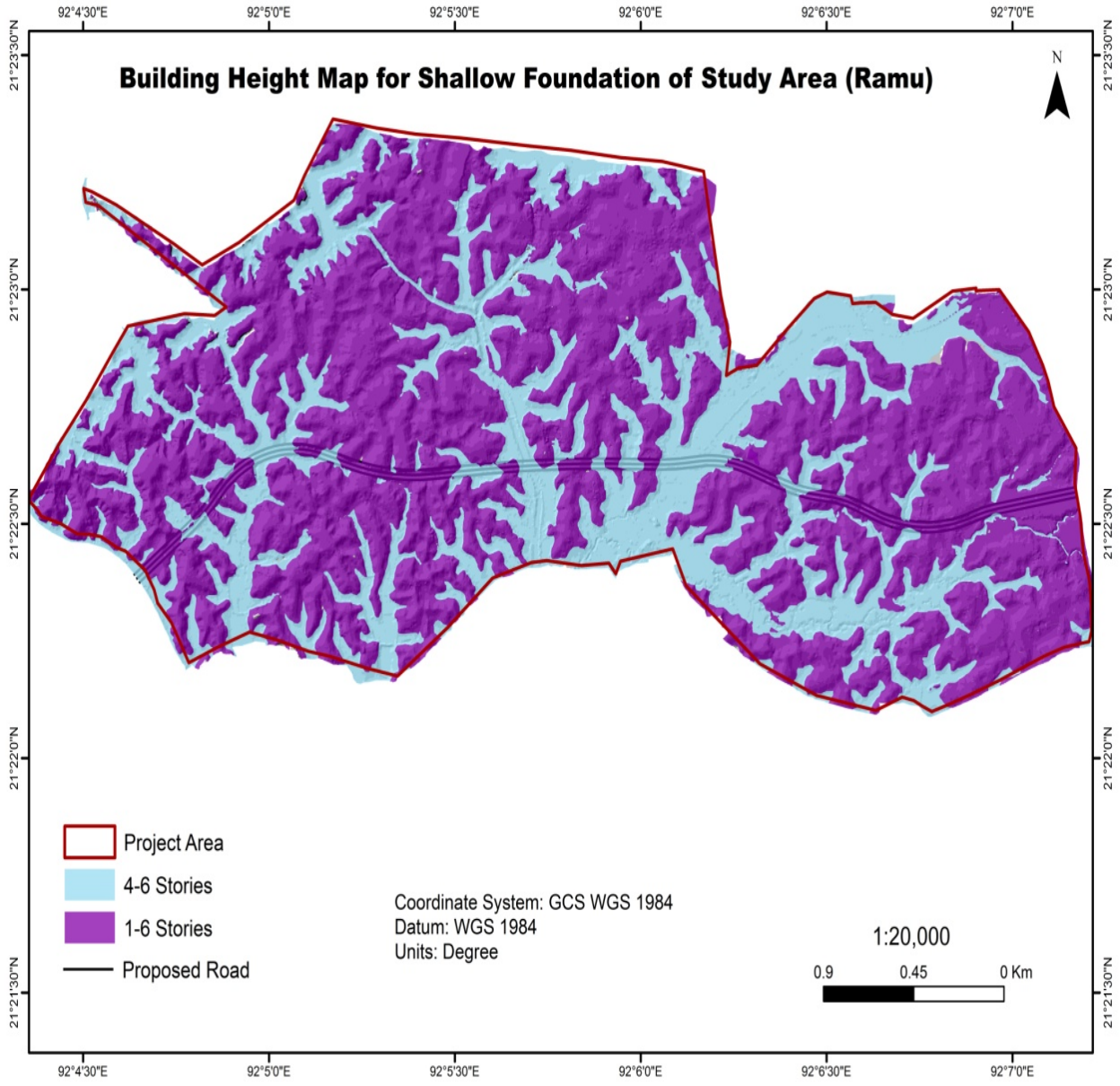
Foundation layer map



- Green shaded area represents zone suitable for shallow foundation to a depth of 03 meters whereas red shaded area indicates places not suitable for shallow foundation zone.

- Usually, valley areas were found to be not suitable for shallow foundation whereas the hill tops were found to be suitable for shallow foundation.

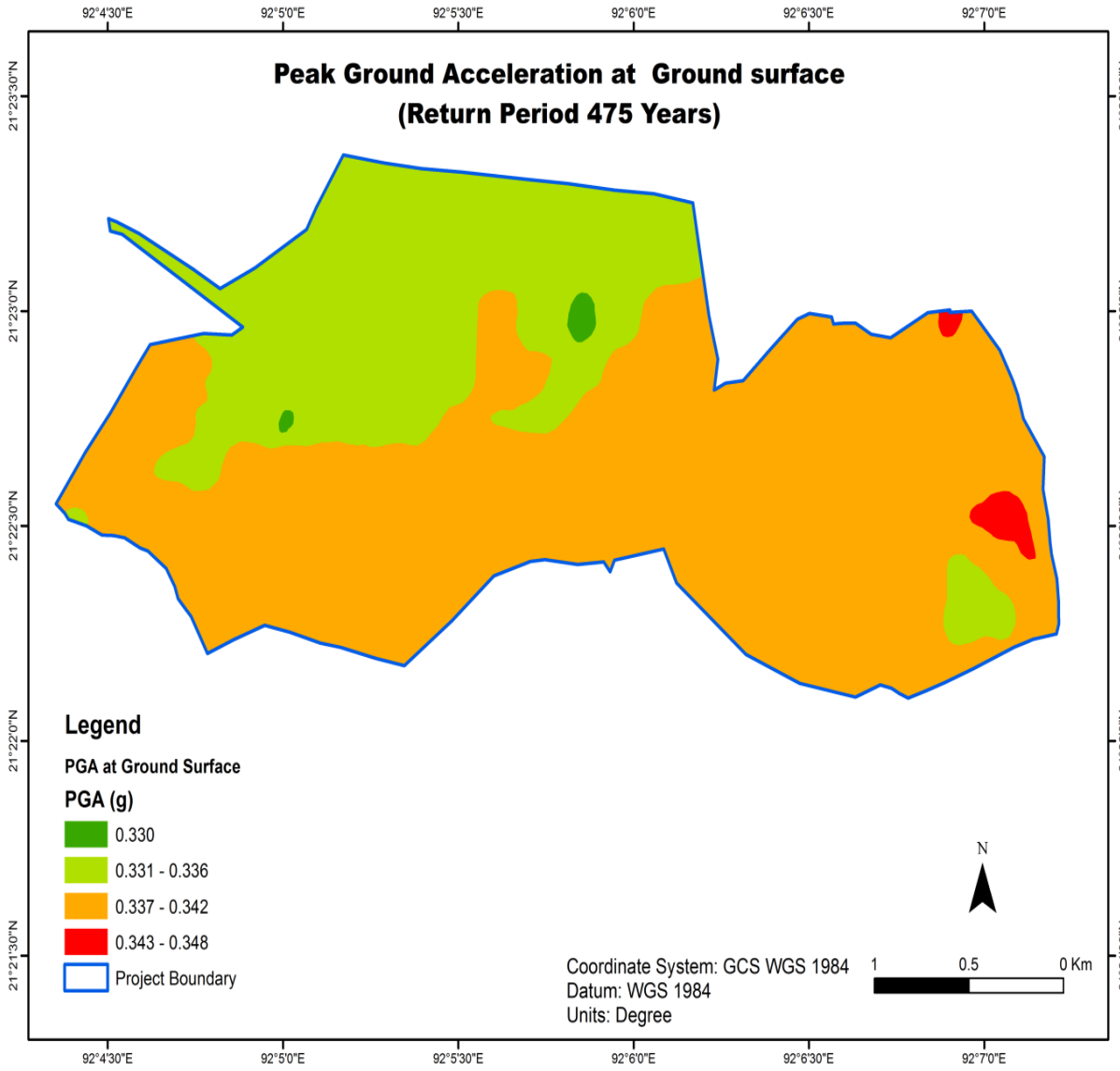
Building Heights



- 4 to 6 (Resonance 0.2-0.3 s) story buildings are suggested for construction in the valley/ depositional flat valley

- Whereas it is 1 to 6 (Resonance: 0.7-0.9s) story buildings for hillock.

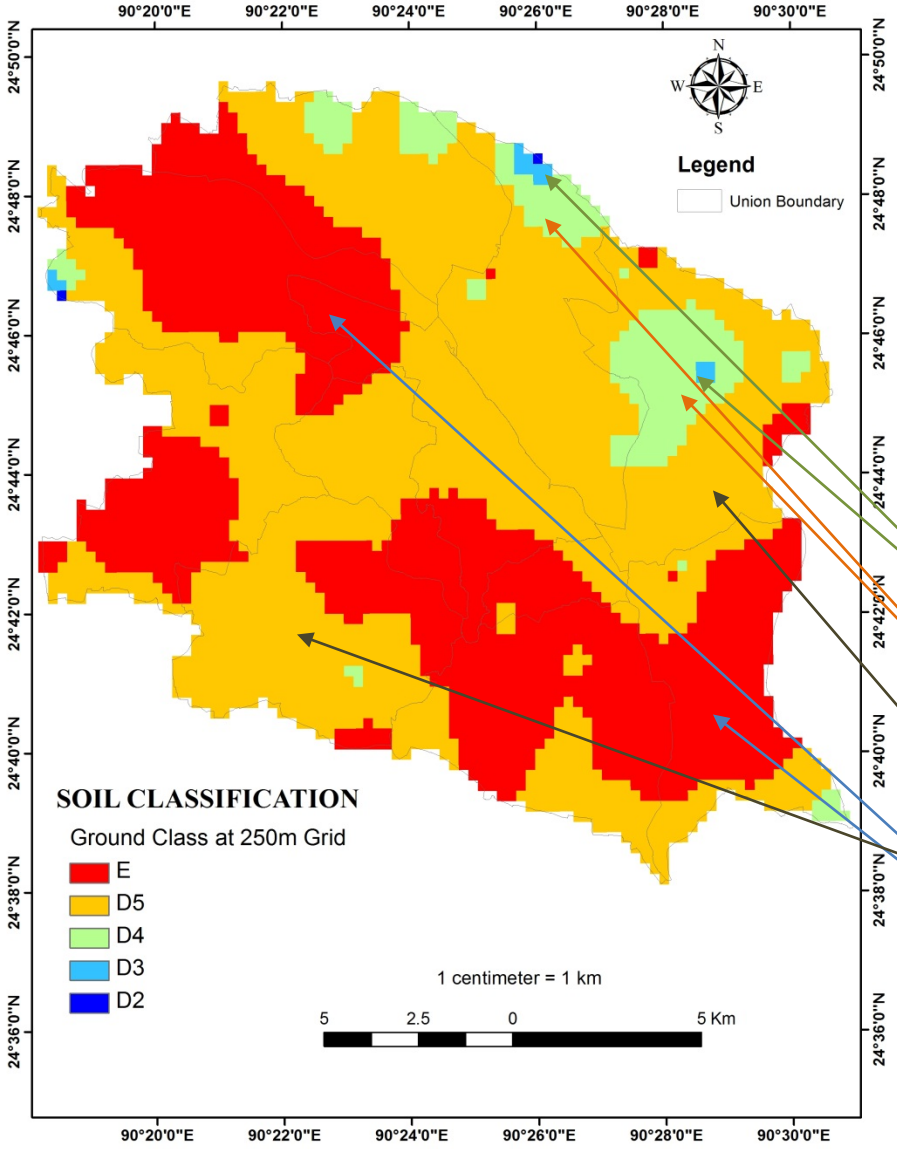
Seismic Hazard Map (Return Period 475 Years)



- The area is located in seismically active zones
- PGA value represents seismic intensity VII to VIII, severely strong ground motion
- Strong structural measures need to be taken for horizontal ground motion of earthquake

Peak Ground Acceleration at Ground surface

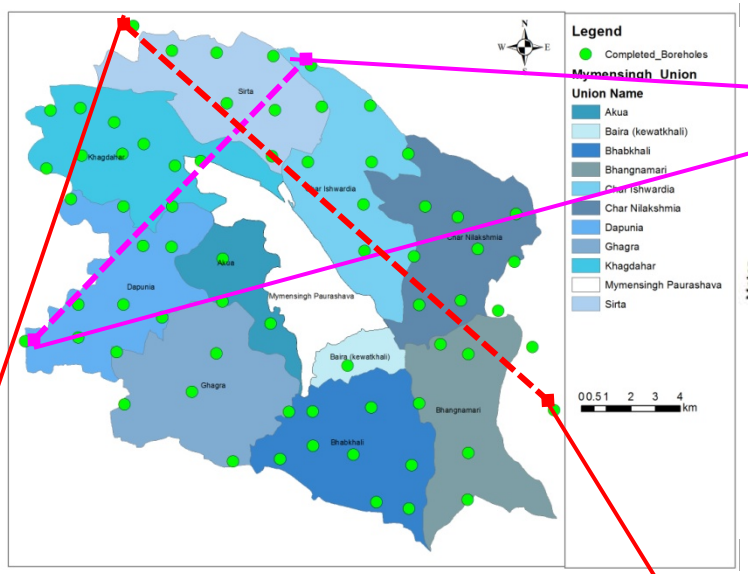
Soil Type Map

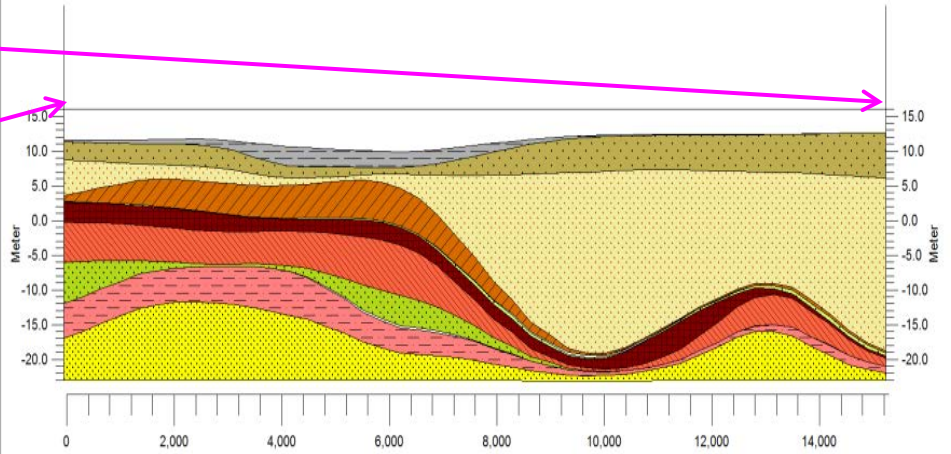


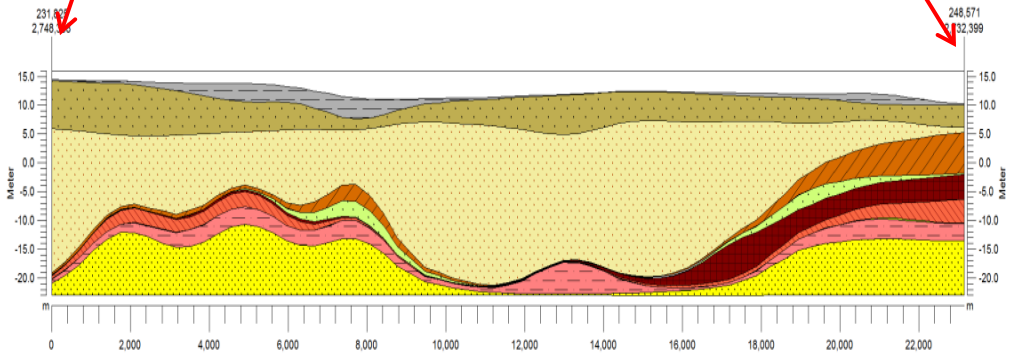
Ground Classification Applied in this Study

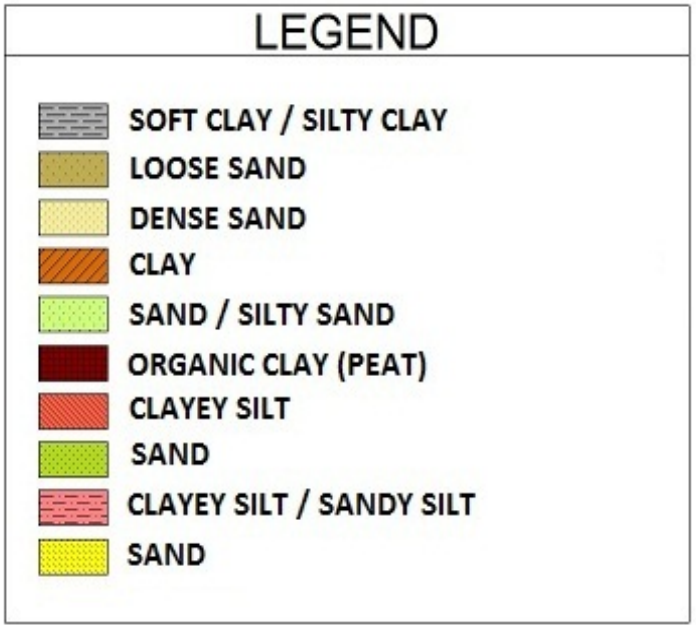
Class	Vs30	Site Class
C	360 - 760 m/sec	Very dense Soil
D1	300 - 360 m/sec	Stiff Soil
D2	250 - 300 m/sec	
D3	220 - 250 m/sec	
D4	200 - 220 m/sec	
D5	180 - 200 m/sec	
E	- 180 m/sec	Soft Soil

Subsurface Lithological Layers

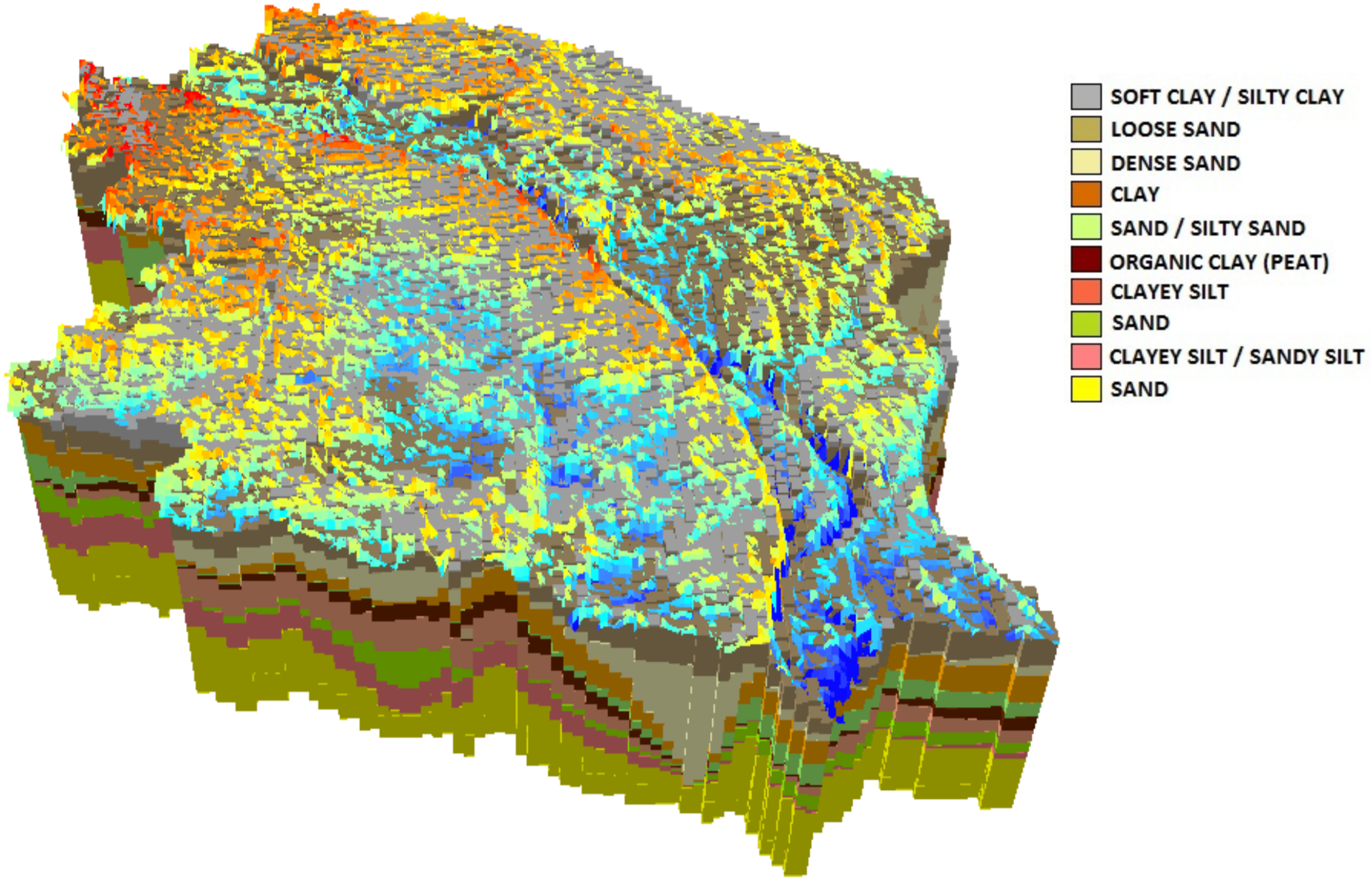




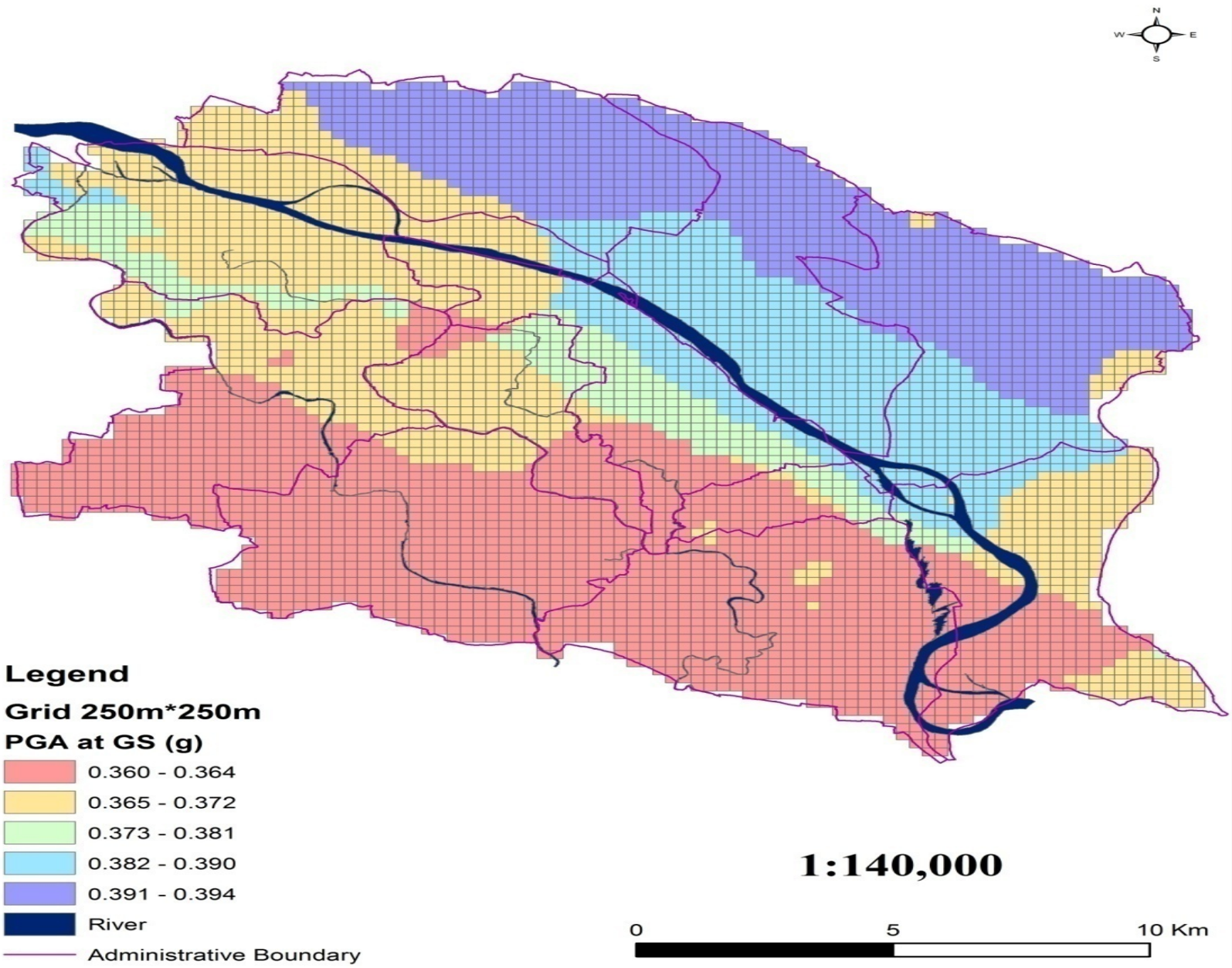




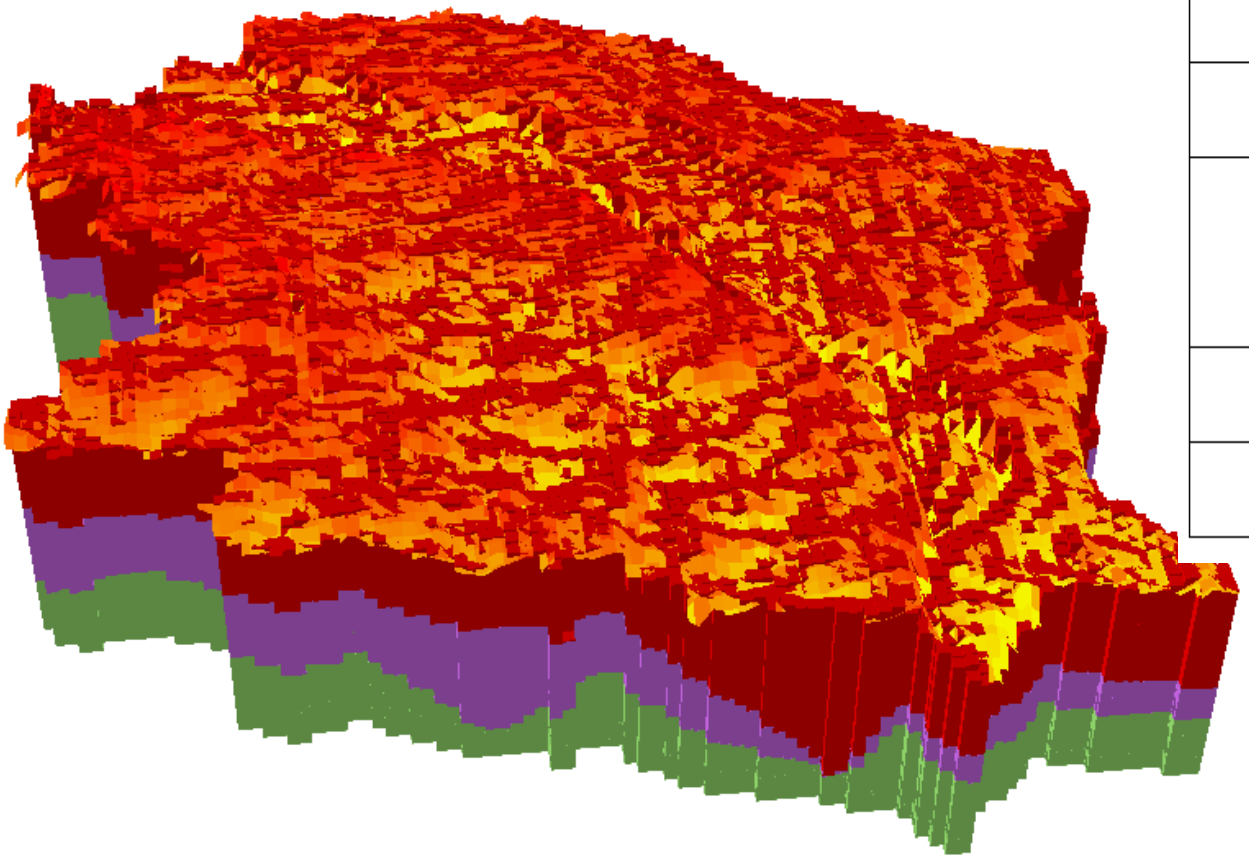
Subsurface Lithological 3D Model



Peak Ground Acceleration (PGA) Map at Ground Surface



Identifying Geological Formation up to Depth 30m



Geological Classification	
Recent	Fill (F)
Holocene	Clayey Soil (H-C)
	Sandy Soil (H-S)
Pleistocene	Modhupur Clay (MC)
Pliocene	Dupi Tila (DT)

Using Data

- Lithology
- N values of Standard Penetration Test (SPT)
- Correlation with existing Stratigraphy in and around of the study area

Final output

Id	Vs30	Soil_Type	VS_Rangs	PGA_EBR	PGA_Soil	SA_0_2s_EBR	SA_0_2s_Soil	SA_1_0s_EBR	SA_1s_Soil	PP	Foundation _Depth (m)	Geomorphic_Unit
1	270	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.59	12	Wide Valley,Gentle Slope,
2	271	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.59	12	Wide Valley,Gentle Slope,
3	268	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.71	12	Hillock with Flat Top,Gentle Slope,
4	267	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.64	12	Wide Valley,Hillock with Flat Top,Gentle Slope,
5	269	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.59	12	Wide Valley,Gentle Slope,
6	271	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.58	12	Gentle Slope,
7	273	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.57	12	Wide Valley,Gentle Slope,
8	275	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.56	12	Wide Valley,Gentle Slope,
9	268	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.76	12	Hillock with Flat Top,
10	266	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.76	12	Hillock with Flat Top,Gentle Slope,
11	264	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.70	12	Hillock with Flat Top,Gentle Slope,
12	263	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.63	12	Wide Valley,Hillock with Flat Top,Gentle Slope,
13	266	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.58	12	Wide Valley,Gentle Slope,
14	271	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.56	12	Gentle Slope,
15	276	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.55	12	Wide Valley,Gentle Slope,
16	280	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.53	12	Wide Valley,Gentle Slope,
17	271	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.63	12	Hillock with Flat Top,Gentle Slope,
18	268	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.68	12	Hillock with Flat Top,Gentle Slope,
19	265	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.68	12	Wide Valley,Hillock with Flat Top,Gentle Slope,
20	260	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.64	12	Wide Valley,Gentle Slope,
21	259	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.59	12	Wide Valley,Gentle Slope,
22	264	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.56	12	Wide Valley,Gentle Slope,
23	271	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.54	12	Wide Valley,Gentle Slope,
24	278	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.52	12	Wide Valley,Gentle Slope,
25	283	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.51	12	Wide Valley,Gentle Slope,
26	262	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.39	8	Narrow Valley,Gentle Slope,Depositional Flat Valley
27	255	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.32	8	Narrow Valley,Gentle Slope,Depositional Flat Valley
28	253	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.27	8	Narrow Valley,Gentle Slope,
29	259	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.41	8	Narrow Valley,Gentle Slope,
30	265	D2	250m/s to 300m/s	0.30	0.342	0.60	0.684	0.225	0.3465	0.56	8	Narrow Valley,Gentle Slope,

All Geological Information at 250m * 250m Grid