MALIR EXPRESSWAY PROJECT

TOPOGRAPHIC SURVEY REPORT

1.0 INTRODUCTION

Karachi Metropolitan, being mega/biggest city of Pakistan has potential to accommodate & attract people from all over the country in providing jobs, business opportunities and housing facilities. Resultantly the population of the city as reported has now reached to the figure of 14.0 million.

Due to the phenomenal population growth, increase in vehicular traffic, congestion and traffic jams issues arise on major roads of city, hence road users are facing inconvenience/hazards like wastage of time/fuel, environmental pollution (Noise + smoke) and accidents etc.

Moreover, Karachi has two sea ports, from where heavy vehicular traffic generates for supply of oil, and other imported goods to up country, thereby adding an extra volume of heavy traffic on city roads up to super highway (Motorway M9) and National Highway N-5.

Considering above situation in view, Local Government Department, Government of Sindh has decided to provide the shortest alternate route to connect Motorway/Super Highway with city center, and after thorough study it is decided that best option is the Construction of a 4-Lane Dualized Expressway along Right Bank of Malir River, starting from Jam Sadiq Bridge and ending at Super Highway (M9) at 50km, near DHA Phase-IX / Kathor.

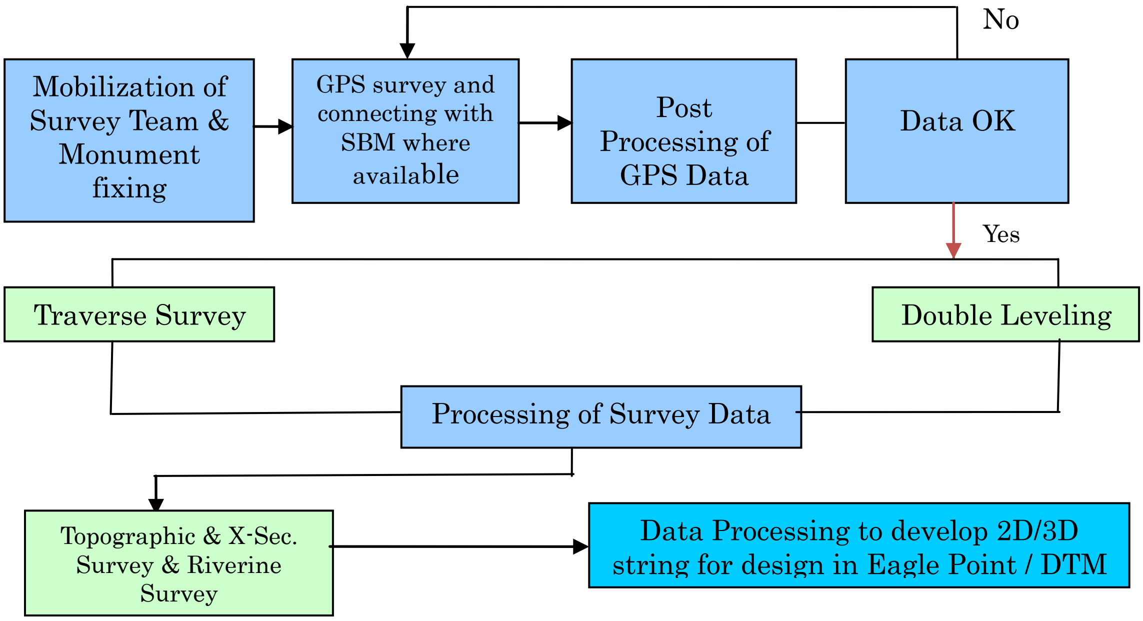
It has also been considered by the Government of Sindh that Development of said expressway may be done under Public Private Partnership mode (PPP), on urgent basis, to bring ease in traffic flows and lives of general public.

To carry out this project under PPP Mode, a consortium of following consultants is engaged:

1. M/s. EA Consulting (Pvt) Ltd — Technical Consultant (Lead Member)
2. M/s. Ernst & Young — Financial Consultant
3. M/s. HaidermotBNR & Co — Legal Consultant

2.0 FLOW CHART OF TOPOGRAPHIC SURVEY

Detailed topographic survey is conducted using contemporary tools and techniques to enable engineers in carrying out detailed engineering design of Project in accordance with the requirements identified in the Terms of Reference. The following flow-chart briefly describes the procedures of different components of this topographic survey.



2.1 Mobilization of Survey Teams

The Consultancy Agreement of this project was signed in August 2017. In the months of September and October, the field activities were not possible because the project area was inundated with flood water. As such, our survey teams were mobilized to project site in December 2017.

After reviewing project requirements vis-à-vis topographic survey, following field teams were mobilized with their equipment

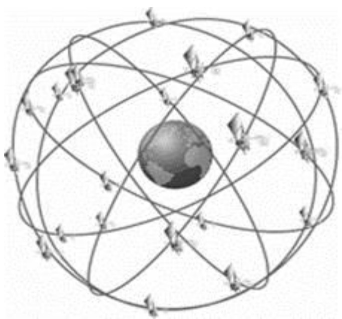
(i) Monument Fixing Team
(ii) GPS Survey Team
(iii) Traverse Survey Team
(iv) Control Leveling Team
(v) Topographic & X-Sec Survey Teams

2.2 Adopted Methodology

Pegging & Monument Fixing

Route Reccee and Pegging was completed by the Survey Team Leader himself, the senior most surveyor. The aim of this activity is to establish control points at suitable and safe places along the route by establishing primary and secondary control points along the approved alignment, and also for the riverine survey. Primary Control Points by GPS are generally established at an interval of less than 10 km to optimize the satellite signal reception, whereas Secondary Control Points are generally established at about 250m to 350m interval considering the visibility in the Project Area. This exercise was carried out both for alignment and riverine surveys.

Permanent Control Pillars using GPS Survey were installed at every five (05) kilometer. Every effort was made to select locations, which were safe from conservation point of view and free of any obstruction to facilitate uninterrupted GPS signals and observation.



Primary Control by GPS for X,Y,Z

A) General

The GPS system was originally designed for military use only, providing sea, air and ground forces of the United States and NATO with an all-weather, high-precision, worldwide real-time positioning system. Though initially designed as a military system, it became freely available for international civil use. The system has a complete set of at least 24 satellites orbiting the earth in a carefully designed pattern. The initial design was for a 24 satellite constellation, each orbiting at an altitude of approximately 20,200 km above the earth, in one of six orbital planes. Each satellite broadcasts a unique "bar code", known as Pseudo Random Noise (PRN) code, which enables GPS receivers to identify the satellites from where the signals came, and makes positioning possible.

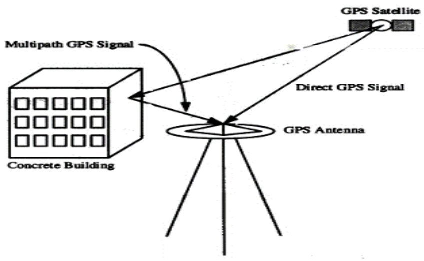
A master control station updates the information (message) component of the GPS signal with satellite ephemeris data and other announcements to the users. This information is then decoded by the receiver and used in the positioning process.

The User Segment is the most important segment of the system and is comprised of all users making observations with GPS receivers. The civilian GPS user community has increased dramatically in recent years, due to the emergence of low cost, portable GPS receivers and the ever-expanding areas of applications in which GPS has been found to be very useful. Some of these applications are: surveying, mapping, navigation and vehicle tracking

B) GPS Limitations

Though GPS can provide a worldwide 3-D position, 24 hours a day, in any type of weather, the system does have some limitations. First, there must be a (relatively) clear "line of sight" between the receiver's antenna and several orbiting satellites. Buildings, trees, mountains, steep cliffs, overpasses, and other obstructions that block the line of sight between the satellite and the observer (GPS antenna) make it impossible to work with GPS. Anything shielding the antenna from a satellite can potentially weaken the satellite's signal to such a degree that it becomes too difficult to make reliable positioning. Any obstruction that can block or interfere with a radio signal can effectively block or interfere with GPS signals.

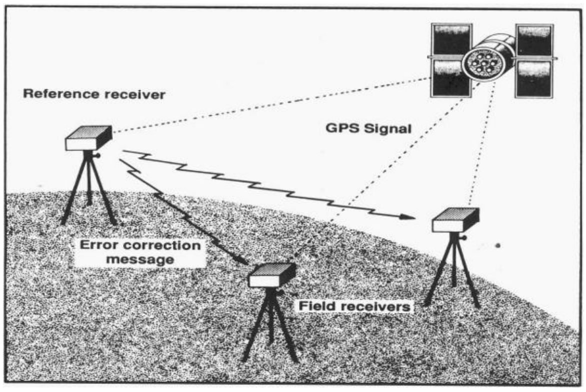
Bouncing of the signal off nearby objects may present another problem, that of distinguishing between the signals coming directly from the satellite and the "echo" signal that reaches the receiver indirectly. This phenomenon is referred to as ***multi-path***. Multi-path refers to the existence of signals reflected from objects in the vicinity of a receiver's antenna that corrupt the direct line-of-sight signals from the GPS satellites, thus degrading the accuracy of both code-based and carrier phase–based measurements. Particularly difficult is close-in multi-path in which the reflected secondary signals arrive only slightly later (within about 100 nanoseconds) than does the direct-path signal, having been reflected from objects only a short distance from the receiver antenna. In areas that possess these types of characteristics, longer observational times or traditional surveying techniques must be used instead of GPS positioning or to complement the GPS positioning. The receiver must receive signals from at least four satellites to be able to make reliable position measurements. In addition, these satellites must be in a favorable geometrical arrangement. The four satellites used by the receiver for positioning must be fairly spread apart. In areas with a relatively open view of the sky, this will almost always be the case because of the way these satellites



were placed in orbit.

C) GPS Point Positioning

The position of a point is determined by measure distances or pseudo ranges from the receiver to at least four satellites. The GPS receiver "knows" where each of the satellites is at the instant in which the distance was measured. These distances will intersect only at one point, the position of the GPS receiver (antenna). The receiver "knows" the position of the satellites, because this information comes from the broadcast ephemeris that is downloaded when the GPS receiver is turned on. The GPS receiver performs the necessary mathematical calculations, then displays and/or stores the position, along with any other descriptive information entered by the operator from the keyboard.



D) Advantages of GPS

The most advantageous aspects of GPS are its accuracy, precision, and efficiency, particularly in survey tasks that span a large area. Traditional terrestrial survey activities that would have normally taken months to complete, now take only a few days utilizing GPS. Real-time applications of GPS enable surveyors to perform quick data collection. GPS is used exclusively to density control networks.

E) GPS Observations

GPS observations using “Trimble GPS 4000 SSI Dual Frequency Instrument” will be carried out using a pair of receivers, the “BASE” and the “Rover”. The Base will be placed at known point and the Rover at the stations whose coordinates to be determined. Static mode of survey will be adopted with small baseline and longer observation time. All coordinates will be observed in UTM Coordinate System.

F) Post Processing of GPS Data

Positioning information provided by GPS contain errors. The errors due to atmospheric effects and orbital perpetrations can be corrected by means of a technique called “Differential Correction”.

During the post processing, the correct coordinates of the unknown points are obtained with reference to the correct coordinates of the known points.

For this Project, coordinates and levels of Survey of Pakistan Bench Marks (SBM) in the vicinity of project roads were explored, however, SoP SBMs could not be found. As such, coordinates/levels observed from GPS were used as reference coordinates for processing of GPS survey data.

At the end of each day the Post Processing of GPS observations in UTM was carried out using the Post Processing software to remove any possible error.

Coordinates obtained through GPS observation were then used for generating coordinates for Traverse Stations i.e. secondary control.

2.3 Secondary Horizontal Control by Traverse for X,Y

Secondary Horizontal Control was established by Traverse Method using the Primary GPS Survey Control Points. These traverse control points were used by topographic survey teams and cross-section survey teams both along the project alignment and for riverine survey. These points were established at suitable places along the route and on protection bunds (10 km upstream and 5 km downstream) by using small size pillars or by driving wooden pegs or by marking the station number by paint on road side permanent structures. Total Station is set at known point (in terms of Easting, Northing & Elevation), Tri-Bridge Target is set on the second known point, which is in direct visual contact from the first point. Values of E,N & H of first and second known points are feed in the Total station, and Total Station reads the second point where the tri-bridge is set. In this way, total station is oriented in terms of bearing, distance and elevation to the survey control established during the GPS survey. The Prism target is then fixed to third location, and Total Station observed angle and distance to this point. When, third point is still there with its prism fixed, the total station is moved to fourth point, re-read the third point for orientation, and fifth point is established using prism target, and so on, until the next GPS known point is reached, where the traverse surveyor closes his observation and checks his work. At the end of Traverse Survey, coordinates of all the unknown points are calculated using angle and distance, observed during the field work. The coordinates of Secondary Control (Traverse) points were ultimately used for Topographic Survey, X-Sec Survey and riverine survey.

The following precautions were taken in traverse observations to achieve the accuracy required for such work.

- Total Station with the least count of 1" (one second of arc) was used for all angular and linear measurements.

- Each traverse angle was observed on two zeroes taking measurements on both left and right faces. The agreement between the two values of the same traverse angle were not allowed to exceed 10". Observations were repeated where the discordance exceeded the given limit. The means of 2 sets (4 measures) of traverse angles were used for computing bearings.

- Total Station were used for all linear measurements. Having an accuracy of around 3mm plus 3 parts per million of distance which can yield high accuracy up to 1 in 25,000.

- Reciprocal linear measurements were made for each traverse leg, thus measuring each distance twice in fore and back directions. The agreement between the two measurements was ensured to be of the order of 1 in 10,000. The means of the two measurements was accepted for the computation of traverse line.

2.4 Secondary Vertical Control by Double Leveling Technique for "Z"

Vertical Control were established using Double Leveling method with precautionary measures as provided hereunder:

- Pentax Titling Leveling Instruments Model L-30 of magnifications 30X was used for control leveling.
- The longest permissible shot was limited to 100 meters provided the staff graduations could clearly be visible. The shots were further reduced to 50 meters and even shorter for accurate reading and to minimize the effect of shimmering created by high temperature.
- Two surveyors observed the leveling line in fore and back directions connecting all the traverse stations of the main traverse line en-route and establishing their own Temporary Bench Marks - TBMs on permanent structures or by marking the station number by paint on road side structures at suitable interval.
- The permissible discordance between "Fore" and "Back" leveling at any Benchmark was kept $\pm$ 0.009 meter (9 mm)
- The accuracy of leveling line is kept 15mm $\sqrt{K}$, where K is the length of line in kilometers.

Horizontal and Vertical Control Point data is attached with this report as ***Annexure-A***

3.0 DETAILED TOPOGRAPHIC SURVEY

The purpose of topographic survey is to collect all topographical (natural and man-made) information of the area of interest to facilitate detailed designing.

The topographic survey was carried out by Total Station to depict all manmade and natural features existing inside the survey corridor. Sokkia Total Stations Power Set 2030-R with built-in electronic Data Collector and Trimble GPS were used for collecting topographic details.

A total station surveying instrument is the central component in modern "field–to–flash" surveying system. Total Station integrates an electronic digital theodolite, an electronic distance measuring instrument (EDM) and a computer in a single functional unit. The electronic digital theodolite automatically measures and displays horizontal and vertical angles. Total Station instruments simultaneously measures distance, as well as directions, and transmit the results automatically to a built-in computer. The horizontal and vertical angles and slope distance can be displayed, upon keyboard commands. Horizontal and vertical distance components are instantaneously computed and displayed. If coordinates of the occupied station and a reference azimuth are input into the system, coordinates of the sighted point are immediately obtained.

To synchronize the work of each party a list of features codes was prepared in advance which covers all the anticipated topographic features that could be encountered during the survey work. The final list of feature codes was feed into the Total Station instrument prior to field work to facilitate the surveyors with the facility of on-line coding.

The method of surveying details through data collector is similar to conventional Plane Table Survey method but the major difference is its capacity of developing topo drawings on any desired scale with three dimensional outputs of every feature / points along with on-screen plotting of them, for minimizing error, which in the case of PT Survey is not possible.

Topographic survey within the survey corridor was conducted and all features and ground details; falling within the survey corridor were recorded. Every care was taken to pick the following details:

- Representative Ground Level
- Sudden Change of ground elevations
- Existing road, including carriageway, shoulders, toe of embankment
- Existing Draining Structures
- Existing nala boundaries, top width and ground features
- Boundaries of Ditches, Eroded Banks
- The outer limits of village boundaries, buildings, huts, hedges, walls
- Location of isolated building/yards
- Roads intersecting the project road, their junction details
- Railway line, if present
- Boundaries of agriculture farms, orchards, graveyards and other land uses

During topographic survey, all existing features, such as roads, tracks, railway lines, houses, huts, graves, trees, underground (if markers are visible) and overhead utilities, water courses, drains, top and bottom levels of cliff, etc. and all other features present within the survey strip area were picked. Spot levels at regular interval were observed to depict the relief of the area.

The instrument, Total Station or GPS, was setup on a control point and its coordinates were fed into recorder. After stationing, the surveyors started taking details of ground by using the feature code database, which had already been saved in the hard drive of data collector.

The Surveyors deployed on detailed survey with Total Stations/GPS, down loads the raw survey data from their electronic data collector to computers as soon as a survey job was completed. This data was then communicated through e-mail to Head Office where team of experienced engineers downloaded it to mapping software for processing and production of drawings. SDR Mapping and Design (Ver. 6.5) and Civil-3D software are used for the processing of the raw survey data.

4.0 RIVERINE SURVEY BY X-SECTION METHOD

The Riverine survey was carried out by to collect X-Section data covering the whole river width at suitable locations. In all 12 such cross-sections were observed. This exercise was carried out for the purpose of Hydrological Report.

5.0 POST PROCESSING OF FIELD DATA, DRAFTING AND PLOTTING

SDR Mapping and Design (Ver. 6.5) and Civil-3D software acts as an interface to transform the Total Station/GPS Data and develop topographic feature Maps and Digital Terrain Model (DTM) using raw elevations. The processed data is converted to ASCII format which is used to develop DXF Format files. These DXF files are imported to AutoCAD software to develop Digital 3-Dimensional Survey Drawing. These AutoCAD drawings are further refined by draftsmen using specific layers, line type, line thicknesses, and text height. A detailed line work and insertion of appropriate symbols is also carried out at this stage to make the survey drawings more legible and easy to read for design engineers. Additional software are used to develop Digital Terrain Model (DTM) using the spot elevation and cross-section data collected during the field survey. This DTM eventually produces contours on any desired contour intervals.

As soon as these survey drawings were printed on appropriate scale, these were sent back to survey teams for field verification. At that stage surveyors visually verify all the survey drawings. All omissions, errors, or missing information were recorded either on drawing manually or, if required digitally, and this data once again was sent back to office for updating the survey drawings.

6.0 AREA DESCRIPTION

Presently there is no road along Malir River. However, on both the Banks of river, protection bunds are available up to National Highway N-5. Using the right bank, light vehicles can travel along the river. However, the right bank protection is not in continues stretch.

River width i.e. bund to bund distance is variable between 300m to 2,000m, at various locations. Project Expressway is proposed on Right Bank of Malir River, because of availability of land, better geometry and access to Several populated areas.

Most of the Expressway influence area is cultivated or barren, however, few residential colonies are encountered in the proposed alignment

1.4 ALIGNMENT DESCRIPTION

The Start point of project expressway is located on Right Bank of Malir River, near Jam Sadiq Bridge.

Near Jam Sadiq Bridge Location, High Tension Power Line is observed. Relocation of this high-power line will be addressed at the detailed design stage.

The geometry of exiting Protection Bund cannot be followed for expressway because it does not meet the geometric design standards. As such, alignment is being proposed between protection bund and Right Bank of river.

From km 0+000 to km 3+000, the proposed alignment travels almost parallel to the protection bund. The land in this reach is Cultivated and barren.

At km 2+800, the proposed alignment passes through the road linking Manzoor Colony to Korangi Industrial area. This link is commonly called EBM Causeway. For crossing of this busy link road, the proposed expressway will overfly this road. An underpass is proposed at km 3+850 for to facilitate localize traffic in this vicinity. Another underpass is proposed at km 4+500 for the facility of localize traffic. At km 5+500 the alignment of proposed expressway crosses disposal of a major tributary of Malir River, for which a bridge is proposed.

Before reaching the major bridge of Shah Faisal Colony and Korangi, three underpasses are proposed at km 6+270, 6+750 and 7+300 to facilitate localize traffic.

A major Interchange is proposed at existing bridge of Shah Faisal Colony and Korangi at km 8+900.

To cater for the localize traffic of Azeem Pura, another underpass is proposed at km. 10+600. Similarly, two more underpasses are proposed at km 13+100 and 13+700 to facilitate localized traffic.

Proposed alignment crosses main railway line at km 14+600. The expressway will overpass the railway line at this location.

Soon after this, the alignment crosses the existing national highway N-5 at km. 15+000, where an interchange is proposed.

At km 15+700, another tributary of Malir River is encountered, which is called Thaddo Nala. At this location, bridge is proposed to facilitate of drainage of this seasonal tributary.

Upto N-5 the proposed alignment passes through the river bed where the land use is mostly agriculture. However, between km 15+700 to km.18+200, the river width is very narrow, and on its both banks, thick populated area can be observed. As such, to maintain the geometric design standards, the proposed alignment has to pass through the existing populated areas between 15+500 to 18+200, which involves property compensation and land acquisition.

From km 18+200 to km 19+000, the proposed alignment passes through cultivated land, where land acquisition may be required.

From km 19+000 21+300 the proposed alignment passes through the broken land of Malir River Bed. This broken land is due to extensive extraction of sand for construction purpose. Deep cut patches feature this area.

From km 21+300 to 22+400 the proposed alignment passes through agriculture/farm land. In this area land acquisition may be required.

From km 22+400 to km 23+300 the proposed alignment passes through an under develop Housing society called Al-Murad Housing Society.

From km 23+300 to 26+700 the alignment passes through mixed land use area featuring agriculture, farms and residential.

From km 26+700 to km 28+100 the proposed alignment passes through the active bed of Malir River, and then enters agriculture land from 28+100 to 32+300. From 32+300 to km 32+700 the alignment passes through the edge of a village. From km 32+700 to km 36+100 the alignment passes through mix land use, comprising agriculture, farm, barren and also a few small residential areas.

At km 36+000, the alignment crosses the existing link road between N-5 and M9. At this point the proposed alignment takes a major left turn, and moves in north direction, following the route of existing link road between N-5 and M9.

The proposed alignment terminates at exiting trumpet interchange of M9, where the km is 38+248 which is about 14 km from Main gate of Bahria Town (about 25 km from Toll Plaza of M-9). At End Point the existing Trumpet type interchange will be upgraded to expressway requirement. As per preliminary alignment design, the length of this expressway is about 39.1 km

7.0 PICTORIAL OF SURVEY WORKS

Some selected photographs of different survey activities are given as follows:


Nikon


1025
GRANTED


37+500


ML
127

Annexure-A

Survey Control Data

LOOP-1

Station No.	Easting (m)	Northing (m)	Elevation (m)
ME90	327299.286	2757563.554	-
ME89	327233.986	2757431.199	54.948
EX1	326795.518	2758558.889	-
EX2	326594.646	2758714.682	-
KQ27	326617.509	2758737.463	56.123
KQ26	326854.205	2758988.544	57.088
KQ25	327112.255	2759288.259	68.361
KQ24	327529.931	2759789.687	60.543
KQ23	327800.241	2760142.099	62.064
KQ22	327929.813	2760288.500	62.529
KQ21	328242.706	2760686.914	63.810
KQ20	328619.799	2761180.816	66.403
KQ19	328745.079	2761288.085	67.062
KQ18	328977.287	2761382.484	66.239
KQ17	329095.900	2761421.978	67.504
KQ16	329374.640	2761716.690	68.856
KQ15	329554.414	2761863.956	69.501
KQ14	330029.633	2762267.266	71.966
KQ13A	330476.757	2762505.077	-
KQ13	330712.180	2762636.989	75.251
KQ12	330931.769	2762746.254	76.033
KQ11	331260.083	2762929.646	77.129
KQ10	331458.952	2763047.095	85.051
KQ9	331834.913	2763253.426	-
KQ8	331921.537	2763420.639	79.733
KQ7	332020.119	2763585.414	80.569
BM4	332046.704	2763632.565	-
BM3	332146.841	2763797.711	-
KQ6	332446.526	2763966.033	79.097
KQ5	332826.005	2764145.922	80.431
KQ4	333243.689	2764238.350	84.013
KQ3	333786.446	2764497.517	85.896
KQ2	334250.526	2764631.242	85.365
BM2	334360.721	2764654.095	-
EABM1	334537.563	2764631.311	-
KQ1	334630.413	2764623.387	96.798
ME130	334958.516	2764492.687	100.171
ME131	335369.095	2764786.792	-
ME132	335457.972	2765006.038	-

LOOP-2

Station No.	Easting (m)	Northing (m)	Elevation (m)
KQ27	326617.509	2758737.463	56.123
KQ26	326854.157	2758988.596	-
KQ28	326461.014	2758602.757	55.483
KQ29	326264.510	2758429.589	54.32
KQ30	326181.889	2758306.008	53.922
KQ31	326152.256	2758180.879	55.244
KQ32	325957.884	2758094.639	52.603
KQ33	325841.682	2758100.785	52.232
KQ34	325752.958	2757636.322	51.403
KQ35	325474.713	2757542.249	51.072
KQ36	325147.218	2757472.750	49.871
KQ37	324995.055	2757249.756	49.824
KQ38	324899.214	2757085.581	47.480
KQ39	324873.269	2756877.074	47.024
KQ40	324840.652	2756599.281	46.896
BM5(LSIDE)	324854.032	2756587.608	46.620
BM6(LSIDE)	325069.824	2756535.891	46.761
ME82	325493.042	2756325.032	46.836
KQ41	324840.255	2756285.673	36.225
KQ42	324753.446	2756058.279	35.526
KQ43	324692.454	2755964.058	38.430
KQ44	324447.180	2755689.955	43.790
KQ45	324361.279	2755578.389	43.284
KQ46	324048.645	2755490.685	43.96
KQ47	323890.270	2755438.351	42.973
KQ48	323762.493	2755348.883	41.470
KQ49	323543.630	2755155.442	40.093
KQ50	323480.822	2754960.499	38.836
KQ51	323046.635	2754630.417	36.877
KQ52	322892.344	2754495.734	36.808
KQ53	322672.113	2754325.578	36.423
KQ54	322521.447	2754145.315	37.054
KQ55	322279.592	2753816.920	34.852
KQ56	322110.851	2753610.925	34.555
KQ57	321758.967	2753248.262	35.914
KQ58	321488.460	2752597.035	24.896
KQ59	321123.129	2752477.362	25.384
KQ60	320875.701	2752203.556	27.527
KQ61	320761.194	2751871.186	25.767
KQ62	320603.272	2751737.142	22.076
KQ63	320121.231	2751327.123	23.955
KQ64	319933.693	2751593.958	24.164
KQ65	319522.121	2751386.107	21.278
KQ66	319491.395	2751271.696	22.174
KQ67	319399.633	2751302.629	21.246
KQ68	319155.089	2751249.705	20.353
ME53	318949.308	2751196.294	-
ME54	319084.859	2751203.303	20.371
BM8(LSIDE)	319070.411	2751150.212	25.439

LOOP-3

Station No.	Easting (m)	Northing (m)	Elevation (m)
ME54	319084.906	2751203.277	-
BM8 R(SIDE)	319070.460	2751150.176	25.439
KQ69	318962.773	2751231.613	19.732
KQ70	318546.870	2751300.859	28.314
KQ71	318186.849	2751140.942	17.239
KQ72	318007.713	2751160.312	17.527
KQ73	317658.510	2751072.726	17.016
KQ74	317494.669	2751069.306	17.234
KQ75	317167.253	2751055.121	16.001
KQ76	316630.758	2751015.745	16.479
BM7	316604.952	2750993.009	16.436
BM-8(L)SIDE	316449.540	2751167.468	21.327
ME42OLD	316373.604	2750595.264	-
KQ77	316290.636	2751253.506	20.653
KQ78	316009.765	2751398.098	19.747
KQ79	315777.448	2751448.303	15.584
KQ80	315664.209	2751716.345	19.078
KQ80A	315187.824	2751740.832	15.013
KQ81	314763.490	2751850.754	19.873
KQ82	314637.367	2751906.811	20.183
KQ83	314382.900	2751991.091	13.544
KQ84	314342.310	2752101.514	18.986
KQ85	314029.248	2752342.418	-
KQ86	313573.263	2752330.863	18.18
KQ87	313324.966	2752278.692	12.352
KQ88	312686.451	2752205.694	18.616
KQ89	312154.469	2752350.773	16.302
KQ90	311903.269	2752024.668	16.122
BM9(L SIDE)	311526.263	2751954.272	15.521
BM10(L SIDE)	311223.080	2751914.150	15.381
KQ91	310961.086	2751919.944	15.193
KQ92	310693.613	2751901.170	14.973
KQ93	310592.562	2751657.498	15.007
EX1	309846.870	2750596.414	-
ME12	309680.866	2750552.416	14.613
ME11	309092.689	2750406.423	-

LOOP-4

Station No.	Easting (m)	Northing (m)	Elevation (m)
ME1	307234.930	2747860.776	12.117
BM2	307290.498	2747875.654	5.403
QK5	306593.926	2747742.144	12.421
QK6	306531.772	2748155.920	10.796
QK7	306568.940	2748560.555	8.821
QK8	306706.196	2748931.519	10.731
QK9	306869.161	2749295.231	12.211
QK10	306979.063	2749583.899	12.423
QK11	307147.308	2750140.752	8.343
QK12	307126.594	2750331.916	8.889
QK13	307019.883	2750676.788	12.900
QK14	307328.243	2751110.100	13.078
QK15	307778.421	2751317.112	9.872
QK16	308388.022	2751501.804	13.791
QK17	309389.587	2751583.613	14.219
QK18	309579.051	2751584.203	14.335
QK19	309930.368	2751566.840	14.444
QK20	310304.268	2751616.019	14.797
QK21	310351.059	2751630.820	14.908
QK22	310509.175	2751624.922	14.959
KQ92	310693.688	2751901.173	14.973
KQ91	310961.077	2751919.941	15.193

Annexure-B

Topographic Survey Drawings