



Municipal Corporation of Greater Mumbai
June 2011

DEVELOPMENT PLAN FOR GREATER MUMBAI 2014-2034

WORKING Paper - 1

**Methodology for Preparation of
Base Map and Detail Assessment
of GIS Data**

DPGM34 Project

Acknowledgements

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We apologize if we have inadvertently omitted anyone to whom acknowledgement is due. We hope and anticipate the work's usefulness for the intended purpose.

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Abbreviations

BEST	Brihanmumbai Electric Supply and Transport Undertaking
CIDCO	City and Industrial Development Corporation
CTP	Comprehensive Transportation Plan
DP	Development Plan
DPGM34	Development Plan Greater Mumbai 2034
DCR	Development Control Regulations
DGPS	Digital Global Positioning System
DPGM	Development Plan for Greater Mumbai
ELU	Existing Land use
FSI	Floor Space Index
GIS	Geographic Information Systems
GoM	Government of Maharashtra
HT Lines	High Tension Lines
LCA	Land Capability Analysis
MR&TP Act	Maharashtra Regional & Town Planning Act
MIDC	Maharashtra Industrial Development Corporation
MCGM	Municipal Corporation of Greater Mumbai
MRVC	Mumbai Railway Vikas Corporation
MUTP	Mumbai Urban Transport Project
MUIP	Mumbai Urban Infrastructure Project
MTHL	Mumbai Trans Harbour Link
MMRDA	Mumbai Metropolitan Region Development Authority
MMR	Mumbai Metropolitan Region
MTSU	Mumbai Transformation Support Unit
MHADA	Maharashtra Housing and Area Development Authority
MSRDC	Maharashtra State Road Development Corporation
MPCB	Maharashtra Pollution Control Board
PLU	Proposed Land use
SRA	Slum Rehabilitation Authority
SWOT	Strengths Weaknesses Opportunities Threats
TDR	Transfer of Development Rights
ToR	Terms of Reference

1. Introduction

The primary purpose of a Base Map is to provide general information about spatial patterns, provide specific information about particular locations, while serving as a base for overlaying various layers of information, spatial and non-spatial. The Base Map is a crucial output of the GIS database. It provides essential information that forms the basis of all further data layers that are added to form the complete database. Typically a Base Map would involve a geo-referenced satellite image over which various data layers are superimposed to form GIS database for Base Map. –

The objective of the creation of a Base Map of acceptable accuracy is to facilitate preparation of the Development Plan for Mumbai 2034. In this context, the Base Map will serve as the underlying reference for the GIS database. This database, then serves further purposes of Existing Land Use Surveys and Mapping, future additional layer overlays for urban planning analysis including existing situation analysis and ongoing and proposed projects, sectoral thematic mapping, scenario building. This finally leads to the Proposed Land Use Maps that form the Development Plan for Mumbai 2034.

Data available has been assessed In terms of data quality received and gaps in the data identified. The Way Forward suggests methods as mutually discussed between Consultant and MCGM during weekly meetings to fast track corrections and proceed with GIS data base and Base Map preparation.

2. Data made available for Preparation of Base Map by MCGM

The spatial data for preparation of this Base Map and GIS Database is the data received from MCGM on 19.05.2011. Projections system used is WGS_1984_UTM_Zone_43N.

The spatial data that MCGM has provided includes GIS data for all the 24 wards within its jurisdiction MCGM has also provided additional data in its possession relevant to the project. Some of the data that has been provided is in CAD vector format which needs geo-referencing first to extract relevant information.

a) Quick Bird satellite image handed over by MCGM

A Quick Bird High resolution satellite image has been provided by MCGM for the scope of the project. MCGM had already got this image geo-referenced during their GIS creation exercise. On the basis of the discussions during the weekly meetings with MCGM, **it has been assumed that this satellite image provided by MCGM is of acceptable accuracy for the preparation of the Base Map for the ELU Surveys and the preparation of the Development Plan.**

1.

b) Digitized Tikka Sheets (Shape Files)

The MCGM has handed over digital data pertaining to 1:500 Tikka sheets. These sheets have been scanned, digitized and converted into GIS vector layers. The digitized data has been placed over the geo-referenced Quick Bird Image to achieve a good reference. Since geo-referencing of Quick Bird image has already been carried out by MCGM at the level of accuracy acceptable to MCGM, it is **therefore assumed that this digitized Tikka data provided by MCGM is of acceptable accuracy for the preparation of the Base Map for the ELU Surveys and the preparation of the Development Plan.**

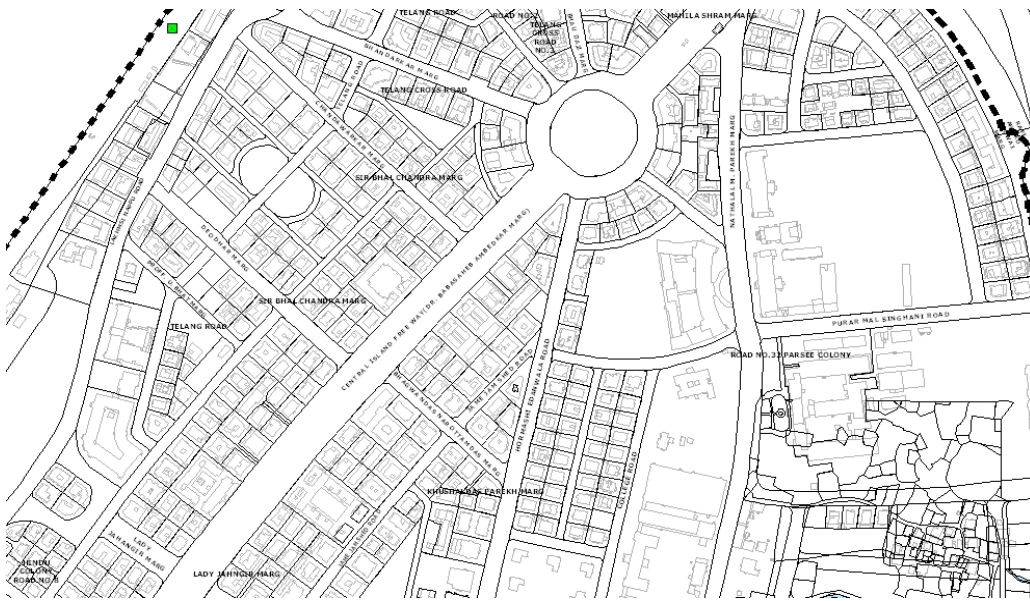


Figure : Sample Base Map – 1 generated from MCGM database

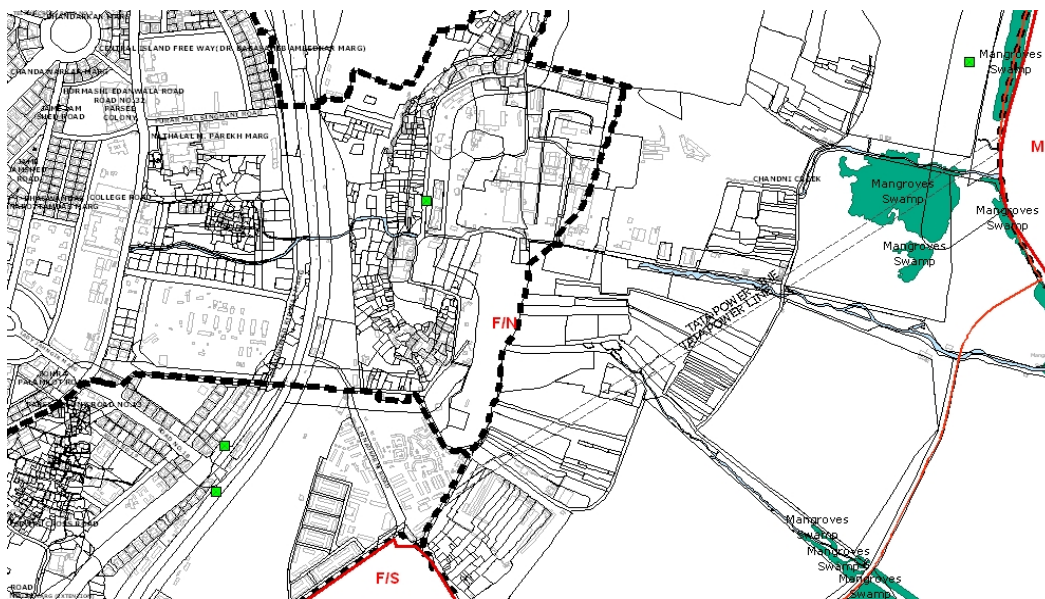


Figure : Sample Base Map – 2 generated from MCGM database

c) Other Data Layers forming present Development Plan (Shape Files)

The MCGM database provided has a number of layers pertaining to spatial data for each of the 24 wards. These layers contain various features such as roads, buildings, nallas etc. It also contains cadastral information related to individual parcels of land. A complete ward-wise listing of the various layers in the database is provided in the Inception Report Appendix. Other details are as indicated below:

DATA	FORMAT	REMARKS
DEVELOPMENT PLAN M.C. MODIFICATIONS	JPG	DP plans of all wards(Approved change of land use details)
DP_SHEETS_JPG	JPG&PDF	DP sheets of all Wards
Quarterly Formats March 2010	Excel	Contains information regarding Acquisitions, CRZ, City list, Modification, Quarterly Formats for the Year 2010
Copy of DCR_APRIL_2011.5221	PDF	DCR Regulations
CRZ Scan Maps Mumbai & Area	JPG	Contains JGP images of CRZ areas surveyed
ESTATE SCHEME IMAGES	JPG	Contains Estate JPG drawings for Ward A, B, C, D, E, FN, FS, GN, GS wards
Maps of Mun Election 227 Wards & 24 Admn Wards	CAD Files (DWG)	Contains administrative ward limits
MRTS STATION	JPG	Contains Approved plans for the MRTS stations
DEVELOPMENT PLAN M.C. MODIFICATIONS	JPG	Contains JPG of sanctioned plans for CITY AREA,EASTERN SUBURB and WESTERN SUBURB
DP_SHEETS_Georeferenced	JPG	Contains Georeferenced Development plan sheets

3. Components of Base Map

The Base map is formed through a series of overlays of spatial data layers as provided by MCGM on a base layer which is the Quick Bird image.

a) Base layer



The Quick Bird high resolution satellite image (0.61m accuracy) of the MCGM jurisdiction that has been provided by MCGM will form the base layer of the Base Map.

Figure : Quick Bird Satellite Image as provided by MCGM

b) Data layers

Over the Quick Bird satellite image of the area under MCGM, several layers available in the database provided by MCGM will be used as overlays to create the Base Map. Layers pertaining to jurisdictional boundaries/ administrative boundaries and special planning areas (under MMRDA and MIDC) will be overlaid. Layers pertaining to natural features like forests, water bodies, hills are essential overlays and shall be extracted from the given data base. Further, layers pertaining to transportation networks (airport, railways and roads) and cadastral parcels will be overlaid.

From the database provided by MCGM, along with the Quick Bird satellite image the following layers will be used to create the Base Map:

- Jurisdiction boundaries: Ward boundaries and other boundaries of spatial disaggregation special planning areas, TP Schemes;
- Physical features: Street blocks, buildings, property (cadastral parcels);
- Transportation: Roads, road centrelines, rail roads, transportation infrastructure parcels, railway stations, airport boundary, highways, water based transportation facilities, BEST bus Depot/bus stations;
- Utility infrastructure: High tension lines, water pipelines (visible above ground);
- Environmentally sensitive areas: National park, nallas, water bodies etc.

c) Data to be updated

Data regarding natural features is not readily available in the data layers provided. Since water bodies sometimes alter courses over time updated data related to water bodies, such as rivers and lakes will be obtained from the Quick Bird satellite image provided. Similarly information regarding hills will be obtained from Contour data which will be provided by the MCGM. Further, updating of the available Base Map layers such as road and road centerlines will also be done based on the Quick Bird Image provided.

The Base Map prepared by the process detailed below will form the base for the Existing Landuse Map. For the MCGM limits the available Base Map has been obtained from the Tikka sheet of 1960's where all the available layers have been digitized at the scale of 1:500. Quick Bird satellite image which (according to *Digital Globe*, the provider of these satellite images) is meant for a scale of 1:5,000 was used to geo-reference the Tikka sheets. Therefore the positional accuracy of the Tikka data corresponds to the geo-referenced satellite image. The digitized scale of 1:500 remains unchanged for the Base Map.

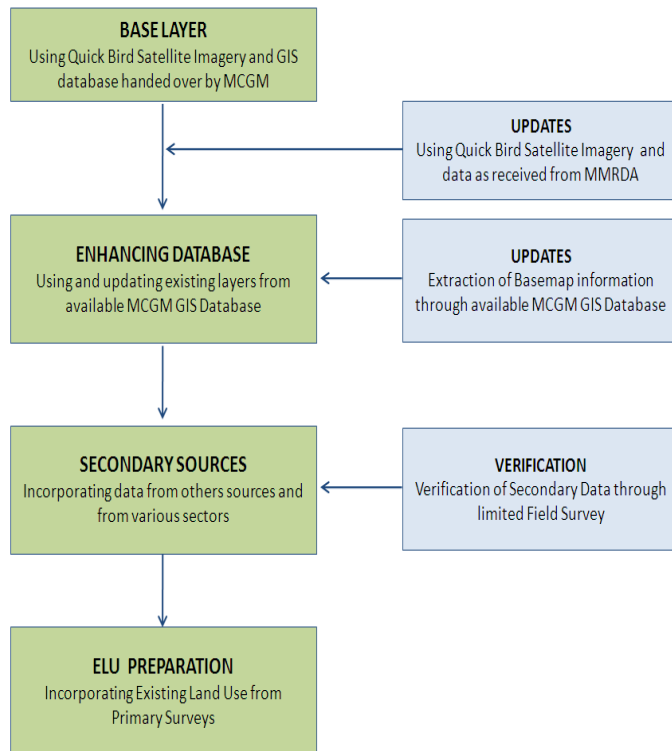


Figure : Base Map Preparation Process

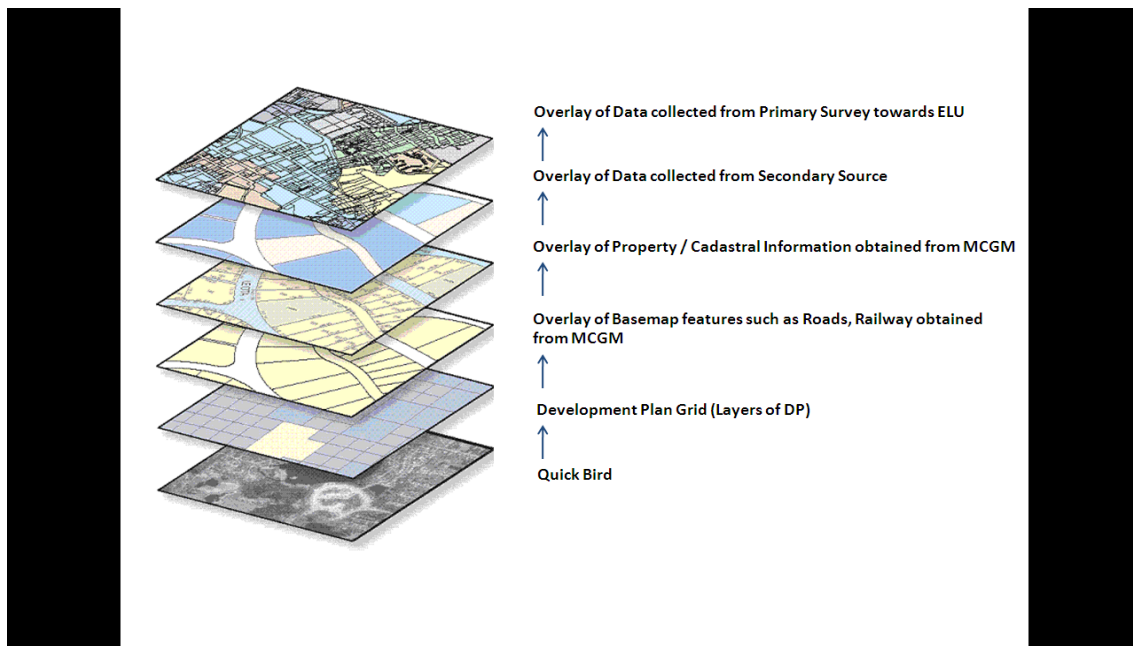


Figure : Diagram of Base Map Preparation Process

4. Quality of Data Received

a) Background

The main objective of this data assessment is to verify the quality of the GIS data handed over by MCGM to the Consultant. The data is checked for its quality with respect to overlay (over the Quick Bird image given by the MCGM), presence of data in all the given layers, attribute information regarding features present, overlay with respect to other available layers and topology issues.

The Base Map layers given by the MCGM contains data for all the 24 wards. However the data is not of same quality in terms of overlay, topology and availability of the data in the layer files. There are also issues related to attributes such as nomenclature, field information and presence of null values in the attribute tables. Please refer to the Inception Report Annexure on quality of data.

There is a major shift ranging from 14 - 60 meters for 6 of the wards which needs to be corrected and brought back to its location using the available Quick Bird Image which is of 0.61 m resolution or preferably through DGPS control points. The high resolution satellite image is a vintage image and does not reflect the latest ground reality. The Base Map shall be updated to reflect the ground reality by updating the layers based on the ELU survey, Google Earth image and other field surveys.

b) GIS Issues and their resolution

Seven types of issues are highlighted here:

i. Quick Bird Image

The Quick Bird image appears cropped short of the MCGM jurisdictional boundary and is incomplete. As a result, there is a minimal loss of data around the coastal edges and at the borders of the jurisdiction of the MCGM. The Quick Bird image 2007-08 of the MMRDA once provided will be utilized by the consultants for updating the data base in the missing areas of the MCGM Quick Bird image.

Figure : Quick Bird image 2007-08 indicating cropped edges short of the MCGM Boundary

ii. Shift in data layers

When the data layer was overlaid over the Quick Bird satellite image, it was noticed that in the case of 6 wards there is a significant shift in the entire data nearly ranging from 19m to 55m. MCGM has asked the Consultant to rectify the errors and shift the data layers back as accurately as possible.

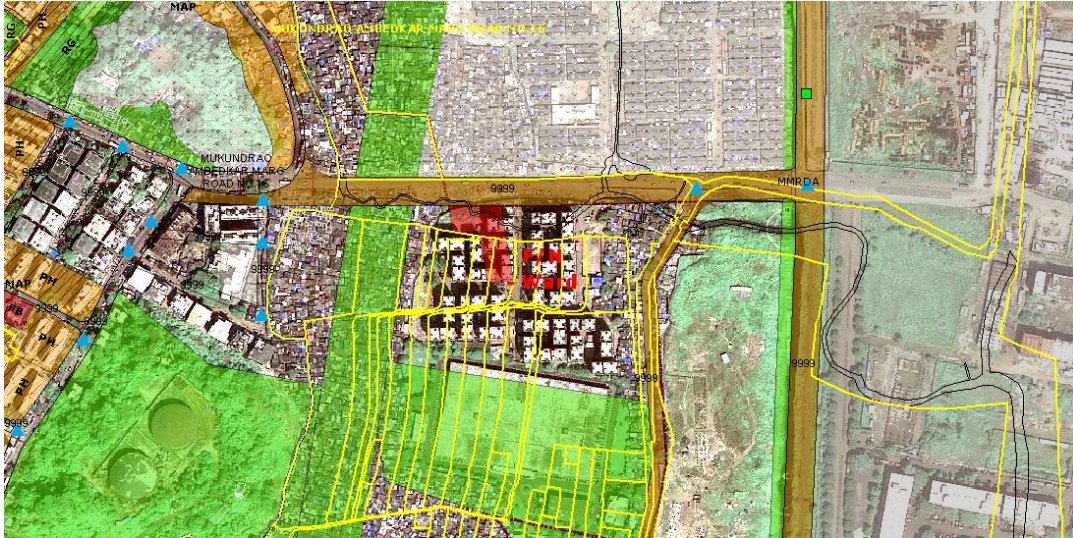


Figure : Example of Ward F/N wherein property boundaries are not matching with Quick Bird

On trying to rectify the data it was found that the data not only requires a shift but also some rotation to have as precise an overlay as possible with visual correction. It has been discussed with the MCGM that this visual correction may entail an error of 3m-8m. There is a risk of creating overlaps/gaps between different wards datasets (since the data has not been merged into one dataset). These gaps/ overlaps would be left as such since these tasks correspond to a land titling/ cadastral project which is beyond the scope of this project.

The Consultant is correcting the data to the extent possible after discussion with MCGM to achieve a level of acceptable accuracy.

In wards H/E, K/W, P, R, S, T where there seems to be a data shift, there continues to be edge matching issues, even after the initial task of repositioning and relocating it back to its original position. A methodology mutually agreed between Consultant and MCGM will be adopted to resolve this.

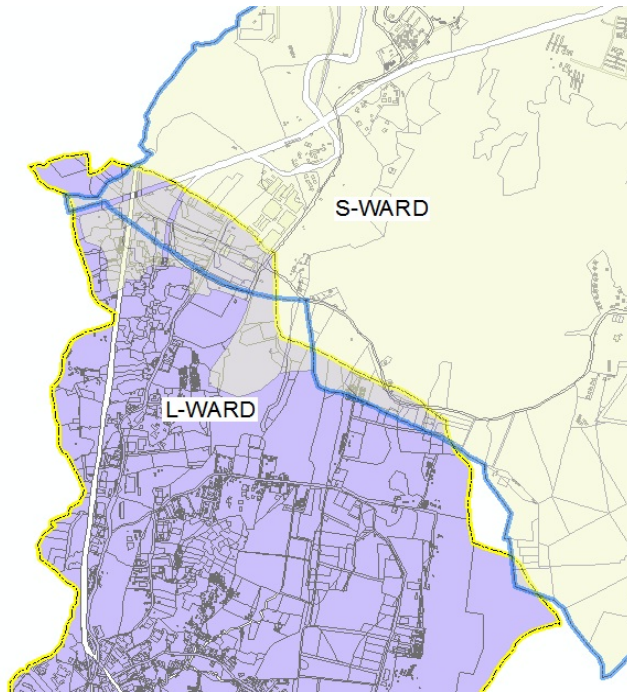


Figure : Edge matching Issues

iii. New buildings

New buildings are found to be missing in all the wards since the data is extracted from old Tikka Sheets. These will be updated by the Consultants based on methodology agreed with MCGM.

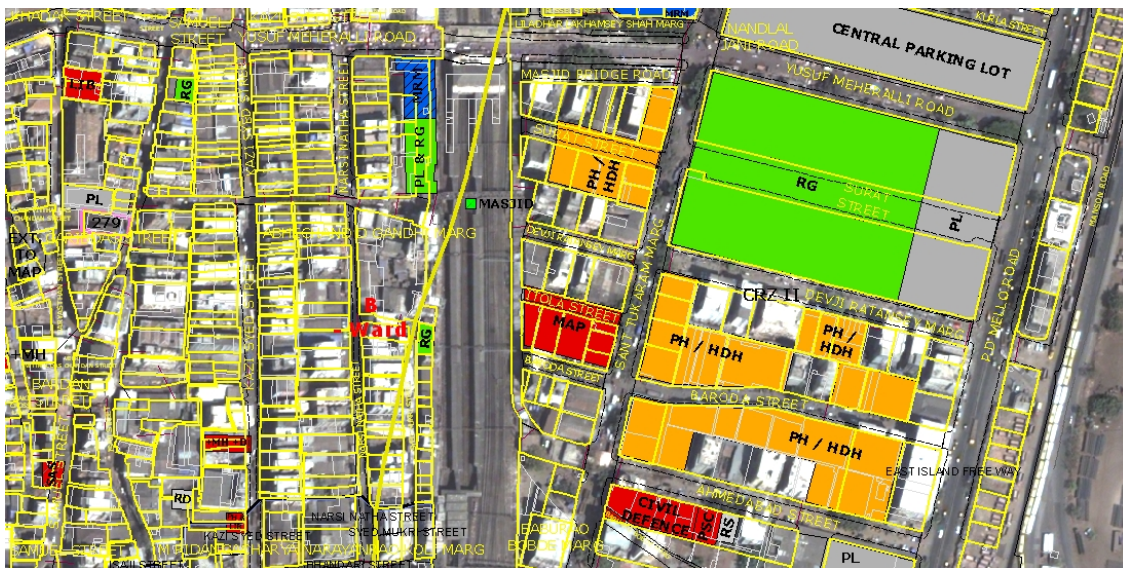


Figure 9: Example of Ward B wherein new buildings are not present and will be updated with methodology agreed mutually

iv. Ward boundaries

The ward boundary layer given by MCGM will be treated as final. Wards M and R are shown as single entities and further subdivisions into M/E, M/W, R/N, R/S, R/C are not shown. The consultant will work with MCGM for delineation of the current status of boundaries.

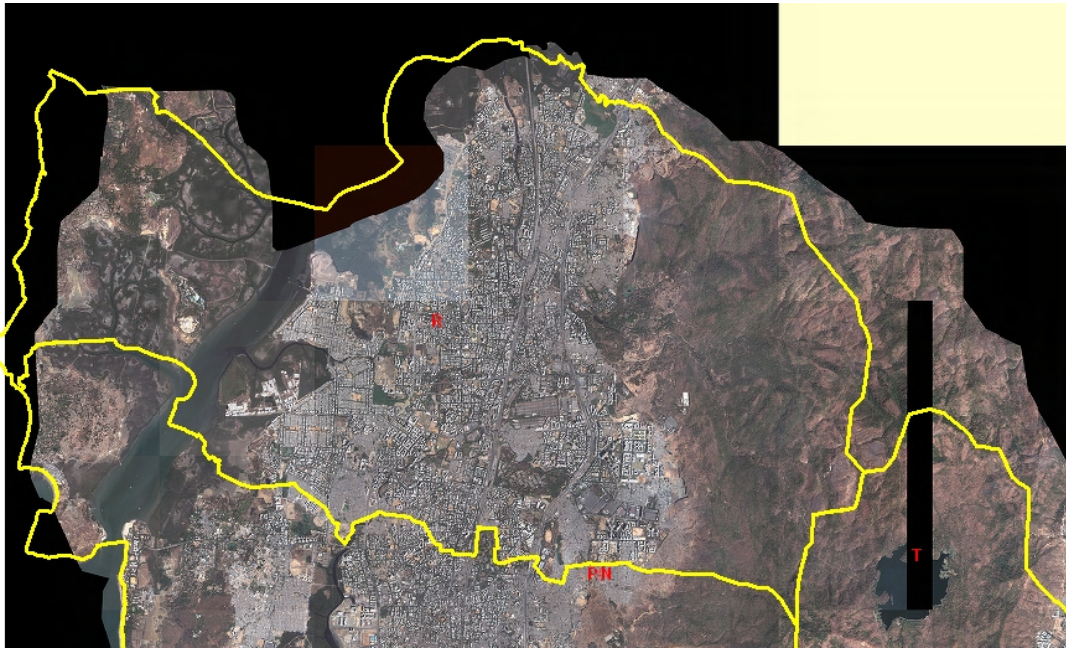


Figure 10: Example of Ward R shown as a single entity without sub divisions

v. Topology

The data also has topology errors such as overlaps, undershoots, and pseudo nodes. These have to be corrected by the Consultant with help from the MCGM.

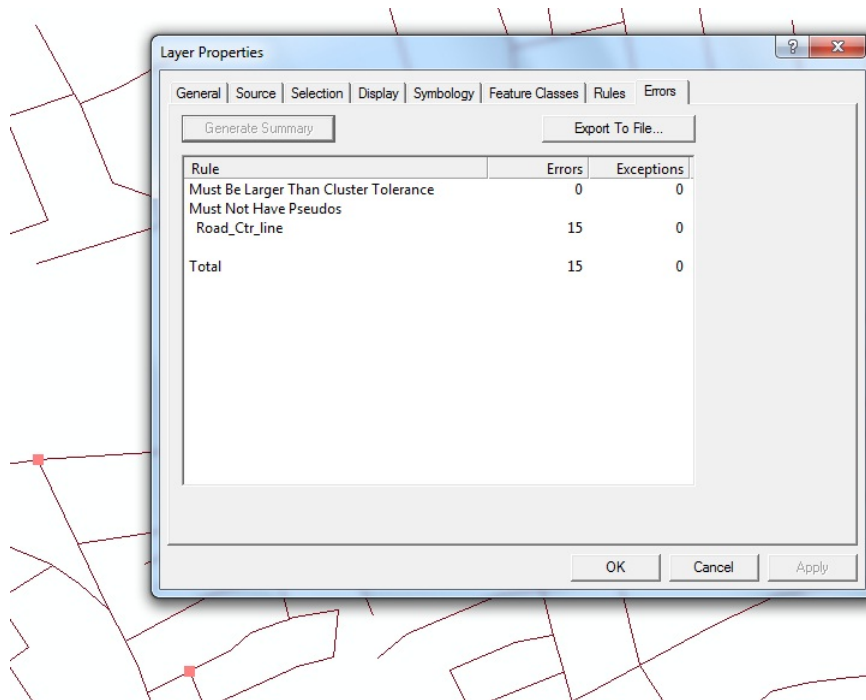


Figure : Example of Ward C with topology errors

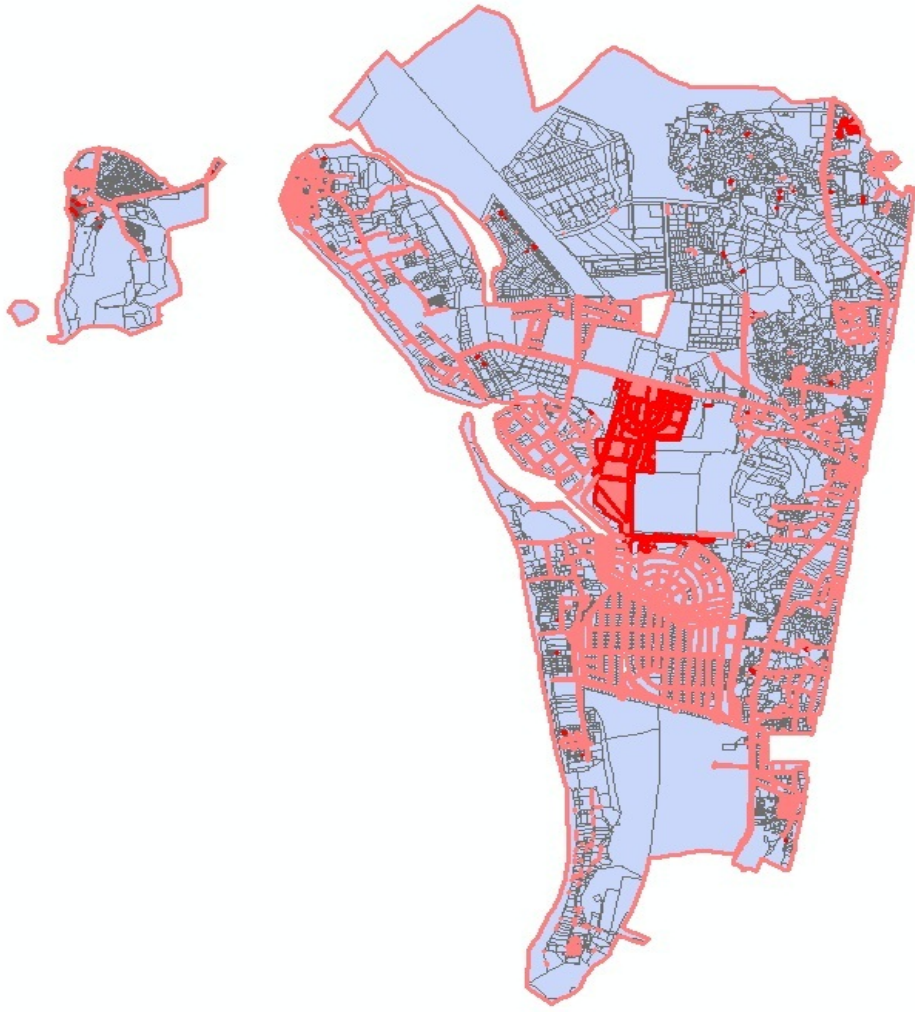


Figure : Topology Errors with reference to Property Layer, example of Ward K/W with topology errors

vi. Attribute Info

The naming of layers does not follow the Nomenclature of having the first letter in capitals; the layers are not named as per standard GIS nomenclature with each layer having its own name and property. Some of the Attribute layers are not completely filled and has lot of missing information.

Attribute data is found missing for some layers, for example, the layer Layout properties, the CTS_CS_No along with village name and division are not complete. The Consultant will not modify cadastral data and will use it as is. The time required for modification will be intimated to MCGM.



Figure : Issues related to nomenclature of feature classes

CTS_CS_NO	PLOT_NO	Name	Village	Village_Division	Ward
	123		MATUNGA	MATUNGA	F/N
	128				
	122		MATUNGA	MATUNGA	F/N
	129				
	9999				
	9999		MATUNGA	MATUNGA	F/N
	117		MATUNGA	MATUNGA	F/N
	131		MATUNGA	MATUNGA	F/N
	119		MATUNGA	MATUNGA	F/N
	132		MATUNGA	MATUNGA	F/N
	133		MATUNGA	MATUNGA	F/N
	134		MATUNGA	MATUNGA	F/N
	116		MATUNGA	MATUNGA	F/N
	135		MATUNGA	MATUNGA	F/N
	9999		DADAR-NAIGAON	DADAR-NAIGAON	F/N
	9999		DADAR-NAIGAON	DADAR-NAIGAON	F/N
	7		DADAR-NAIGAON	DADAR-NAIGAON	F/N
	121		MATUNGA	MATUNGA	F/N
	118		MATUNGA	MATUNGA	F/N
10	9999		MATUNGA	MATUNGA	F/N
505	464		DADAR-NAIGAON	DADAR-NAIGAON	F/N
505	9999		DADAR-NAIGAON	DADAR-NAIGAON	F/N
505	21/5		DADAR-NAIGAON	DADAR-NAIGAON	F/N
505	21/4		DADAR-NAIGAON	DADAR-NAIGAON	F/N
505	9999		DADAR-NAIGAON	DADAR-NAIGAON	F/N
505	43		DADAR-NAIGAON	DADAR-NAIGAON	F/N
505	9999		DADAR-NAIGAON	DADAR-NAIGAON	F/N
505	463		DADAR-NAIGAON	DADAR-NAIGAON	F/N
505	21/6		DADAR-NAIGAON	DADAR-NAIGAON	F/N
505	44		DADAR-NAIGAON	DADAR-NAIGAON	F/N

Figure : Issues related to attribute table

There is a difference in field characteristics in the attribute data for different wards; for example, it has a short integer for ward H/W for the filled Bldg id, it is a string for the same field in ward K/E and in ward M and N the field has long integer as its character. This causes a problem in uploading of data

into a single database where it is necessary to have common properties for all the fields to load it into a single database. Time required for the same will be intimated to MCGM.

Bldg Id	Bldg Name	Bldg No	No Floors	Remarks	Ward
Short Integer	100	50	10	255	HW
16	100	50	10	255	KE
16	100	50	10	255	L
Longer Integer	100	20	10	254	M
Longer Integer	100	100	50	254	N
16	100	50	10	255	KW
Short Integer	100	20	10	254	P
Short Integer	100	20	10	254	R
254	254	254	254	255	S
Short Integer	100	20	10	255	T

Figure : Issues related to Attribute Field Characteristics

c) Summary Assessment Matrix for GIS Data for each of the wards

Summary Assessment Matrix for GIS Data for each of the wards

Projection System used:

WGS_1984_UTM_ZONE_43N

Sl no Ward Name

1. Ward A

Total No of layers: 59

No of layers with data: 35

Total Topology errors: 484

Gaps: 450

Overlap: 34

Overlay status (As per Quick Bird image from MCGM): Good

Global view of Topology errors



Example of Topology error



2. Ward B

Total No of layers: 60

No of layers with data: 37

Total Topology errors: 274

Gaps: 273

Overlap: 1

Overlay status (As per Quick Bird image from MCGM): Good



3. Ward C

Total No of layers: 59

No of layers with data: 29

Total Topology errors: 288

Gaps: 286

Overlap: 22

Overlay status (As per Quick Bird image from MCGM): Good



4. Ward D

Total No of layers: 60

No of layers with data: 34

Total Topology errors: 170

Gaps: 159

Overlap: 11

Overlay status (As per Quick Bird image from MCGM): Good



5. Ward E

Total No of layers: 59

No of layers with data: 32

Total Topology errors: 269

Gaps: 258

Overlap: 11

Overlay status (As per Quick Bird image from MCGM): Good



6. Ward F/N

Total No of layers: 59

No of layers with data: 32

Total Topology errors: 155

Gaps: 126

Overlap: 29

Overlay status (As per Quick Bird image from MCGM): Good



7. Ward F/S

Total No of layers: 60

No of layers with data: 32

Total Topology errors: 116

Gaps: 98

Overlap: 18

Overlay status (As per Quick Bird image from MCGM): Good



8. Ward G/N

Total No of layers: 60

No of layers with data: 43

Total Topology errors: 86

Gaps: 75

Overlap: 11

Overlay status (As per Quick Bird image from MCGM): Good



9. Ward G/S

Total No of layers: 60

No of layers with data: 43

Total Topology errors: 62

Gaps: 60

Overlap: 2

Overlay status (As per Quick Bird image from MCGM): Good



10 Ward H/E

Total No of layers: 61

No of layers with data: 46

Total Topology errors: 317

Gaps: 303

Overlap: 14

Overlay status (As per Quick Bird image from MCGM): Shift of 55 meters



11 Ward H/W

Total No of layers: 62

No of layers with data: 50

Total Topology errors: 746

Gaps: 734

Overlap: 12

Overlay status (As per Quick Bird image from MCGM): Good



12. Ward K/E

Total No of layers: 60

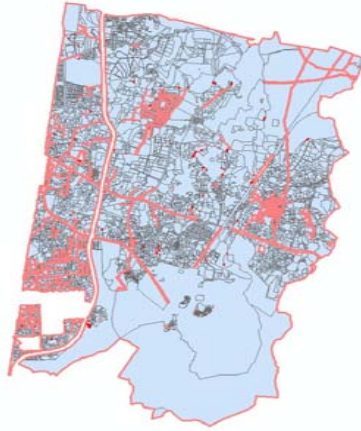
No of layers with data: 47

Total Topology errors: 366

Gaps: 268

Overlap: 98

Overlay status (As per Quick Bird image from MCGM): Good



13. Ward K/W

Total No of layers: 61

No of layers with data: 49

Total Topology errors: 841

Gaps: 548

Overlap: 266

Overlay status (As per Quick Bird image from MCGM): Shift of 55 meters



14. Ward L

Total No of layers: 62

No of layers with data: 34

Total Topology errors: 461

Gaps: 382

Overlap: 79

Overlay status (As per Quick Bird image from MCGM): Good



15. Ward M

Total No of layers: 61

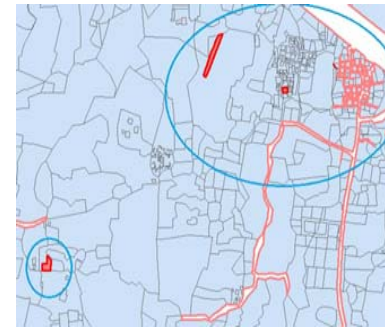
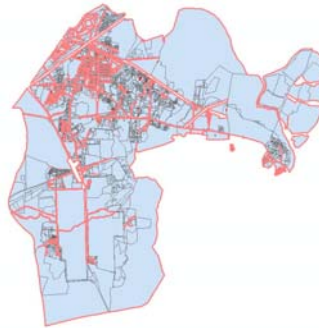
No of layers with data: 34

Total Topology errors: 593

Gaps: 557

Overlap: 36

Overlay status (As per Quick Bird image from MCGM): Good



16. Ward N

Total No of layers: 60

No of layers with data: 44

Total Topology errors: 305

Gaps: 241

Overlap: 64

Overlay status (As per Quick Bird image from MCGM): Good



17. Ward P

Total No of layers: 61

No of layers with data: 42

Total Topology errors: 628

Gaps: 512

Overlap: 116

Overlay status (As per Quick Bird image from MCGM): Shift of 48 meters



18. Ward R

Total No of layers: 61

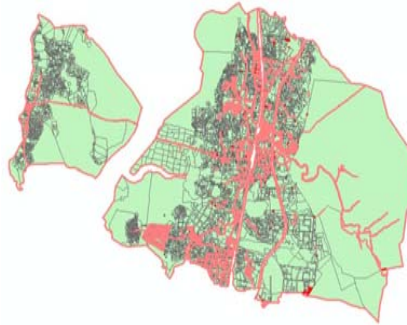
No of layers with data: 40

Total Topology errors: 678

Gaps: 487

Overlap: 191

Overlay status (As per Quick Bird image from MCGM): Shift of 60 meters



19. Ward S

Total No of layers: 60

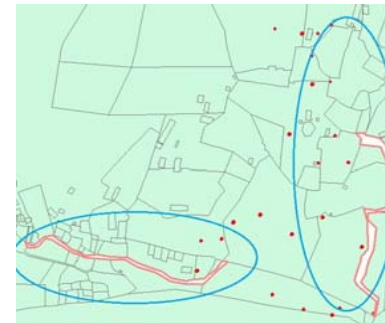
No of layers with data: 34

Total Topology errors: 274

Gaps: 165

Overlap: 109

Overlay status (As per Quick Bird image from MCGM): Shift of 60 meters



20. Ward T

Total No of layers: 61

No of layers with data: 32

Total Topology errors: 449

Gaps: 226

Overlap: 223

Overlay status (As per Quick Bird image from MCGM): Shift of 14 meters



5. Way Forward

The Consultant is currently working towards the creation of a database of acceptable accuracy. Rectification of errors on the GIS data provided is being done through the methods suggested above. Ward wise data layers are also being consolidated into a contiguous database for the entire area under MCGM jurisdiction.

Once the data is rectified, the Base Map will be prepared through consolidation of requisite layers as described above. This will serve as the base for the Existing Land Use mapping exercise.

Carrying out primary surveys to ascertain the existing land use will be the next step. These will result in overlays on the Base Map to create the Existing land Use Map.

Further overlays will be prepared for the sectoral findings from secondary surveys and data collected, towards existing situation analysis.

