67-08-43 Digital Ground Survey
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Amendments

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1 INTRODUCTION

This document establishes the requirements for detail surveys conducted for Main Roads Western Australia. Survey shall be performed and presented as defined herein.

This document should be used in conjunction with Main Roads Surveying and Mapping guideline “D12#436049 Digital Ground Surveys”.

1.1 REFERENCES AND RELATED DOCUMENTS


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<tr>
<th>Document Number</th>
<th>Description</th>
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<tr>
<td>D17#301448</td>
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<td>D15#224538</td>
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<td>D14#152062</td>
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### 1.2 DEFINITIONS

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tr>
<td>AGI</td>
<td>Asset &amp; Geospatial Information Branch, MRWA</td>
</tr>
<tr>
<td>AHD</td>
<td>Australian Height Datum</td>
</tr>
<tr>
<td>ALS</td>
<td>Aerial LiDAR Survey</td>
</tr>
<tr>
<td>BM</td>
<td>Benchmark</td>
</tr>
<tr>
<td>DBYD</td>
<td>Dial Before you Dig (1100.com.au)</td>
</tr>
<tr>
<td>DGS</td>
<td>Digital Ground Survey (Detail Survey)</td>
</tr>
<tr>
<td>DTM</td>
<td>Digital Terrain Model</td>
</tr>
<tr>
<td>Formed Surface</td>
<td>Unsealed Manmade / engineered surface eg. unsealed road</td>
</tr>
<tr>
<td>GDA94</td>
<td>Geodetic Datum Australia 1994</td>
</tr>
<tr>
<td>GenIIO</td>
<td>File format, required deliverable for Digital Ground Surveys</td>
</tr>
<tr>
<td>GNSS</td>
<td>Global Navigation Satellite Systems</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<td>LiDAR</td>
<td>Light Detection and Ranging</td>
</tr>
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<td>MCP</td>
<td>Minor Control Point</td>
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<td>MGA</td>
<td>Map Grid Australia</td>
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<td>Mobile Laser Scanner</td>
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<tr>
<td>MRWA</td>
<td>Main Roads Western Australia</td>
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<tr>
<td>MX</td>
<td>MX Road Design Software</td>
</tr>
<tr>
<td>Natural Surface</td>
<td>Any surface formed by natural or geological events</td>
</tr>
<tr>
<td>RPA</td>
<td>Remotely Piloted Aircraft</td>
</tr>
<tr>
<td>RRM</td>
<td>Road Reference Mark</td>
</tr>
<tr>
<td>RTK GPS</td>
<td>Real-time Kinematic Global Positioning System</td>
</tr>
<tr>
<td>Sealed Surface</td>
<td>Sealed road, path, driveway, carpark etc</td>
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<tr>
<td>SLK</td>
<td>MRWA Straight Line Kilometre (Refer to interactive online resource here)</td>
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<td>SSM</td>
<td>Standard Survey Mark</td>
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<td>Survey Portal</td>
<td>Main Roads WA online Surveying GIS web-page</td>
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<tr>
<td>TIN</td>
<td>Triangulated Irregular Network</td>
</tr>
<tr>
<td>TLS</td>
<td>Terrestrial Laser Scanner</td>
</tr>
<tr>
<td>UAV</td>
<td>Unmanned Aerial Vehicle</td>
</tr>
<tr>
<td>UUS</td>
<td>Underground Utilities Survey Standard</td>
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1.3 ENTRY ONTO LAND

It is the consultant's responsibility to seek and obtain permission from landowners, occupiers or management authorities before entering any property to undertake survey work. Property includes Crown land which may consist of Reserves, National Parks or State Forests. Survey work may include, but is not limited to, investigation, capture, placement and coordination of points.

The consultant shall maintain a written report of all contact made with landowners while working on the survey contract. Details of landowner contact are to be outlined in the metadata statement.

Any queries made by land owners with respect to the project are to be referred to the Main Roads Project Manager.

If access to the land is denied by the owners the contractor will be required to contact the Main Roads Project Manager immediately to discuss the need for entry onto the land. If entry is required for the completion of the contract and there are no other alternatives, then Main Roads will arrange formal notification using delegated powers under the Land Administration Act. A formal notice of entry requires Main Roads to provide 7 days’ notice to the owners. The process to arrange the formal notice of entry may take some time and the consultant must liaise with the Project Manager to ensure disruption to the contract schedule is minimised.

1.4 WORKING WITHIN THE ROAD RESERVE

Anyone carrying out operations on a road open to traffic has a duty of care under common law to take all reasonable measures to prevent accident or injury to construction workers & road users, damage to assets owned by Main Roads & other utility providers and to maintain existing environment.

The Consultant shall be responsible for Traffic Management in accordance with the Main Roads “Traffic Management Requirements for Works on Roads” Code of Practice.

The consultant at all times must implement and maintain a Safe System of Work which demonstrates compliance to the Occupational Health and Safety Act 1984 and the Occupational Health and Safety Regulations 1996. The consultant must have a documented Safe System of Work, which is to be provided to the Principal (Main Roads WA) at the commencement of works and the principal is to be notified of any amendments to their Safe System of Work.

1.5 ENVIRONMENTAL IMPACT

All work is to be performed such that environmental impact is minimised. Any breach of environmental and heritage legislation during the execution of works is the sole responsibility of the Consultant.

The Consultant shall ensure any disturbances are kept to an absolute minimum. The Consultant shall reinstate, clean-up and leave the site as close to its pre-disturbed condition as possible on completion of any work or investigation.

New tracks shall not be formed, existing tracks altered, fencing cut, clearing carried out, or damage or disturbance made of any kind unless approved by the Main Roads Project Manager.

The Consultant shall be responsible for the cost of reinstating any damage to property resulting from their work.
1.6 HERITAGE / ABORIGINAL SITES

Any site or suspected Aboriginal site found in the field must not be disturbed and shall be reported immediately to MRWA.

In the event that human skeletal material is uncovered, work will cease within 50m of the material and the location of the material reported to Police. In the event that artefacts or material of Aboriginal origin is discovered, work will cease within 50m of the material and a qualified Archaeologist will investigate the item(s) and take appropriate actions.

1.7 OWNERSHIP OF DATA

All materials and information as part of undertaking projects for Main Roads WA shall become the property of Main Roads WA. It shall not be used, copied or reproduced for any other purpose without the prior written approval by Main Roads WA.

2 REQUIREMENTS FOR MRWA DIGITAL GROUND SURVEYS

Work and deliverables for MRWA Digital Ground Surveys are to be in accordance with this standard.

3 COORDINATE SYSTEM / PROJECT ZONE / SURVEY DATUM

Digital Ground Survey models are to be supplied in the Main Roads’ Project Zone coordinate system (Additional information: MRWA Project Zones Guideline).

The correct/appropriate zone should be specified in the request for survey.

Where more than one zone may appear applicable, the most appropriate zone is to be defined by the MRWA Senior Geodetic Surveyor or Surveying & Mapping specialist.

Where a project spans multiple zones, the areas for each zone are to be clearly defined.

Project zone parameters are available online via the Main Roads WA online Surveying GIS webpage, known as the “Survey Portal”.


Or from the Senior Geodetic Surveyor (Ph: 138 138).
surveying@mainroads.wa.gov.au

Heights are to be relative to the Australian Height Datum (AHD). Features captured with GNSS must use the latest AUSGeoid model to derive AHD height. The latest AUSGeoid model is available from the Geoscience Australia website (http://www.ga.gov.au).

The Project zone, height datum and Geoid model used must be specified on the metadata statement.
4 SURVEY CONTROL

All survey control used for Digital Ground Surveys is to meet or exceed positional standards (horizontal and vertical) specified in Main Roads Standard ‘67/08/36 Road Reference Marks’ (RRM) standard.

Suitable and sufficient survey control is required to meet specified accuracies relative to capture methodology and equipment.

4.1 VERTICAL NETWORK

A differential level traverse is to be undertaken for the extents of the survey area.

All existing control immediately adjacent to a detail survey site must be included in the differential level traverse.

Differential levelling is to be in accordance with MRWA standard “67-08-38 Differential Levelling”

4.2 DETAILS OF SURVEY CONTROL

Details of survey control used, adjacent to and relevant to the survey are required, and must be included in the “Survey Report”.

This is in addition to the requirements of any other applicable standards.

Any new Road Reference Marks required must be established according to Main Roads Standard ‘67/08/36 Road Reference Marks’.

4.3 SURVEY CONTROL IN GENIO SURVEY MODEL

Coordinates of survey control points within the survey model file must be true final adjusted/verified position. (i.e. They must not be field captured coordinates - radiation / RTK GNSS).

For Landgate benchmarks the horizontal position should be as captured by the detail survey, but with the true confirmed Landgate benchmark height.

5 DETAIL DEFINITION & FEATURE CODING

All natural and artificial features occurring within the survey project area shall be captured and represented as coded points or strings in the model. Some feature codes are directional – code/direction to be applied accordingly.

Measurement accuracies of points and string features shall be in accordance with their accuracy class from the feature code list in reference to the nominated measurement accuracies.

5.1 FEATURE CODING / CODE LIST

The standard features and codes for Digital Ground Surveys are provided as a separate file/document, available from the MRWA Survey & Mapping Standards web-page.
All features within the defined survey area are to be captured/modelled. Any relevant feature not represented in the code list must still be captured and represented in the survey model/file. A new unique code is to be assigned (i.e. one not already existing in standard code list).

Point feature codes must start with “P”. Any feature with code starting with a letter which is not “P” must be a string (i.e. contain a minimum or 2 connected points). String codes must be defined by a 2 alpha character code, and must not start with a “P”.

Non-standard feature codes must be noted and described in the metadata statement and survey report.

5.2 SEALED ROAD SURFACES

Class A, B or C features, must **NOT** be captured with RTK GNSS/GPS. This includes sealed road features.

Sufficient strings must be captured/modelled across road surfaces to ensure the shape is accurately defined to specified accuracies and tolerances. At a minimum, any sealed road surface with a ‘crown’ requires a string to be surveyed approximately 1m either side of the crown and coded ‘RØ’. All line marking must be captured and coded appropriately according to type.

Cross-sectional and longitudinal shape of the seal must be accurately defined within specified accuracy tolerances.

Surveyed points for edges of seal must be positioned carefully to ensure accurate cross-fall representation.

If the inconsistency of the seal edge horizontal position with respect to required cross-fall point/string is greater than the required horizontal accuracy (Class C feature, 50mm), an additional string is required. In this situation, the cross-fall point is to be coded R0, and the true edge of seal; RE.
Strings defining the road and formation shall be captured such that their respective points align perpendicular to the direction of the road. Refer to example in image below.
5.3 INTERSECTIONS / AREAS WITH COMPLEX SURFACE SHAPE

Intersections may have a complex surface shape that is not suitably defined and represented by capture of specific detail features alone.

*Sufficient strings are to be captured/modelled such that the shape is accurately defined to achieve required accuracies and tolerances.*

On-road/seal cannot be captured with RTK GNSS.

On-road/seal capture/modelling to define shape, but not representing specific features, are to be coded “R0” strings (i.e. minimum 2 connected points)

5.4 DIRECTIONAL CODE STRING FEATURES

String feature codes with “Left” or “Right” are directional. (eg. Top of bank, edge of drain, edge of concrete, building). The direction of the string and the code used are to be such that the feature is on that side.

In the case of top of banks, the feature is the bank itself, and directional string coding is to suit accordingly. Eg. NT is “BANK TOP – LEFT”.

5.5 TREES

All trees within the survey area with trunk diameter greater than 0.1m are to be captured/modelled and represented in the survey model.

Trunk diameters are to be evaluated at 1.5m above ground. Tree point features are to have ground level height/z-value.

Dense areas of other (smaller diameter) trees/vegetation/scrub/shrubs should be delineated with “TL” TREE-LINE – FACE OF TRUNKS or “GS” BUSH-LINE coded feature as appropriate.

Tree-line TL string should be captured at the face of tree trunks.
Tree-line, tree canopy and bush-line strings TL/GS are to be 2d *(i.e. have null height, -999 in GenIO file)*.

If project is captured by MLS, *and* specific true tree diameters are requested, these are to be represented as a circle of the trunk diameter, and Coded “TD” (Trunk Diameter). TD strings are to be 2D strings *(i.e. have null height, -999 in GenIO file)*

Tree Canopies are not required, unless specifically requested (Code GT).

**5.6 DRAINAGE STRUCTURES**

Invert and obvert of pipe/structure must be captured for open/accessible drainage structures. *(“Obvert” level is top inside edge of pipe/box)*

Where evident, the connection and direction of pipes/boxes is to be shown by an appropriately coded string (e.g. “DC” – Culvert, “DB” – Box Culvert (Both Internal Edges). Ends of these strings are to be at invert level. When this is the case, separate invert “PIL” points are not necessary.

Box culverts must be captured with a “DB” coded string at inside edge of box structure, and be a polygon / rectangle.

Where an apron exists, only the reasonably accessible/exposed section need be captured (Edge of concrete, directional code; SE/SF).

Strings in addition to those shown here are also required to satisfy detail survey requirements as covered elsewhere in this standard

Internal dimension and description of pipes / boxes is to be recorded and displayed as text/annotation. (e.g. 2XRCP 450MM)

Text/Annotation for the condition should also be shown where relevant.
Enclosed drainage structures are not to be captured unless specifically requested. The ground surface feature must still be represented (i.e. lid/manhole cover, metal grate, side entry pit…)

Where an invert cannot reasonably be accessed due to site conditions / silting, text/annotation is to be included in the survey model/GenIO to describe the issue.

In the case of a round pipe’s invert obscured by significant silting, the possibility of obtaining an internal diameter measurement and applying it to create an invert level measurement should be considered.

5.7 GUARDRAILS & BARRIERS

The road side face of guardrails and barriers must be captured at ground level and appropriately coded according to type. An additional string must be captured at the top of the structure (Barrier Top - Code TB). This defines the height of the barrier / guardrail.

Concrete barriers are to have both faces captured at the base as well as the height string along the top.
5.8 BRIDGES

Bridges are to be represented using the available codes.

All features pertaining to bridges must be separate strings for the area of the bridge between abutments. eg, Continuing longitudinal features string must be split/broken between the bridge abutments. This may require duplicate points at start/ends of strings such that the features still appear connected as appropriate.

A guide to expectations and use of coding follows in the images below.

Note that bridge expansion joints are to be captured as a string, Coded “BJ”, with sufficient points to follow the shape of the road and other strings/break-lines.
5.9  GUIDEPOSTS (PGP)
Guideposts must be captured/modelled and included in GenIO model, as per code “PGP”.

5.10  DRIVEWAYS
Driveway material types are to be represented using available codes.
5.11 POWERLINES (EA)
Where the true height of powerlines can be obtained/extracted easily (e.g. from LiDAR scan/point cloud) the powerline feature should be modelled in 3d, with at least 3 points defining each span – a point at either end where supported, and one point at the lowest point.

Otherwise, overhead power lines are to be modelled as code “EA” 2D strings (i.e. have null height, -999 in GenIO file).

Individual wires do not need to be represented. Where the powerline is modelled in 3d, only the lowest powerline need be defined.

A single “EA” string must denote the location of power lines between poles and or structures (such as buildings). Power lines must be captured to at least the edge of the requested survey extent.

5.12 CENTRALLY LOCATED STRING FEATURES
Some features are defined by a string running through the centre of the feature.

5.13 STEPS / STAIRS
Steps / Stairs are to have their extremities captured resulting in a closed polygon (Code SS)
### 5.14 ELECTRIC LIGHT POLES (& POWER POLES WITH LIGHTING ATTACHED)

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>MULTIPLE LIGHT POLE</td>
<td>D LM</td>
</tr>
<tr>
<td>ELECTRIC LIGHT POLE</td>
<td>D EL</td>
</tr>
</tbody>
</table>

These codes represent multiple and single electric light poles. These are defined by a first measurement (1) at the centre of the pole with a second measurement (2) in the direction of the light/luminaire, NO FARTHER THAN THE NEXT FEATURE/BREAKLINE IN THE SURVEY MODEL. In the case of a multiple light the second measurement is taken towards any one light/luminaire only. Both points are to have ground level height/RL.

Where a power-line also connects to a pole with a light, the pole feature should be captured and coded as EL (electric light pole).
5.15 PAVEMENT ARROWS
These codes represent various pavement turning arrows. These are defined by a first measurement (1) at the start or base of the arrow with a second measurement (2) taken along the axis of the arrow at its point of extremity.

5.16 BUS SHELTER

<table>
<thead>
<tr>
<th>BUS SHELTER</th>
<th>D</th>
<th>SB</th>
</tr>
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</table>

Bus Shelters are to have their extremity defined as a closed polygon (Code SB). Levels of points are to be at ground level. Any associated concrete slab or paving / path etc must be captured and coded accordingly.

5.17 RAIL BOOM GATES

<table>
<thead>
<tr>
<th>RAIL BOOM GATE</th>
<th>D</th>
<th>GX</th>
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</table>

Boom Gates are defined by a string with the first measurement at the centre of the boom gate’s support post and the second measurement at the end of the boom at its lowered position. Both points should have their RL at ground level.
5.18 **MANHOLES - CIRCULAR AND SQUARE (INCLUDING GULLIES)**

These structures are to be closed polygon string features (i.e. the first and last point of the string is to be the same point, except where the feature abuts another coded feature (eg. kerb). The feature is to be defined by its outer extremity (not the lid/cover). Circular manholes are to be represented with sufficient points in the final GenIO to ensure a smooth circle is plotted.

5.19 **SIDE ENTRY PITS**

<table>
<thead>
<tr>
<th>SIDE ENTRY PIT</th>
<th>B</th>
<th>DX</th>
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</table>

Side entry pits have a manhole access lid behind the kerb. The pit opening and the manhole must be surveyed. The concrete apron deflector slab at the entry of the pit must be captured with an appropriate directional 'edge of concrete' code (SE / SF). The ‘KERB, BOTTOM / GULLY’ (RB) string runs across the opening of the side entry pit with a point captured at the centre of the throat on the concrete apron.
6 DATA MODELLLED FROM EQUIPMENT OTHER THAN TOTAL STATION OR RTK GNSS

For any points/strings in the final GenIO derived from methods other than total station or RTK GNSS, those points/strings must be supplied as separate GenIO file(s). The filename must depict the method of survey capture and modelling, defined in section “File Naming”. The primary/main GenIO model file must also contain the points/strings, making a complete model in itself.

7 TIN MODEL - 3D DXF OF GROUND TRIANGULATION

The true “ground model” triangulation (DTM TIN) is to be generated using appropriate features/points/strings/break-lines. A 3d DXF of the TIN terrain model (ground surface) is to be provided as a deliverable.

Refer to separate feature code list file and “Non-Tinable” column for features which are excluded from triangulation ground.

The feature code list is available from the MRWA Survey & Mapping Standards web-page.

8 FEATURES EXCLUDED FROM TRIANGULATION

Refer to separate code list “D17#307405” and “Tinable?” column for features which are excluded from ground triangulation.

Additionally, surveyors undertaking field survey capture should consider and may deem it necessary to include/exclude other specific points/strings to define true ground surface in the generation of their triangulation, which is to be lodged as 3d DXF.

9 REQUIRED ACCURACY

Accuracy of features captured shall be according to the relevant ‘Accuracy Class’ specified in the feature code list, with reference to the table below:

9.1 MEASUREMENT ACCURACIES FOR FEATURES & FEATURE CLASSES

RTK GNSS/GPS must NOT to be used for capture of class A, B or C features.

<table>
<thead>
<tr>
<th>CLASS</th>
<th>HORIZONTAL ACCURACY</th>
<th>VERTICAL ACCURACY</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>± 15 mm</td>
<td>± 10 mm</td>
</tr>
<tr>
<td>B</td>
<td>± 20 mm</td>
<td>± 15 mm</td>
</tr>
<tr>
<td>C</td>
<td>± 50 mm</td>
<td>± 20 mm</td>
</tr>
<tr>
<td>D</td>
<td>± 150 mm</td>
<td>± 40 mm</td>
</tr>
<tr>
<td>E</td>
<td>± 250 mm</td>
<td>± 50 mm</td>
</tr>
</tbody>
</table>

Note: Features with Class “U” in feature code list denote Underground Utilities Survey (UUS) Model standard features of “Data” & “Planning” Quality. These are 2d (i.e. have null height, -999 in separate UUS GenIO file).
9.2 MAXIMUM POINT SPACING

In addition to satisfying all other accuracy requirements, side lengths of triangles of the Digital Terrain Model generated from the survey model must not exceed **25m on sealed or formed surfaces** and **50m in all other areas**. Survey model point/string density and spacing must ensure that this condition is met.

9.3 DIGITAL TERRAIN MODEL (DTM) ACCURACY

Digital Terrain Model surfaces generated from the survey model must meet vertical deviation and volume difference tolerances.

9.3.1 DTM VERTICAL DEVIATION CONFORMANCE

The survey model fails where more than 5% of points are outside the relevant vertical accuracy from the table below. In addition to this, outliers/gross errors must not exist. Any gross errors/outliers found render the survey model non-conforming to this MRWA standard.

<table>
<thead>
<tr>
<th>SURFACE TYPE</th>
<th>VERTICAL ACCURACY</th>
<th>CLASS</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEALED ROAD</td>
<td>± 25 mm</td>
<td>C</td>
</tr>
<tr>
<td>FORMED SURFACE</td>
<td>± 80 mm</td>
<td>D</td>
</tr>
<tr>
<td>NATURAL SURFACE</td>
<td>± 250 mm</td>
<td>E</td>
</tr>
</tbody>
</table>

9.3.2 VOLUME VERIFICATION

In order to satisfy surface conformance, the volume (m$^3$) between the true surface and the survey model surface (DTM) must be less than the area of the verification surface (m$^2$) multiplied by the applicable ‘volume factor’ below.

<table>
<thead>
<tr>
<th>SURFACE TYPE</th>
<th>VOLUME FACTOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>SEALED ROAD</td>
<td>0.010</td>
</tr>
<tr>
<td>FORMED SURFACE</td>
<td>0.020</td>
</tr>
<tr>
<td>NATURAL SURFACE</td>
<td>0.050</td>
</tr>
</tbody>
</table>
10 TEXT / ANNOTATION

Text / Annotation within the survey model GenIO is required for the following features at a minimum:

- Culvert type/material, dimensions and number of pipes or boxes
  - **NOTE**: Culvert / pipe dimensions must be internal measurements.
  - Culvert/environment condition should be noted if invert could not be accessed.
- Road names
- Names of rivers, streams and lakes
- Names and numbers of SSM’s, RRM’s, Minor Control, BM’s or any other control used for the survey or located in the survey project area
- SLK post distance values
- Focal point sign distance values
- Sign contents / description (e.g. speed signs ‘90km/h’)
- On-road painted text/lettering.
- Information on services markers (e.g. Optic Cable 1.2m o/s North parallel to road)

Additional text / annotation for other relevant / significant features or characteristics within or adjacent to the survey area should be included.

Text / annotation is to be included in the Digital Ground Survey GenIO file.

Text / annotation must be situated at an appropriate coordinate location accompanying the feature or characteristic being described. The orientation of the text / annotation should maximise legibility but minimize interference with other features. Text / annotation for linear features should be aligned with the feature. Culvert descriptions must be in line with the direction of the culvert. Text / annotation for survey control, sign descriptions and details, SLK posts and focal point distance markers should be aligned perpendicular to the road.

The maximum length (including spaces) for any single element of text / annotation is 44 characters.

If the content exceeds 44 characters, multiple text elements are required and must be positioned correctly to ensure legibility.

The text content must all be on one line (i.e. not contain “carriage returns”).

The text content must contain only alpha-numeric characters and spaces (i.e. no special characters, eg. _ - “ , . / ).

The height of the text is to be **1m** in ground units.

11 GENIO FILE FORMAT - POINT OR STRING CODES

Point feature codes must start with “P”.

Any feature with code starting with a letter which is not “P” must be a string (i.e. contain a minimum or 2 connected points). String codes must be defined by a 2 character alpha code, and must not start with a “P”.
12 GENIO FILE FORMAT – MODEL NAME IN HEADER

Format for model/layer name in GenIO header is to be as follows

H006 25 27 DGS YYY94

**Where:**
- **H006** is the Main Roads Road Number;
- **25 27** is the approx. “from” and “to” SLK of the Road;
- **YYY94** is the Project Zone / coordinate system (*can be more than 3 characters where necessary*).

It must only contain alphanumeric characters and “spaces”. Maximum length is 26 characters, including spaces.

All data must be in **one model/layer**.

**Eg.**

GENIO M53 2 14 DGS PCG94 017,NORM 001FORMAT(3D23.17,/,D23.17,11A4)

**Note:** SLK’s can be obtained interactively from here:

<table>
<thead>
<tr>
<th>SLK</th>
<th>MRWA Straight Line Kilometre (Refer to interactive online resource here)</th>
</tr>
</thead>
</table>

13 PHOTOS WITH LOCATION GEOTAG

Photos are encouraged where their depiction may be beneficial. Location / geotagging should be enabled where practicable.
14 LODGED INFORMATION / DELIVERABLES

The following are the deliverables to be lodged for Digital Ground Surveys:

- Digital Ground Survey MX GenIO file
  - All data to be in **one model/layer**
- Separate GenIO file(s) of any points/strings derived from methods other than total station or RTK GNSS. Separate file for each different method.
- Any points/features in the model derived from RPA/UAV (imagery or LiDAR derived) must be lodged as separate GenIO file.
- 3d DXF of TIN terrain model (ground surface)
- If any of the survey model is derived from point cloud, geo-reference Point cloud must be lodged in accordance with MRWA standards/documents.
  - MLS: D14#152062
  - ALS: D15#224538
- Metadata Statement in accordance with Main Roads Western Australia standard (using MRWA template, available here)
- Metadata is to be included in the GenIO file header as comment lines. Metadata detail/comment lines in the GenIO file must be preceded by three spaces.
- Survey Report, as per MRWA template D17#301448
- Photos, “Location enabled/geotagged”.jpg

Digital Ground Survey outputs/deliverables must be lodged to the nominated Main Roads officer and Main Roads WA Asset and Geospatial Data Manager or Senior Spatial Analyst (Engineering).

Lodgement may use the following email address surveying@mainroads.wa.gov.au.

The Main Roads officer received survey data must also deliver all the information to the Main Roads WA Asset and Geospatial Data Manager or Senior Spatial Analyst (Engineering).

Including as a minimum

- Statement that the project has been conducted and completed according to this Digital Ground Survey standard
- Project Name
- Project Description
- Reference / Contract Number (where applicable)
- Project Zone Name
- Road Name / Number and SLK extents.
- Summary and description of non-standard feature codes used
- Information of all control used or established
- Summary of contact with landowners and members of public
- New control point (RRM) information according to ’67-08-36 Road Reference Marks’ standard
- New control point (MCP) information according ’67-08-37 Minor Control Points’ standard
15  FILE NAMING

Lodged GenIO model, metadata, report and 3d dxf triangulation files must be appropriately named according to the naming convention below:

\[ H006\_25.3\_27.5\_XXXXXX\_YYY94.\text{ext} \]

Where;

- **H006** is the Main Roads Road Number;
- **25.3\_27.5** is the “from” and “to” SLK of the Road;
- **XXXXXX** is either:
  - “DGSGEN” Digital Ground Survey, GenIO;
  - “DGSMTD” Metadata, .pdf;
  - “DGSREP” Survey Report, .pdf/.doc/.docx;
  - “DGSMLS” Points/Strings from MLS, where applicable, GenIO;
  - “DGSTLS” Points/Strings from TLS, where applicable, GenIO;
  - “DGSAimg” Points/Strings from aerial imagery, where applicable, GenIO;
  - “DGSTimg” Points/Strings from terrestrial imagery, as applicable, GenIO;
  - “DGSTIN” 3d DXF of TIN terrain model (ground surface), .dxf;
- **YYY94** is the Project Zone / coordinate system. *(Can be more than 3 characters where necessary.)*
- **.ext** is the file type extension.
  - *gen* for GenIO file.
  - *pdf* for metadata, in accordance with MRWA metadata requirements and template format
  - *doc, .docx, .pdf* for survey report - word or portable document format (pdf)
  - *dxf* for 3d DXF of TIN terrain model (ground surface)

If any of the survey model is derived from point cloud, the point cloud must be lodged. MLS and ALS requirements are defined in the relevant Main Roads WA Documents (MLS: D14\#152062, ALS: D15\#224538)

Where spherical imagery, driven video or similar product is captured, this may be requested for lodgement as a required deliverable.

**Note:** SLK’s can be obtained interactively from here:

<table>
<thead>
<tr>
<th>SLK</th>
<th>MRWA Straight Line Kilometre (Refer to interactive online resource here)</th>
</tr>
</thead>
</table>

16  SURVEY REPORT

Survey report is to be completed and lodged, using the MRWA template D17\#301448, available from the MRWA Survey & Mapping Standards web-page.
17 UNDERGROUND UTILITIES MODELS

Underground utilities models may be requested with Digital Ground Survey projects

These are to be in accordance with MRWA standard 67-08-121 "Underground Utilities Survey Standard" ("UUS" standard) to the Class specified.

MRWA may supply some spatial utilities information which may be useful for modelling and GenIO output in accordance with the Class C & Class D UUS requirements. This information is to be extracted and supplied by (or under the direction of) the MRWA Data Manager, Asset & Geospatial Information (AGI)

Other underground utilities which may exist in areas will still need to be identified and sourced as necessary to satisfy the requirements of the UUS standard. This includes Dial Before You Dig (DBYD). Any MRWA supplied information should be validated against DBYD data for any utility information supplied to ensure completeness, currency and congruency.
18 FEATURE CODES

The standard features and codes for MRWA 67-0-43 Digital Ground Surveys are provided as a separate file/document, in comma delimited text (.csv) format.

It is available from the MRWA Survey & Mapping Standards web-page, or at the direct link below.

| D17#307405 | Feature Codes, Digital Ground Surveys |

The code list file also defines whether the feature is 2D or 3D, and which features are TINABLE/NON-TINABLE for the true “ground model” triangulation (DTM TIN).