Mobile Laser Scanning Standard
D14#152062
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<td>Senior Engineering Surveyor</td>
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<td>D14#152062</td>
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<td>Issue Date</td>
<td>July 2019</td>
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Amendments

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<tr>
<td>30</td>
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1 INTRODUCTION

The purpose of this document is to establish Main Roads requirements for delivery of mobile laser scan surveys.

1.1 SCOPE

This document will apply to all work related to mobile laser scanning that is procured by Main Roads WA.

Advice and further information on this delivery document can be obtained by contacting the Survey and Mapping Manager, Survey and Mapping section, Main Roads (Phone 138 138) or surveying@mainroads.wa.gov.au.

1.2 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.

1.3 REFERENCES AND RELATED DOCUMENTS

<table>
<thead>
<tr>
<th>Document Number</th>
<th>Description</th>
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<tbody>
<tr>
<td>D17#301448</td>
<td>Survey Report, MRWA template</td>
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<td>D15#321963</td>
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<td>D12#436049</td>
<td>MRWA Guideline “D12#436049 Digital Ground Surveys”</td>
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<td>MRWA Guideline “D12#434788 Data Lodgement”</td>
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<td>D12#434826</td>
<td>67-08-121 &quot;Underground Utilities Survey Standard&quot;</td>
</tr>
<tr>
<td>D15#224538</td>
<td>Aerial LiDAR Document</td>
</tr>
<tr>
<td></td>
<td>Landgate Guideline for GNSS Geodetic Surveys</td>
</tr>
<tr>
<td></td>
<td>Land Administration Act 1997</td>
</tr>
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</table>

Main Road survey standards can be found online at this link.
## 1.4 DEFINITIONS

The following terms used in this procedure have the specific meanings indicated:

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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<tbody>
<tr>
<td>AHD</td>
<td>Australian Height Datum.</td>
</tr>
<tr>
<td>BM</td>
<td>Landgate survey control mark - Bench Mark</td>
</tr>
<tr>
<td>Contractor</td>
<td>The party named in the contract to perform the Services</td>
</tr>
<tr>
<td>Contract Manager</td>
<td>The Main Roads individual who has a responsibility to provide a specific service through a contract for the Project Manager.</td>
</tr>
<tr>
<td>Design Grade MLS</td>
<td>A mobile scan point cloud model that is positioned to levelled MLS Ground Targets, and MLS verification survey undertaken.</td>
</tr>
<tr>
<td>DGS</td>
<td>MRWA Digital Ground Survey Standard 67-08-43</td>
</tr>
<tr>
<td>DTM</td>
<td>Digital Terrain Model – Digital 3D model of the terrain surface</td>
</tr>
<tr>
<td>GNSS</td>
<td>Global Navigation Satellite Systems</td>
</tr>
<tr>
<td>Local Project Zone</td>
<td>A local transverse Mercator projected coordinate system created by Main Roads to meet tolerances for building roads and bridges on the earth's curved surface.</td>
</tr>
<tr>
<td>MCP</td>
<td>Minor Control Mark.</td>
</tr>
<tr>
<td>MLS</td>
<td>Mobile Laser Scan. A point cloud generated from a laser scanner attached to a moving vehicle.</td>
</tr>
<tr>
<td>MRWA</td>
<td>Main Roads Western Australia</td>
</tr>
<tr>
<td>MVCM</td>
<td>MRWA Minor Vertical Control Mark</td>
</tr>
<tr>
<td>MX Roads</td>
<td>Road design software.</td>
</tr>
<tr>
<td>PDOP</td>
<td>Positional (3D) dilution of precision value for navigation satellite geometry</td>
</tr>
<tr>
<td>Project Manager</td>
<td>The Main Roads individual that is responsible for the overall road project.</td>
</tr>
<tr>
<td>RRM</td>
<td>Road Reference Mark. A Main Roads survey control mark.</td>
</tr>
<tr>
<td>Survey Control</td>
<td>Survey control points that can consist of SSMs, RRM, BMs and MCPs</td>
</tr>
<tr>
<td>Survey Portal</td>
<td>A web application within the Main Roads Western Australia web site that contains information on MRWA’s local project zones, road reference marks and outlines of existing project survey areas.</td>
</tr>
<tr>
<td>TIN</td>
<td>Triangulated irregular network (Delaunay triangulation)</td>
</tr>
<tr>
<td>TLS</td>
<td>Terrestrial Laser Scan. A point cloud generated from a fixed point laser scanner</td>
</tr>
<tr>
<td>Untargeted MLS Point Cloud</td>
<td>A mobile scan point cloud capture and model that is positioned only based on GNSS position, post-processed from base stations – no MLS Ground Targets used/processed. MLS verification survey is not required.</td>
</tr>
<tr>
<td>Verified Control</td>
<td>Located and checked for physical stability and quality</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>--------</td>
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<tr>
<td></td>
<td>Verified vertical/level to its reference marks where applicable, or levelled to at least one adjacent control point of suitable quality in a closed/2-way loop Static GNSS baseline, RTK GNSS, or total station connection (from RTK temporary points is acceptable) for horizontal verification to adjacent/nearby control point(s).</td>
</tr>
<tr>
<td>VCM</td>
<td>MRWA Vertical Control Mark</td>
</tr>
<tr>
<td>VRS</td>
<td>Virtual Reference Station</td>
</tr>
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2 SITE REQUIREMENTS

2.1 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 any work. Property includes Crown land which may consist of Reserves, National Parks or State Forests.

The contractor shall maintain a written report of all contacts. Details about all contact must be outlined in the Survey Report.

Any queries made by landowners or members of the public with respect to the project are to be referred to Main Roads WA.

If access onto land is refused by the landowners, the contractor is required to contact the Main Roads Survey Manager 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 can arrange formal notification using delegated powers under the Land Administration Act 1997. 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 contractor must liaise with the Survey Manager to ensure disruption to the contract schedule is minimised.

2.2 WORKING WITHIN THE ROAD RESERVE

Any party undertaking work on a road open to traffic has a duty of care by law to take all necessary and reasonable measures to prevent accident or injury to any person, or damage to property.

The Occupational Safety and Health Act specifically requires:

- An employer to provide a safe place of work for its employees and
- Any person in control of a workplace, to take measures to ensure persons who have access to that workplace (including road users in case of a roadworks site) are not exposed to hazards.

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

2.3 SAFETY REQUIREMENTS

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.

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) upon request and the principal is to be notified of any significant amendments to their Safe System of Work.

Incidents are to be documented and recorded by the Consultant and notified to the Principal and classified into the following incident and injury categories

- Near miss
• Serious Incidents
• Lost time injuries (LTI)
• No lost time injuries (NLTI)
• Medically Treated Injury (MTI)
• First Aid Injury (FAI)
• Damage (over 10% of the contract value)

All lost time injuries and serious incidents are to be documented on the Main Roads WA Safety, Health and Wellbeing Incident Report Form or via the electronic reporting system if made available under contract. All Serious Incidents must be reported to the Principal immediately in accordance with the Main Roads WA Incident Management Procedure for Significant Incidents. Within five business days, the Consultant must provide a detailed report on the incident occurrence, a causal analysis of the incident and recommended actions to control the risks to prevent future occurrence.

The Main Roads WA Safety, Health and Wellbeing Incident Report Form can be accessed through the “Contractor Reporting Forms” on the Main Roads web page.

The Contractor shall detail and implement Risk Management procedures that will identify, assess and implement control measures to manage all Health, Safety and Environmental risks applicable to the Consultant’s works. The consultant may utilize the Safety, Health and Wellbeing templates including the Main Roads WA Safe Work Method Statement (SWMS) or the Main Roads WA Job Safety Environment Analysis Form (JSEA).

The Main Roads WA Safe Work Method Statement (SWMS) and Main Roads WA Job Safety Environment Analysis Form (JSEA) can be accessed through the Contractor Reporting Forms on the Main Roads WA web page.

2.3.1 ENTERING MANHOLES

Manholes and underground areas are not to be entered without a comprehensive confined space procedure. This process must be documented in the contractor’s safe working system and evidence of this process supplied to Main Roads WA upon request. Main Roads encourages all personnel to avoid confined space work as much as possible.

2.3.2 ASBESTOS CONTAINING MATERIALS

Underground infrastructure, including but not limited to Telstra pits and conduits, is known to contain Asbestos and Asbestos Containing Materials. Considerations must be made to allow for safe systems of work that minimise the risk posed on workers.

2.4 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 contractor.

The contractor shall ensure any disturbances are kept to an absolute minimum. The contractor 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 Survey Manager. The contractor shall be responsible for the cost of reinstating any damage to property resulting from their work.
Potholing of services requires the excavation of soil from the existing ground. The following is to be observed by all contractors when performing this activity on site:

- Soil or other foreign material must not be imported to site or exported from site.
- All efforts to minimise transportation of material around a site is expected and no material should be transported more than 500m from its natural location.
- Companies performing potholing services must have adequate systems and processes to prevent the spread of plant seeds, environmental contaminations and diseases such as die back.

### 2.5 HERITAGE / ABORIGINAL SITES

Main Roads personnel and contractors must be aware two key pieces of legislation that guide how we operate: the Aboriginal Heritage Act 1972 and the Heritage of Western Australia (Heritage) Act 1990. The former Act deals with Aboriginal heritage sites whilst the latter deals with non-Aboriginal heritage sites. It is a requirement of both Acts that Main Roads does not disturb any heritage sites without permission from the relevant authority.

A summary of the each Act and their requirements are:

**Aboriginal Heritage Act 1972**

- Aboriginal heritage in WA is protected by the Aboriginal Heritage Act 1972.
- It is an offence to excavate, damage, destroy or in any way alter any place that is considered an Aboriginal site; whether or not the place was known to exist at the time the damage occurred.
- A site may be of a sacred or ceremonial nature (an ethnographic site), and/or contain artefacts associated with traditional cultural life (an archaeological site).
- If Main Roads is unable to avoid damage to an Aboriginal heritage site, consent must be sought to disturb the site under Section 18 of the Act.
- Main Roads considers any ground disturbing within an Aboriginal site without s18 consent to constitute a potential breach of the Act.
- There are significant penalties for not complying with this Act. Penalties apply to the individual who damages a site and ‘any director, manager, secretary, or similar officer of a body corporate’ where damage to a site occurs due to their ‘consent, connivance or neglect’.

**Heritage of Western Australia (Heritage) Act 1990**

- The Heritage Act 1990 provides for and encourages the conservation of places, which have significant cultural heritage value in the state.
- The Act requires that proposals, which may impact upon heritage places protected under this Act, should be referred to the Heritage Council of WA. This would include works by Main Roads within the MRS, works outside the MRS requiring local government approval, and any works affecting a heritage place indirectly.
- Historical heritage assessments need to commence prior to construction, which will identify heritage impacts and determine need for referral and approval pathway followed, if necessary, by consultation with the Heritage Council.

No disturbance to these sites without the required approvals. 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.

3 MOBILE LASER SCAN SURVEYS – “DESIGN GRADE” & “UNTARGETED”.

Main Roads requires mobile laser scan surveys to be of quality, accuracy, and formats as defined herein.

This document defines different requirements for two classes of mobile laser scan surveys – “Design Grade” & “Untargeted”.

For “Design Grade MLS”, the contractor must ensure that the resulting point cloud is of suitable accuracy and quality to meet Main Roads “67-08-43 Digital Ground Survey standard” requirements for extracted/modelled features.

“Untargeted” MLS surveys result in a point cloud with position based on GNSS and other sensors, post-processed from base stations. For this type of survey MLS Ground Targets and MLS verification are not required.

3.1 SURVEY EXTENTS

The project survey extents will be defined geographically by Main Roads WA. Where a 67-08-43 Digital Ground Survey Standard model is defined as the required output, the MLS must adhere to the “Design Grade MLS” requirements defined herein.

The final 67-08-43 Digital Ground Survey Standard model must be complete for the survey extents. This will typically require supplementary survey via other appropriate methods to infill areas or features that cannot or are not suitably modelled from the MLS.

For MLS surveys defined as “Untargeted”, survey extents will generally be defined only by longitudinal extents.

3.2 COORDINATE SYSTEM

Survey data/models must be delivered in the stipulated local Main Roads WA project zone and Australian Height Datum (AHD).

Details of the project zone parameters are available online within the Main Roads Survey Portal.


Or from the Senior Geodetic Surveyor (Phone: 138 138).

3.3 GNSS BASE STATIONS FOR MLS

The following apply for both “Design Grade MLS” and “Untargeted MLS”.

Existing control points with the best available positional uncertainty and suitable sky visibility are to be used as base stations.
All GNSS base stations used for processing the MLS must be defined in the survey report, including the adopted coordinates.

Range from base station to captured point cloud must not exceed 10km.

Virtual Reference Station (VRS) positions/systems must not be used.

Control used as base stations must be “Verified”:

In this context, “Verified” control means the control point is:

- Located and checked for physical stability and quality
- Static GNSS baseline, RTK GNSS, or total station connection (from RTK temporary points is acceptable) for positional verification to adjacent/nearby control point(s).

### 3.4 DESIGN GRADE MLS

Design grade MLS must comply with the following control requirements.

#### 3.4.1 DESIGN GRADE MLS – EXISTING CONTROL

All other existing control within or adjacent to the survey extents must be sought on site, and details noted in the “Survey Report”.

Details are to include:

- Physical condition (Good / Poor / Destroyed)
- GNSS suitability with respect to physical obstructions to satellite signal (Good / Poor).

#### 3.4.2 DESIGN GRADE MLS – VERTICAL CONTROL NETWORK

A differential level traverse is to be undertaken for the extents of the survey area and must include all existing control within or adjacent to the survey extents and all newly created control. Control outside the extents of the survey area that must be included in level network will be specified in project scope.

This requirement may be waived for freeways and major highways, as directed by the survey project manager and defined in the survey project scope.

Differential levelling is to be in accordance with Main Roads WA standard "67-08-38 Differential Levelling", with the exception that two-way levelling is not required, provided the levelling run closes to better than 12rootK against existing verified control.

Aluminium staves must not be used.

Any new control required or stipulated in survey scope/request is to be established in accordance with the relevant Main Roads WA standards.
3.4.3 SURVEY CONTROL FOR DESIGN GRADE MLS SURVEY

3.4.3.1 Design Grade MLS Survey Control Marks

An RRM, SSM with levelled height, or benchmark upgraded with RRM quality XY position is to exist throughout the survey extents at no more than 4km intervals. New RRM control must be constructed in accordance with Main Roads WA Standard “67-08-36 Road Reference Marks”

A description of control survey methodology, vertically and horizontally, must be presented in the survey report. Any issues are to be documented.

The Main Roads WA Senior Geodetic Surveyor can be contacted for advice on:

- Additional work relating to control outside the immediate scope of work.
- The quality and consistency of the existing survey control in and around the project area.
- Supply of new Road Reference Mark (RRM) numbers, plaques (for built up areas) and witness plates for the establishment of new control points.
- The principles to establishing new Road Reference Marks in the field if required.

3.4.3.2 Vertical Control Marks (VCM)

Vertical control marks “VCM” are to be established at no more than 1200m interval. VCMs must be constructed as per the Main Roads WA RRM standard, (Main Roads WA Standard “67-08-36 Road Reference Marks”) with the exception that reference marks are not required. The following requirements apply:

- Specific naming for new marks must be used, as allocated by Main Roads WA
- VCMs are to be established on site a minimum of 15 metres (preferably >25 metres) from the existing centreline.
- Approximate XY position required ~10m accuracy is acceptable (eg float GNSS position, or smartphone GNSS location…). Vertical accuracy is to be in accordance with 67-08-38 Differential Levelling
- VCM specific blue witness plate on star iron picket is required, or a pair of stakes/fence droppers may be used (available from Main Roads WA)
- Summary sheets or diagrams are not required
- Name, coordinates, description of type of mark and location description/measurements must be reported and delivered in comma-delimited csv, and in survey report.

3.4.3.3 Minor Vertical Control Marks (MVC)

Minor Vertical Control Marks “MVC” must be established with no more than 400m spacing along the MLS survey extent and must be included in the level traverse.

Any existing control point (being SSM, BM, RRM or MCP) that is suitably spaced removes the requirement for an MVC.

Options for the physical mark established for MVC’s are:

- Star iron picket, with or without concrete
- Steel spike, Cooke’s nail (set in bitumen where possible)
- Nail and plate
- Ramset nail in concrete
  …Or similar
The following requirements apply:

- Approximate XY position required ~10m accuracy acceptable. (eg float GNSS position, or smartphone GNSS location…) Vertical accuracy is to be in accordance with 67-08-38 Differential Levelling.
- Name, coordinates, description of type of mark and location description/measurements must be reported and delivered in comma-delimited csv, and in survey report.
- Specific naming for new marks must be used, as allocated by Main Roads WA.

### 3.4.4 STATIC GNSS AND LEVELLING SURVEY DATA

#### 3.4.4.1 Static GNSS

Static GNSS data at base stations is to be logged/recorded in accordance with Landgate Guideline for GNSS Geodetic Surveys, with the exceptions/variations below. Static GNSS data must be lodged to Main Roads WA as part of the deliverables.

- 2.6 - Do not need to repair or replace damaged reference marks (RM)
- 3.8 / 7.6 – Specific log sheets etc not required, as long as other details and records are met/supplied (in Main Roads WA survey report or other lodgement)
- 5.3 – Use coordinate values/datum as stipulated by MAIN ROADS WA (Contractor to request if required)
- 6.1 - Network adjustment is to be least squares, constrained to existing RRM/Landgate GDA94 based values
- 7.1 - Use data formats/naming from MAIN ROADS WA standards as first preference, and revert to Landgate when there is no specific MAIN ROADS WA definition.
- 8 – Generate and provide documentation as per MAIN ROADS WA requirements

**NB - Antenna heights:** Record and Provide details and images/photos as per Landgate Standard, section 3.7 & 7.7.

#### 3.4.4.2 Levelling

In the case of “Design Grade” MLS, where levelling of the site is included, raw digital level data file(s) and ASCII file of digital level data is to be lodged with deliverables.

The level Instrument and staff make/model/type is to be noted in the survey report.

### 3.4.5 SURVEY CONTROL TABLE / FILE

A list of all survey control must be included within the survey report and lodged as a .csv/excel spreadsheet. At a minimum this must contain coordinates, description of the type of mark, physical condition (Good / Poor / Destroyed / New) and GNSS sky visibility/suitability. (Good / Poor)

All SSMs, BMs, RRM’s, VCM’s, MVCM’s, MLS ground target points and MLS verification survey/validation points must be included.
3.4.6 DESIGN GRADE MLS – MOBILE LASER SCAN GROUND TARGETS REQUIREMENTS (MLS)

Control and ground targets used to tie down/register the MLS survey will be at the discretion of the consultant. The amount/spacing of MLS control targets may differ depending on the consultant’s equipment and methodology.

The MLS ground target spacing proposed by the consultant must be documented within the consultant’s offer.

Consultants must ensure that the quality and distribution of MLS ground targets is sufficient to produce a point cloud of suitable accuracy for any area where relevant features would be extracted for DGS GenIO modelling in accordance with 67-08-43 Digital Ground Survey Standard.

Main Roads may prescribe a specific MLS ground target density interval in the project scope.

3.4.7 MLS GROUND TARGETS AND THE WORKSITE

MLS ground targets or other control marks must not be permanently marked or painted on roads or paths.

MLS ground targets must be kept to a minimum in size. MLS ground target locations can be in the shoulder of the road, located within line markings or within the centreline of the road. Use of existing features or objects already on site is encouraged.

Due care must be taken to ensure that any material or substances used for targeting will not damage the road, environment or cause any harm to humans, animals or machinery.

Survey points such as coordinated nails flush with the surface, deck spikes flush with the surface and buried pins may be retained but all target material and fastenings (i.e. plastic, paper, pins, wire, nails etc) must be removed from the site as soon as possible after scanning and before the completion of the project.
3.5  MULTIPLE RUN REQUIREMENTS FOR MOBILE LASER SCANS

Multiple runs of mobile laser scanning over the project area or site are required.

Main Roads requires the project area, site or road surface to be scanned a minimum of three separate times.

On carriageways with 2 or more lanes, runs must by driven in the two outside lanes of each carriageway.

3.6  ENVIRONMENTAL CONDITIONS FOR DATA CAPTURE

Main Roads requires that all MLS surveys are carried out with consideration and mitigation of the following environmental factors:

- Road surfaces to be dry, or as dry as possible at time of scanning
- Avoid scanning in high heat, significant dust or rain
- Timing of scanning is to be considered to reduce undesirable physical obstructions captured in the point cloud (e.g. traffic)
3.7 REPORTING, EQUIPMENT DETAILS AND QUALITY ASSURANCE

The “Equipment used” section of the D17#301448 Survey Report Template is to contain the following information at a minimum:

- Scanner model name and number
- Scanner range
- Scanner frequency
- Capture height above ground
- Software used and details or documentation of ground classification methodology

The following Quality Assurance information must be supplied

- Boresight calibration report
- Graph of X Y Z RMS values vs GPS time based on processed GNSS IMU trajectories.
- Graph of PDOP vs GPS time
- A graph of GPS time vs the base line lengths over the project area.

3.8 UNTARGETED MLS

“Untargeted” MLS surveys result in a point cloud with position based on GNSS only, post-processed from base stations. Requirements are the same as Design Grade MLS, with the following exceptions:

- Existing control within or adjacent to the survey extents does not need to be sought.
- Differential level traverse for extents of the survey area is not required
- 4km interval control is not required
- VCMs and MVCMs are not required
- Does not require verification survey
4 POINT CLOUD DATA SUPPLY REQUIREMENTS

“Design Grade MLS” point clouds must be processed to be suitable to meet Main Roads WA 67-08-43 Digital Ground Survey Standard extraction/modelling accuracy and quality specifications.

Untargeted MLS must be captured and supplied to enable possible future upgrade to design grade MLS with additional control field work and processing.

Point clouds must conform to the following requirements.

4.1 FILE FORMAT AND NAMING
The point cloud data must be supplied as las or laz files.

Filenames must not contain spaces. (Use underscore “_” instead)

4.2 COORDINATE DECIMAL PLACES
Coordinates within the lodged las or laz files must be 3 decimal places.

4.3 RGB COLOUR
RGB Coloured point cloud, processed from photography is not mandatory unless specified in project scope.

4.4 REQUIRED POINT CLOUD ATTRIBUTES
The following attributes are required within the delivered point cloud data.

- Intensity
- Return number
- Number of returns
- GPS time
- Scan angle

4.5 CLASSIFICATION
At a minimum, the point cloud must be classified into ground and non-ground points.

4.6 POINT NUMBER LIMITS
Lodged point clouds must be tiled into separate files that must not exceed 3 GB or 100 million points.

4.7 MERGED RUNS
Lodged point clouds are to be of all runs merged.

4.8 INDEX FILE FOR POINT CLOUD TILES
A coordinated index file of the point cloud tile extents must be supplied in .dxf format. The index file must reference the lodged point cloud filenames.
5 VERIFICATION SURVEY (DESIGN GRADE MLS ONLY)

Verifications survey requirements defined below apply only to “Design Grade MLS”.

5.1 Verification Survey – Validation points

Validation points are to be established in cross-section (minimum 3 points) on the sealed road surface at no more than 350m intervals, for the extents of survey.

These validation points must not be used as part of the MLS adjustment, and must be more than 50m in distance from any control points or sites used or constrained in the MLS registration or adjustment.

Validation points must be captured in the field, and are not to be included or used in the processing or generation of any other project deliverables.

Validation points must have height that is spirit levelled, or by total station from spirit levelled control. They must be horizontally positioned to +/-30mm horizontal accuracy.

The vertical component of validation points are to be compared against the adjusted MLS point cloud. Height difference is to be reported.

Validation points are to be lodged as a comma-delimited text file, with XYZ coordinates, and description of type/feature.

5.2 Statistical Analysis

The verification survey data and the MLS Point Cloud data are to be statistically analysed.

The minimum statistics to be included in the survey report are:

- Number of validation points
- Mean
- Standard Deviation
- Range
- Maximum Residual Value
6 LODGED INFORMATION / DELIVERABLES

Deliverables must be lodged to the nominated Main Roads officer and via surveying@mainroads.wa.gov.au

The Main Roads officer/project manager in receipt of survey data must deliver all the information to the Main Roads WA Asset and Geospatial Data Manager or Senior Spatial Analyst (Engineering).

The following items must be lodged:

- MLS point cloud data set(s) in .las or .laz format, version 1.3, as defined in this document.
- Survey report, with contents as defined within this document, and based on document template D17#301448 Survey Report Template
- Verification survey data; Validation points are to be lodged as a comma-delimited text file, with XYZ coordinates and description.
- A statistical analysis of the verification survey compared to the MLS data, as per 5.2
- Metadata statement in accordance with D15#321963 "Survey Metadata Standard",
  - Using pdf template form D15#329516 Metadata Statement Form - Point Cloud
- Index file for point cloud tiles; dxf format.
- Details of survey control as defined in 3.4.4
- Geodetic outputs in accordance with Landgate Guideline for GNSS Geodetic Surveys with the exceptions as specified in section STATIC GNSS AND LEVELLING SURVEY DATA
7 FILE NAMING CONVENTION

Lodged .las / .laz files, metadata, verification and report must comply with the following naming convention.

Road number_SLK Range_Descriptor_Zone_Tile Number.ext

Where;

Road number is the Main Roads Road Number or the local road number. The Main Roads number will consist of a 4 character H or M number and a local road will be a 7 digit number.

SLK Range is the start and end SLKs for the entire survey;

Descriptor must be one of the following.

“MLSYYYYMM” point cloud data; .las/.laz format, year and month descriptor;
“MLSVER” the verification survey, validation points; .txt/.csv
“MLSMTD” Metadata, .pdf;
“MLSREP” Survey Report, .pdf/.doc/.docx;
“MLSINDEX” MLS tile index, .dxf;

Zone is the Project Zone / coordinate system.

.ext is the file type extension.
-.csv / .txt or comma-delimited validation point coordinate 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 point cloud .las / .laz index file
-.las / .laz point cloud format.