# Digital Estate Management
# BIM and CAD Standards

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# Table of Contents


**1. Introduction ..... 4**
1.1. Introduction to the Digital Estate ..... 4
1.2. Summary of Amendments to CAD and BIM Standards ..... 4
1.3. Background ..... 4
1.4. Project Applicability Matrix ..... 4
1.5. Definitions and Acronyms ..... 5

**2. General Requirements ..... 6**
2.1. Conditions of Compliance ..... 6
2.2. Drawing Transmittal Requirements ..... 6
2.3. File Naming Convention ..... 6

**3. BIM Standards and Guidelines ..... 7**
3.1. Design Software Compatibility and Versions ..... 7
3.2. BIM File Format Requirements ..... 7
3.3. BIM Model Delivery ..... 7
3.4. BIM Execution Plan Development and Implementation ..... 7
3.5. BIM Authoring Software for Major Projects ..... 7
3.6. BIM Model Coordination and Collaboration ..... 8
3.7. Level of Development (LOD) Guidelines for BIM Projects ..... 8
3.8. Revision Control, Version Management, and Data Exchange ..... 8
3.9. Geospatial and Coordinate Standards ..... 8
3.10. VBIS (Virtual Building Information System) Integration ..... 8

**4. CAD Standards and Guidelines ..... 10**
4.1. CAD File Format Requirements ..... 10

**5. Asset Information Requirements ..... 11**
5.1. AIR Development and Implementation ..... 11
5.2. Asset Data Delivery ..... 11
5.3. Post-Project Responsibilities ..... 11
5.4. Documentation and Reporting ..... 12

**6. Project Information Requirements ..... 13**
6.1. Asset Register Deliverable ..... 15

**7. CAD Drawing and Model Production and Delivery ..... 16**
7.1. Drawing and Model Production Guidelines: ..... 16
7.2. Drawing and Model Coordination and Audits ..... 16
7.3. Drawing and Model Submission Process ..... 16
7.4. Integration of BIM in Projects ..... 16

**8. Collaboration and Communication ..... 18**
8.1. Roles and Responsibilities ..... 18

8.2. Data Security and Integrity ..... 18
8.3. Training and Competency ..... 18
8.4. Common Data Environment (CDE) Management ..... 18

**9. Survey Requirements ..... 20**
9.1. Feature Surveys ..... 20
9.2. Underground Services ..... 20
9.3. Landscape Features ..... 21

**10. Reality Capture and Delivery ..... 21**

**APPENDIX A - DRAWINGS, AS-BUILTS & MANUALS - FORMAT & SUBMISSION ..... 22**

**APPENDIX B – LUNR SUBMISSION GUIDELINES ..... 25**

**APPENDIX C – LOD DEFINITIONS FOR BIM PROJECTS ..... 26**

**APPENDIX D – INDUSTRY STANDARDS ..... 27**

**APPENDIX E – FILE NAMING ..... 28**

**APPENDIX G - ASSET INFORMATION TEMPLATE ..... 29**

**APPENDIX H - UNIQUE ENTITY CODES - VBIS ..... 37**

**APPENDIX I - UNDERGROUND SERVICES SURVEY INFORMATION ..... 38**

**APPENDIX J - UNDERGROUND SERVICES UNIQUE ENTITY CODES ..... 47**

**APPENDIX K – REALITY CAPTURE AND DELIVERY GUIDELINES ..... 50**

# 1. Introduction

## 1.1. Introduction to the Digital Estate

The Digital Estate is a comprehensive framework that underscores University of Melbourne's commitment to advancing the digital management of the physical assets, including building sand facilities. In alignment with industry best practices and standards such as ISO 19650 and the Victorian Digital Asset Strategy (VDAS), Digital Estate program lays out a strategic roadmap for the systematic transition towards the next generation of facilities management. This transition extends its reach to our CAD and BIM standards, reflecting our evolving approach to project delivery.

## 1.2. Summary of Amendments to CAD and BIM Standards

The following summarises the recent changes to the CAD and BIM Standards document. The University is incorporating principles of BIM into Project Delivery; hence the Standard is being renamed to BIM and CAD Standards.

## 1.3. Background

The purpose of this document is to provide clear and standardised guidelines for project teams involved in design, construction, and facilities management projects at the University of Melbourne. These guidelines encompass both CAD and BIM aspects to ensure that projects adhere to uniform practices, regardless of their scale or complexity.

In this document, the requirements for the AS BUILT drawings are outlined. The objective is to obtain a high-quality uniform set of documents that can easily be uploaded into the University's online repository, LUNR.

These Standards should be read in conjunction with the UoM consultant agreement or building contract (when applicable).

BIM is becoming increasingly integral to the University's project lifecycle, enabling comprehensive digital representations of facilities.

## 1.4. Project Applicability Matrix

To ensure that the standards presented in this document applied appropriately, the Project Applicability Matrix, as outlined below, aids in determining the specific requirements applicable to each project.

| | Low risk | Medium risk | High risk |
|---|---|---|---|
| **Low cost** | In development | In development | In development |
| **Medium cost** | In development | In development | In development |
| **High cost** | In development | In development | In development |

## 1.5. Definitions and Acronyms

| Term | Definition |
|---|---|
| **CAD** | Computer Aided Drafting. |
| **AS-BUILT** | Measured and revised drawings documenting the full extent of completed building works. |
| **MGA** | Map Grid Australian. MGA refers to the UTM (Universal Transverse Mercator) grid system used in Australia. The country is divided into a series of zones, each with its projection and coordinate system. Melbourne University is in Zone 55. |
| **AHD** | Australian Height Datum. AHD is focused on vertical measurements, ensuring that height measurements are standardized and can be compared across different locations |
| **GDA** | Geocentric Datum of Australia. GDA covers both horizontal (latitude and longitude) and vertical (ellipsoidal heights) measurements, providing a comprehensive framework for positioning in three dimensions. |
| **DWG** | Default AutoCAD drawing file format. |
| **LAYER** | Electronic drawing sheet within a drawing file upon which data can be drawn and manipulated. A layer can be turned on or off as required. |
| **BIM** | Building Information Modelling is a collaborative process that involves generating and managing digital representations of a facility's physical and functional characteristics. |
| **LUNR** | The University's online database is used for storing CAD files and related documents. |
| **ISO19650** | ISO 19650 is an international standard that focuses on managing information over the whole life cycle of a built asset using building information modelling (BIM). It provides guidelines and requirements for effective information management and collaboration in construction and infrastructure projects. |
| **VBIS** | VBIS tags provide an ontology for assets in the built environment. The VBIS tags comprise a four-level structure that provides unique alphabetic tags per type of asset. |

# 2. General Requirements

## 2.1. Conditions of Compliance

All consultants and contractors engaged in university projects are expected to meet the specifications defined in the CAD and BIM Standards established by the Space Management Team, Business Services, University of Melbourne. These standards serve as a foundation for consistency, accuracy, and effective collaboration throughout the project's lifecycle.

The University's Space Management Team provides consultants and contractors with copies of Melbourne University Information files. Information files can be either in proprietary (e.g., dwg) or Open (e.g., pdf) formats.

Consultants and contractors are to use Melbourne University files for reference only and accepts no liability for their accuracy for purposes of building design and construction.

The consultants/contractors shall provide the Space Management Team with "As-Built" AutoCAD drawings. These drawings should accurately depict the final state of the constructed environment and should be submitted no later than four weeks after achieving practical completion.

The University of Melbourne's CAD and BIM standards establish consistent procedures, formats, and expectations for the creation, exchange, and management of design and construction information. These standards ensure effective collaboration, accuracy, and data interoperability throughout the project lifecycle. Project teams must adhere to these standards to maintain high-quality documentation.

## 2.2. Drawing Transmittal Requirements

Drawing files must meet these basic criteria or they will not be accepted.

- All "As-Built "drawings are to be marked in an obvious fashion with the text "As-Built" on both the CAD files and the PDF copies of the drawings.
- One set of "As-Built" information per project is required. Multiple contracts or building requisitions shall not be combined into one set of "As-Built" documentation.
- All computer files shall be submitted through the UoM online submission portal – LUNR https://documents.lunr.app/#/login

Please refer to:

- "APPENDIX A - DRAWINGS, AS-BUILTS & MANUALS - FORMAT & SUBMISSION" document for detailed submission and format guidelines and
- "APPENDIX B – LUNR SUBMISSION GUIDELINES" for instructions on submissions through the LUNR platform.

## 2.3. File Naming Convention

Standardised naming practices enhance clarity and organisation. Adhere to these conventions for effective project management:

- Adopt a standardised naming convention based on ISO 19650 for CAD and BIM files, folders, and components. See APPENDIX E – FILE NAMING for the file naming breakdown.
- Maintain consistency in file names to ease file organisation and retrieval.
- Any deviations from APPENDIX E – FILE NAMING must be approved by UoM.

# 3. BIM Standards and Guidelines

## 3.1. Design Software Compatibility and Versions

The choice of design software is pivotal to project success. To ensure effective collaboration and consistent outcomes, the following guidelines apply: APPENDIX E – FILE NAMING

- Utilise the designated design software versions that align with the University's standards.
- Ensure compatibility among project stakeholders using the same software and file versions.

Whenever CAD drawings are generated using software other than the designated CAD platform, they must be converted into the AutoCAD .dwg file format. This conversion is mandatory before transferring the drawings to UoM or as per the request of the UoM CAD Manager upon completing any project phase.

The responsibility for ensuring the accuracy and alignment with UoM CAD Drawing Standards during the translation process rests with the Contractor. Any expenses incurred due to inaccuracies or deficiencies in the translation or drafting will be the contractor's responsibility.

The final submissions of plots to UoM must be generated from the translated CAD file, rather than the original CAD file.

## 3.2. BIM File Format Requirements

Ensure accurate file formats for BIM data exchange and interoperability. Adhere to the following requirements for BIM files:

- All BIM files shall conform to industry-standard file formats such as .ifc or .rvt.
- Maintain a consistent drawing unit of one millimetre for BIM files.

## 3.3. BIM Model Delivery

For efficient BIM model delivery, adhere to these guidelines:

- Submit BIM files through the designated Lunr upload function or other approved platforms.
- Ensure compliance with the BIM model delivery requirements outlined in "Section 7: Model Production and Delivery.

Please refer to:

- "APPENDIX A - DRAWINGS, AS-BUILTS & MANUALS - FORMAT & SUBMISSION" document for detailed submission and format guidelines.

## 3.4. BIM Execution Plan Development and Implementation

For projects involving BIM, a BIM Execution Plan (BEP) is integral. It outlines project-specific details for coordination, modelling, and collaboration while aligning with university standards:

- Develop and implement a BEP for major projects.
- Address coordination, model development, information exchange, and collaboration in the BEP.
- Ensure the BEP complies with the University's overall CAD/BIM standards and project-specific requirements.

## 3.5. BIM Authoring Software for Major Projects

The choice of BIM authoring software significantly impacts project outcomes. To ensure effective collaboration and adherence to standards, follow these recommendations:

- Utilise specified BIM authoring software compatible with the University's BIM standards.
- Ensure the chosen software supports efficient collaboration and data sharing.
- Emphasise the requirement that 2D design elements must be connected to their corresponding 3D models using BIM-enabled software.
- Comply with guidelines for consistent and accurate data exchange between 2D and 3D representations.

## 3.6. BIM Model Coordination and Collaboration

Effective coordination of BIM models is crucial to avoid clashes and inconsistencies. Coordinate system and datum standards will be consistent with those specified in Section 3.9 (Geospatial and Coordinate Standards). Additionally, the following coordination practices will be followed:

- BIM models shall be aligned with the designated coordinate systems to ensure an accurate representation of building elements in their real-world context.
- Clash detection and resolution processes will be implemented to identify and rectify clashes between different disciplines' models.
- Models from various disciplines shall be integrated using coordination software to visualise and resolve any spatial conflicts.
- Clear communication protocols will be established to address coordination issues and ensure timely resolution.

## 3.7. Level of Development (LOD) Guidelines for BIM Projects

LOD guidelines define the degree of detail in BIM models. Establish consistent expectations:

- Define the LOD requirements for various elements of the BIM model at different project stages. See APPENDIX C – LOD DEFINITIONS FOR BIM PROJECTS for the LOD breakdown.
- Address any clashes or conflicts identified during the coordination process.

## 3.8. Revision Control, Version Management, and Data Exchange

Effective data management is vital for project integrity. Adhere to these practices:

- Establish a robust revision control and version management system for both CAD and BIM models.
- Document changes and updates to track the evolution of models over time.
- Define data exchange formats and protocols for seamless sharing of CAD and BIM data.
- Ensure compatibility with industry standards to facilitate smooth data exchange.

## 3.9. Geospatial and Coordinate Standards

For all spatial data and feature surveys, the following coordinate systems and datums must be used:

- Map Grid Australia, Zone 55 (MGA 55) GDA 2020 for horizontal coordinates.
- Australian Height Datum (AHD) for vertical coordinates.

## 3.10. VBIS (Virtual Building Information System) Integration

VBIS is a critical component of the University of Melbourne's asset management strategy, and its integration with CAD and BIM standards is essential for effective project management. VBIS provides a classification system

for categorising assets based on their value and importance within the project. Please refer to APPENDIX H - UNIQUE ENTITY CODES - VBIS

- **VBIS Codes for Asset Classification:** Contractors and designers are required to assign VBIS codes to every asset within the project. These codes help prioritise and manage assets effectively throughout the project lifecycle.
- **Integration with CAD and BIM Standards:** VBIS integration ensures that asset data captured in CAD and BIM models align with asset classifications, enabling accurate reporting and decision-making.
- **Compliance:** Project teams and stakeholders are expected to comply with VBIS integration requirements as outlined in this section and ensure that VBIS codes are correctly assigned to project assets.

# 4. CAD Standards and Guidelines

## 4.1. CAD File Format Requirements

Accurate file formats are crucial for data exchange and interoperability. Ensure adherence to the following requirements for CAD files:

- CAD files shall be in AutoCAD 2020 (.dwg) file format or previous versions.
- One drawing unit = one millimetre
- Use standard installation fonts and line-type files provided by AutoCAD.
- Eliminate external references, ensuring that x-refs are bound or will not be accepted
- Files must be purged
- There shall be one AutoCAD file per completed drawing
- Multiple drawing sheets shall not be contained in one AutoCAD file
- Drawing entities shall be in model space
- All CAD files of building floor plans must have a BASE set to “0,0,0” and the floor plans drawn to the same grid coordinates on each CAD file
- All entities within the drawing file must have the colours and line types set to BYLAYER.

The documentation to be supplied MUST include:

- PS Number as provided by the project manager on each title sheet of the drawing
- Marked with “AS BUILT” on each title sheet of the drawing
- Marked with the correct DATE on each title sheet of the drawing
- Marked with correct REVISION numbers on each title sheet of the drawing.

All queries relating to the CAD Standards should be directed via the university-appointed project manager assigned to your project.

# 5. Asset Information Requirements

Asset Information Requirements (AIR) are essential components of the University of Melbourne's CAD and BIM standards. They define the specific information and data that must be captured, documented, and delivered as part of the project to ensure effective asset management throughout the building's lifecycle. Adherence to AIR standards is critical for maintaining the University's infrastructure and supporting efficient facilities management.

## 5.1. AIR Development and Implementation

Effective development and implementation of AIR are fundamental for the successful management of university assets. Follow these guidelines:

- **Identify and Document Required Data**: At the project initiation phase, identify and document the specific asset data and information required for each project. This may include details such as equipment specifications, maintenance schedules, warranties, and operational manuals.
- **Align with University Standards**: Ensure that the asset information aligns with the University's established VBIS data standards and classifications, making it consistent and compatible with existing systems. Refer to APPENDIX G - ASSET INFORMATION TEMPLATE
- **Collaborate with Stakeholders**: Involve key stakeholders, including facilities managers, operations teams, and end-users, in the development of AIR to capture their requirements and expectations effectively.
- **Integrate with BIM**: If the project involves Building Information Modeling (BIM), integrate AIR requirements with the BIM model. Define how asset data will be linked to specific BIM components or objects.
- **Define Data Formats**: Specify the formats in which asset information should be delivered. Common formats include spreadsheets, PDFs, or industry-standard data formats (e.g., COBie for BIM projects).

## 5.2. Asset Data Delivery

Properly delivering asset data is crucial for smooth operations and maintenance. Adhere to the following guidelines:

- **Include Asset Data in Deliverables**: Ensure that all relevant asset information is included in the project deliverables. This may involve creating separate documentation for asset data or integrating it into existing project documents.
- **Clear Documentation**: Provide detailed documentation for each asset, including its location, specifications, maintenance requirements, and any relevant warranties or guarantees.
- **Delivery Methods**: Specify the methods and channels for delivering asset data. This may include electronic submission through a designated portal or the inclusion of physical documentation in project handover.
- **Training**: If necessary, include training materials or plans for facilities management and operations staff to effectively utilise the asset data provided.

## 5.3. Post-Project Responsibilities

Asset information management extends beyond project completion. Ensure that asset data remains up-to-date and accessible:

- **Maintenance and Updates**: Define procedures for updating asset information as equipment or systems change over time. Assign responsibility for ongoing data maintenance.
- **Integration with Facilities Management Systems**: Ensure that the asset data seamlessly integrates with the University's facilities management systems for efficient tracking and maintenance.
- **Accessibility**: Specify how authorized personnel can access asset information when needed, ensuring data is readily available for maintenance, inspections, and repairs.

- **Audits and Compliance**: Establish processes for auditing and verifying the accuracy and completeness of asset data to maintain compliance with University standards.

## 5.4. Documentation and Reporting

Accurate documentation and reporting are essential for monitoring asset performance and compliance. Implement the following:

- **Reporting Requirements**: Define regular reporting requirements for asset performance, maintenance schedules, and any critical issues that require attention.
- **Key Performance Indicators (KPIs)**: Establish KPIs to assess the effectiveness of asset management and compliance with AIR.
- **Review and Improvement**: Periodically review and refine AIR based on lessons learned from previous projects and evolving University needs.

By integrating Asset Information Requirements into project workflows and ensuring the consistent delivery of asset data, University projects can contribute to more effective facilities management and enhanced infrastructure sustainability.

# 6. Project Information Requirements

The following table defines a standardised set of attributes required for each project asset. These attributes provide a consistent and comprehensive basis for documenting assets. They enable effective asset tracking, maintenance, and reporting by contractors and project stakeholders.

| Attribute Name | Definition | Mandatory/Optional |
|---|---|---|
| **Name** | Name of asset. Can ideally be VBIS level 2, 3 or 4 classifications (product, sub-type or sub-sub-type). | Mandatory |
| **Description** | A short Description of the asset may include the type and size of the asset, or location within the space. Used to identify the asset. | Mandatory |
| **Campus Code** | Three-letter campus code. | Mandatory |
| **Building Code** | Three to four-letter code uniquely identifying building. | Mandatory |
| **Floor Code** | Code representing asset floor. | Mandatory |
| **Room Code** | Code representing space or room. | Mandatory |
| **Layer** | The specific layer within the University of Melbourne's defined layering system is where the asset is located (e.g., architectural, structural, electrical). | Optional |
| **Space Type** | A classification specifying the functional use or purpose of the space associated with the asset (e.g., office, laboratory, classroom). | Optional |
| **Floor Capacity** | The maximum permitted occupancy capacity for the space associated with the asset is crucial for occupancy permit and safety purposes. | Optional |
| **Areas within Polylines (non-Reportable Areas Deducted)** | Details regarding areas enclosed by specific polylines related to the asset, excluding non-reportable areas such as desks, furniture, or other elements that are not considered part of the asset. | Optional |
| **Criticality** | Rating between 1-5 classifying the criticality of the asset, 1 being most critical, 5 being least critical. If criticality is not defined, use VBIS mapping to look up standard asset criticality. | Optional |
| **Latitude** | Latitude of the asset. | Optional |
| **Longitude** | Longitude of asset. | Optional |
| **Manufacturer** | Asset manufacturer. | Optional |

| | | |
|---|---|---|
| **Model Number** | Asset model number. | Optional |
| **Warranty ID** | Asset Warranty ID. | Optional |
| **Asset ID** | ID number uniquely identifying the asset. | Optional |
| **Install Date** | Asset installation date. | Optional |
| **Replacement Cost** | Cost to replace the asset. | Optional |
| **Replacement Date** | The date at which asset replacement is required. Defined by asset manufacturer or UoM guidelines. | Optional |
| **Replacement Date Calculation** | Replacement date calculation is to be used in the absence of a specific replacement date. Calculated from installation date and replacement period. | Optional |
| **Replacement Period** | The lifespan of the asset. The period between the installation date and the required replacement date. | Optional |
| **Purchase Cost** | Asset purchase cost. | Optional |
| **Status** | Operational status of the asset. Can be active, inactive, disposed, or lost | Optional |
| **Comments** | Comments can be observations upon asset audit or notes informing changes and updates. All comments should be dated. | Optional |
| **Condition** | Asset condition rating between 1-5, 5 being excellent condition and 1 being very poor condition. The TEFMA condition rating system is adopted. | Optional |
| **Expected Condition** | Expected asset condition rating between 1-5, 5 being excellent condition and 1 being very poor condition. The TEFMA condition rating system is adopted. | Optional |
| **Cost Depreciated Value** | Asset depreciated value. Difference between purchase cost and current estimated value. | Optional |
| **Failure Index** | Rating between 1-5 classifying the risk of asset failure, 1 being highest failure risk, 5 being least failure risk. | Optional |
| **Design Life** | The design life of the asset. Expected period before replacement is required. Defined by manufacturer. | Optional |
| **Asset UoM Contact** | First and last name of UoM staff member to contact regarding the asset. | Optional |

| | | |
|---|---|---|
| **Salvage Value** | The current estimated value of the asset. | Optional |
| **Serial Number** | Asset serial number. | Optional |
| **Barcode** | Asset Barcode | Optional |
| **Date Last Changed** | The date at which the asset details were last changed. Usually date of the most recent asset audit. | Optional |
| **Date Record Created** | The date at which the asset was first recorded. | Optional |
| **Warranty Period** | Asset Warranty period. | Optional |
| **VBIS Code** | VBIS Code. Can be looked up using the VBIS classification table. | Optional |

These common attributes should be integrated into CAD/BIM modelling and documentation practices. Contractors and project stakeholders are expected to adhere to these standards when providing asset information for the project.

For more detailed information and attribute requirements, please refer to the University of Melbourne's Asset Information Template provided in the Excel Spreadsheet.

## 6.1. Asset Register Deliverable

This EIR forms the basis for how each contractor involved in the project needs to fill out the 'asset register' deliverable in the Project Management Plan (PMP). Contractors are expected to provide accurate and complete information for each asset, adhering to the specified common attributes and metadata descriptions.

# 7. CAD Drawing and Model Production and Delivery

## 7.1. Drawing and Model Production Guidelines:

Producing CAD drawings and models is fundamental to effective project documentation. This section outlines guidelines and procedures to ensure high-quality production.

**Drawing Production:**

- Utilise designated design software versions aligned with University standards.
- Adhere to established CAD file format requirements for uniformity.
- Follow naming conventions for files and folders to streamline organisation.

**Model Production:**

- Develop CAD and BIM models by University standards.
- Maintain consistency in software versions and file formats.
- Utilise naming conventions for files, folders, and elements within the BIM model.
- Organise model components according to respective disciplines and systems.
- Implement a logical hierarchy for model elements to facilitate easy navigation and understanding.

## 7.2. Drawing and Model Coordination and Audits

Coordination and auditing are pivotal for accuracy and quality in CAD drawings and models.

**Drawing Coordination:**

- Collaborate with cross-disciplinary teams to ensure accurate design representation.
- Address potential clashes or conflicts that surfaced during coordination.

**Model Coordination and Clash Detection:**

- Conduct regular coordination meetings to review clash detection results.
- Utilise clash detection software to identify and resolve clashes.

**Drawing and Model Audits and Verification:**

- Conduct audits periodically to verify alignment with specifications.
- Document changes made during the audit process and update accordingly.

## 7.3. Drawing and Model Submission Process

Submitting CAD drawings and models is a crucial aspect of project delivery.

**Drawing Submission:**

- Utilise the University's designated online repository, LUNR.
- Ensure strict compliance with drawing transmittal requirements.

**Model Submission:**

- Prepare BIM models according to specified LOD and information delivery requirements.
- Use the designated submission platform to upload BIM models and documentation.

## 7.4. Integration of BIM in Projects

Integrating BIM principles enhances project efficiency across various scales.

**Comprehensive BIM Implementation:**

- For new buildings and major projects, involve key stakeholders in the BIM process.
- Include detailed information about all systems and components in BIM models.

**BIM Integration in Small-Scale Projects and Fit-Outs:**

- Utilise BIM for space planning, furniture layouts, and coordination.
- Apply BIM principles to manage information exchange and ensure accurate documentation.

# 8. Collaboration and Communication

Efficient collaboration and clear communication are fundamental to the success of projects. This section outlines the roles, responsibilities, data security, training, and management of the Common Data Environment (CDE) for effective collaboration among project stakeholders.

## 8.1. Roles and Responsibilities

Clearly defined roles and responsibilities are essential for streamlined collaboration. Project stakeholders must understand their roles and the contributions they bring to the project. Key roles include:

- Project Manager: Oversees the project's overall execution, coordinates stakeholders, and ensures adherence to standards.
- BIM Manager: Manages the implementation of BIM processes, coordinates BIM-related activities, and oversees model quality.
- Discipline Leads: Lead multidisciplinary teams and ensure design integration within their respective domains.
- Designers: Create design solutions based on project requirements and collaborate to achieve an integrated design.
- Contractors: Execute construction based on design documents and provide feedback for improvement.
- Facility Managers: Ensure a seamless transition from construction to operations, maintaining accurate facility information.

## 8.2. Data Security and Integrity

Maintaining data security and integrity is paramount to protect sensitive project information and ensure its accuracy. Key considerations include:

- Access Control: Implement appropriate access controls to limit data exposure to authorised personnel.
- Data Encryption: Apply encryption methods to safeguard data during transfer and storage.
- Data Backups: Regularly back up project data to prevent loss due to unexpected events.
- Change Management: Establish procedures for documenting and managing changes to project data.

## 8.3. Training and Competency

Ensuring that project team members have the necessary skills and knowledge is essential for effective collaboration. Training and competency initiatives include:

- Training Programs: Offer training in relevant software, tools, and BIM methodologies to enhance skills.
- Continuous Learning: Encourage ongoing professional development to keep up with industry advancements.
- Cross-Training: Promote cross-disciplinary training to foster multidisciplinary understanding.

## 8.4. Common Data Environment (CDE) Management

The Common Data Environment (CDE) serves as the central repository for project data and fosters collaboration. Key considerations include:

- Platform Selection: Choose an appropriate CDE platform that aligns with project needs.
- Data Structuring: Organise data within the CDE in a clear, consistent manner to facilitate easy retrieval.
- Version Control: Implement version control to track changes and maintain the accuracy of project data.
- Document Management: Ensure that all project-related documents are managed within the CDE for comprehensive access.

# 9. Survey Requirements

The following are special requirements for the Feature Survey and Underground Services documentation.

## 9.1. Feature Surveys

All plans shall be orientated with North to the top of the screen. Where a campus survey drawing is used there shall be NO rotation to the drawing.

All elements shall be surveyed in three coordinates (X, Y, Z) using only Map Grid Australia, Zone 55 (MGA 55) and Australian Height Datum (AHD).

Where available within the campus, a minimum of three benchmarks shall be used and tied to one another to check for any possible variation in the coordinates or RL. Where no guaranteed benchmarks exist in the campus area, the contractor must place at least three control points in the campus area by a qualified surveyor. The coordinates and mapped positions of these control points must be submitted with the final work. The control points must be placed in stable areas where there is little chance of them being destroyed.

Contours shall be displayed on all drawings at a suitable contour interval where applicable.

Trees of a height of one metre or more shall be surveyed. The position of the tree shall be surveyed as the middle of the trunk, measured at one metre above ground level.

Landscape features, including but not limited to paths, garden beds, outdoor infrastructure, hard landscape features, and soft landscape features, shall be accurately surveyed and represented in the drawings.

## 9.2. Underground Services

All constructed underground services shall be mapped on the campus survey plan, and their relationship to landscape features should be clearly indicated.

The investigation shall provide the following information for each service detected, regardless if part of the service is above ground or underground:

- The service location on plan together with an offset measurement from the nearest building line.
- Material of pipe or conduit.
- Depth or cover to pipe, conduit or cable.
- Diameter of pipe or conduit.
- The reduced level on pit covers.
- The depth and exact location of the pit, including the edges of the pits.
- The inverted level of pipes or conduits converging at a pit.
- Documentation on the type of pit, material and depth of the pit, type of lid, and state of repair of the pit.
- In the cases of an array of conduits, the surveyor shall provide information on how many conduits are empty and how many are being used.
- All isolation valves to buildings or other set areas, this is to include valves inside and outside buildings, and their relation to landscape features.
- Landscape features that may be affected by underground services should be clearly identified and documented.

The contractor shall also detail all service entity information as specified in Appendix I – ‘Underground Services Survey Information’.

The final documentation for underground services shall be provided in two formats incorporating an AutoCAD Drawing file and an Excel Spreadsheet. To enable Excel information to be associated with the right service entity

on the CAD file, each Excel record will have a unique entity code. The format for this code is specified in Appendix J – 'Underground Services Unique Entity Codes'.

The pit number for pits shall be the same as the unique entity code as specified above.

All abbreviations used in the documentation of the underground services must be fully defined within the legend of all title sheets.

As an **exception** to Section 4.1, underground service Cad files shall comprise of external reference files. One AutoCAD CAD file for each service type surveyed.

The Space Management Team, University of Melbourne can provide records of known services through the LUNR repository upon request.

### 9.3. Landscape Features

The landscape survey shall include accurate data on the following landscape features:

- Outdoor infrastructure, including overhead and underground services, signage, bins, furniture, hydration stations, emergency phones, bike repair stations, poster poles, barbeques, compost bins, water features, pots, bollards, bird baths, irrigation assets, and more.
- Hard Landscape Features, such as paths, fence lines, gateways, furniture, retaining walls, kerb and channel, buildings (including entries), and other structures within the site boundary.
- Soft Landscape Features, including informal path edges, trees, garden beds, lawns, ponds, and all vegetation above 1 meter in height.
- Level Information to accurately represent the ground surface topography.

The survey should identify and differentiate various landscape features with appropriate symbols and layers for clear representation.

Landscape features shall be represented in AutoCAD drawings scaled at 1:1 meters and using EPSG: 7855 (GDA 2020 Zone 54/55). Electronic files larger than 8MB must be zipped for transmission.

The survey shall accurately capture all landscape features and their relationship to underground services, buildings, and other site elements.

Surveyors must conduct all necessary investigations, including Dial Before You Dig and electronic service detection, to accurately locate landscape features and their connections to underground services.

## 10. Reality Capture and Delivery

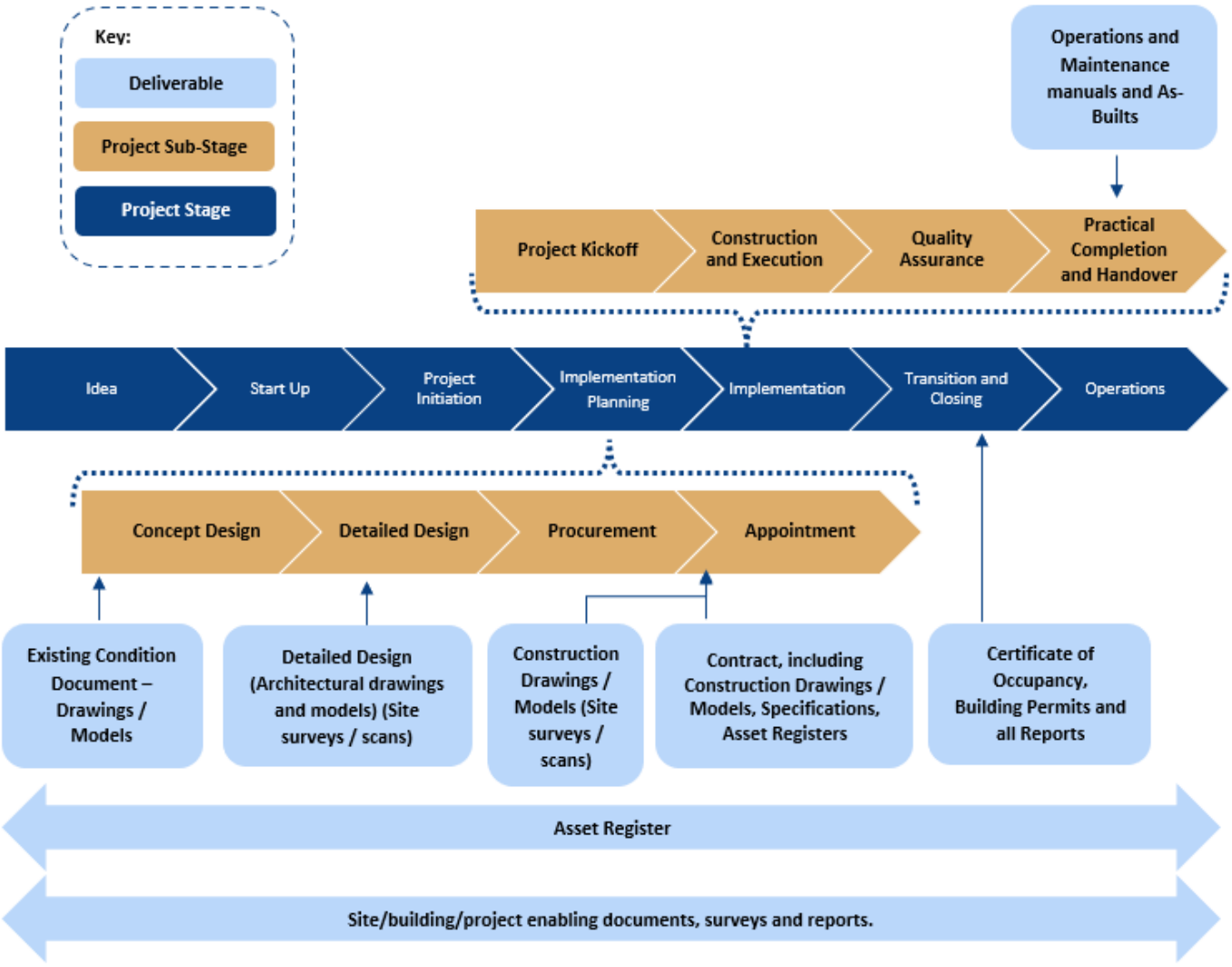
Reality capture solutions digitally capture existing asset or actual jobsite conditions. These solutions leverage various visual capture methods, including but not limited to, laser scans, photography, videography and drone-mounted cameras, to capture source data. Contractors must capture source data in alignment with the University of Melbourne reality capture data requirements, file formats and delivery documentation requirements defined in APPENDIX K – REALITY CAPTURE AND DELIVERY GUIDELINES, to align with CAD and BIM standards. All reality capture data captured by contractors is IP of and owned by University of Melbourne. Contractors must ensure complete accessibility of the captured data and upload it to University of Melbourne Lunr platform or as agreed with Space Management to allow University of Melbourne to keep a record of existing asset and job site conditions. Reality capture contractors must be qualified as defined in APPENDIX K – REALITY CAPTURE AND DELIVERY GUIDELINES.

# APPENDIX A - DRAWINGS, AS-BUILTS & MANUALS - FORMAT & SUBMISSION

This appendix provides quick guidelines for format and submission for all stages of a project.

**Drawings, As-builts & Manuals for Space Management**

*Quick Guidelines for Format & Submission*



**Submission timing, format, and purpose**

| Deliverable | Stage | Format | Purpose |
|---|---|---|---|
| **Detailed Design Drawings**<br>**Architectural floor plans with furniture layout** | End of the Detailed Design stage within Implementation Planning | .pdf | For issuance of room numbers |
| **Construction Drawings**<br>**Architectural floor plans with furniture layout** | End of the Procurement stage within Implementation Planning | .dwg & .pdf | For updating SIS |
| **Contract: including Construction Drawings/ Models, Specifications, and Asset Registers** | End of the Procurement stage within Implementation Planning | .pdf, .dwg, .rvt / .ifc as agreed, .xlsx | For space management planning and operations |
| **As-Builts**<br>**All architectural drawings (incl. joinery drawings) Structural drawings**<br>**All services & all disciplines**<br>**Site & feature surveys 7 U.G Services** | Within 4 weeks of practical completion | .dwg & .pdf | Operational readiness |
| **Manuals** | Practical completion | .pdf | Operational readiness |
| **Asset Register**<br>**A comprehensive record of project assets. The Asset Register is linked to the University's Information Requirements within the CAD and BIM Standard which defines the necessary asset information and metadata requirements throughout the project lifecycle.** | Throughout the project lifecycle (Implementation Planning stage) | .csv (excel) | Asset Management System Integration |
| **Certificate of Occupancy, Building Permits and all Reports** | Practical completion | .pdf | Operational Readiness |
| **Site/building/project enabling documents, surveys and reports**<br>**e.g. site condition & analysis reports, soil tests, site surveys, underground services surveys, precinct feasibility plans, master-plan feasibility & analysis reports, building condition reports, latent condition reports, reports on existing building services, landscape analysis, product specifications)** | Throughout the project lifecycle (Implementation Planning stage) | .pdf | To inform ongoing management of the Estate |

| | | | |
|---|---|---|---|
| **Existing Conditions Document**<br>**Including existing drawings and models** | Before Concept Design | .ifc / .rvt or as agreed | Accurate depiction of existing conditions for design |
| **Design Models** | Detailed Design | .ifc / .rvt or as agreed | Visualisation and communication of design intent |
| **Construction Models** | End of Construction documentation (Implementation Planning stage) | .ifc / .rvt or as agreed | Support for construction planning and coordination |
| **As-Built Models** | Before Practical Completion | .ifc / .rvt or as agreed | Accurate record of completed construction |

# APPENDIX B – LUNR SUBMISSION GUIDELINES

All As-Built drawings, surveys, models, reports, certificates, permits and manuals must be submitted electronically through the LUNR repository (links below) as per instructions outlined in the LUNR help page.

LUNR Registration: https://documents.lunr.app/#/register

LUNR Login: https://documents.lunr.app/#/login

LUNR Help: https://documents.lunr.app/#/help

**Further instructions for As-built documentation:**

- Drafting conventions must be compliant with internationally accepted CAD drafting standards. The naming of layers must be self-explanatory or a legend provided in place.
- All external references (xrefs) must be bound.
- There must be only one sheet/drawing per DWG and PDF file.
- As-built documentation is to include all project specifications and schedules.

**Further instructions for manuals**

- Submit electronic manuals only. Printed manuals are no longer required.
- Manuals must be consolidated as one singular PDF per volume.
- Manuals must include a cover page (Building Request number, project title, building number, room number, year, et al) index and coherently sequenced contents as would a printed copy.
- Manuals are to provide concise descriptions, technical details, operation and maintenance instructions and schedules, commissioning records, log books, catalogues, principles of operation, method of operation and other information that will enable the ongoing operation and maintenance of the fabric, services, plant and equipment.

**Roles and Responsibilities:**

| Role | Responsibility |
|---|---|
| **Construction Team / Contractor** | Responsible for uploading As-Built drawings, surveys, models, reports, certificates, permits, and manuals upon project completion. |
| **Project Manager** | Oversees the As-Built documentation submission process, ensuring that all documentation is complete, accurate, and complies with CAD and BIM standards. |
| **Document Manager**<br>**(If applicable)** | Manages and maintains the As-Built Documents in the LUNR repository, ensuring proper organisation and accessibility for stakeholders. |
| **Facility / Asset Manager** | Responsible for owning and overseeing the ongoing operation and maintenance of the facility, ensuring that all necessary documents in the LUNR repository are available and up-to-date. |

**As-Built submission requirement**

- As-Built submissions are a mandatory requirement and must be provided in PDF format, with each drawing as a separate PDF file, not bundled in zip files.
- These guidelines are essential to maintain a standardised and efficient digital asset management process at the University of Melbourne. All project teams are expected to adhere to these requirements for consistency and data integrity.

Sensitivity: General

# APPENDIX C – LOD DEFINITIONS FOR BIM PROJECTS

| | LOD | Description |
|---|---|---|
| Design Intent | 100 | The Model Element may be graphically represented in the Model with a symbol or other generic representation, but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e. cost per square foot, tonnage of HVAC, etc.) can be derived from other Model Elements.<br><br>BIMForum 2019: LOD 100 elements are not geometric representations. Examples are information attached to other model elements or symbols showing the existence of a component but not its shape, size, or precise location. Any information derived from LOD 100 elements must be considered approximate. |
| | 200 | The Model Element is graphically represented within the Model as a generic system, object, or assembly with approximate quantities, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.<br><br>BIMForum 2019: At this LOD elements are generic placeholders. They may be recognizable as the components they represent, or they may be volumes for space reservation. Any information derived from LOD 200 elements must be considered approximate. |
| | 300 | The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.<br><br>BIMForum 2019: The quantity, size, shape, location, and orientation of the element as designed can be measured directly from the model without referring to non-modelled information such as notes or dimension call-outs. The project origin is defined, and the element is located accurately with respect to the project origin. |
| Construction BIM | 350 | The Model Element is graphically represented within the Model as a specific system, object, or assembly in terms of quantity, size, shape, location, orientation, and interfaces with other building systems. Non-graphic information may also be attached to the Model Element.<br><br>BIMForum 2019. Parts necessary for coordination of the element with nearby or attached elements are modelled. These parts will include such items as supports and connections. The quantity, size, shape, location, and orientation of the element as designed can be measured directly from the model without referring to non-modelled information such as notes or dimension call-outs. |
| | 400 | The Model Element is graphically represented within the Model as a specific system, object or assembly in terms of size, shape, location, quantity, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the Model Element.<br><br>BIMForum 2019. An LOD 400 element is modelled at sufficient detail and accuracy for fabrication of the represented component. The quantity, size, shape, location, and orientation of the element as designed can be measured directly from the model without referring to non-modelled information such as notes or dimension call-outs |
| | 500 | The Model Element is a field verified representation in terms of size, shape, location, quantity, and orientation. Non-graphic information may also be attached to the Model Elements.<br><br>BIMForum 2019. Since LOD 500 relates to field verification and is not an indication of progression to a higher level of model element geometry or non-graphic information, this Specification does not define or illustrate it. |

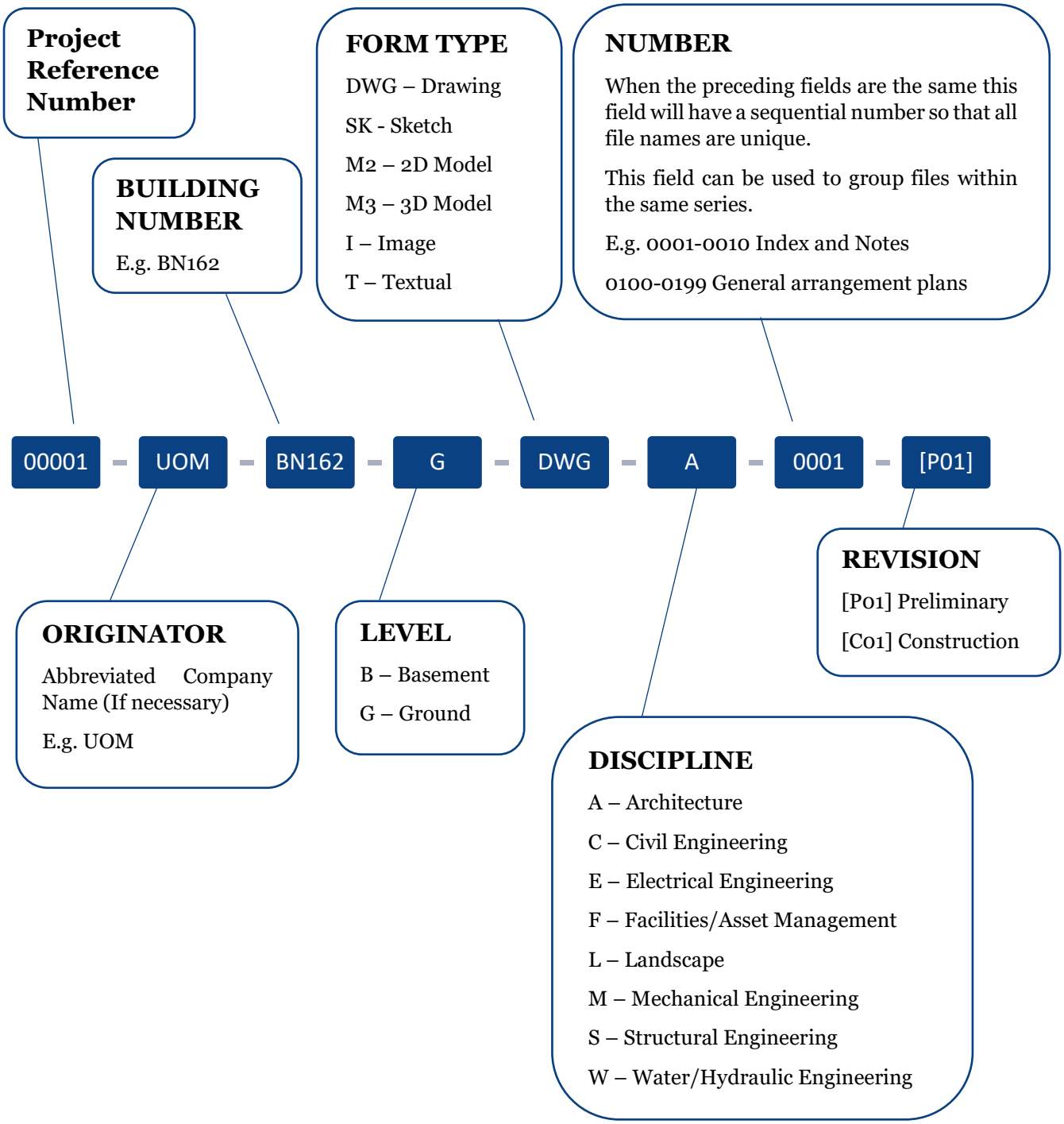
# APPENDIX D – INDUSTRY STANDARDS

| Document | Description |
|---|---|
| **ISO 19650 – 1: 2018** | Organisation and digitisation of information about buildings and civil engineering works, including building information modelling (BIM) -- Information management.<br>Information management using building information modelling -- Part 1: Concepts and principles |
| **ISO 19650 – 2: 2018** | Organisation and digitisation of information about buildings and civil engineering works, including building information modelling (BIM) -- Information management.<br>Information management using building information modelling -- Part 2: Delivery phase of the assets |
| **ISO 19650 – 3: 2020** | Organisation and digitisation of information about buildings and civil engineering works, including building information modelling (BIM) -- Information management.<br>Information management using building information modelling -- Part 3: Operational Phase of the assets |
| **ISO 19650 – 4: 2022** | Organisation and digitisation of information about buildings and civil engineering works, including building information modelling (BIM) -- Information management.<br>Information management using building information modelling -- Part 4: Information exchange |
| **ISO 19650 – 5: 2022** | Organisation and digitisation of information about buildings and civil engineering works, including building information modelling (BIM) -- Information management.<br>Information management using building information modelling -- Part 5: Security-minded approach to information management |
| **Uniclass2015** | The aim for this is to have a fully developed structured, indexed and standardised information classification system for all the industry to easily access in a common<br>format which integrates with the BIM toolkit |
| **BIMForum LOD Specification 2019** | Level of Development (LOD) Specification and Commentary when using LOD to specify model development across project stages. |
| **Victorian Digital Asset Strategy** | Supporting the use of ISO 19650, COBie and Uniclass 2015 standards. |
| **VBIS** | VBIS is an industry standard asset categorisation system and unified communication syntax. VBIS is designed to facilitate the standardisation of asset categorisation particularly suited to unified searching of facilities management databases and linking a range of asset centric FM applications such as asset registers, service systems, life cycle analysis systems, O&M manuals, virtual reality systems and emerging cloud-based facilities. |

Sensitivity: General

# APPENDIX E – FILE NAMING

Breakdown of the example file name 00001-UOM-BN162-G-DWG-A-0001[P01].dwg



# APPENDIX G - ASSET INFORMATION TEMPLATE

This appendix documents the asset information required by the University of Melbourne.

A pro forma spreadsheet is available from the University of Melbourne Space Management Team before commencement of any work.

| SERVICE | ENTITY | INFORMATION | SAVED | | FIELD TYPE | COMMENTS |
|---|---|---|---|---|---|---|
| | | | DWG | EXCEL | | |
| **Common attributes** | All | Name | | X | Text | Name of asset. Can ideally be VBIS level 2, 3 or 4 classifications (product, sub-type or sub-sub-type). |
| | | Description | | X | Text | Short Description of the asset may include type and size of asset, or location within the space. Used to identify the asset. |
| | | Campus Code | X | X | Text-Three letter campus code. | Three letter campus code. |
| | | Building Code | X | X | Text- Three letter campus code | Three to four letter code uniquely identifying building. |
| | | Floor Code | X | X | Alphanumeric - 3-character code signifying floor | Code representing asset floor. |
| | | Room Code | X | X | Alphanumeric - 4-character code signifying room | Code representing space or room. |
| | | Criticality | | X | | Rating between 1-5 classifying the criticality of the asset, 1 being most critical, 5 being least critical. If criticality not defined, use VBIS mapping to look up standard asset criticality. |
| | | Latitude | | X | Numeric GPS co-ordinate | Latitude of asset. |
| | | Longitude | | X | Numeric GPS co-ordinate | Longitude of asset. |
| | | Manufacturer | | X | Text | Asset manufacturer. |
| | | Model Number | | X | Alphanumeric | Asset model number. |
| | | Warranty ID | | X | Alphanumeric | Asset Warranty ID. |
| | | Asset ID | | X | Alphanumeric | ID number uniquely identifying the asset. |
| | | Install Date | | X | DD_MM_YYYY | Asset installation date. |

| | | | | |
|---|---|---|---|---|
| | Replacement Cost | X | $ AUD | Cost to replace asset. |
| | Replacement Date | X | DD_MM_YYYY | Date at which asset replacement is required. Defined by asset manufacturer or UoM guidelines. |
| | Replacement Date Calculation | X | DD_MM_YYYY | Replacement date calculation is to be used in the absence of a specific replacement date. Calculated from installation date and replacement period. |
| | Replacement Period | X | Numeric | Lifespan of asset. Period between installation date and required replacement date. |
| | Purchase Cost | X | $ AUD | Asset purchase cost. |
| | Status | X | Text | Operational status of asset. Can be active, inactive, disposed, or lost |
| | Comments | X | Text | Comments can be observations upon asset audit or notes informing changes and updates. All comments should be dated. |
| | Condition | X | Numeric | Asset condition rating between 1-5, 5 being excellent condition and 1 being very poor condition. The TEFMA condition rating system is adopted. |
| | Expected Condition | X | Numeric | Expected asset condition rating between 1-5, 5 being excellent condition and 1 being very poor condition. The TEFMA condition rating system is adopted. |
| | Cost Depreciated Value | X | $ AUD | Asset depreciated value. Difference between purchase cost and current estimated value. |
| | Failure Index | X | Numeric | Rating between 1-5 classifying the risk of asset failure, 1 being highest failure risk, 5 being least failure risk. |
| | Design Life | X | Numeric | Design life of asset. Expected period before replacement is required. Defined by manufacturer. |
| | Asset UoM Contact | X | Text | First and last name of UoM staff member to contact regarding the asset. |
| | Salvage Value | X | $ AUD | Current estimated value of asset. |
| | Serial Number | X | Alphanumeric | Asset serial number. |
| | Barcode | X | Alphanumeric | Asset Barcode |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Date Last Changed | | X | DD_MM_YYYY | Date at which the asset details were last changed. Usually date of most recent asset audit. |
| | | Date Record Created | | X | DD_MM_YYYY | Date at which the asset was first recorded. |
| | | Warranty Period | | X | Numeric | Asset Warranty period. |
| | | VBIS Code | X | X | Text | VBIS Code. Can be looked up using VBIS classification table. |
| **Mains Water** | Pipes | Material | X | X | Text, 10 characters | Detect material type and use standard code on drawing |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Diameter | X | X | Integer, 6 characters | In millimetres |
| | | Pressure | | X | Integer, 10 characters | Assumed pressure in pipe |
| | | Location | X | | | Shown accurately on drawing |
| | | Offset | X | | | To nearest building line on drawing |
| | | Depth to pipe | X | X | Real, 8 characters, 2 decimals | In meters |
| | | RL at exposed points | X | | Real, 8 characters, 2 decimals | In meters |
| | Valves | Valve Type | | X | Text, 64 characters | How to determine where valves are because of pipe material changes ie. Poly to copper. |
| | | Date Installed | | X | Date format, dd/mm/yyyy | Predict year if unknown |
| | | Location | X | | | Is isolation valve inside buildings our outside |
| | | Offset | X | | | To nearest building line on drawing |
| | Pumps | Pump Type | | X | Text, 64 characters | |
| | | Offset | X | | | To nearest building line on drawing |
| | Water Meter | Meter Type | | X | Text, 64 characters | Describe make and type of meter |
| | | Date Installed | | X | Date format, dd/mm/yyyy | Predict year if unknown |
| | | Location | X | | | |
| | | Offset | X | | | To nearest building line on drawing |
| **Stormwater** | Pipes | Material | X | X | Text, 64 characters | Detect material type and use standard code on drawing |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Direction of Flow | | X | | | Arrow on drawing |
| | | Date Installed | | | X | Date format, dd/mm/yyyy | Predict year if unknown |
| | | Diameter | | X | X | Integer, 6 characters | In millimetres |
| | | Location | | X | | | Do not locate minor stormwater down pipes |
| | | Offset | | X | | | To nearest building line on drawing |
| | | Depth to pipe | | X | X | Real, 8 characters, 2 decimals | In meters |
| | | RL at exposed points | | X | | Real, 8 characters, 2 decimals | In meters |
| | | IL at pits | | X | X | Real, 8 characters, 2 decimals | In meters |
| **Fire Service** | Pipes | Material | | X | X | Text, 64 characters | |
| | | Date Installed | | | X | Date format, dd/mm/yyyy | |
| | | Diameter | | X | X | Integer, 6 characters | In millimetres |
| | | Location | | X | | | Is isolation valve inside buildings our outside |
| | | Offset | | X | | | To nearest building line on drawing |
| | | RL at exposed points | | X | | Real, 8 characters, 2 decimals | In meters |
| | | Depth to pipe | | X | | Real, 8 characters, 2 decimals | In meters |
| | Hydrant | Date Installed | | | X | Date format, dd/mm/yyyy | |
| | | Diameter | | | X | Integer, 6 characters | In millimetres |
| **Electricity** | Cable | LocationHigh/LowtLighting | Voltage/Stree | X | X | Text, 2 characters (HV, LV, ST) | Shown accurately on drawing |
| | | Depth | | X | X | Integer, 6 characters | In meters |
| | | Voltage rating | | X | X | Integer, 6 characters | |
| | | Type | | | X | Text, 64 characters | |
| | | Date Installed | | | X | Date format, dd/mm/yyyy | |
| | | Location | | X | | | Shown accurately on drawing |
| | | Offset | | X | | | To nearest building line on drawing |
| | Conduits | Array arrangement | | X | | | Show diagram of array as per standards |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Depth | X | X | Real, 8 characters, 2 decimals | In meters |
| | | | Used/Unused | X | | | |
| | | | Type | | X | Text, 64 characters | |
| | | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | | Location | X | | | Shown accurately on drawing |
| | | | Offset | X | | | To nearest building line on drawing |
| **Gas** | Pipes | | High/Low pressure | X | X | Text, 2 characters (LP, HP) | |
| | | | Depth | X | X | Real, 8 characters, 2 decimals | In meters |
| | | | Type | | X | Text, 64 characters | In meters |
| | | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | | Diameter | X | X | Integer, 6 characters | In millimetres |
| | Gas Regulator | | Regulator Type | | X | Text, 64 characters | |
| | | | Regulator Pressure | | X | Integer, 6 characters | |
| | | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | | Location | X | | | Shown accurately on drawing |
| | | | Offset | X | | | To nearest building line on drawing |
| | | | Location | X | | | Shown accurately on drawing |
| | | | Offset | X | | | To nearest building line on drawing |
| **Valves** | | | Valve Type | X | Integer, 6 characters | Gate or Sluice | Is isolation valve inside buildings our outside |
| | | | Date Installed | X | Date format, dd/mm/yyyy | | |
| | | | Location | X | | | Shown accurately on drawing |
| | | | Offset | X | | | To nearest building line on drawing |
| **Telephone** | Cable | | Location | X | | | Shown accurately on drawing |
| | | | Depth | X | X | Real, 8 characters, 2 decimals | In meters |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Type | | X | Text, 64 characters | |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Offset | X | | | To nearest building line on drawing |
| | | Number of pairs | X | X | Integer, 6 characters | |
| **Security** | Devices | Type of device | X | X | | |
| | | Location | | | | Shown accurately on drawing |
| | Cable | Location | X | | | Shown accurately on drawing |
| | | Type | | X | Text, 64 characters | |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Depth | X | | Real, 8 characters, 2 decimals | In meters |
| | | Offset | X | | | |
| **Fibre Optic** | Cable | Location | X | | | Shown accurately on drawing |
| | | Type | | X | Text, 64 characters | |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Depth | X | | Real, 8 characters, 2 decimals | In meters |
| | | Offset | X | | | To nearest building line on drawing |
| **Sewer** | | Material | X | X | Text, 10 characters | |
| | | Direction of Flow | X | | | Arrow on drawing |
| | | Date Installed | | X | Integer, 6 characters | |
| | | Diameter | X | X | | In millimetres |
| | | Location | X | | | Shown accurately on drawing |
| | | Offset | X | | | To nearest building line on drawing |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Depth to pipe | X | X | Real, 8 characters, 2 decimals | In meters |
| | | IL at pits | X | X | Real, 8 characters, 2 decimals | In meters |
| | | RL at exposed points | X | | | In meters |
| **Hot Water** | Pipes | Material | X | | | |
| | | Date Installed | X | X | | |
| | | Diameter | X | X | | In millimetres |
| | | Location | X | | | Shown accurately on drawing |
| | | Offset | X | | | To nearest building line on drawing |
| | | Depth to pipe | X | X | Real, 8 characters, 2 decimals | In meters |
| | | Level at exposed points | X | | | In meters |
| **All Services** | Pits | Lid Type | | X | Text, 64 characters | |
| | | Unique Pit Number | X | X | Text, 10 characters | Refer to CAD standards for pit numbering standard |
| | | Condition of pit | | X | Text, 64 characters | |
| | | IL of converging conduits or pipes | X | | | In meters |
| | | RL of top of pit | X | X | Real, 8 characters, 2 decimals | In meters |
| | | Pit depth | | X | Real, 8 characters, 2 decimals | In meters |
| **Refrigeration** | Freezers | Refrigerant Type | | X | Text, 10 characters | |
| **Landscape** | Landscape Assets | Furniture Type | | X | Text, 10 characters | |

| | | | | |
|---|---|---|---|---|
| | Furniture Material | | X | Text, 10 characters |
| | Layer | X | | Text, 10 characters |

# APPENDIX H - UNIQUE ENTITY CODES - VBIS

All underground entities surveyed will be supplied with a unique entity code. This code will be tabled in an Excel spreadsheet with the information as requested in APPENDIX C – LOD DEFINITIONS FOR BIM PROJECTS. The unique entity code shall also be noted on the drawing next to the entity concerned and be bounded by a polyline.

The format of this code is made up of two sub-parts. The first sub-part is a prefix representing the underground service of the entity. A list of these prefixes is documented below. The second sub-part is a unique five-digit number that will be supplied to the entity sequentially.

| VBIS CODE PREFIX | DESCRIPTION |
|---|---|
| **AC** | Acoustics |
| **CV** | Civil |
| **CO** | Communications |
| **EL** | Electrical Lighting |
| **EP** | Electrical Power |
| **FD** | Fire Detection |
| **FR** | Fire Resistance |
| **FS** | Fire Suppression |
| **FFE** | Furniture, Fittings & Equipment |
| **HY** | Hydraulics |
| **IT** | Information Technology |
| **KE** | Kitchen Equipment |
| **LS** | Landscape |
| **ME** | Mechanical |
| **MLE** | Medical & Laboratory Equipment |
| **MG** | Medical Gases |

# APPENDIX I - UNDERGROUND SERVICES SURVEY INFORMATION

This appendix documents the underground service entities that are required, by the University of Melbourne, to be surveyed. It also specifies the types of information required for each underground service.

A pro forma spreadsheet is available from the University of Melbourne Space Management Team prior to commencement of any work.

# UNDERGROUND SERVICES INFORMATION REQUIREMENTS

| SERVICE | ENTITY | INFORMATION | SAVED | | FIELD TYPE | COMMENTS |
|---|---|---|---|---|---|---|
| | | | DWG | EXCEL | | |
| **Mains Water** | Pipes | Material | **X** | **X** | Text, 10 characters | Detect material type and use standard code on drawing |
| | | Date Installed | | **X** | Date format, dd/mm/yyyy | |
| | | Diameter | **X** | **X** | Integer, 6 characters | In millimetres |
| | | Pressure | | **X** | Integer, 10 characters | Assumed pressure in pipe |
| | | Location | **X** | | | Shown accurately on drawing |
| | | Offset | **X** | | | To nearest building line on drawing |
| | | Depth to pipe | **X** | **X** | Real, 8 characters, 2 decimals | In meters |
| | | RL at exposed points | **X** | | Real, 8 characters, 2 decimals | In meters |
| | Valves | Valve Type | | **X** | Text, 64 characters | How to determine where valves are because of pipe material changes ie. Poly to copper. |
| | | Date Installed | | **X** | Date format, dd/mm/yyyy | Predict year if unknown |
| | | Location | **X** | | | Is isolation valve inside buildings our outside |
| | | Offset | **X** | | | To nearest building line on drawing |
| | Water Meter | Meter Type | | **X** | Text, 64 characters | Describe make and type of meter |

| SERVICE | ENTITY | INFORMATION | SAVED | | FIELD TYPE | COMMENTS |
|---|---|---|---|---|---|---|
| | | | DWG | EXCEL | | |
| | | Date Installed | | X | Date format, dd/mm/yyyy | Predict year if unknown |
| | | Location | X | | | |
| | | Offset | X | | | To nearest building line on drawing |
| **Stormwater** | Pipes | Material | X | X | Text, 64 characters | Detect material type and use standard code on drawing |
| | | Direction of Flow | X | | | Arrow on drawing |
| | | Date Installed | | X | Date format, dd/mm/yyyy | Predict year if unknown |
| | | Diameter | X | X | Integer, 6 characters | In millimetres |
| | | Location | X | | | Do not locate minor stormwater down pipes |
| | | Offset | X | | | To nearest building line on drawing |
| | | Depth to pipe | X | X | Real, 8 characters, 2 decimals | In meters |
| | | RL at exposed points | X | | Real, 8 characters, 2 decimals | In meters |
| | | IL at pits | X | X | Real, 8 characters, 2 decimals | In meters |
| **Fire Service** | Pipes | Material | X | X | Text, 64 characters | |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Diameter | X | X | Integer, 6 characters | In millimetres |

| SERVICE | ENTITY | INFORMATION | SAVED | | FIELD TYPE | COMMENTS |
|---|---|---|---|---|---|---|
| | | | DWG | EXCEL | | |
| | | Location | X | | | Is isolation valve inside buildings our outside |
| | | Offset | X | | | To nearest building line on drawing |
| | | RL at exposed points | X | | Real, 8 characters, 2 decimals | In meters |
| | | Depth to pipe | X | | Real, 8 characters, 2 decimals | In meters |
| | Hydrant | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Diameter | | X | Integer, 6 characters | In millimetres |
| **Electricity** | Cable | Location<br>High/Low Voltage/Street Lighting | X<br>X | X | Text, 2 characters (HV, LV, ST) | Shown accurately on drawing |
| | | Depth | X | X | Integer, 6 characters | In meters |
| | | Voltage rating | X | X | Integer, 6 characters | |
| | | Type | | X | Text, 64 characters | |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Location | X | | | Shown accurately on drawing |
| | | Offset | X | | | To nearest building line on drawing |

| SERVICE | ENTITY | INFORMATION | SAVED | | FIELD TYPE | COMMENTS |
|---|---|---|---|---|---|---|
| | | | DWG | EXCEL | | |
| | Conduits | Array arrangement | X | | | Show diagram of array as per standards |
| | | Depth | X | X | Real, 8 characters, 2 decimals | In meters |
| | | Used/Unused | X | | | |
| | | Type | | X | Text, 64 characters | |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Location | X | | | Shown accurately on drawing |
| | | Offset | X | | | To nearest building line on drawing |
| **Gas** | Pipes | High/Low pressure | X | X | Text, 2 characters (LP, HP) | |
| | | Depth | X | X | Real, 8 characters, 2 decimals | In meters |
| | | Type | | X | Text, 64 characters | In meters |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Diameter | X | X | Integer, 6 characters | In millimetres |
| | | Location | X | | | Is isolation valve inside buildings our outside |
| | Valves | Valve Type | | X | Integer, 6 characters | Gate or Sluice |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |

| SERVICE | ENTITY | INFORMATION | SAVED | | FIELD TYPE | COMMENTS |
|---|---|---|---|---|---|---|
| | | | DWG | EXCEL | | |
| | | Location | X | | | Shown accurately on drawing |
| | | Offset | X | | | To nearest building line on drawing |
| | Gas Meter | Meter Type | | X | Text, 64 characters | |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Location | X | | | Shown accurately on drawing |
| | | Offset | X | | | To nearest building line on drawing |
| | Gas Regulator | Regulator Type | | X | Text, 64 characters | |
| | | Regulator Pressure | | X | Integer, 6 characters | |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Location | X | | | Shown accurately on drawing |
| | | Offset | X | | | To nearest building line on drawing |
| **Telephone** | Cable | Location | X | | | Shown accurately on drawing |
| | | Depth | X | X | Real, 8 characters, 2 decimals | In meters |
| | | Type | | X | Text, 64 characters | |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |

| SERVICE | ENTITY | INFORMATION | SAVED | | FIELD TYPE | COMMENTS |
|---|---|---|---|---|---|---|
| | | | DWG | EXCEL | | |
| | | Offset | X | | | To nearest building line on drawing |
| | | Number of pairs | X | X | Integer, 6 characters | |
| **Security** | Devices | Type of device | X | X | | |
| | | Location | | | | Shown accurately on drawing |
| | Cable | Location | X | | | Shown accurately on drawing |
| | | Type | | X | Text, 64 characters | |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Depth | X | | Real, 8 characters, 2 decimals | In meters |
| | | Offset | X | | | |
| **Fibre Optic** | Cable | Location | X | | | Shown accurately on drawing |
| | | Type | | X | Text, 64 characters | |
| | | Date Installed | | X | Date format, dd/mm/yyyy | |
| | | Depth | X | | Real, 8 characters, 2 decimals | In meters |
| | | Offset | X | | | To nearest building line on drawing |
| **Sewer** | | Material | X | X | Text, 10 characters | |

| SERVICE | ENTITY | INFORMATION | SAVED | | FIELD TYPE | COMMENTS |
|---|---|---|---|---|---|---|
| | | | DWG | EXCEL | | |
| | | Direction of Flow | X | | | Arrow on drawing |
| | | Date Installed | | X | Integer, 6 characters | |
| | | Diameter | X | X | | In millimetres |
| | | Location | X | | | Shown accurately on drawing |
| | | Offset | X | | | To nearest building line on drawing |
| | | Depth to pipe | X | X | Real, 8 characters, 2 decimals | In meters |
| | | IL at pits | X | X | Real, 8 characters, 2 decimals | In meters |
| | | RL at exposed points | X | | | In meters |
| **Hot Water** | Pipes | Material | X | | | |
| | | Date Installed | X | X | | |
| | | Diameter | X | X | | In millimetres |
| | | Location | X | | | Shown accurately on drawing |
| | | Offset | X | | | To nearest building line on drawing |
| | | Depth to pipe | X | X | Real, 8 characters, 2 decimals | In meters |

| SERVICE | ENTITY | INFORMATION | SAVED | | FIELD TYPE | COMMENTS |
|---|---|---|---|---|---|---|
| | | | DWG | EXCEL | | |
| | | Level at exposed points | X | | | In meters |
| **All Services** | Pits | Lid Type | | X | Text, 64 characters | |
| | | Unique Pit Number | X | X | Text, 10 characters | Refer to CAD standards for pit numbering standard |
| | | Condition of pit | | X | Text, 64 characters | |
| | | IL of converging conduits or pipes | X | | | In meters |
| | | RL of top of pit | X | X | Real, 8 characters, 2 decimals | In meters |
| | | Pit depth | | X | Real, 8 characters, 2 decimals | In meters |

# APPENDIX J - UNDERGROUND SERVICES UNIQUE ENTITY CODES

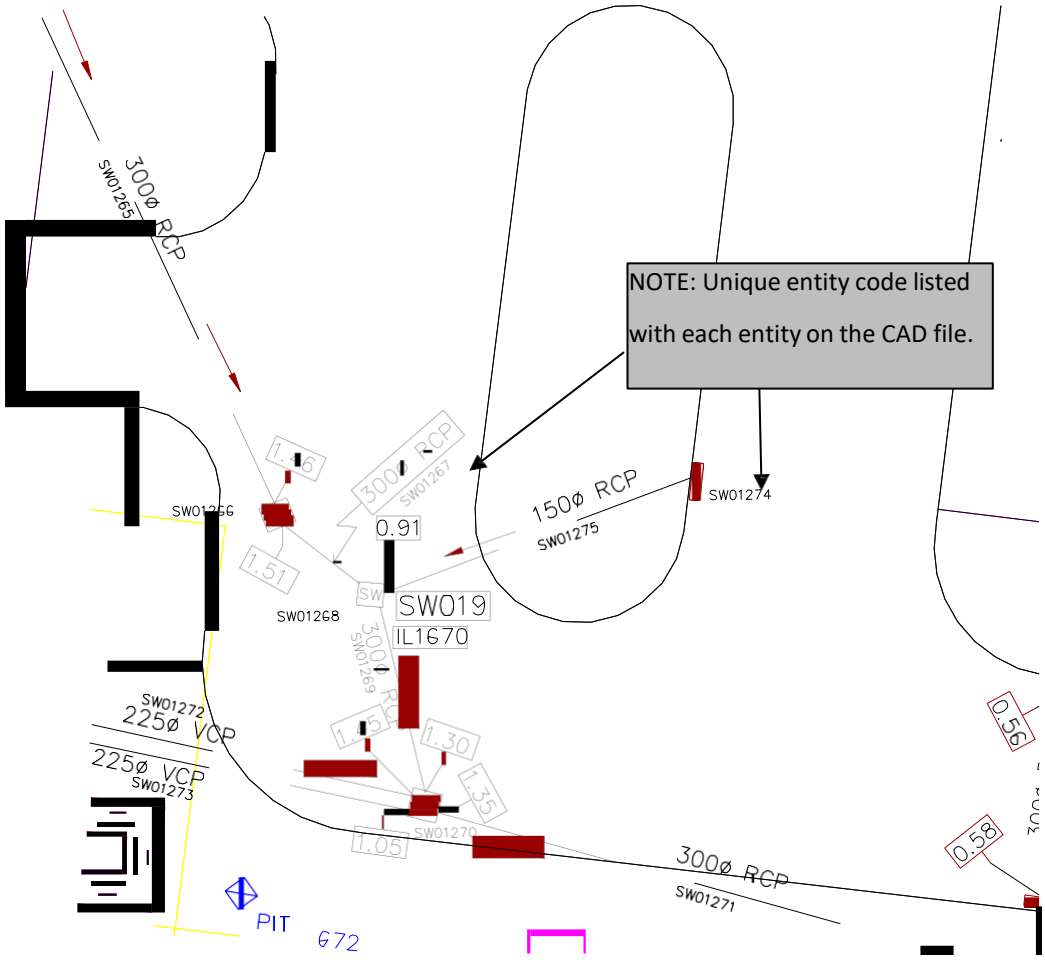
All underground entities surveyed will be supplied with a unique entity code. This code will be tabled in an Excel spreadsheet with the information as requested in Appendix C. The unique entity code shall also be noted on the drawing next to the entity concerned and be bounded by a polyline.

The format of this code is made up of two sub parts. The first sub part is a prefix representing the underground service the entity. A list of these prefixes is documented below. The second sub part is a unique five digit number that will be supplied to entity sequentially.

| CODE PREFIX | DESCRIPTION |
|---|---|
| **CFS** | CAMPUS FIRE SERVICE |
| **COM** | COMPUTERS |
| **CSS** | CENTRAL SUPERVISORY SYSTEM |
| **CTD** | COOLING TOWER DISCHARGE |
| **EGC** | EMERGENCY GENERATOR CONNECTION |
| **GAS** | GAS MAINS |
| **HV** | HIGH VOLTAGE ELECTRICITY |
| **HW** | HOT WATER |
| **LV** | LOW VOLTAGE ELECTRICITY |
| **MW** | MAINS WATER |
| **S** | SEWER |
| **SL** | STREET LIGHTING |
| **SP** | STEAM PIPES |
| **SW** | STORM WATER |
| **T** | TELECOMMUNICATIONS |
| **UGE** | GENERAL ELECTRICAL |

Following is an example of table information supplied with a drawing.

**A CAD file for underground storm water;**




The associated Excel spreadsheet;

STORM WATER

Pipes

| Entity Code | Material | Date | Dia | Depth |
|---|---|---|---|---|
| **SW01265** | RCP | 1965 | 300 | 1.45 |
| **SW1267** | RCP | 1965 | 300 | 1.5 |
| **SW01269** | RCP | 1980 | 300 | 1.3 |
| **SW01271** | RCP | 1980 | 300 | 1.35 |
| **SW01272** | VCP | 1955 | 225 | 1.45 |
| **SW01273** | VCP | 1956 | 225 | 1.05 |
| **SW01273** | RCP | 1985 | 150 | 0.9 |

| Pits |
|---|

Sensitivity: General

| Entity Code | Date | Cover Type | Condition | RL Top | Depth |
|---|---|---|---|---|---|
| **SW-P01266** | 1965 | 35mm Gatic | Good | 4.55 | 1.70 |
| **SW-P01268** | 1980 | Concrete Lid | Poor | 4.56 | 1.5 |
| **SW-P01270** | 1980 | 35mm Gatic | Fair | 4.56 | 1.6 |
| **SW-P01274** | 1985 | Gatic SEP | Good | 4.40 | 1.35 |

# APPENDIX K – REALITY CAPTURE AND DELIVERY GUIDELINES

**1 Data Requirements**

A. Photographs:

a. 360 degree spherical imagery

360 imagery to be captured by appropriate 360 degree cameras or laser scanners with 360 degree imagery capability. Image locations to be between 5m – 10m apart with smaller distances for tighter internal spaces. Deliverable must allow for online indexing and navigation interface between capture locations.

b. Photogrammetry (ground based)

Photographs/ imagery capture for ground based photogrammetry to be taken with inspection grade high- resolution digital photography. Images must be taken with a minimum 75% overlap. Hardware must meet the following minimum specifications:

- Full frame sensor (35mm)
- 21 megapixel resolution
- Mechanical shutter
- Min. 16mm wide angle lens

For outdoor photogrammetry, ideally overcast conditions with even lighting and sufficient Lux levels.

c. Photogrammetry (Aerial)

Photographs/ imagery capture for aerial based photogrammetry or mapping must be taken with a CASA certified UAV and flown by a RePL which hold all appropriate licenses and certifications. The minimum quality requirements of the imagery is 1.5cm GSD or 1.5cm/ Px. Ideally flown in overcast conditions with even lighting and sufficient lux levels.

B. Videos:

Contractor must be capable of all below video documentation requirements. Contractor must be able to demonstrate these capabilities by presenting exemplar documentation upon request. Video documentation must be recorded in no less than 1920x1080p HD video format.

a. Documentation of facilities management, operations and maintenance training presentations/demonstrations for key equipment and systems.

b. Documentation of any other key construction inspections, milestones or events as required by client.

c. Documentation of live site conditions at a point in time specified by the client, captured via Contractor-piloted UAV.

C. Point Clouds:

Perform LiDAR capture of current project conditions, as required. Scan positions to have sufficient overlap (min. 30%) and/or use of scanning targets to assist with alignment and quality control. Geolocation to be used where applicable and available. 3D Laser scanner must be integrated with HDR spherical imaging system and hardware must meet the following minimum specifications:

- 15 Mpixel 3-camera system, 150Mpx full dome capture, HDR, LED flash Calibrated spherical image, 360° x 300°
- 3D point accuracy: 5mm@10m, 8mm@ 20m
- Range Min 0.5m – Max 60m

**2 Delivery Documentation Requirements**

A. Photography and Video documentation:

a. Indexing and navigation system will utilize actual construction drawings or equivalent as the basis for an interactive on-line interface. For all photographic documentation referenced herein, indexing and navigation must be organized by both time (date-stamped) and location throughout the Project. Access interface will include multiple active projects per user, if applicable, and recent documentation activity summaries per project allowing for direct access to project plans and shoots from summary display. Documentation activity can be queried by date range via activity searches.

b. Documentation will combine indexing and navigation system with inspection grade high-resolution digital photography designed to capture actual conditions throughout construction and at critical milestones. Documentation will be accessible on-line within 24 hours after each shoot, through the use of an internet connection. Documentation will allow for multiple user access simultaneously, on-line. Access shall adhere to industry standards for information security and protection of data. Multi-tiered access levels shall be achievable through use of individual passwords, if applicable. Users will be able to identify other authorized users on the project.

c. Online interface will allow users to comment (privately or publicly) on images, shoots, and projects and to create customizable tags that can be reviewed through integrated reporting functionality. These images and reports must be made available through PDF and a standalone link. All images or reports will be identified by time, date, location, and include associated comments that can be archived indefinitely. The administrator can restrict commenting functions. Commenting permissions, per user, can be set to either (1) read/write, (2) read only, or (3) no read/no write permissions at the option of the administrator.

B. 3D mesh model and mapping documentation:

a. 3D mesh model and orthomaps from the photogrammetry workflow to be provided on a platform that allows clients to be able to instantly view, annotate and measure distance, elevation, area, and volumetric quantities.

b. File exports must be availabe for the following data:

- PDF summary reports of measurements and quantities
- Orthomosiac imagery (Geotiff)
- Contour elevation files (DXF/ SHP/ DWG)
- 3D Mesh models (OBJ, FBX, 3MX, GLB)

C. Point Cloud documentation:

a. Post processing to include scan registration, cleanup and integration into measurable 360-degree walk-through to allow for simultaneous viewing of walk-through & current location as indexed to architectural plans. Any points within the point cloud that exceeds 30 metres from scanner position to be removed as with data picked up from moving objects, reflections, artifacts etc.

b. Offline point cloud deliverables must be provided in the following file types: .LGS, .RCP/.RCS, .e57.

c. 360 imagery taken from the scanner must be provided in the following file types: .jpg, .png.

d. Scan registration report must be provided as a PDF outlining alignment results and deviations.

**3 Contractor Qualifications**

A. The Contractor must have a minimum of five years' experience providing expert visual project documentation to the Construction and Facilities Management Industries, using an advanced software platform, indexing system and navigation interface.

B. The Contractor's portfolio of completed documentation must include projects representative of the current project's type, size, duration, and complexity, with at least five demonstrable examples completed within the last 2 years.

C. The Contractor must directly employ field personnel able to demonstrate proficiency in execution of photographic and video documentation for construction projects, including reality capture, configuration of webcam systems and use/knowledge of associated equipment.

D. Field personnel shall be OSHA certified, if applicable per the project specific safety programs. Coordination with project teams will be accomplished through a designated representative on-site at the project, typically a superintendent or a project manager. Contractor will also attend OAC meetings. Contractor's operations team will provide regular updates regarding the status of the documentation, including completed elements of the documentation, the availability of recent documentation online and anticipated future shoot dates.

E. The Contractor must directly employ field personnel which hold all licenses and certifications required by the applicable regulatory authority for commercial UAV piloting.

F. The Contractor must be able to respond to site visit requests with qualified personnel within 48 hours of notice.

G. The Contractor must abide to all local and federal laws including the Privacy and Data Protection Act 2014(Vic)(PDP Act), and to the best of their abilitiy, avoid capturing personable identifiable data such as appearances, number plates, personal documentation. Any such data captured will have to be anonymised or removed in any deliverables.