Guideline

Building Information Modelling (BIM) for Transport and Main Roads

A guide to enabling BIM on Road Infrastructure Projects

May 2017
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1 Introduction

This document sets out the Digital Engineering Policy for Transport and Main Roads. It provides an overview of the departments plan for the implementation of Building Information Modelling (BIM) processes and methodology in the delivery of road infrastructure projects. Transport and Main Roads will review this policy for continued suitability at a minimum annually, and circulate to all staff.

The State Infrastructure Plan (SIP) released in March 2016 outlined a new strategic direction by the State Government for the planning, investment and delivery of infrastructure in Queensland. The SIP Part B; Program outlined five infrastructure directions for Queensland, including promoting “The most efficient procurement and the better use of existing assets”.

Under that direction, Implementation Action 15 sets a goal for the State to progressively implement the use of Building Information Management (BIM) into all major state infrastructure projects by 2023. The driver behind this is the up to 20% productivity increase that is reported to be delivered through BIM. To achieve this, client stakeholders, designers and constructors need to firstly embrace the processes outlined in this guide, then develop them to maximise the efficiency and effectiveness of their particular part in the industry.

At the State Government level, the Queensland BIM Working Group (QBIMWG) will inform and advise the Queensland Government on key items relating to BIM. This leadership group, through a pragmatic collaborative approach, will develop principles, policy and a framework for the progressive adoption of BIM on major infrastructure projects across Government by mid-2023.

At the National level, the Council of Australian Governments (COAG) Infrastructure Working Group agreed to establish a national working group to develop a national approach to the use of BIM in the delivery of infrastructure projects (National Digital Engineering Working Group - NDEWG). This initiative elevates the importance of the Queensland work and presents an opportunity to both leverage and align it with the developing national approach.

The Department of Transport and Main Roads has representation on both of these working groups. Transport and Main Roads has developed its BIM processes and methodology based on the principles outlined in the NATSPEC National BIM Guide. (This document is available free of charge at http://www.natspec.com.au).

1.1 What is BIM

There are many definitions of BIM (Building Information Modelling) and can be found in research documentation, all of which have a common theme that BIM is a process focused on information management. BuildingSmart defines it as follows:

“BIM is a digital representation of the physical and functional characteristics of a building. As such, it serves as a shared knowledge resource for information about a building, forming a reliable basis for decisions during its life cycle from inception onward.”

Transport and Main Roads is committed to the implementation of Digital Engineering and fully supports the collaborative working approach for the design, construction, operation and management of the departments’ full transport infrastructure and facilities portfolio. Transport and Main Roads will work with service providers and the state government to achieve the benefits of an integrated Digital Engineering framework.
The Digital Engineering Framework, incorporating BIM, is a comprehensive approach involving the
generation and management of transport infrastructure assets using 3D digital representations of their
physical and functional characteristics. Digital Engineering includes implementation of BIM technology,
processes and systems throughout the Infrastructure acquisition, management and operations
lifecycle.

BIM is the process of creating digital data sets formed of graphical (3D models) and non-graphical
information (documents) in a shared digital space known as a Common Data Environment (CDE).

The non-graphical information is linked to the graphical 3D model. When you explore and click on
different parts of the 3D representation, you’ll be able to access the information about it. Clicking on an
object for example might give you information on its material type, quantity, cost, and spatial location,
just to name a few of the attributes that can be assigned to the object. The whole thing is known as a
“data set” or “information model”.

The key principal is that BIM is not any single act or process. It is not creating a 3D model in isolation
from others or utilising computer-based design. It is being aware of the information needs of others as
you undertake your part of the process.

A BIM model can contain information / data on design, construction, logistics, operation, maintenance,
budgets, schedules and much more. The information contained within BIM enables richer analysis
than traditional processes. Information created in one phase can be passed to the next for further
development and reuse.

BIM can also come in different forms (or maturity levels). At the most basic level, the various BIM
forms may be described as follows:

- **Level 0 BIM**
  In its simplest form, Level 0 effectively means no collaboration. 2D CAD drafting only is
  utilised, mainly for construction information. Output and distribution is via paper or electronic
  prints, or a mixture of both. The majority of the industry is already well ahead of this now.

- **Level 1 BIM**
  This typically comprises a mixture of 3D CAD for concept work, and 2D for drafting of statutory
  approval documentation and construction information. CAD standards are managed, and
  electronic sharing of data is carried out, often managed by the contractor. This is the level at
  which many organisations are currently operating, although there is limited collaboration
  between different disciplines – each publishes and maintains its own data.

- **Level 2 BIM**
  This is distinguished by collaborative working – all parties use their own 3D CAD models, but
  not necessarily working on a single, shared model. The collaboration comes in the form of how
  the information is exchanged between different parties – and is the crucial aspect of this level.
  Design information is shared through a common file format, which enables any organisation to
  be able to combine that data with their own in order to make a federated BIM model, and to
  carry out interrogative checks on it. Hence, any CAD software that each party used must be
  capable of exporting to one of the common file formats such as IFC (Industry Foundation
  Class) or COBie (Construction Operations Building Information Exchange).

- **Level 3 BIM**
Currently seen as the holy grail, this represents full collaboration between all disciplines by means of using a single, shared project model which is held in a centralized repository. All parties can access and modify that same model, and the benefit is that it removes the final layer of risk for conflicting information. This is known as ‘Open BIM’. Current nervousness in the industry around issues such as legal status of the design model will have for construction (e.g. Binding, Informational, Reference, Reuse) need to be resolved.

This guide is aimed at providing guidance to achieve Level 2 BIM.

1.2 How this guide is structured

The guide follows the normal progression of a project:

- planning
- design
- construction
- finalisation
- asset management / operation.

1.3 Benefits of BIM

BIM delivers benefits throughout the entire asset life cycle. These benefits are enhanced when the process is considered as a whole and the information / data requirements are coordinated. They can be summarised as:

**Benefit: Cost savings**

Achieved through:

- Improved design process
  - clearer requirements identified by the client
  - enhanced clash detection identification in the design phase.

- Reduced construction cost
  - increased efficiency
  - improved scheduling
  - increased offsite prefabrication
  - reduced rework.

- Reduced operations and maintenance cost
  - more efficient design
  - reduced maintenance requirements
  - better tracking of maintenance.

**Benefit: Better data / information capturing – Asset Database enhancement**

Achieved through:

- Existing conditions modelling
• improved capture of site specific conditions
  • provides access to data at any stage of the project’s lifecycle.

• As-constructed model delivery
  • improved Asset Management Database information.

**Benefit: Less rework – reduction of work effort through the elimination of errors / omissions / process**
Achieved through:

• Improved design process
  • design reviews and visualisation
  • coordinated approach to discipline specific model development.

• Reduced construction cost
  • improved project coordination
  • improved construction scheduling.

• Reduced operations and maintenance cost
  • access to improved Asset Database for maintenance activities.

**Benefit: Improved productivity – reduction of man hours to achieve an output**
Achieved through:

• Improved design process
  • reduced resource needs to achieve design outputs
  • 3D modelling with enriched object / attribute information.

• Reduced construction cost
  • utilisation of machinery guidance systems for construction
  • optimisation of construction sequencing, methods and processes.

• Reduced operations and maintenance cost
  • access to improved Asset Database for maintenance activities.

1.4 **Purpose of the guideline**

The creation of this Guideline has been driven by the need to improve the delivery of road infrastructure projects. The aim has been to create a departmental-centric document that:

• promotes the use of BIM throughout the project life cycle
• creates a common language for the industry to use
• clarifies the briefing process for designers and constructors
• clarifies the handover deliverables for designers and constructors
• improves the level of coordination in both design, construction and finalisation phases
• promotes a more proactive approach to Asset Management
creates a clear path for the future development of the industry.

The guideline does not cover every aspect of BIM in detail. Its primary focus is on the design, construction and finalisation phases of a project life cycle. To realise the maximum benefits of BIM, the information / data created during the design, construction and finalisation phases must be fed into asset management systems.

A BIM philosophy can be applied to creating and operating all types of assets: buildings, industrial facilities or civil infrastructure. To simplify the language used, the guideline is focused on road infrastructure type projects.

The geospatial data provided from survey tools is a key input into BIM.

1.5 BIM in Transport and Main Roads

The department has been progressively moving towards documenting in 3D over the past two decades. This has been driven primarily by a desire to improve the quality of design and deliver projects more efficiently as advancements in 3D CADD modelling software became more readily available. The advancements in the tools to efficiently design and document in 3D have accelerated in recent years to a point where the current systems, processes and policies are falling behind in terms of currency and relevance. In some cases, the current processes hinder our ability to adopt / utilise the new tools, systems, processes and practices.

On most significant / complex projects, design teams are now documenting in 3D. This is delivering the benefits of improved coordination. Coordinated 3D modelling is only one aspect of the BIM process. To date the focus on BIM implementation has been at a project level. However, over the past couple of years there has been a push in the department to expand BIM to a network level, from design into construction and finalisation, to provide better data for Asset Management which is managed at a network level via a suite of internal asset management systems.

An increasing number of projects are requiring the contractor to maintain the BIM model throughout the construction phase and provide an “As-Built” model at handover.

This guideline aims to aid further development of this process by:

- increasing the department’s project managers understanding of the benefits of BIM so that they can better brief their design teams
- creating a common language so that the department, internal and external designers, and constructors understand what they are being asked to provide
- outlining the process that should be followed to efficiently implement BIM on a project with the end in mind
- providing a framework so that those new to BIM can understand what is involved and decide if / how they could benefit from adopting BIM.

Further work needs to be done in developing a legal framework to build BIM requirements into both design and construction contracts.

1.6 Transport and Main Roads’ Principles of BIM implementation

1. All Project Briefs for the engagement of Consultant’s for Engineering Projects must provide clear definition of the Employer Information Requirements (EIR) for each stage of project development. There will be a need for BIM EIR scalability depending on the level of project
complexity and risk. Not all projects may require the application of BIM process. Major projects will have the EIR defined as an Appendix to the Scope of Works and Technical Criteria (SWTC), while a stand-alone BIM Project Brief may be used for other project types.

2. All proponents tendering for departmental projects will be required to demonstrate the proposed approach, capability, and capacity to deliver the BIM requirements for the department as outlined in the EIR prior to the tender award stage.

3. A BIM Management Plan (BMP) shall be developed by the successful proponent outlining how they will address the following:
   i. project objectives and goals
   ii. information management protocols (roles, responsibilities and obligations)
   iii. qualifications and experience of information modelling leadership staff
   iv. communication and collaboration strategies amongst the Contractors team and with the Contractor’s Information Modelling Manager and the Administrator
   v. methodology for ensuring the validation of Information Modelling and CAD files, project-wide
   vi. plan for file sharing, storage and retrieval, data security, and
   vii. additional requirements as defined in the Employer Information Requirements or BIM Brief.

4. Design authoring – discipline modellers producing definitive information in the discipline specific models which they control, sourcing information from other models and sources as required, leading to the development of the Federated Model or information exchange in the Common Data Environment (CDE).

5. Provision of a Common Data Environment (CDE) to store shared asset detail and information accessible to all individuals.

6. Development of discipline specific information models using one of the following combinations of enabling tools:
   i. discipline-based software; with individual proprietary databases, that have limited operability between them or with associated design analysis software
   ii. discipline-based software, with individual proprietary databases, that are fully interoperable, but with limited interoperability with associated design analysis software
   iii. discipline-based software, with individual proprietary databases, and associate design analysis software that are fully interoperable, or
   iv. single source platform software, with a single external relational database, and associated design analysis software that are fully interoperable.
2 BIM basics

2.1 Definitions

A complete glossary of BIM terminology is provided in Section 7 of this document. Following are some key definitions to aid the reader with interpreting the next sections and to provide an overview of how the key documents and roles in BIM relate to each other.

Models and federation

For the majority of projects, each designer or discipline will produce their own model, e.g. Drainage, PUP, Structures, Road. These models can be then combined or “federated” to create a single shared model. Interdisciplinary coordination, a process also known as clash detection, can be confirmed in the federated model. Required changes are made in the individual discipline models.

On large projects discipline models may be split into multiple, smaller models to cater for internal processes and make file sizes more manageable.

Figure 2.1: Example of a federated model

Project BIM Brief

Outlines “what” is required.

The Project BIM Brief is developed by the Project Manager prior to engaging the consulting team. It provides an outline of the project and the goals / objectives and benefits that the department wants to achieve from BIM. It should include sufficient detail to allow the consultants to adequately assess the
commercial and programme implications of the department’s BIM expectations. The Project BIM Brief may also be referred to as the Employer Information Requirements (EIR).

The BIM Brief / EIR forms part of the contract documentation.

**Project BIM Management Plan**

Outlines “how” the requirements of the EIR will be delivered.

This is the key document for successfully implementing BIM on a project. An expansion of the Project BIM Brief, it is developed collaboratively by the project team after they have been engaged and prior to commencing the design. It is a live document and can be updated throughout the design, construction and finalisation phases. It expands on each of the department’s goals as outlined in the Employer Information Requirements document, and how they are to be achieved. The Project BIM Management Plan allocates key responsibilities and defines the processes, procedures and tools to be used.

At the completion of the design phase, the Project BIM Management Plan will be passed from the design team to the construction team who will modify and supplement it with construction phase BIM activities.

**BIM Uses**

Outlines “uses” that BIM processes can be applied to in the modelling.

BIM covers a number of processes or tasks, e.g., cost estimation, clash detection, existing conditions modelling, design authoring and coordination, just to name a few. To create a common language this guideline lists these as “BIM Uses”. Most international BIM guides contain a similar listing of Uses. For this guideline, 21 separate Uses have been identified. These have been taken from the Penn State BIM Execution Planning Guide with minor terminology changes to match the road transport infrastructure context. Some of the Uses will be commonly used on projects; others are an indication of where BIM may be applied in the future. For each Use an outline definition is provided.

**BIM Manager**

The person engaged by the department’s Project Manager (either independently or as an extension to another role). The BIM Manager leads the production of the Project BIM Management Plan and coordinates the input of the other project participants. Their focus is combining / federating the various models into a single, coordinated model that contains consistent and structured information / data.

The BIM Manager may be engaged for the entire project or separately for the design and construction phases.

**Discipline BIM Coordinator**

The lead modeller from each of the design disciplines. Discipline BIM Coordinators are responsible for ensuring that their models comply with the BIM Management Plan. They lead the coordination activities for their respective teams.

**2.2 BIM and project management**

The implementation of BIM on a project does not replace the project management function. The Project Manager must retain overall control of the project programme, deliverables and communication. The Project BIM Brief and Project BIM Management Plan should be supplements to
the project management documentation. In creating the BIM plans the aim should be to not duplicate what is contained within the overall project plans.

2.3 **Legal implications of BIM**

**Consultant selection**

The Project BIM Brief should be provided to the consultants along with other project information as a part of the Invitation to Offer process. The Invitation to Offer must clearly outline the department’s BIM expectations. The expectations should focus on the specific BIM goals and benefits that the department has identified in the Employer Information Requirements / BIM Brief.

As with the other parts of the Invitation to Offer, the Project BIM Brief will form a part of the consultant engagement contract when it is executed. In assembling the contract, care must be taken to avoid contradictions between the various documents. A clear order of precedence must be provided.

It must be clearly detailed in the Invitation to Offer how the BIM process will be managed and what each individual will be responsible for. It is recommended that the role of the BIM Manager be specifically detailed and not combined with the general “Lead Consultant” role description. The functions may be performed by the same organisation, but the requirements and skills required of the roles are separate.

If, during the development of the Project BIM Management Plan, the scope or responsibilities of an organisation are changed, this should be treated in the same way as any other scope change under the contract.

The consultant’s responsibilities with respect to timeliness, completeness and quality of deliverables are no different under a BIM delivery method. The contract (including the Project BIM Brief and / or Project BIM Management Plan) must clearly state what is to be produced and by when. However, with a BIM process there may be far more interdependencies that need to be included. These must be considered when developing the delivery programme.

**Contractor engagement**

The Invitation to Offer process must clearly outline the department’s BIM expectations of the contractor. The expectations should focus on the specific BIM goals and benefits that the department has identified. The Employer Information Requirements (EIR) will be outlined in the Project BIM Brief and will form part of the contract.

**Model disclaimers and Intellectual Property**

With a BIM process there are far more interdependencies between the documentation during the design and construction phases. The exchange of models is the very basis of the BIM process. All users need to understand the level of reliance that they can place on the models they are receiving. The NATSPEC National BIM Guide recognises the various legal status that can be assigned to a Design Model viz. Binding, Informational, Reference, and Reuse, and the need to document this model status in the BIM Management Plan (BMP).

BIM models can contain far more information than traditional electronic deliverables. To maximise the benefits of BIM this information must be freely available for others to use. It is important to recognise that irrespective of the type of contract used, the ownership of Intellectual Property must be covered.
3 Project BIM Brief

The Project BIM Brief is developed by the department’s Project Manager prior to engaging the consultant team.

In developing the Project BIM Brief the Project Manager should look at the overall goals and objectives of the project and consider how a BIM approach can aid in the achievement of these goals. For each goal, the specific BIM Uses that relate to achieving that goal can be identified. In finalising the BIM uses to be specified, the department’s Project Manager should consider both the benefits and likely costs associated with the use.

The Project BIM Brief must contain the following information:

- project Information
- key project contacts
- project goals / objectives
- BIM Use competency requirements
- client specific requirements
- project deliverables
- reference documents and standards.

The Project BIM Brief should identify construction phase and operation phase BIM Uses required by the department, even if only the design phase services are being procured. The requirements of later phases may impact on what the consultants need to produce.

In responding to the Invitation to Offer the consultants should address how they will implement the specified BIM Uses that fall within their scope.

If the project is being procured on a Design and Construct (D&C) basis, the consultant / contractor responses to the Invitation to Offer should clearly illustrate who will address each BIM Use and their specific competence in the relevant BIM Management Plans.

4 Project BIM Management Plan

The Project BIM Management Plan will be developed by the BIM Manager after the consultants have been engaged and before design documentation has commenced, or as part of the Early Contractor Involvement depending on the contract type. It is a collaboratively produced document with each Discipline BIM Coordinator ensuring that their specific requirements are included.

The BIM Management Plan is developed by the contractor in response to the departments’ Project BIM Brief.

The project BIM Management Plan generally contains the following information:

- project information
- BIM Management
- key project contacts
- project goals / objectives
- information management and exchange
• BIM Uses
• collaboration
• project deliverables
• quality control
• model element responsibilities, and
• reference documents and standards.

The Project BIM Management Plan should be considered a live document. It should be updated if project drivers change.

A construction phase BIM Management Plan should be prepared as soon as the contractor has been engaged.

A BIM Manager may be engaged for the entire project or separately for the design and construction phases. This can be two different parties. If the latter, those parties should work together to develop the construction phase BIM Management Plan.

The contractor and sub-contractors need to clearly understand the stage to which the design models have been taken. The project deliverables should include all of the department’s requirements for the handover models and data.

5 Modelling and documentation practice

The following are the key considerations for modelling and documentation best practice.

5.1 Planning the modelling process

All projects have slightly different drivers and all companies will have different modelling standards and protocols. It is not the intention of this guide to try and make all projects the same. This is both impractical and would inhibit innovation. However as a minimum, all planning and modelling processes shall comply with the department’s survey and modelling standards / policies / and guidelines. Refer to the following references for more details:

• Drafting and Design Presentation Standards
• TMR Surveying Standards
• Specifications
• Other relevant departmental technical policies, standards and guidelines found on the departmental website via http://www.tmr.qld.gov.au/business-industry/Technical-standards-publications

The collaborative development of the BIM Management Plan is where the standards, processes and procedures for the project are aligned.

5.2 Model location and orientation

Models should be located in accordance with the department’s survey standards / policies and guidelines.

All survey plan co-ordinates must be on the Map Grid of Australia (MGA), which is based on the Geocentric Datum of Australia (GDA). All survey levels must refer to Australian Height Datum.
The Contractor must ensure that all surveying complies with the *TMR Surveying Standards*. The *TMR Surveying Standards* are comprised of a manual in two parts; a Schedule and Technical Notes.

### 5.3 Naming conventions and structures

The ability to efficiently reuse data throughout the life of the model and the asset it relates to is one of the greatest benefits of BIM. In discussion with the department's Project Manager and other stakeholders the BIM Management Plan should define:

- the granularity and naming conventions for elements, and as a minimum comply with the requirements of the department’s *Drafting and Design Presentation Manual*, and
- specific parametric requirements for elements.

Even if the end use of the model / data has not been confirmed, the data must be created in a structured and consistent way for future translation.

### 5.4 Level of Development (LOD)

LOD is a scale that can be used to show the reliability of content that is expected to be included for specific model elements at different times during model development. The main purpose of LOD when incorporated in BIM Management Plans is to give clarity to each member of a design / construction team as to what they are required to author in their models at each stage and to what extent others can rely on them.

The NATSPEC BiM Paper “BIM and LOD” references the American Institute of Architects Draft Document G202-2012 *Building Information Modelling Protocol Form* which defines Level of Development as follows:

> “The Level of Development (LOD) describes the minimum dimensional, spatial, quantitative, qualitative, and other data included in a Model Element to support the Authorised Uses associated with such LOD”.

The NATSPEC BiM Paper defines five LODs as described below. Each subsequent level builds on the previous level and includes all the characteristics of the previous levels.

The levels defined (with associated content requirements) are:

- **LOD 100 Conceptual**: 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 metre, etc.) can be derived from other model elements.

- **LOD 200 Approximate geometry**: the Model Element is graphically represented in 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.

- **LOD 300 Precise geometry**: the Model Element is graphically represented in the model as a specific system, object, or assembly accurate in terms of quantity, size, shape, location, and orientation. Non-graphic information may also be attached to the Model Element.

- **LOD 400 Fabrication**: the Model Element is graphically represented in the model as a specific system, object, or assembly that is accurate in terms of quantity, size, shape, location, and orientation with detailing, fabrication, assembly, and installation information. Non-graphic information may also be attached to the Model Element.
• **LOD 500 As-built**: the Model Element is a field verified representation accurate in terms of size, shape, location, quantity and orientation. Non-graphic information may also be attached to the Model Element.

The LOD concept encompasses a number of aspects of design elements:

- level of graphic detail / precision of modelling
- amount, quality and relevance of non-graphic information, and
- type of non-graphic information, e.g. embedded in model elements, linked to model elements, separate from, but cross-referenced to, model elements.

While all these aspects contribute to the concept of LOD, they do not define it, LOD is the sum value of them all.

Essentially, when all of these aspects are taken into consideration, LOD represents the extent to which information about an element can be relied on for decision making purposes at a particular point in time. This is the most critical notion in the context of collaborative working arrangements.

### 5.5 Data and workflow management

Although BIM is focused around the models, a lot of non-graphical / non-model data will be produced in a project. This non-model data will need the same level of management and coordination as the BIM models themselves. These non-model data although not feasible / practical to be stored within the model would need to be linked with relevant model elements. Examples of non-model data include photos taken by inspectors, test results / reports, design exception reports, and so on.

Data Management Systems (DMS) are readily available and used extensively in projects for some time now. These type of systems can add significant value to the management of non-model data and linking them to the relevant model elements.

The DMSs can also provide value in allowing workflows to be automated during project delivery. This will improve coordination of data collection and dissemination to various team members.

A Common Data Environment (CDE) should be set up to manage the sharing of the project information with all members of the project team.

### 5.6 Model coordination (clash detection)

One of the key benefits of the BIM process is the ability to coordinate modelled elements. Significant savings can be made on site by resolving coordination issues in the modelled environment.

Each Discipline BIM Coordinator is responsible for ensuring that the models they are responsible for are coordinated both within themselves and with the other disciplines. Main coordination issues should be resolved prior to models being federated and run through clash detection processes.

### 5.7 Model handovers

When issuing a model, the Discipline BIM Coordinator should include a Model Description Document (MDD) that includes crucial information about the model. The MDD should be named so that it can be readily associated with the correct model and describe the contents of the model and explain its purpose and limitations.

The format and content of the MDD should be agreed and documented as a part of developing the BIM Management Plan.
5.8 **BIM deliverables**

The Project BIM Brief should clearly outline what deliverables are required. Currently, contracts are based on 2D paper documents (drawings, reports, schedules and specifications). As the BIM process matures all this information could be provided within the BIM model.

As a minimum, when the model must form part of the handover documents, either from the design team to the department / contractor or from the contractor to the department, then the following should be confirmed:

- separate models or combined
- format / file type, and
- what is (and isn’t) included in the model.

Where 2D deliverables have been generated from the model, they should accurately represent the view of the model and not be modified in their 2D format.

6 **Enabling asset management via BIM**

This document is not aimed at providing a comprehensive guide to enhanced information contained in the Asset Management System (AMS). However, it is the operational phase of the asset that has the greatest overall costs and offers the greatest possibilities for improvement.

The As-Built Models produced at the completion of the project contain a huge amount of information. To provide the best benefit for ongoing input into the Asset Management System this information should be:

- focused on the data needed to maintain and operate the asset
- validated, verified and consistently structured (e.g. via schemas) to allow direct or easy translation into the department’s Asset Management systems, and
- include any design information relevant to Asset Management.

To maximise the likelihood of the above being achieved the concept of “starting with the end in mind” should be applied throughout the project. The Asset Management team should have input to establishing the Project BIM Brief and should review the Project BIM Management Plan.

7 **Glossary**

The following are terms used in this guideline or in common usage in discussion about BIM.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>4D BIM</td>
<td>A 3D model linked to time or scheduling data. Model objects and elements with this data attached can be used for construction scheduling analysis and management. It can also be used to create animations of project construction processes.</td>
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<tr>
<td>5D BIM</td>
<td>A 4D BIM linked to cost data. The time data adds another dimension to cost data, allowing expenditure to be mapped against the project program for cash flow analysis, etc.</td>
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<tr>
<td>Term</td>
<td>Definition</td>
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<tr>
<td>Asset Management System (AMS)</td>
<td>A suite of IT systems (i.e. ARMIS, ROAMS, BIS, etc.) that supports Asset Management.</td>
</tr>
<tr>
<td>Australian Height Datum (AHD)</td>
<td>The datum used for the determination of elevation in Australia. The determination used a national network of benchmarks and tide gauges and set Mean High Water as zero elevation.</td>
</tr>
<tr>
<td>BIM Coordination Room</td>
<td>A purpose-designed room set up to facilitate the coordination of digital models by members of the BIM Team. It includes IT infrastructure such as cabling, projectors and/or smart boards that allow the room’s occupants to view models together for coordination, collaborative design, etc.</td>
</tr>
<tr>
<td>BIM Management Plan (BMP)</td>
<td>A formal document that defines how the project will be executed, monitored and controlled with regard to BIM. A BMP is developed at project initiation to provide a master information/data management plan and assignment of roles and responsibilities for model creation and data integration throughout the project.</td>
</tr>
<tr>
<td>Building Information Management (Data Definition)</td>
<td>Building Information Management supports the data standards and data requirements for BIM use. Data continuity allows for the reliable exchange of information in a context where both sender and receiver understand the information.</td>
</tr>
<tr>
<td>Building Information Model (BIM) (Product)</td>
<td>An object-based digital representation of the physical and functional characteristics of a road or structure. The Building Information Model serves as a shared knowledge resource for information about a facility, forming a reliable basis for decisions during its lifecycle from inception onward.</td>
</tr>
<tr>
<td>Building Information Modelling (BIM) (Process)</td>
<td>A collection of defined model uses, workflows, and modelling methods used to achieve specific, repeatable, and reliable information results from the model. Modelling methods affect the quality of the information generated from the model. When and why a model is used and shared impacts the effective and efficient use of BIM for desired project outcomes and decision support.</td>
</tr>
<tr>
<td>BIM Manager</td>
<td>Leads and coordinates the BIM processes for the project.</td>
</tr>
<tr>
<td>BIM Coordinator</td>
<td>BIM leader for each discipline of a project.</td>
</tr>
<tr>
<td>BIM Use</td>
<td>A unique task or procedure on a project which can benefit from the application and integration of BIM into that process.</td>
</tr>
<tr>
<td>CAD</td>
<td>Computer Aided Design. A geometric/symbol based computer drawing system that replicates hand drawing techniques.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
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<td>Common Data Environment (CDE)</td>
<td>The common data environment is a central repository where construction project information is housed. The contents of the CDE are not limited to assets created in a 'BIM environment' and it will therefore include documentation, graphical model and non-graphical assets.</td>
</tr>
<tr>
<td>Employer Information Requirements (EIR)</td>
<td>A set of Employer's Information Requirements (EIR) is a key document for those working to the Level-2 BIM process. It is intended to be part of the wider tender document set for the procurement of the Design Team and the Constructor. See also BIM Brief.</td>
</tr>
<tr>
<td>Deliverables</td>
<td>The product of engineering and design efforts to be delivered to the client as digital files and / or hardcopy documents. Typically, this would be the concept submittal and the corrected final design. A deliverable may have multiple phases.</td>
</tr>
<tr>
<td>Federation</td>
<td>The combination of multiple discipline specific models into single model for review or coordination.</td>
</tr>
<tr>
<td>Geographic Information System (GIS)</td>
<td>A system that integrates hardware, software, and data for capturing, managing, analysing, and displaying all forms of geographically referenced information.</td>
</tr>
</tbody>
</table>
| Industry Foundation Class (IFC)            | A system of defining and representing standard architectural and construction-related graphic and non-graphic data as 3D virtual objects to allow data exchange among BIM tools, cost estimation systems, and other construction-related applications in a way that preserves ability to perform analysis on those objects as they move from one BIM system to another. IFC files saved or exported from BIM-authoring software can be used for the following tasks:  
  - coordination of BIM models and related design disciplines  
  - clash detection  
  - rules-based checking  
  - Building Code compliance  
  - sharing models between different BIM-authoring softwares  
  - COBie data derived from BIM models  
  - energy testing data derived from BIM models  
  - systems simulation.                                                                                                                                                                                                                                                   |
| Interoperability                           | The ability of two or more systems or components to exchange information and to use the information that has been exchanged.                                                                                                                                                                                                                  |
### Legal status of the Design Model to construction:

- **Binding:** imposing a legal (contractual) obligation between the author/s and recipient/s. Used in this context to mean a Design Model that represents what has to be constructed under the terms of the contract.

- **Informational:** a Design Model that conveys non-binding information relevant to the project that may be useful to its recipient/s. No formal claims are made about its accuracy and it is provided on an ‘as is’ basis.

- **Reference:** a Design Model that is intended to be used for ‘read-only’ purposes such as recording model development at different stages of the project or clash detection. Once Design Models are designated ‘Reference’, they shall not be edited further. Reference Design Models can be used as the basis for bid preparation but cannot form part of the contract documents. A model has to be designated ‘Binding’ for this purpose. Reference models shall be sufficiently accurate for their intended purpose.

- **Reuse:** a Design Model authorised by its authors for modification or further development by its recipients.

### Map Grid of Australia (MGA)

A coordinate system based on the Universal Transverse Mercator projection and the Geocentric Datum of Australia. The unit of measure is the metre.

### Level of Development (LOD)

The Level(s) of Development (LOD) describes the level of completeness to which a model element is developed.

### 8 References

<table>
<thead>
<tr>
<th>Reference</th>
<th>Source</th>
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<tbody>
<tr>
<td>NATSPEC Project BIM Brief</td>
<td><a href="http://www.natspec.com.au">www.natspec.com.au</a></td>
</tr>
<tr>
<td>NATSPEC BIM Management Plan Templates</td>
<td><a href="http://www.natspec.com.au">www.natspec.com.au</a></td>
</tr>
<tr>
<td>BIM Project Execution Planning Guide V2.1</td>
<td>The Computer Integrated Construction Research Program at the Pennsylvania State University <a href="http://www.bim.psu.edu">www.bim.psu.edu</a></td>
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