DELIVERING FOR QUEENSLAND

Manual

Project Cost Estimating Manual (PCEM)

November 2025 (9th Edition)

Queensland Government

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Feedback

Please send your feedback regarding this document to: tmr.techdocs@tmr.qld.gov.au

Foreword

The Ninth Edition of the *Project Cost Estimating Manual* (PCEM) reflects significant updates to the estimating processes and related policies of the Department of Transport and Main Roads (the department) since the previous edition. It incorporates the requirements of the departments Infrastructure Cost Estimating Addendum and integrates feedback from the department's regional estimating champions and external service providers to enhance usability and effectiveness.

This edition has also been shaped by recent updates to Australian Government policies and guidance documents, which have influenced the department's approach to cost estimating.

In recent years, the construction industry has faced unprecedented cost escalation pressures due to supply chain disruptions, rising costs of key commodities, and a shortage of skilled labour. These challenges have had a substantial impact on the cost of projects and programs delivered by the department. In response, the department remains committed to producing accurate project cost estimates by adopting innovative approaches to address these issues.

The department has recently taken on the responsibility for planning, developing, and delivering large-scale rail infrastructure projects. To support this expanded role, the document now includes rail-specific guidance. This edition places greater emphasis on cost estimating across all modes of transport infrastructure—road, rail, maritime, public transport, and active transport—serving freight, commuter, and recreational networks.

Recognising the importance of accurately and promptly communicating factors that affect cost estimate confidence, the Portfolio Investment and Programming Division has developed supplementary resources. These include the *Project Risk Management and Contingency Development Process Manual* and the *Cost Estimation and Escalation Brochure*. These documents should be read in conjunction with this document.

Compliance with the requirements outlined in this document is mandatory for all cost estimates prepared for departmental projects included in the Queensland Transport and Roads Investment Program (QTRIP). Exceptions apply to OnQ Type 3 projects, asset maintenance projects under $10M, and projects within the Maintenance, Preservation and Environment (MPE) and Road Operations (RO) Investment Programs, as defined in the *Transport Infrastructure Asset Management Policy*.

All estimators, project managers, engineers, technical staff, and external service providers must adhere to the requirements of this document when preparing cost estimates at any stage of the project lifecycle for applicable projects.

Revision register

Rev #	Edition	Amended by	Date
1	Draft Release	PCEM management team	July 2002
2	1st Edition	PCEM management team	Feb 2004
3	1st Edition Ver 1.1	PCEM management team	April 2004
4	2nd Edition	PCEM management team	Dec 2004
5	3rd Edition	PCEM management team	Dec 2007
6	4th Edition	PCEM management team	July 2009
7	5th Edition	PCEM management team	May 2012
8	6th Edition	PCEM management team	Sep 2015
9	7th Edition	PCEM management team	June 2017
10	8th Edition	PCEM management team	December 2021
11	8th Edition Ver 1.1	PCEM management team	22 December 2021
12	9th Edition	PCEM management team	November 2025

Manual management plan

Purpose of the update

The department's guidelines and manuals are routinely updated to ensure they align with the most up to date processes and policies of the state and federal governments.

This document is managed through the following roles:

Role	Position / person
Manual Customer	General Manager – Portfolio Investment and Programming
Manual Sponsor	Executive Director – Program Development and Performance
Manual Manager	Director (Program Management Improvement) – PMI
PMD Representation	Director (Delivery Risk)
Manual Review Team	Manager (Estimating and Risk) – PMI Principal Engineer (Estimating and Risk) – PMI PMI Senior Engineer (Estimating and Risk) – PMI Regional / District Estimating Champions

Amendment and review strategy

Transport and Main Roads welcomes feedback about this document. Please send feedback via estimating.support@tmr.qld.gov.au for the attention of the manual manager, who will acknowledge all feedback, suggested changes and improvement requests.

The manual owner and review team are responsible for ensuring the manual is updated to meet the department's needs. To this end the manual manager, in collaboration with the manual review team will:

- review feedback and comments
- monitor the context / environment the manual operates within, and
- recommend appropriate action to the manual sponsor.

Manual availability

The PCEM is available in PDF format on the Transport and Main Roads website www.tmr.qld.gov.au.

Uncontrolled document

All downloaded and printed copies of this document are uncontrolled. The source website should be routinely checked for updated versions.

Acronyms

Acronym	Expansion
3PCM	Portfolio, Programming, Project and Contract Management System
APDV	Agreed Project Delivery Value
BCDF	Business Case Development Framework
BCR	Benefit Cost Ratio
BIM	Building Information Modelling
BI Publisher	Business Intelligence Publisher
BPPs	Best Practice Principles
CapEX	Capital Expenditure
CBA	Cost Benefit Analysis
CBS	Cost Breakdown Structure
CBRC	Cabinet Budget Review Committee
CDE	Common Data Environment
CPI	Consumer Price Index
DES	Department of Environment and Science
DITRDCSA	Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts
EPPM	Enterprise Project Portfolio Management
DVR	Digital Video Record
EFCT	Estimate For Comparison with Tenders
FFA	Federal Funding Agreement
IMD	Infrastructure Management and Delivery Division
ISC	Infrastructure Sustainability Council
ITS	Intelligent Transport Systems
MIC	Minor Infrastructure Contract
MOU	Memorandum of Understanding
MPE	Maintenance, Preservation and Environment
MPO	Maintenance, Preservation, and Operations
MRP	Main Road Specifications for Principals' activities
MRS	Main Road Specifications for construction activities
MRTS	Transport and Main Roads Technical Specification

Acronym	Expansion
MSQ	Marine Services Queensland
NLTN	National Land Transport Network
NPA	National Partnership Agreement
NPV	Net Present Value
NTT	Notices To Tender
OBIEE	Oracle Business Intelligence Enterprise Edition Analytics Tool
OpEx	Operating Expenditure
OPPM	Oracle Primavera Portfolio Management
PAD	Property Acquisitions and Disposals
PAF	Project Assessment Framework
PAI	Principal Arranged Insurance
PCAR	Program Controls Analysis and Reporting
PCB	Project Cost Breakdown
PCECC	Project Cost Estimating Control Checklist
PCEM	Project Cost Estimating Manual
PE	Preliminary Evaluation
PIP	Portfolio Investment and Programming
PLSL	Portable Long Service Leave
PMF	Program Management Framework
PMI	Program Management Improvement
PPI	Policy, Planning, and Investment
PPR	Project Proposal Report
PUP	Public Utilities and Plant
QR	Queensland Rail
QRSPP	Queensland Road System Performance Plan
QTRIP	Queensland Transport and Roads Investment Program
RCP	Risk Context Profile
RFI	Requests For Information
RO	Road Operations
RTCC	Risk, Time, Cost and Contingency
S1D	Preliminary Design

Acronym	Expansion
S2D	Detailed Design
SASR	Strategic Assessment of Service Requirements
TCAF	Transport Corridor Acquisition Fund
TIP	Transport Infrastructure Portfolio
TIPPS	Transport Infrastructure Portfolio Plans and Schedule
TP	Transport Policy
TSP	Transport Strategy and Planning
WBS	Work Breakdown Structure

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1 Introduction

1.1 Purpose and application

The *Project Cost Estimating Manual* (PCEM) aims to guide both the Department of Transport and Main Roads (department) internal staff and external cost estimators on policies, requirements, rules, and standards for preparing cost estimates for transport infrastructure projects. Reliable cost estimate information has multiple applications, including:

- Plan developed by the department and provided to the Commonwealth annually which provides a long-term (10-year) strategic view of a state's land transport infrastructure priorities, including priority projects that have or are seeking a Commonwealth funding contribution over the next 10 years and how they will be sequenced.
- Support for investment decisions at the business case stage of a project.
- Justification of costs across the project life cycle.
- Verification of intended costs before projects enter tender stages.
- Estimation of cost variations and alternative completion options, and
- Continual cost control throughout the project's phases.

The document highlights the importance that all risks, such as land acquisitions, Public Utility Plant (PUP) relocations and environmental offsets, need to be managed, and to be managed, they need an appropriate estimate for the cost as part of the project scope.

Cost estimating is a crucial piece of the wider project cost management approach. To apply this effectively, it is recommended to understand the relevant policies, methodologies, and processes based on the project's funding source and its complexity. These documents combined deliver a thorough groundwork for administering estimating services within the department.

1.2 How to use the manual

This document serves as a reference guide for various stakeholders engaged in departmental infrastructure projects, including departmental employees, external contractors, consultants, and local government councils.

It is important to note that all paper versions of this document are considered uncontrolled, and no updates or notifications will be sent out for any changes made to it. For the most current published version of this document, stakeholders are directed to the Transport and Main Roads website at www.tmr.qld.gov.au.

1.3 Manual structure

This document is designed to offer detailed guidance in a progressive format for users engaged in transport infrastructure delivery estimating in the department. This guidance includes foundations such as policies, principles, and processes, and extends to the complexities of non-road infrastructure projects as touched upon in Section 11.

As one advances through the document, they will encounter information on functions, roles, standards, project staging, risk management, contingency planning, and the tools employed in estimating. Moreover, this document outlines strategic recommendations for creating project estimates that cater to varying requirements and end-goals for different purposes.

1.4 Relationship to other systems

The *Project Cost Estimating Manual* (PCEM) serves as a reference for project cost estimating within the context of several frameworks and methodologies including the Integrated project Management Framework (PMF), Queensland Transport and Roads Investment Program (QTRIP), Project Assessment Framework (PAF) process, and federal cost estimation guidance that supports nationally significant projects. Additionally, it aligns with the Federation Funding Agreement Schedule on Land Transport Infrastructure Projects (FFAS), Infrastructure Australia (IA), the Business Case Development Framework (BCDF), and the OnQ project management methodology. This document works in tandem with the department's *Project Risk Management and Contingency Development Process Manual* to enrich risk management and contingency development processes.

In situations where other manuals and guides are referenced for the cost estimating function in the department and a conflict arises, the document with the most recent publication date should be given precedence. Any conflicts should be reported to the manual owner for further review and necessary corrective actions through the established feedback process.

2 Estimating policy, strategies and standards

2.1 Policy statement

The Transport and Main Roads *Infrastructure Cost Estimating Policy* mandates that cost estimates for projects included in the QTRIP must adhere to the specifications outlined in the PCEM. This policy offers guidance and lays out the standards for consistency, accuracy, and the required confidence level for cost estimates related to transport infrastructure projects, applying to both state and nationally funded projects.

The key principles that can be identified from the provided document excerpts for estimating policy include:

- Estimates must be created in conformity with the department's QTRIP Governance Principles, Project Assessment Framework (PAF) for Major Projects, the department's OnQ project Management Methodology, Work Breakdown Structure (WBS), and Transport and Main Roads Specifications (MRS).
- For all projects except certain Maintenance, Preservation, and Operations (MPO) projects under $10M, an 'unlikely' to be exceeded at 90% confidence level is required for estimates to support project prioritisation and affordability from Business Case milestone.
- This document recognizes the inherent uncertainties in projects and that there can be incomplete or sometimes unavailable project scope information needed to create project estimates. Such circumstances must be identified and factored into project risk registers.
- The cost estimating process must support the effective prioritisation of investments and ensure accurate reporting of transport infrastructure funding submissions.
- Cost estimates must be continually dependable and exercised within the broader context of project and program management frameworks.
- Estimates must be presented using the prescribed estimate document format, (classifying into capital (CapEx) and operating (OpEx) expenditure, prior to submission for making investment decisions, as per the department's *Infrastructure Asset Accounting Policy*.
- Estimates must be subjected to review and approval processes, based on consistent, clear lines of responsibility and accountability, ensuring uniform costing standards and controls are applied to any cost information released.
- Users of the estimating manual, including external service providers who develop estimates for departmental projects, are required to follow the department's *Infrastructure Cost Estimating Policy* and the *Policy Addendum*.

- Estimating methods must be appropriate for the project and include dividing it into approved WBS elements, applying rates and additional costs, and summing elemental costs to obtain a complete estimate.
- A scalable approach is recommended, allowing cost estimators and approving managers to jointly determine the level of estimating rigour and documentation required.
- Estimates are supported by engineering and design efforts informed through technical investigations as design informs costing estimates that are robust, defensible, and risk adjusted with an appropriate contingency allowance, with a well-defined scope and breakdown of projects costs, as defined in the design sections of the Business Case Development Framework by State Development, Infrastructure and Planning.
- Estimates must allow sufficient contingency through a risk based approach (See EP153 *Project Risk Context Profiles* and EP176 *Contingency management of infrastructure projects* at Engineering policies), accounting for any extraordinary cost escalation pressures due to supply chain shortages, cost rise in key commodities and shortage of skilled labour force which can create significant cost impact to projects and programs delivered by the department.
- Estimate performance must be re-assessed and reviewed at all funding gates. This will ensure that the actual project costs are neither significantly over and above the originally estimated total project cost, nor significantly under the estimated cost at any given stage of the project life cycle.

The policies and manuals referenced above are published on the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

2.2 Applicability

The scalability is a key feature of the cost estimating manual, permitting cost estimators and managerial personnel to collaboratively decide on the appropriate degree of thoroughness and documentation details needed for their specific estimating activities.

The onus is on the individual business units within the department to apply the manual's requirements effectively to produce realistic cost estimates and to ensure their staff have the requisite skills and expertise for these estimating tasks. Moreover, external service providers tasked with creating estimates for departmental projects are obligated to adhere to the stipulations set out in this document.

2.3 Estimating rationale

The department utilises cost estimation as a key tool to support the prioritisation of investment candidates and accurate reporting for transport infrastructure funding at both state and national levels. The approach acknowledges that projects are subject to inherent uncertainty, which can lead to situations where project scope information needed for estimates is incomplete or unavailable.

This necessitates the identification and inclusion of such circumstances in project risk registers to ensure that the development process of project contingencies remains robust and precise. In doing so, the department can assure the reliability of estimate values within the project and program management framework, while also establishing strategies and processes for developing project contingencies and handling potential risks associated with cost estimations.

2.4 Performance standards and measurements

The estimate accuracy and reliability are expected to improve as a project progresses through its life cycle. This improvement stems from systematic reviews, updates, and approval processes at defined points in the project timeline. The cost estimates should be evaluated at key investment gating points, and the variance in actual project costs, when compared to estimates, should fall within specified ranges at each phase of the project lifecycle as described in Table 2.4. It delineates the acceptable percentage variances of completed project costs relative to estimates, arranged by project phase, as follows:

Table 2.4 – Cost estimate performance standard (measured at project finalisation phase)

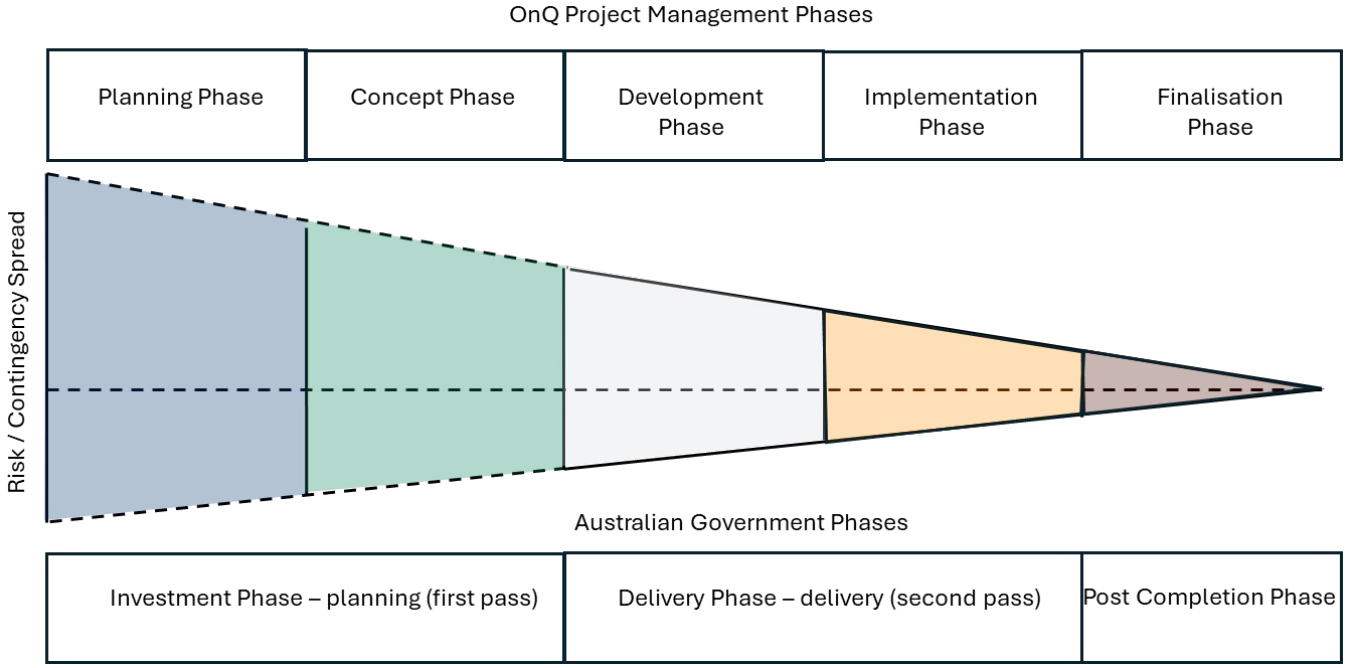
Project phase	Cost estimate document	Percentage variance of completed project cost	
		Lower	Upper
Planning (or identification)	Strategic / Detailed Planning	-70%	+70%
Concept	Business case	-40%	+40%
Development	Stage 1 design	-20%	+20%
Development	Stage 2 design	-10%	+10%
Implementation	Construction	-2.5%	+5%

*Source Business Case Development Framework, Stage 3 Detailed Business Case Guideline, page 96, Release 3.1, Department of State Development, Infrastructure and Planning, and, Risk, Time, Cost and Contingency (RTCC) Guidelines, Business case sourced from Victoria Treasury.

This structured approach allows for consistency in measuring estimation performance and provides a framework to anticipate acceptable variances at each stage of the project.

Table 2.4 is also represented as a cone of accuracy in Figures 2.4(a) and 2.4(c) which were extracted from the federal *Best Practice Cost Estimation Standard for Publicly Funded Road and Rail Construction.*

Figure 2.4(a) – The ideal project cost history

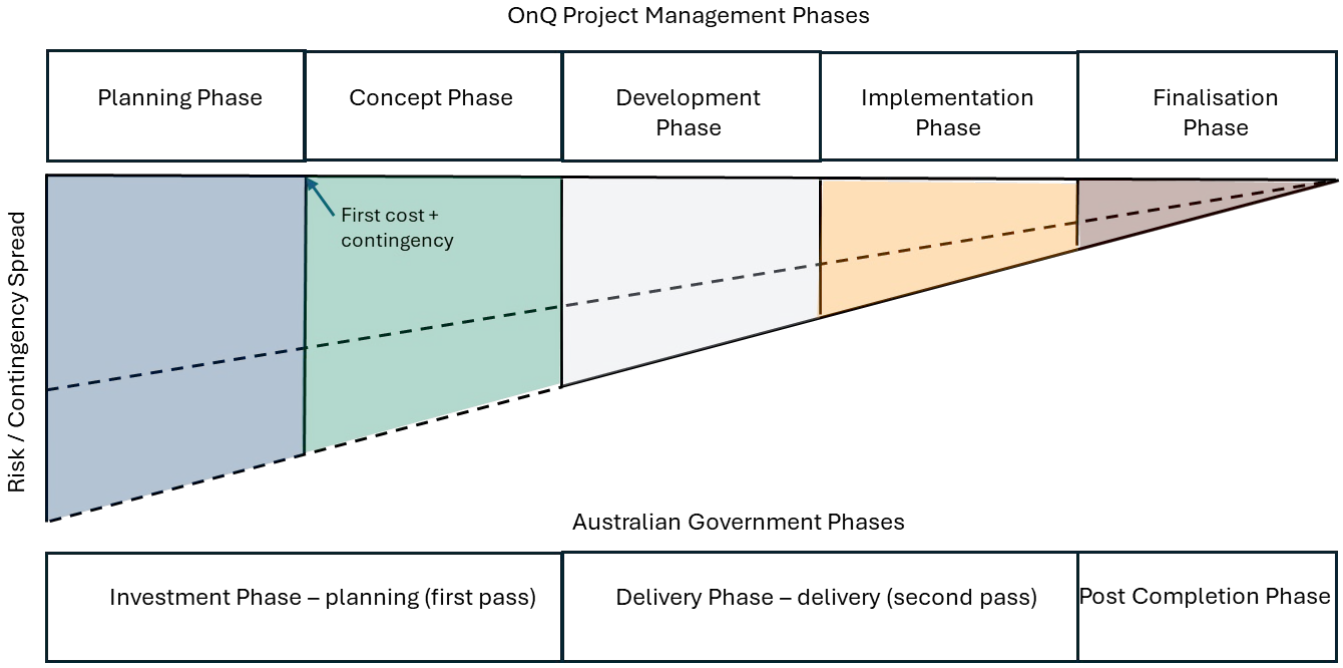


An '**ideal**' project where the **final cost is the first cost excluding contingency** = a project where the net cost of anticipated risk and contingency items was zero and there was no net cost changes.

Based on the extracted document portions, an 'ideal' project is one where the final project cost matches the first cost estimate and does not take into account contingencies.

For an 'acceptable project', as depicted in Figure 2.4(b), the final cost encompasses the original contingency estimates but does not exceed them. It should be noted that not all projects are carried out adhering to these standards.

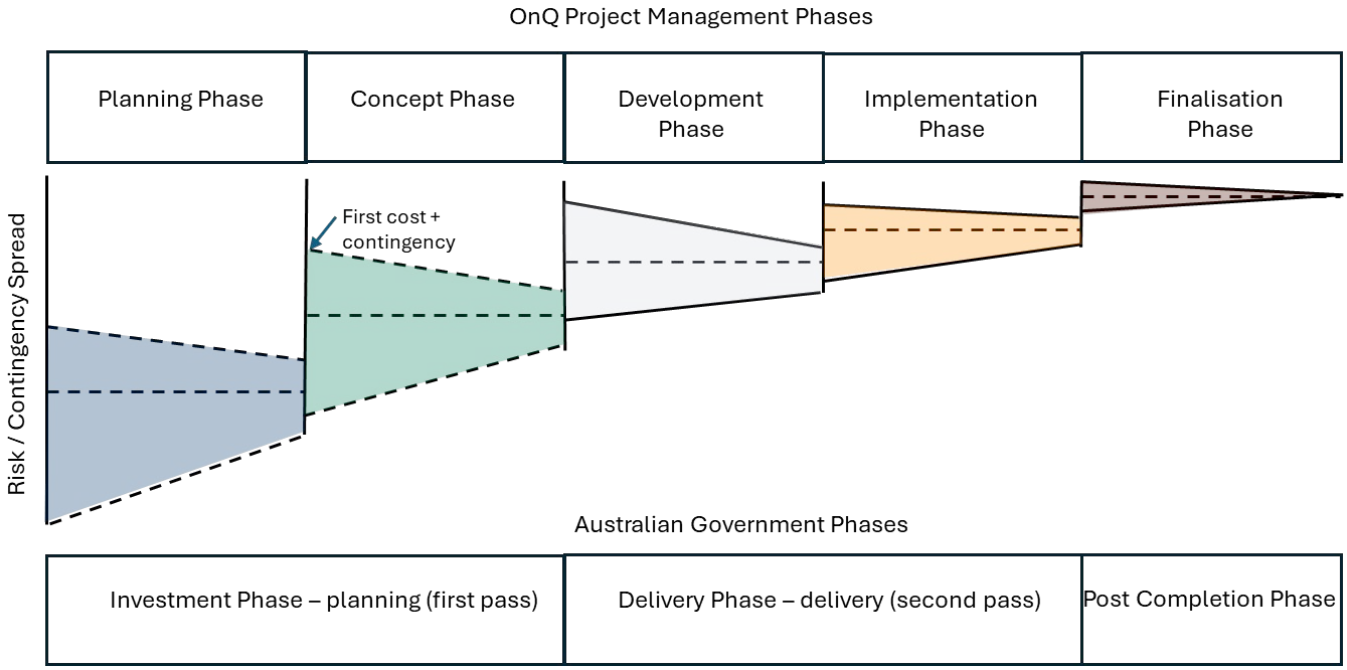
Figure 2.4(b)An acceptable project cost history



An '**acceptable**' project where the **final cost does not exceed the first cost excluding contingency** = a project where all the risks and contingence items occurred or where net changes were absorbed within the risk and contingency allowance.

Figure 2.4(c) shows an 'unacceptable' cost history where the base estimates and contingencies are being continually revised upwards.

Figure 2.4(c) An unacceptable project cost history



A project where the **final cost is well above the first cost excluding contingency** = a project where there was either or a combination of:

- Extra risks eventuated above those anticipated
- Extra cost changes occurred plus all the anticipated risks eventuated, and/or
- Excessive cost changes occurred even though risks were less costly than anticipated.

In the planning phase of projects, the strategic and detailed strategic planning estimates are used to inform the Transport and Main Roads 10-year program. This program, as well as the federal Department of Infrastructure, Transport, Regional Development, Communications, Sport and the Arts (DITRDCSA)'s Annual Infrastructure Plan, relies on estimates that may not always be based on fully defined project scopes.

Despite this lack of detailed information, the estimates beyond the business case are expected to have a 90% confidence factor (P90), indicating a high level of certainty that the costs will not be exceeded upon project completion.

The estimates provided at the planning phase contribute to a long-term strategic outlook on land transport infrastructure priorities for the state, informing federal investment decisions. It is essential to exercise caution when publishing these figures due to the potential implications on funding and sequencing of future infrastructure projects.

Furthermore, it should be noted that while planning funding may be granted during the federal Investment Phase (first pass), this does not ensure subsequent delivery funding,

emphasizing the preliminary nature of this investment phase. The development of a robust project business case and/or a delivery proposal is integral to moving forward in securing delivery funding. The estimate should include sufficient allowance for earlier site investigations and design to better inform project risks in the business case to arrive at a more realistic project outturn costs and budget. When preliminary site investigations, which are normally undertaken in Development Phase using Capital funding, are moved to Concept Phase to undertake early site investigations, the preliminary site investigation classification remains as Capital (or CAPEX).

The development of Business Case estimates in Concept Phase is a critical aspect of project delivery, facilitating investment decisions and ensuring that projects can be completed within the agreed budget throughout their life cycle. The percentage ranges for these estimates are suggestive and should be weighed against the foundational information that establishes their context. Adjustments to cost estimates can arise due to several factors including changes in scope, assumptions, price alterations, and encountered contingencies – with such modifications not always being favourable.

Moreover, performance standards associated with cost estimates are retrospectively evaluated at the project's finalisation phase, and alternative interim measures may be utilized by regional and district offices to actively monitor the control over their estimates, such as assessing the cost variance from previous estimates. Consistent evaluation and assessment are mandated by the QTRIP Governance Principles, ensuring the reliability, consistency, and accuracy of estimates, as well as recognizing and fulfilling potential training necessities.

The specific details regarding the procedures, methodologies, and requirements to develop and manage Business Case estimates, as well as their integration within the QTRIP, are provided in this document and the QTRIP Governance Principles document.

2.5 Estimating practices

The following estimating practices are used in the department for supporting the estimating processes referred to in Section 4.1.

2.5.1 Practices for developing base estimate

The accuracy of any cost estimate is intrinsically linked to a clearly defined project scope. The accuracy of cost estimates is highly dependent on how well the project scope is articulated, detailing the work that must be performed during a project or stage and therefore identifying the cost elements that need to be estimated.

A poorly defined project scope can lead to significant decreases in estimate accuracy due to the necessity of making numerous assumptions to address the gaps in scope.

Consequently, the initial estimate may not be aligned or representative of the final product. To counteract the impact of limited scope definitions on early estimates, project teams may need to make reasoned assumptions regarding what is included within the scope and what is not, to facilitate the development of cost estimates by estimators.

A comprehensive project scope enables the generation of work packages—a division of the principal project deliverables into smaller, more manageable segments as per the Work Breakdown Structure (WBS). The work packaging process allows for the assignment of quantities, costs, and/or rates to each task, which in turn aids in the formulation of the baseline estimate, contributing to a more accurate and realistic cost estimation process.

Estimators must consider the breakdown of work activities across the entire lifespan of a project and ensure these are accounted for at least down to Level 3 of the standard project Work Breakdown Structure (WBS). Transport infrastructure projects' work packages are developed according to specific asset classes stipulated in the department's *Transport Infrastructure Asset Management Policy*. This policy covers asset classes such as roads, road structures, busways, light rail systems, active transport infrastructure, and maritime infrastructure.

For major rail infrastructure (for example: Logan & Gold Coast Faster Rail Project , Beerburrum to Nambour Rail Upgrade), the Government has decided that Transport and Main Roads should deliver rail projects on behalf of Queensland Rail and if this is the case, Transport and Main Roads should capitalise the asset while it is being built (as the asset is under department control at this time) and then transferred out through equity when the asset is complete. Depending on the project, there could be some form of financing attached to the asset, and this would have to be reviewed on a case-by-case basis.

When projects fall outside the scope of OnQ, estimators are required to follow the cost estimating procedures specified by the funding source or process to create cost estimates.

If non-first principles cost estimating methods are being used, it is important that historical unit rates referenced (as mentioned in Section 9.1) come from projects similar in nature. Furthermore, these rates must be adjusted adequately to ensure they are contextually relevant and appropriate for the project estimate at hand. Adjustments should take into account factors like the age of the unit rates, market condition changes, specific project or departmental requirements, contractor overheads and profit margins, differences in constructability, as well as variations in methodology and project delivery method.

When adjusting historical unit rates for cost estimating in project management within the described policy context, it is essential to consider several factors that affect the accuracy and relevance of the cost estimate. These factors include:

- **The currency / age of the unit rates:** Rates must be current or adjusted to reflect present-day values.
- **Changes to prevailing market conditions:** Market conditions can alter costs significantly, so estimates must account for these fluctuations.
- **Specific project / departmental requirements:** Each project may have unique requirements that necessitate adjustments to the unit rates.
- **On-and-off site contractor overheads and profit margin:** Overheads and profit margins must be incorporated into the unit rate calculations.
- **Variations in constructability, methodology, and project delivery method:** Different construction methodologies and project delivery methods can impact the overall cost, and
- **Location and updated site conditions and so on:** Site-specific conditions such as geotechnical issues or access challenges also require consideration in the cost estimate.

The factors influencing the cost estimate of a project must be thoroughly evaluated and adapted as necessary, with the cost estimate being accurate and reflective of the project-specific conditions. After developing an estimate, it should be categorised into Capital Expenditure (CapEx) and Operational Expenditure (OpEx) in accordance with the department's *Infrastructure Asset Accounting policy* requirements. Refer to the Transport and Main Roads *Cost Classification Guideline for Transport Infrastructure Projects*, accessible on the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

This strategic classification should persist throughout the project's lifecycle. Estimates are required to be presented in the standard estimate structure format provided by the department, including details of the project's scope (both in-scope and out-of-scope elements) and any underlying assumptions. All cost estimates should be expressed in outturn dollars, which represent the projected total cost upon project completion.

For projects receiving Australian Government funding, the costs need to be detailed using the Project Cost Breakdown (PCB) template alongside the Project Proposal Report (PPR). For detailed information regarding land transport infrastructure projects, refer to the *Notes on Administration for Land Transport Infrastructure Projects 2024-2029*.

Additionally, the cost estimates for QTRIP projects need to be regularly updated and recorded within the department's Portfolio, Program, Project and Contract Management (3PCM) system at every approval stage known as 'gating points'.

The learnings register within the 3PCM system is instrumental in documenting estimating lessons that can subsequently be employed for benchmarking purposes.

2.5.2 Practices connected with risk assessment

The purpose of a cost estimate is to give a realistic projection of the total cost for a particular project scope, accounting for inherent uncertainties as outlined in Figure 3.1(a). The contingency allowance represents the measure of residual risk relative to achieving project objectives, and a proper risk evaluation process is necessary to establish the right level of contingency. Gaining confidence in the cost estimate requires a rigorous risk assessment and the development of a suitable contingency allowance.

Estimators are required to create a compliant risk register for significant OnQ Types 1, 2, and 3 transport infrastructure projects, with an emphasis that while maintaining a risk register for Type 3 MPO and smaller projects (under $10M) is optional, it is beneficial for all projects.

The department's recommended risk evaluation approaches for developing cost estimates (project type definitions are given in Section 2.6.4.2) are as follows:

- **Major Projects and OnQ Type 1 projects** (which utilises the PAF framework), dictate a quantitative risk assessment and probabilistic methods for risk evaluation to ensure higher levels of certainty and confidence on budgetary impact.
- **OnQ Type 2** also require a quantitative risk assessment and probabilistic methods for risk evaluation, to ensure similar levels of certainty and confidence on budgetary impact.
- **OnQ Type 3** projects may use a qualitative approach for risk assessment and a deterministic way to evaluate risks. These should still meet the criteria of being 'unlikely' to exceed at a 90% confidence level in estimates upon project completion.
- **OnQ Type 3 MPO less than $10M**, are exempt from these requirements.

For projects funded by the Australian Government with a total cost over $25M, probabilistic cost estimation techniques are mandated to generate P50 and P90 outturn costs unless the Commonwealth grants a specific exemption. Furthermore, a detailed breakdown of costs and supplementary information must be provided for the review of specific project elements.

For projects with a delivery proposal that exceeds $25M in total cost, including contingency, it is mandatory to submit the cost estimates using the Project Cost

Breakdown (PCB) template format. Conversely, projects valued under $25M, except for maintenance, should use the Small Road Project Proposal Report Template and are not required to present their cost estimates in the PCB format. Regardless of the project size, the Australian Government advocates for the utilization of probabilistic cost estimation methods whenever feasible, as outlined in the *Notes on Administration for Land Transport Infrastructure Projects 2024-2029*.

Refer to *Notes on Administration for Land Transport Infrastructure Projects 2024-2029* for more information.

For projects that receive national funding, the Australian Government requires it to prepare P90 cost estimates using a quantitative approach that employs probabilistic techniques and tools such as the @Risk software for the project risk evaluation. The government mandates the submission of supporting information along with the P90 estimate including probability distributions, simulation details, Tornado diagrams, and summary statistics provided at 5% intervals from 5% to 95%. This detailed submission is needed for review purposes.

2.5.3 Practices connected with contingency development

Contingency is an integral component of the project budget setting process, prior to an investment decision being made. All cost estimates must include appropriate contingency allowance based on the outcomes of the evaluation of residual risks associated with the project. To achieve the confidence in contingency allowances included in project budgets, the department made available the following frameworks, processes, and guidance documents:

- The Transport and Main Roads Risk Management Framework – provides overarching requirements for integrated risk management practices and consistent and coordinated risk management processes across the department.
- The *Project Risk Management and Contingency Development Process* Manual – provides guidance to identify, analyse, mitigate, assess project risks and develop contingencies for estimating purposes.
- The Australian Government Guidance Notes (*Guidance Note 3A – Probabilistic contingency estimation* and *Guidance Note 3B – Deterministic contingency estimation*) – provides the Australian government requirements in managing project risks for nationally funded projects, and
- Queensland Transport and Roads Investment Program (QTRIP) Transport and Main Roads QTRIP Project Delivery – Cost Estimation and Escalation Brochure.

2.5.4 Practices connected with cashflow and escalation

Cash flow, crucial for managing project budgets, is the movement of funds in and out during project delivery. Accurate cash flow forecasting is essential in QTRIP projects, incorporating estimated financial flows for each year aligned with the project's approved budget.

The 3PCM solution's Cashflow sheet enables Project Managers to use information from estimators to construct project cash flow over the duration and adjust for escalation rates annually updated by the department and informed by the Australian Government. Alternatively, the estimators may also use the Estimation Calculator from Annexure H pf PCEM.

Continuous review and updates of the project's expenditure flow and cash flow are necessary throughout the delivery process to ensure accurate forecasting. The forecasting should include both allocated and unallocated contingency expenditure.

The department releases annual updates on the escalation rates informed by the Australian Government. Cost escalation is applied to all QTRIP project cost estimates to allow for cost increases due to inflationary factors that occur during the life of the project. This activity is known as presenting cost estimates in out-turn dollars. To convert the estimate into outturn costs, the estimator must apply escalation rates to the cash flow.

Drivers of escalation include changes in market conditions, and general industry or regional-wide productivities. This contrasts with the contingency, which is aimed to manage and mitigate project-specific risks. The QTRIP Cost Estimation and Escalation Brochure provides guidance on how to manage potential project cost overruns of the QTRIP projects by applying extra-ordinary local contingency reflecting local cost pressures. For example, the significant QTRIP infrastructure investment expected in the next 7 years covering Brisbane 2032 Olympic and Paralympic Games and other infrastructure activity, the local escalation in affected areas of the state is expected to drive beyond national averages.

2.5.5 Practices connected with maintaining the estimate currency

The Project cost estimates play a critical role at the investment decision stage by setting budgetary limits, influencing economic benefit-cost ratios, and determining project viability. As project timelines extend, cost estimates may become outdated, especially during periods of high inflation. For those reasons, it is crucial for cost estimates to reflect the most current data before presented to make investment decisions.

When a cost estimate for projects valued over $25M is 12 months or more outdated from the base date, it must undergo revalidation process which can range from a simple

update to a complete overhaul. The person who undertakes the estimate review process makes the determination as to whether the age of the estimate and/or any changes adopted warrants simple update or complete overhaul of the estimate.

For QTRIP projects over $25M, the project estimates need to be current to be considered for investment decisions as follows.

If the project estimate is between 6–12 months old from the estimate base date: Consider updating with current rates and any changes to the risk register.

If the project estimate is between 12–24 months old from the estimate base date:

- No scope change: It must be updated with the current rates and any changes to the risk register.
- Scope change: It must be recreated. This include developing the cost estimate from first principles, updating the register, probabilistic modelling of project risks and application of escalation, if there are any changes to the project schedule.

If the project is over 24 months old from the estimate base date: it must be recreated, regardless of scope. This include developing the cost estimate from first principles, updating the register and probabilistic modelling project risks and application of escalation, if there are any changes to the project schedule.

The federal project cost breakdown (PCB) template provides mechanism to uplift cost estimates using a “fit for purpose” approach. The PCB templates for roads and rail can be downloaded from the department’s internal PIP SharePoint site, or by emailing estimating.support@tmr.qld.gov.au.

The individual work items in a cost estimate can also be updated using the Expert Estimation software and the up-to-date SmartCost database with a minimal effort.

However, a complete overhaul is required if:

- There has been a significant change in project scope, resulting in considerable cost impacts to the cost estimate leading to the investment decisions, or
- New policy requirements since the base date have significantly affected project costs.

Under these conditions, a new project cost estimate must be generated following the prescribed methodology.

The cost estimates prepared for high-value or high-risk projects must be subjected to a thorough review by an independent third party (known as concurrence review) as per the Section 4.1.13.2 of this document to ensure they conform to the Transport and Main Roads estimating standards and aligned with the project intent.

If a cost estimate has gone through a revalidation process to qualify for an investment decision, then it must be subjected to the concurrence review process to ensure it is fit for purpose.

2.6 Related policies, standards and frameworks

This document references the following key policies, standards and frameworks:

- Transport Infrastructure Asset Accounting Policy and Guidance
- Transport Infrastructure Portfolio (TIP)
- Transport Infrastructure Portfolio Governance Framework
- OnQ Project Management Framework
- Project Assessment Framework (PAF) for major projects
- QTRIP Governance Principles 2025-26 to 2028-29
- QTRIP Savings Management Policy
- Portfolio, Program, Project and Contract Management (3PCM) system
- *Network Optimisation Framework*
- *Cycling Infrastructure Policy* and *Queensland Walking Strategy*
- *Smart Motorways Policy*
- *Flood Risk Mitigation Policy*
- *Movement and Place Policy*
- *Road Safety Policy* and *Safe Systems Assessment*
- *Accessibility and Inclusion Policy*
- Arterial Operations
- *Sustainability Assessment*, and
- *Transport Infrastructure Asset Management Policy*.

The department supports Queensland Government priorities by developing investment strategies focused on the state's strategic transport needs. These strategies include identifying and funding high-priority projects and managing an efficient transport portfolio. To ensure such an approach aligns with government priorities, justifies projects, and manages transport infrastructure effectively, the use of sound strategic decisions, project cost estimates, and cost control measures is essential.

2.6.1 Transport and Main Roads Infrastructure accounting policy and guidance

In accounting for infrastructure assets, project costs must be categorised as Capital Expenditure (CapEx) and Operating Expenditure (OpEx) according to the *Financial Management Practice Manual* (FMPM).

This classification must be done before presenting the projects for budget approval. Initially, all construction costs are treated as CapEx, while administrative and indirect costs not directly attributable to bringing the asset to operational condition are treated as OpEx.

The guidelines for the treatment of project expenditure are detailed in the *Cost Classification for Transport Infrastructure Projects* guideline, Transport and Main Roads *Financial Management Practice Manual* (FMPM). External parties can request copies from estimating.support@tmr.qld.gov.au.

The additional information can be obtained from Recording of Costs as Capital or Operating manual or on *Cost Classification for Transport Infrastructure Projects* guideline.

2.6.2 Transport Infrastructure Portfolio

The Transport Infrastructure Portfolio (TIP) encapsulates a strategic 10-year transport infrastructure investment vision, encompassing diverse projects and assets. To govern this portfolio, the Transport Infrastructure Portfolio Governance Framework directs the structures, accountabilities, management systems, and controls for departmental decision-making across all lifecycle stages.

This framework is applicable to department's that focus on portfolio governance, management, program development, performance, and program delivery within the prescribed organisational structure.

The TIP includes investments ranging from small (less than $1M) to very large (greater than $1B) and as diverse as road, busway, rail, active and marine projects and comprises transport planning and policy studies; maintenance, preservation and operation of existing transport infrastructure assets; new transport infrastructure assets and supporting transport asset classes; and management of existing and future transport corridors, including managed motorways and transport corridor acquisitions. The TIP Portal on the department's internal SharePoint site provides information on portfolio, program and benefits management approaches, policies and templates to manage the TIP. External parties can request copies from estimating.support@tmr.qld.gov.au.

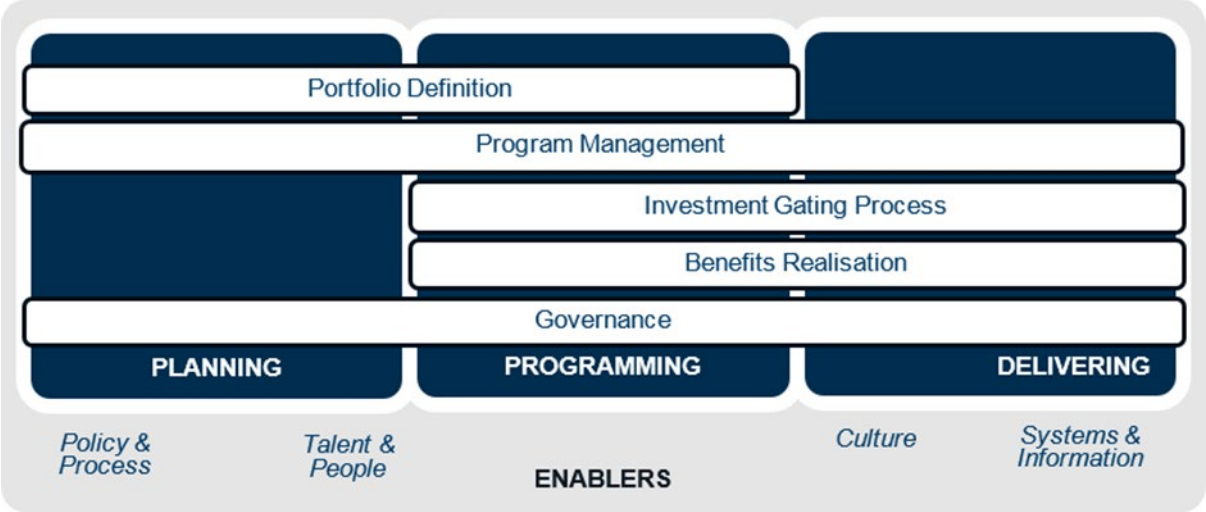
2.6.3 Transport Infrastructure Portfolio Governance Framework

The Transport Infrastructure Portfolio (TIP) framework details structures, accountabilities, portfolio management systems, and controls for departmental decision-making

throughout various lifecycle stages of portfolio, program, and project management. This framework is especially relevant for areas of the department primarily engaged in prioritisation, planning, programming, and delivery of the TIP. The organisational structure is designed to reflect distinct functional accountabilities divided as follows:

- Portfolio governance and management, including program development and performance activities, which are managed by the Portfolio Investment and Programming (PIP) Branch.
- Policy direction and program planning, which are the responsibility of the Transport Policy (TP) Branch and Transport Strategy and Planning (TSP) Branch, and
- Program prioritisation, which is overseen by Senior Responsible Owners assigned to each Investment Program.

Figure 2.6.3 – Portfolio management framework



2.6.4 OnQ project management framework

For successful project management, the OnQ Integrated Project Management Framework outlines a methodology that should be adapted to the project's size and complexity, emphasizing the importance of good planning, effective scoping, resourcing, and carefully managed implementation and delivery.

The OnQ framework includes a methodology with 5 sequential phases: strategic planning, concept, development, implementation, and finalisation, and provides necessary templates, resources, and tools.

Further information on OnQ can be accessed via the Project Management Hub on the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

2.6.4.1 OnQ and estimating

Estimates are refined throughout the OnQ project phases, and the OnQ Project Classification system guides the level of detail required for cost estimating according to the project's complexity and risk profile.

The strategic planning and detailed planning estimates provide indicative costs of projects which should only be used for planning and are calculated in current dollars since exact timing for project development and delivery might be uncertain at earlier stages. Planning projects that are funded by the Australian Government have additional requirements. The projects receiving Australian Government funding may have additional requirements, detailed in the *Notes on Administration for Land Transport Infrastructure Projects 2024-2029*.

2.6.4.2 OnQ project types

The OnQ framework classifies the projects in the QTRIP into 3 types on the project complexity and risk profile as detailed in the Table 2.6.4.2(a). It considers project value, complexity and risk profile to determine the project type.

Table 2.6.4.2(a) – Project types

Project Type	Description
Major projects	Complex, high or extreme risk transport infrastructure projects, requiring higher levels of investigation, rigour and control and the estimated total project costs are over $250M.
Type 1 project	Complex / high or extreme risk transport infrastructure projects, requiring higher levels of investigation, rigour and control.
Type 2 project	Straight forward / medium risk transport infrastructure projects, requiring moderate levels of investigation, rigour and control.
Type 3 project	Simple / low risk transport infrastructure projects, requiring lower levels of investigation, rigour and control.
Type 3 (MPO)	Low cost (less than $20M) and low risk maintenance, preservation and operations projects.

Here is the detailed classification and requirements for various types of transport infrastructure projects:

Major Projects:

- Estimated capital cost exceeding $250M.
- Required to comply with the Project Assessment Framework (PAF).
- Need to demonstrate strategic objectives and value for money.

- Must have Investment Infrastructure Committee (IIC) endorsement for proceeding at all PAF stages, and
- Design Development Report.

OnQ Type 1 Projects:

- Complex and/or with high or extreme infrastructure construction or cost risks.
- Total project cost usually between $100M to less than $250M.
- Incorporate components of PAF.
- Required IIC gating approval at OnQ Project Proposal, Options Analysis, and Business Case stages, and
- Design Development Report.

OnQ Type 2 Projects:

- Straightforward and medium-risk projects.
- Total project cost usually from $50M to $100M.
- Require moderate levels of investigation, rigour, and control, and
- Design Development Report.

OnQ Type 3 Projects:

- Simple and low-risk projects.
- Total project cost less than $50M.
- Lower levels of investigation, management, and control required.
- High-risk land purchase or passenger transport investments might classify them above Type 3 despite the cost, and
- Design Development Report.

OnQ Type 3 – MPO projects:

- Maintenance, Preservation, and Operations (MPO).
- Total project costs less than $20M, and
- Guided by *Transport and Main Roads Transport Infrastructure Asset Management Policy* and the QTRIP process.

Queensland Road System Performance Plan (QRSPP) Projects:

- Smaller scale works on the state-controlled road network.
- Covering Maintenance, Preservation and Environment (MPE), Road Operations (RO), and
- Simplified cost code structure categorised into CapEx or OpEx.

These classifications help to establish clear protocols for the stages of approval and investment based on complexity, risk, and estimated cost.

Operations (RO) and investment groups have simplified requirements. Similarly, the Australian Government has exemptions for maintenance projects under the *National Land Transport Act 2014*. The cost code structure for QRSPP projects is simplified to either CapEx or OpEx category.

2.6.5 Project Assessment Framework (PAF)

The Project Assessment Framework (PAF) is a foundational system used by the Queensland Public Sector to ensure that project evaluation, procurement, and delivery activities are performed effectively and efficiently, securing value for money from government investments. The PAF demands a consistent and rigorous methodology for evaluating projects at critical points throughout their lifecycle.

Transport and Main Roads applies the PAF to all major transport infrastructure projects (above $250M in estimated total cost).

Additionally, the PAF is not solely for infrastructure or public-private partnership (PPP) projects but serves as a whole-of-government project assessment process.

Key principles of the PAF include transparent decision-making, evidence-based support for decisions, and strategic alignment with agency objectives. The Cabinet Budget Review Committee (CBRC) oversees the project initiatives conformance to government policy, needs, priorities, and affordability, with regular cabinet approval processes applied to PAF projects.

For more information about the PAF requirements, please refer to the Project Assessment Framework webpage of the Queensland Treasury.

2.6.5.1 Major project gating process

The Major Project Gating process, an essential component of PAF, applies to projects over $250M or those with significant risk and complexity. Project owners are responsible for aligning governance arrangements with requirements set by the Queensland Treasury, Department of Infrastructure, Transport, Regional Development, Communications, Sport and Arts (DITRDCSA) and Infrastructure Australia (IA).

The PIP Project Evaluation unit ensures that the department’s project evaluations are robust and adhere to the PAF and the Queensland PPP Guidelines (which support the National PPP Guidelines), as well as other frameworks and guidelines such as ATAP, the IAAF and BCDF.

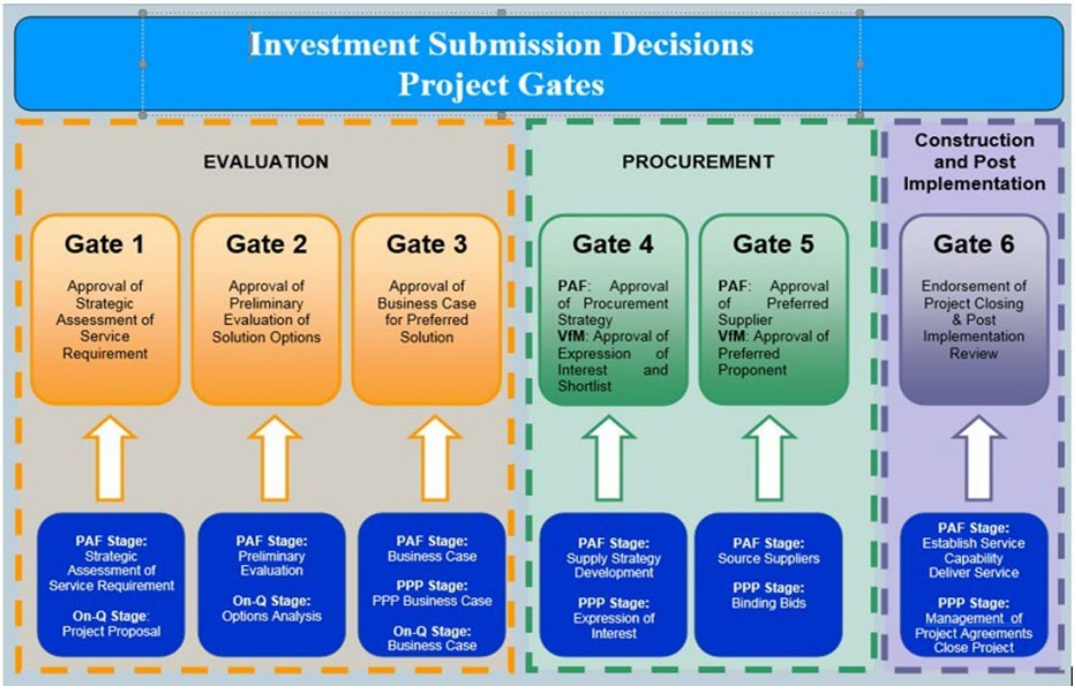
Information about the project gating process is provided in Figure 2.6.5.1 below.

Table 2.6.5.1 – The minimum estimate requirements in different phases of various project types

OnQ				Major Projects		Federal		CapE X / OpEx
Phase	Estimate		Estimate Type	Phase	Estimate Type	Phase	Estimate Type	
	Type 1 & 2	Type 3						
Strategic planning / Detailed Planning	Strategic planning / Detailed Planning		Benchmark Category 1 estimate	Strategic and Detailed planning	Benchmark Category 1 estimate	Identification	To develop Scoping PPR equating to First Pass as per the federal Notes of Administration.	OpEx
Concept	Project proposal		** Subject to federal submission requirements	Strategic Assessment of Service Requirements (SASR)	** Subject to federal submission requirements	Scoping	P50 & P90 as out-turned and non-outturned costs for projects over $25M when submitting PPRs for funding approval** Concept Phase outputs are used to develop the Development and/or Delivery Phase PPRs equating to Second Pass as per the federal Notes of Administration.	OpEx
	Options analysis (P50 & P90) Only for short listed or preferred option		Category 2 in P50 & P90 confidence level for all shortlisted options for OnQ Type 1	Preliminary evaluation	Category 2 in P50 & P90 confidence level for all shortlisted options			
	Business case	Business case / Type 3 scope identification	Category 3 in P50 and P90 confidence level for OnQ Types 1 and 2	Business case	Category 3 in P50 and P90 confidence level			

OnQ				Major Projects		Federal		CapE X / OpEx
Phase	Estimate		Estimate Type	Phase	Estimate Type	Phase	Estimate Type	
	Type 1 & 2	Type 3						
Development	S1D and S2D designs		Category 4 & 5 in P50 and P90 confidence level for OnQ Types 1 and 2	Supply strategy development / source suppliers	Category 4 and 5 for S1D and Category 5 for S2D in P90 confidence level	Development	P50 & P90 outturned and non-outturned costs for project approval process. Actual costs for previous phases. Development phase outputs for develop Delivery Phase PPR.	CapEx / OpEx
Implementation	Construction activities		Complete APDV (P50 and P90) post tender for OnQ Types 1 and 2 providing updated costs	Establish service capability / deliver service	APDV (P50 and P90) post tender providing updated costs	Delivery	Actual costs for previous phases (if undertaken). An estimate for the Delivery Phase using known tender information.ost procurement / cost schedule update.	CapEx /OpEx
Finalisation	Handover, review and close out		Actual costs and residual property costs	For endorsement of project closing	Actual costs and residual property related costs	Post completion	Actual costs and residual property costs + with Project Cost Breakdown Template.	OpEx

Figure 2.6.5.1 – Projects gating process model



2.6.5.2 Non-major project gating

The OnQ Type 1 project gating process is applied to projects that have an estimated capital expenditure ranging from $100M to $250M. However, projects that exhibit significant risk or complexity but have a lower financial threshold may still be considered as OnQ Type 1. This process mandates the creation of a gating submission which includes an OnQ report relevant to the specific phase of the project—be it the project proposal, options analysis, or business case.

The OnQ Type 1 project gating ensures the best option (fit for purpose) is identified and increases confidence for the department that projects are consistently achieving OnQ minimum standards (by completing 3 gating reviews) prior to an investment decision.

It is important to note that the classification of a project as a major rail project is not solely based on the financial aspect; technical and operational changes, along with the associated complexity and risks, are also critical factors. While a project cost can serve as a general guide, this figure does not fully encapsulate the intricacies involved in rail projects, which tend to be capital-intensive because of the expensive nature of railway infrastructure, technology, and the required safety standards within this sector.

The PIP Project Evaluation unit ensures that the department's project evaluations are robust and meet the requirements of Queensland Government's Project Assessment Framework (PAF) by undertaking non-major project Gating Assurance for OnQ Type 1 projects at:

- Gate 1 (Project Proposal)
- Gate 2 (Options Analysis, and
- Gate 3 (Business Case).

To understand the interplay between cost estimation, the Project Management Framework (PMF), and the OnQ project management framework, refer to Figure 2.6.8.

For more in-depth information, the QTRIP Governance Principles document on the department's internal SharePoint site should be referenced, albeit this resource is internal. External parties can request copies from estimating.support@tmr.qld.gov.au.

2.6.6 Queensland Transport and Roads Investment Program (QTRIP)

The Queensland Transport and Roads Investment Program (QTRIP) is a comprehensive document that outlines the investment strategy for road and transport infrastructure in Queensland, planned over a 4-year period. It encompasses not just projects managed by the department, which forms the Transport and Main Roads portion of QTRIP, but also includes capital programs of Queensland Rail and the Gold Coast Waterways Authority. Developed annually, QTRIP aligns with the *Transport Infrastructure Act 1994* and coincides with the State Budget's release cycle, receiving approval from the Minister for Transport and Main Roads.

The content of QTRIP spans across various levels, detailing projects on local, state, and national networks, with the Queensland Government collaborating with the Australian Government, local governments, and industry stakeholders to set funding priorities. The program structure of QTRIP is characterized by a firm funding commitment for the initial 2 years with indicative funding outlined for the succeeding 2 years, offering a clear projection of funding and planning for industry and local government.

QTRIP management involves a coordinated effort across several divisions within the department, namely the Policy, Planning, and Investment (PPI) Division, the Infrastructure Management and Delivery (IMD) Division, which includes RoadTek, Rail Division and the Translink Division. Additionally, Queensland Treasury, Queensland Rail, and the Gold Coast Waterways Authority contribute to the development process of QTRIP, each with its respective roles in influencing the project assessment and infrastructure management as it relates to Queensland's transport and road networks.

Overall, QTRIP serves as a strategic framework for delivering transport and road infrastructure projects that align with governmental policies and stakeholder requirements, ensuring a cohesive approach to advancing Queensland's transportation system.

2.6.7 QTRIP Savings management policy

The *QTRIP Savings Management Policy* and *QTRIP Contingency and Savings Application Guideline* are designed to provide clear procedural guidance for managing the project contingency funds and savings within the Transport Infrastructure Portfolio (TIP).

It applies to sizeable projects with significant budgets, as well as those concerning various transport and infrastructure upgrades and improvements across Queensland. Specifically, the policy pertains to projects that have a total budget of $10M or more, investment groups linked to major roadway and transport upgrades, and any other projects the department identifies as relevant.

The local government grants are exempted from this policy.

A key feature of the policy is the use of the Agreed Project Delivery Value (APDV) for performance reporting. The APDV is the revised agreed project budget at contract award (approval of preferred supplier) for projects included in the scope of this policy.

Detailed information on this policy can be found in Sections 5 and 6 of the *QTRIP Savings Management Policy* and Endnotes within the *QTRIP Contingency and Savings Application Guideline* on the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

2.6.7.1 Australian Government Savings Management Policy

For projects listed under the Federation Funding Agreement Schedule (FFA) on Land Transport Infrastructure Projects, the department is required to inform the Australian Government (DITRDCSA) of the agreed contract price including contingency and escalation. The department must also provide an updated comprehensive project cost estimate at P50 and P90 (outturned) confidence levels.

For projects with a funding commitment of $100M or more, the DITRDCSA has the authority to conduct a formal cost estimation review after the award of the main construction contract. If it is found that the project can be completed for less than the initially estimated cost based on the contract price, the DITRDCSA, in collaboration with the department, can adjust its funding allocation to match the updated estimate. Federal funding savings that are identified through this process are subject to a review conducted jointly by the PIP division of the department and the Australian Government.

2.6.8 Integrating portfolio, program and OnQ frameworks with QTRIP

Robust project estimation is crucial and involves the collaboration of estimators with portfolio and program managers to ensure the available funding is effectively controlled. Strategic level cost estimates are generated to assist in the investment decision-making process, aligning with the investment strategy.

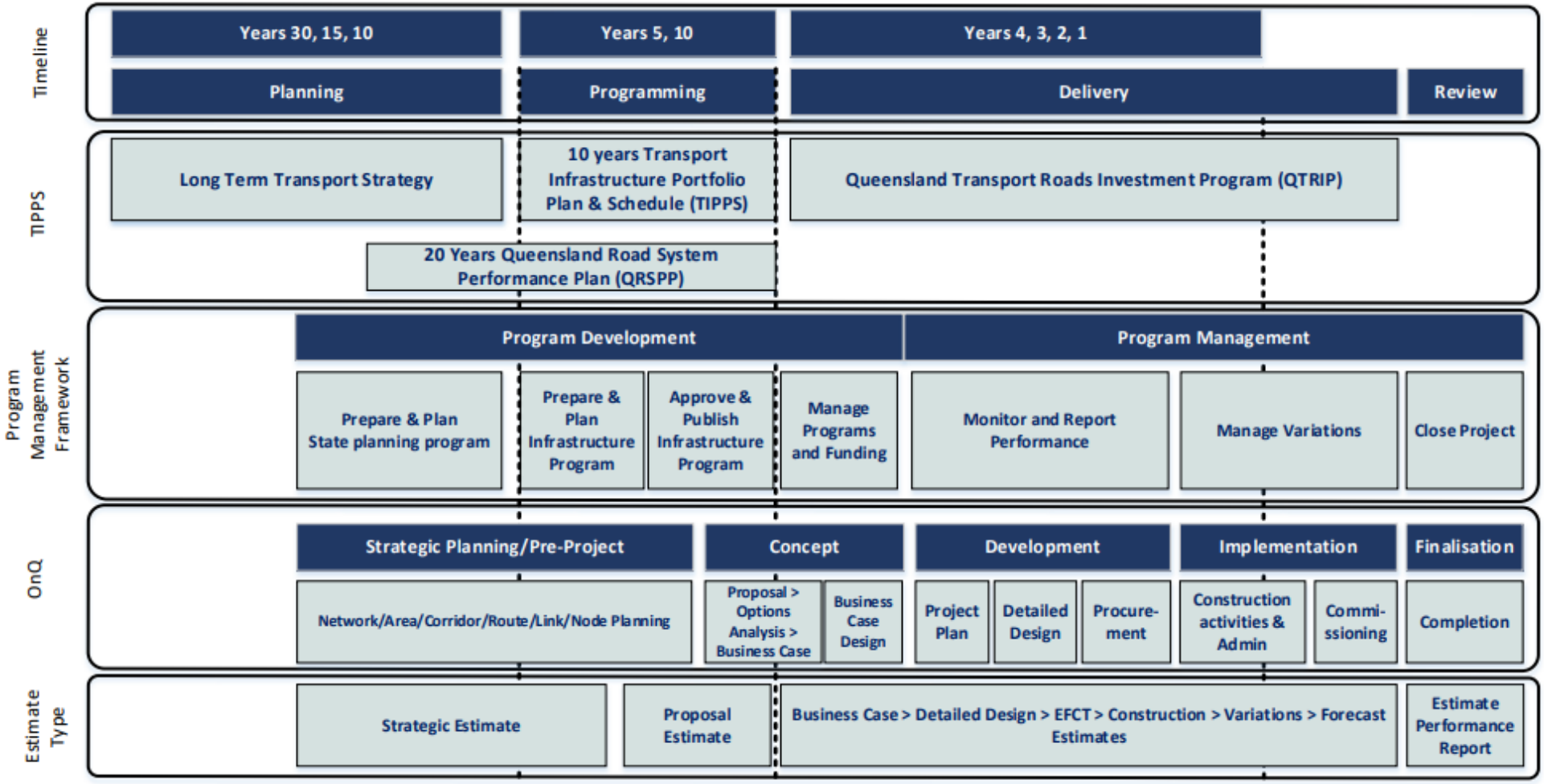
The QTRIP includes funding allocations not only for transport road infrastructure but also for Queensland Rail's capital program and Gold Coast Waterways Authority's capital works program. The Transport Infrastructure Portfolio Plan and Schedule (TIPPS) provides a strategic investment direction for a 10-year period and details the 10-year funding plan for the portfolio, including the current 4-year QTRIP.

To progress a project within the QTRIP, there are stringent business rules across:

- published planned investments in the QTRIP, and
- contractually committed investments published in the QTRIP with revised project budget at contract award (approval of preferred supplier) – See Section 2.6.7.

In addition, Estimates for Comparison with Tenders (EFCT) are also critical at the tender award stage for verifying that budgets are adequate for project delivery. For additional details on EFCT, one should refer to Section 5.4.3.2 of the document. A visual illustration in Figure 2.6.8 outlines the connection between the estimating functions and the OnQ methodology.

Figure 2.6.8 – Relationship between program and project management



2.6.9 Portfolio, Program, Project and Contract Management (3PCM) system

The 3PCM system is a 3-layered Oracle Primavera suite used by the department to manage the Transport Infrastructure Portfolio (TIP). It consists of Oracle Primavera Portfolio Management (OPPM), which is used for investment prioritisation and portfolio reporting among other functions. Unifier, which enables the delivery of programs, projects, and contracts; and P6, which integrates project schedules with activities across the projects.

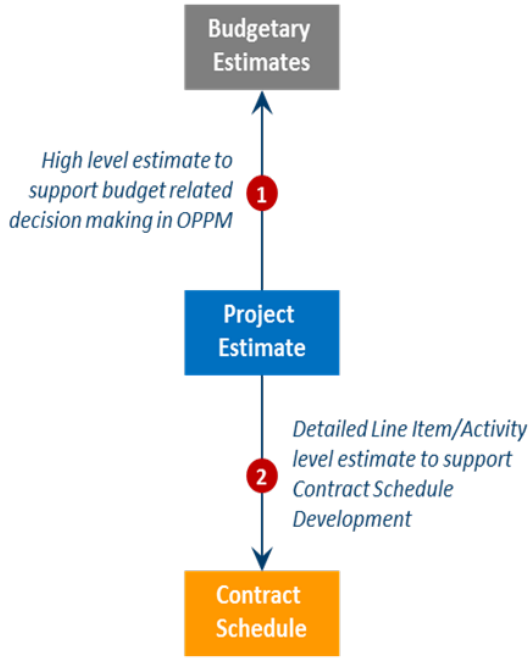
The process of project creation involves creating candidate investments in OPPM, gathering necessary investment information for approval, and then transferring the approved project into the Unifier layer where all data is stored and can be extracted using BI Publisher and OBIEE tools for further analysis.

This system aligns with the OnQ project management methodology to ensure effective management through different project phases.

2.6.9.1 Cost estimating context in 3PCM system

Figure 2.6.9.1 demonstrates the relationship between budget estimates, project estimates and contract schedules in the 3PCM system.

Figure 2.6.9.1 – Alignment between project estimates, budgets and contract schedules in 3PCM



The high-level cost estimates QTRIP projects provide information for the budget-setting and decision-making processes at the OPPM level, and the detailed activity-level estimates support the tender generation and contract scheduling.

2.6.9.2 Capturing cost estimates in 3PCM system

Capturing cost estimates in the 3PCM system for QTRIP projects is crucial as it facilitates the generation of tender prototype documents and provides benchmark data for similar projects. There are 2 methods for capturing cost estimates in the 3PCM system:

- Direct entry of estimate line items using the Estimate Form in the Unifier. This method is recommended for projects with small estimates, involving less than 20 cost line items, requiring manual entry of details like WBS items, MRS numbers, quantity, rate, and cost codes, and
- Use of the Estimate Import Template, suitable for large projects, where externally created cost estimates in Excel format are arranged to match the data fields of the Estimate Form in the 3PCM Unifier before being uploaded into the system.

The Estimate Import Template is designed to simplify the import process, with prefilled 3PCM system-compatible information, regularly updated to keep pace with the department's Technical Specifications publication cycle.

This template is structured into 4 levels for ease of navigation:

- Level 1: MRS / MRP/ Non-standard (90000 series Items) level
- Level 2: Group level (MRS / MRP)
- Level 3: Sub-group level (within each MRP and MRS group)
- Level 4: Work Item level

Guidance Document for Capturing Cost Estimating Information in 3PCM Unifier System Part B Develop the Cost Estimate on using the Estimate Import Template is available on the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

2.6.9.3 Work packages

A work package is a group of tasks in a cost estimate or a contract schedule with a specific scope of work and project sub-components. Tasks are typically grouped into work packages based on asset class, engineering discipline, funding sources, geographical location or whether a particular work activity is delivered by the contractor or the principal.

Each Work Package constitutes a separate schedule of works to be completed. It is at the discretion of the estimator how many work packages are required to deliver the project and what types of work items are to be included in each work package.

Following are some typical examples of Work Packages:

- To separate types of work activities (for example, if a project contains a large bridge, road widening, and line marking, a separate work package may be required for each component).
- Separating the principal's cost and construction cost in a schedule.
- Geographical location of works (for example, 150.100 km to 152.200 km section on the Bruce Highway), and
- Sources of funding (the work components to be delivered using capital funding and element management funding require separated work packaging).

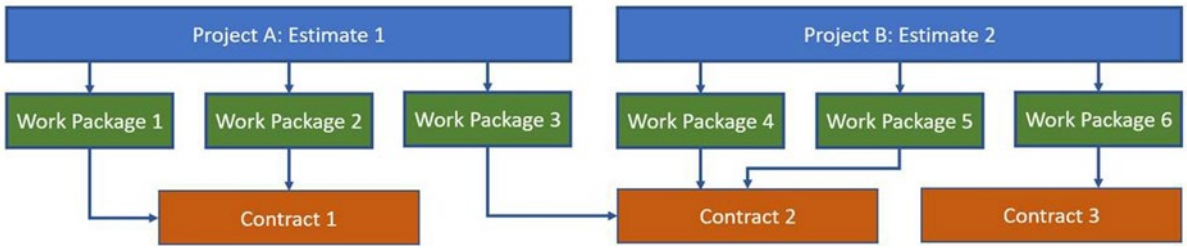
When utilising the Estimate Input Template, cost items can have Work Package IDs allocated across all levels of the template so that 3PCM Unifier will output this information in the tender schedule when generating the tender documents.

2.6.9.4 Project to contract relationship

3PCM system can manage and report on contracts that cover multiple projects. It facilitates the linkage of contracts to various projects, each potentially with a different source of funding. Work packages are employed at the project level to facilitate this capability and are connected to the respective tender or contract schedule.

An example provided in Figure 2.6.9.4 illustrates this structure. The Project A described as a bridge construction project financed by the capital works budget, and Project B as a line marking project financed by the Element 45 budget. Within these projects, work packages are allocated to different contracts: work packages 1 and 2 of Project A are under Contract 1, while work package 3 of Project A, along with work packages 4, 5, and 6 of Project B, are under Contract 2.

Figure 2.6.9.4 – Hierarchy of projects, work packages and contracts



2.6.10 Transport Infrastructure Portfolio Plans and Schedule (TIPPS)

The Transport Infrastructure Portfolio Plan and Schedule (TIPPS) represents a critical element in the Queensland Government's strategic planning for transport infrastructure investments. It not only encapsulates the department’s policies, strategies, and long-term planning efforts into a 10-year vision, but also offers a funding framework that takes

financial constraints into account. This ensures that all chosen transport infrastructure investments align with both the portfolio's and the Government's strategic goals.

Once the guidelines for TIP Prioritisation and the Portfolio Funding Allocation for Year 5 have been approved, the Portfolio Management Office (PfMO) formulates the TIPPS. As a culminating step of the Portfolio Definition Process, TIPPS presents the confirmed Indicative Funding Profile for the next decade, methodically broken down by distinct Investment Programs.

To be considered for inclusion in the Queensland Transport and Roads Investment Program (QTRIP), projects must be clearly specified within the TIPPS under one of its 15 designated investment groups.

Additionally, these projects must be designated as priorities within the State Planning Program—a more focused segment of TIPPS—for them to be eligible for initial funding leading up to the business case stage.

Furthermore, they should be earmarked as being a priority for obtaining national funding If that is sought.

2.6.11 Building Information Modelling (BIM)

The Building Information Modelling (BIM) and Digital Engineering Framework is an advanced approach for managing transport infrastructure assets. It utilizes 3D digital representations that detail both physical and functional characteristics of assets, encompassing all related data throughout their lifecycle, from planning and design to construction and operation.

BIM facilitates enhanced information sharing, promoting better-informed decision-making. It does so by compiling both graphical (such as 3D models) and non-graphical data (like documents) within a Common Data Environment (CDE), where non-graphical information is connected to the respective elements of the graphical model. This comprehensive system not only allows users to retrieve detailed data like material types, quantities, costs, and locations but also leads to improved cost estimate accuracy, design processes, construction economies, and lowered operations and maintenance expenses.

For more detailed information about BIM, inquiries should be directed to the Digital Systems Team in the Infrastructure Management Division of the department.

2.6.12 Transport and Main Roads Accessibility and Inclusion Strategy

The Transport and Main Roads Accessibility and Inclusion Strategy is a guiding document that reaffirms the department’s dedication to creating accessible and inclusive transport services across Queensland. The focus of this strategy is to benefit all citizens, including those with disabilities, the elderly population, and individuals living in remote areas.

Complementing this strategy, the Transport and Main Roads *Accessibility and Inclusion Strategy and Action Plan 2025–2027* aims to enhance public transport accessibility for persons with disabilities or reduced mobility, aligning with the Queensland Government's broader commitment to inclusion.

Both the above strategy and the plan are framed within the context of existing legislative standards, such as the *Disability Discrimination Act 1992* and the *Disability Standards for Accessible Public Transport 2002*.

All department projects must thoroughly review and adhere to the relevant accessibility standards.

It is essential that all department projects creatively and proactively embed these principles to ensure equal access and convenience for all Queenslanders.

Engaging with customers and stakeholders for collaborative design is critical for ensuring that the final infrastructure meets the diverse needs of the community.

The cost estimates should factor all expenses associated with accessibility features including at design, implementation, and risk assessment activities.

Funds must be allocated for the dissemination of accessibility and mobility information to the relevant entities tasked with post-project management.

A Compliance Report must be created for each project, detailing how it meets the requirements of the disability standards. This strategy and the plan can be accessed on the department’s internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

2.6.13 Australian Government Policies and Frameworks

The federally funded projects are implemented through the Federation Funding Agreement Schedule (FFA) on Land Transport Infrastructure Projects. This supersedes the previous National Partnership Agreement on Land Transport Infrastructure Projects (NPA).

The federal *Notes on Administration for Land Transport Infrastructure Projects* provide detailed guidance on the Federation Funding Agreement Schedule's (FFA) implementation, ensuring transparency around the legal, regulatory, financial, and policy frameworks for recipients of land transport infrastructure investment funding.

It specifies how significant changes to a project's scope, costs, benefits, contribution, or timeline must be documented in writing by the involved parties before any decision is made.

For more information on the Australian Government requirements, refer to the federal *Notes on Administration for Land and Transport Infrastructure Projects 2024-2029*.

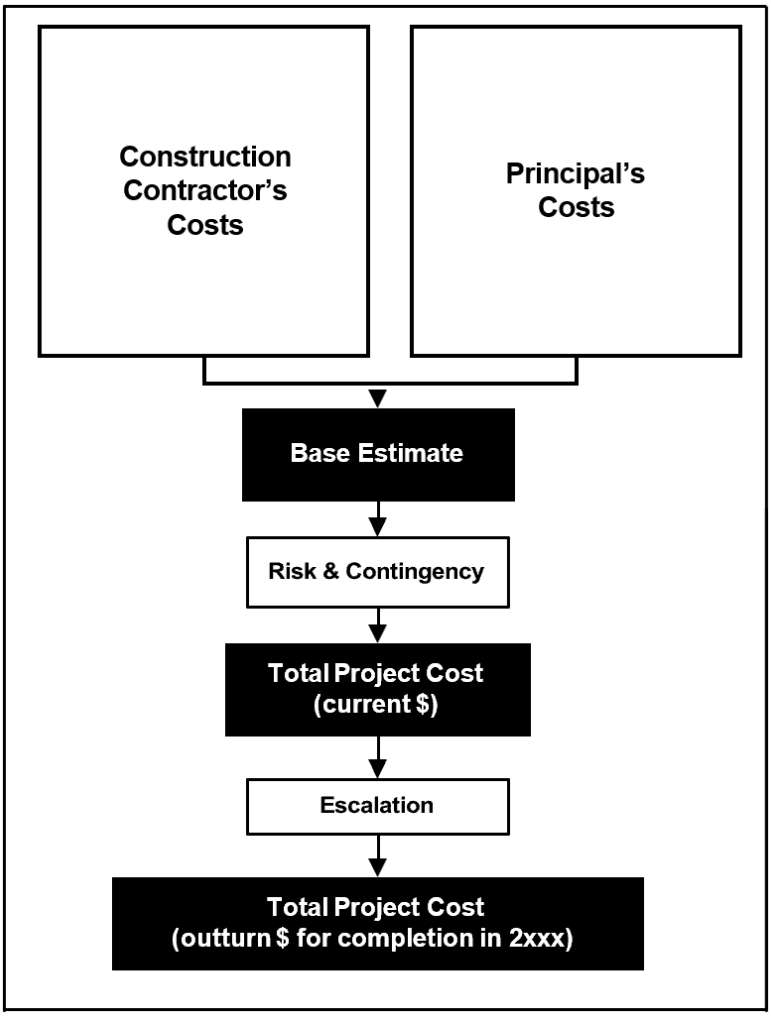
3 Estimate structure

3.1 Overview

The total project cost is derived by combining the contractor's cost and principal's costs to form the base estimate, then adding risk and contingency to this base estimate.

The estimate structure depicted in Figures 3.1(a) and Figure 3.1(b) highlights the major components of every cost estimate.

Figure 3.1(a) – Condensed project estimate structure



Cost estimates for departmental projects utilise a unique numbering system for work activities, which aligns with the standard work items numbering system detailed in the Main Road Specifications for construction activities (MRS) and principals' activities (MRP). Additional MRS have been developed for rail covering trackwork, overhead lines and equipment, power supply and distribution and signalling and communication. This system categorizes work activities and defines quality standards and measurements for each item of work.

Construction contractor’s costs

This cost component required to execute the tasks or activities tied to a project's construction aspects. It comprised of costs paid to the construction contractor which includes direct costs, indirect costs, and margins.

The Direct construction costs entail the expenses for labour, plant, materials, and specialist subcontract work that are necessary to complete the project. Indirect construction costs cover items such as project insurance, site management, and supervision.

Overheads and margins encompass the contractor's corporate costs, business unit costs, the allowance for the contractor's risk, and the profit margin.

Principal's costs

The principal's costs comprise the expenditure that the principal incurs when planning, conceptualising, developing, delivering, and finalising a project, covering all phases of the project.

Included in these costs are project management, contract management, stakeholder consultation, property resumptions, PUP relocation, fees and levies, and materials provided by the principal.

See Section 3.3 of this document for more information.

Base estimate

The base estimate includes both the construction contractor's costs and the principal's costs but does not incorporate contingency or escalation allowances.

Contingencies are financial reserves set aside for unforeseen costs during project delivery, and escalations are provisions for potential cost increases due to factors such as inflation or changes in market rates.

Risk and contingencies

A contingency allowance represents the residual risks within a project, signifying the degree of uncertainty or confidence in the project's cost estimate. It is essential to have a clear understanding and definition of contingency to ensure the project's successful delivery. The project team is responsible for evaluating the impact of risks on the cost estimate and determining a suitable contingency allowance.

The quantification of these contingency allowances is carried out through risk management processes as outlined in AS/NZS ISO 31000 *Risk Management*. Detailed guidance on managing risks and developing contingency plans is available in Section 10 of

the PCEM, as well as in the department's *Project Risk Management and Contingency Development Process Manual*.

Total project cost (current dollars)

The base estimate includes the total project cost in current dollars.

It is crucial to document the date of the estimate when these current dollar values are used to maintain the visibility of their relevance and the validity of the historical estimate.

Escalation

Escalation is applied to QTRIP project estimates to provide adequate funding to compensate the project for cost increases due to inflationary factors that occur during the life of the project. This activity is known as presenting estimates in out-turn cost or dollars. Escalation must be applied to base estimates as well as risk and contingencies.

All QTRIP projects, barring maintenance and operations, are uniformly escalated using rates issued by the Australian Government Project Cost Breakdown (PCB) templates for road and rail.

Additional details on escalation are available in Section 3.5 of this document.

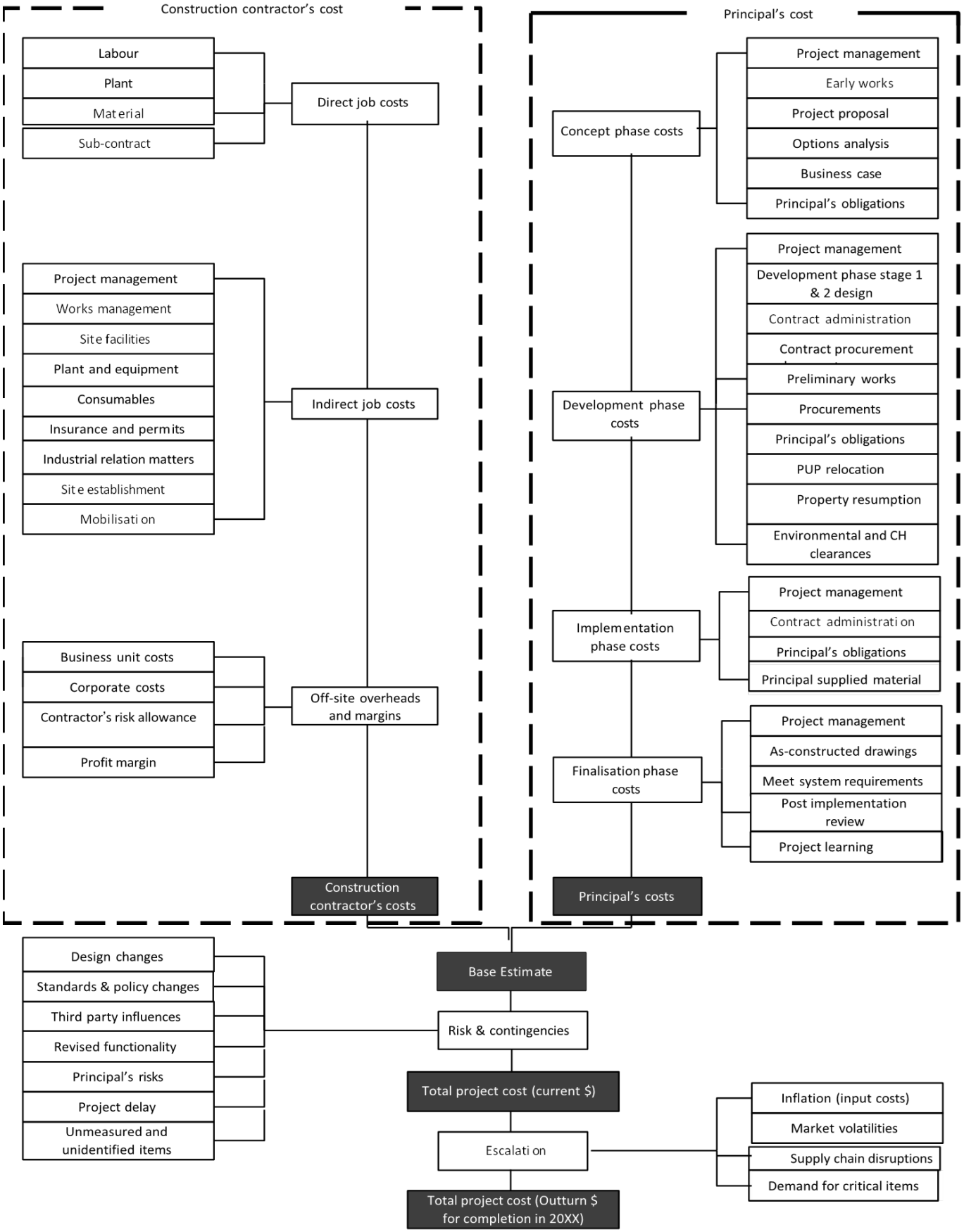
Total project cost (outturn dollars for completion in 20XX)

Total project cost in outturn dollars is the projected total project cost which must be used for planning and budgeting purposes.

This cost is calculated to include various elements that may affect the final amount, accounting for factors such as market volatilities, inflation related to input costs, and potential risks or changes in project functionality that may arise.

A detailed version of this cost structure is provided in Figure 3.1(b) below illustrates each component of the project estimate in more depth, including direct job costs, contractor's overheads, principal's costs, contingencies, and the application of escalation to reflect pricing changes over the project timeline.

Figure 3.1(b) – Detailed project estimate structure



3.2 Construction contractor's costs

3.2.1 Direct job costs

The inputs for determining direct costs include the scheduled quantity of work, unit costs of work items, resource availability, and production rates. Typical direct costs for a road infrastructure project comprise components and subcomponents such as labour, with its gross wages and salaries, and award allowances like construction worker allowances and construction camp allowances.

These details are summarized in Table 3.2.1 of this document.

Table 3.2.1 – Examples of direct job costs

Components	Subcomponents
Labour	Gross wages and salaries. Award allowances such as construction worker allowance, construction camp allowance, overtime loading, annual leave loading, site-specific allowances, and severance allowances. Other associated costs such as, superannuation, training, work cover, payroll tax, personal protective equipment, labour administration support costs. Contractor site facilities, site offices and services for the camp, accommodation, photocopier, computers, service charges (telephone, power, water and sewerage), office maintenance (cleaning and refuse disposal).
Plant	The contractor's plant hire costs on a dry hire basis (that is exclusive of fuels, oils, expendables, ground engaging tools and operator). Fuel, consumables, ground engaging tools, plant items and transport of plant.
Materials	The material required to deliver the project outcomes such as pavement materials, pipe and box culverts, bridge components, steel, and concrete. Temporary materials not incorporated in the final works such as traffic barriers, sheet piling, formwork, silt fences etc. Delivery costs of the materials to the site.
Subcontract	The work components of the project delivered though the subcontract such as erection of deck units, installation of guard rails, sheet piling etc. The subcontract plant hired on a wet hire basis, including fuels and oils, expendables, ground engaging tools and operator).

3.2.2 Indirect job costs

Indirect job costs are allowances included in project estimates for expenses that are necessary for project management but are not related to the construction of the project itself. To incorporate these costs into a cost estimate, there are 2 main methods: they can either be shown against individual schedule items or distributed across scheduled activities, either by applying a uniform percentage markup on direct job costs or allocating them to specific activities.

Detailed cost estimates for tenders use the basic cost method at the subcomponent level, as detailed in Table 3.2.2.

Table 3.2.2 – Examples of contractor's on-site indirect job costs

Cost category	Component	Subcomponent
On-site indirect job cost overheads (recurring)	Project management	Project manager, project engineer, supervisors, account clerk.
	Works management	Admin officers, systems officers, surveyor, lab technician.
	Plant and equipment	Site staff transport vehicles, job trucks, pumps, generators, floats and loose tools.
	Consumables	Stationery, miscellaneous materials.
	Insurance and permits	Government charges, permit fees, insurances for contractor, bank guarantees and financial charges.
	Travel	Travel costs not included in wages and salaries.
	Site establishment	Transport and erection of construction of site facilities.
On-site overheads indirect job costs (fixed)	Mobilisation	Mobilisation of site offices and amenities for contractor, principal's team and in some cases, subcontractors.

3.2.3 Off-site overheads and margin

The contractor's off-site indirect costs, often referred to as off-site overheads, include business unit costs such as management of operations, finance, human resources, advertising, and business systems, as well as corporate costs associated with contract administration, business development, finance, human resources, technical and contract advice.

Additionally, there are fixed off-site allowances for contractor's contingencies and risk allowances to cover unforeseen items not provided elsewhere in the total job costs.

Table 3.2.3 below illustrates typical off-site overheads and margins for an infrastructure project.

Table 3.2.3 – Examples of contractor's on-site indirect job costs

Cost category	Component	Subcomponent
On-site indirect job cost overheads (recurring)	Business unit costs	Business running costs such as management of operations, finance, human resources, advertising and business systems.
	Corporate costs	Costs associated with contract administration, business development, finance, human resources, technical and contract advice.
Off-site allowances (fixed)	Contractor's contingencies and risk allowances	An allowance included in the contractor costs to cover unforeseen items which are not provided for elsewhere in the total job costs.
Margin	Profit margin	Contractor's profit, often calculated as part of the total project cost and included in the overheads.

3.3 Principal's costs

Principal's costs encompass the expenditures the principal incurs during the planning, conceptualization, development, delivery, and finalisation of a project.

The department utilizes a standard Work Breakdown Structure (WBS) and Cost Breakdown Structure (CBS) to outline the principal's work components within each project phase. These structures guide the formulation of the principal's costs, which are integral to the total cost estimate of a project and are not subject to additional overheads and profit margins. Table 3.3 below provides project management costs for various project stages in details.

Table 3.3 – Examples of principal's costs

Cost category	Component	Subcomponent
Establishment costs	Planning, design and delivery costs	Planning, design, community consultation, geotechnical investigation, cadastral and engineering surveys, principal arranged insurance (PAI).
Contract management	Administration costs	Accounting fees, legal charges, probity and auditor costs, records keeping, drawing transmittals, archiving, and contracts de development and so on.

Cost category	Component	Subcomponent
Project management	Business requirements	Project management costs involving project proposal, options analysis, business case, project planning, contract supervision and project finalisation activities.
	PUP relocation	All direct and indirect costs incurred by the principal including overheads for design and project management.
		All direct and indirect costs incurred by the principal including PUP coordination and service location.
		Civil works associated with the PUP relocation.
	Property resumption	Planning, community consultation, land acquisition, geotechnical surveys, cadastral and engineering surveys, valuation, legal fees and compensation.

The standard hourly resource rates used to calculate principal's costs are set by the relevant business unit within the department annually.

A comprehensive description of the principal's costs is accessible via the Estimate Import Template. This template is designed by the department to aid in the estimation of costs. For the most up-to-date information and resources, this template is available for download from the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

3.3.1 Planning phase costs

The objective of the Planning Phase is to determine the best courses of action to undertake, ensuring they are in line with strategic goals and policy directions of the department.

OnQ project management framework encompasses the entire project lifecycle, which includes numerous phases: the Planning Phase, Concept Phase, Development Phase, Implementation Phase, and Finalisation Phase.

At the initial Planning Phase, this framework identifies projects suitable for inclusion in the QTRIP by considering a governmental and transport hierarchy at the national, state, regional, and local levels. Each level targets specific networks or programs to align projects with overarching strategies and policy objectives.

At the national level, this involves the National Road Networks and programs like the Australian Road Assessment Program and Infrastructure Australia Priority List.

The state level focuses on initiatives such as Roads Connecting Queensland specific to the department where regional and local considerations consider local priorities and areas requiring attention or improvement.

3.3.1.1 Strategic planning / Detailed planning costs

At the strategic and detailed planning stages of project development, the focus is on assessing potential transport benefits and learning outcomes to define the project scope. This assessment occurs at various levels, such as network, corridor, area, or link, by addressing the needs and problems to be resolved, using the information from available studies.

The aim of strategic planning and detailed planning is to create a fit-for-purpose approach that aligns with the strategic regional vision, including land-use outcomes and priorities that influence national, state, and regional transport system responses.

The planning phase's goals include establishing a broad transport intent, setting objectives and performance targets that meet consistent standards (both interim and vision), considering corridor protection, and determining the benefits and strategic scope of the project.

3.3.1.2 Detailed planning costs

The detailed planning stage plays a crucial role in project development. It involves generating a high-level scope definition for specific sections of a project, taking into account design considerations for various elements such as routes, links, corridors, nodes, and operations.

Key activities during this stage include examining route and link planning within the framework of broader corridor and area strategies. For projects that necessitate a new or modified route, this stage encompasses the assessment of demand, exploration of alignment options, and detailed planning for the chosen alignment, which subsequently results in the protection of the corridor or acquisition of land to facilitate the development of the new or altered route.

3.3.2 Concept phase costs

The concept phase of the OnQ Integrated Project Management Framework, includes the following project stages:

- the preparation of a Project Proposal (PP)
- the conduct of Option Analysis (QA), and
- and the formulation of a Business Case (BC).

For projects funded by the Australian government, these stages correspond respectively to PAF Gate 1 (SASR or OnQ Project Proposal), PAF Gate 2 (PE or OnQ Options Analysis), and PAF Gate 3 (Business Case).

The concept phase covers costs associated with the development of the project proposal, option analysis, selection of a preferred option, for which the cost estimates must accompany required confidence levels.

For projects with a more complex nature, the concept phase may incur extra activities like federal Project Proposal Report (PPR) development, land acquisition, PUP (Public Utility Plant) relocations, cadastral and engineering surveys, geotechnical analysis, and design investigations.

3.3.2.1 Project proposal costs

The investment proposals under $250M undertake the OnQ Project Proposal stage, while those exceeding $250M undertake a Strategic Assessment of Service Requirements (SASR) stage.

This project stage aims to support the investment decision-making process to substantiate and articulate the problem, opportunity and/or the service need and ensure that the benefits being targeted are a priority for the State and Australian Governments (if applicable).

The project proposal phase under the OnQ project management methodology encompasses a range of activities, which are:

- creating all necessary documentation, which includes conducting feasibility studies
- carrying out environmental impact and heritage assessment studies
- conducting preliminary traffic modelling, and
- engaging in public consultation and similar activities.

A significant portion of the expenses in this stage is attributed to project management costs which can be calculated based on first principles-costing or derived from benchmarked values. To develop a comprehensive project cost estimate at this stage,

clearly identifying the work elements outlined in the Concept Estimate and engaging with key stakeholders such as asset managers, utility service (PUP) providers, and local government utility agencies may be required.

3.3.2.2 Strategic Assessment of Service Requirements (SASR) costs

The Strategic Assessment of Service Requirements (SASR) is part of the Project Assessment Framework (PAF), and it is mandated for projects likely to exceed an investment of $250M, as well as for projects that are complex or may cause significant liability due to property hardship acquisitions.

This stage, known as the Project Scoping stage for Australian government-funded projects, a detailed appraisal or study of broad project alternatives must be conducted.

The appraisal considers how well the alternatives address the problem to meet the Infrastructure Investment objectives and identifies a preferred alternative solution for progression to the Project Scoping phase.

Key activities undertaken during this stage are:

- define the need to be addressed and outcome sought
- scope the outcome sought
- identify potential solutions to achieve the outcome
- develop a detailed plan and budget for conducting a preliminary evaluation of the potential solutions, and
- seek approval to proceed.

3.3.2.3 Options analysis / preliminary evaluation (PE) costs

Option analysis is a process designed to develop and evaluate specific options that will be included in a business case for projects. This stage encompasses the development of comparative options supported by preliminary assessments, traffic modelling, community consultation, and cost estimates. To establish the preferred option, activities that span both work management and project management are required.

For major projects, this stage will be the Preliminary Evaluation stage. The key objective of the preliminary evaluation is to arm government decision-makers such as the Cabinet Budget Review Committee (CBRC) with adequate information to decide whether the project should advance to the business case development stage.

For OnQ projects (less than $250M), this stage will be the Options Analysis stage.

As the costs associated with fully developing a business case can be significant, particularly for large or complex projects, only those projects deemed affordable, and a

priority should be progressed. Therefore, the information generated in the preliminary evaluation stage should be sufficiently detailed to assist decision makers in determining the priority and affordability of the potential project and, if it is to proceed, the form it should take to deliver the best value for money.

For major projects and OnQ Type 1 and 2 projects (value greater than $50M), the cost estimates of the short-listed options during the options analysis / preliminary evaluation stage need to be derived using a first principles cost estimating approach and a probabilistic method for risk assessment. All the findings from the preliminary risk analysis should be systematically documented, comparing the risks associated with each option and incorporating them into the cost and benefit valuations used in financial and economic analysis.

Additionally, a summary illustrating the integration of each risk into the cost or benefit evaluations is required for projects valued over $5M.

A desktop market sounding, and delivery model assessment should be prepared for preliminary evaluations, that is, for OnQ Type 1 and Major Projects. A qualitative value for money assessment should also be undertaken, to determine whether the project has potential to be conducted as a PPP business case.

3.3.2.4 Business case development costs

The business case development stage is key in the project development and delivery process, as it involves a detailed comparative analysis of shortlisted project options and delivery models from earlier stages. It is aimed at finding the best solution to fulfill service requirements while ensuring value for money.

The business case is crucial for advising decision-makers of the major projects like the Cabinet Budget Review Committee (CBRC) to make an informed decision regarding whether to invest in the proposed project.

This is the most critical stage in the project development because the project budget is determined at this stage and information in the business case are used to compare what was achieved against what was approved.

The deliverables at the business case stage include the following:

- reporting of the final options considered and further analysed using the qualitative / quantitative approach
- multi-criteria analysis results, investigations to identify the section-specific risks, demands, conditions, constraints, and potential impacts on the environment and community
- any specific design considerations (extended design domain or design exceptions)

- P50 and P90 cost estimates
- economic analysis results and benefit realization plans
- selection of the preferred option, noting in some circumstances, the government may instruct the project to proceed directly to the preferred option
- conducting preliminary geotechnical, hydraulic, hydrological, environmental, and cultural heritage risk assessments
- increase scope of these investigations to better address cost certainty based on known causal factors of cost overrun, for example PUP, PFAS and EPBC, and
- proposed delivery model, market sounding and constructability review.

3.3.3 Development phase costs

The development phase of a project, based on the documents provided, involves meticulous scrutiny of the approved preferred project option outlined in the business case. It focuses on identifying any limitations or challenges by conducting comprehensive investigations. This phase encompasses a range of concurrent activities which include:

- Formulating the project plan.
- Setting up project controls.
- Advancing phase design.
- Managing contract tendering processes.
- Obtaining necessary project approvals.
- Additionally, the phase typically incorporates the following specific activities:
- Carrying out detailed cadastral and engineering surveys.
- Engaging with the community.
- Conducting further geotechnical, hydraulic, hydrological, environmental, and cultural heritage risk assessments.
- Performing field assessments or surveys.
- Engaging in consultations, negotiations, and obtaining heritage approvals.
- Searching for utilities locations, and
- Further developing the design work based on the Business Case's recommended concept.

For projects receiving funding from the Australian Government, this stage involves in-depth planning and design of the chosen option, including updates to the Benefit Cost Ratio (BCR), thorough and adjusted budgets, scheduling, and determining procurement methods. It may also encompass initial construction activities and property acquisition.

Particularly for major and OnQ Types 1 and 2 projects, the development phase is divided into 2 distinct sub-stages: Stage 1 (S1D) and Stage 2 (S2D), each with its own specific design costs and objectives.

3.3.3.1 Development phase – Stage 1 (S1D) Design costs

The development phase preliminary design, or Stage 1 Design (S1D), provides the reference for compliance checking for the development phase design against the business case outcomes and serves to ensure that the project design aligns with the approved scope and the options detailed in the business case and the associated cost estimate remains within the approved budget before proceeding to Stage 2 Design (S2D).

Nonetheless, it is also noted that not every project following the QTRIP will undertake the S1D step, as some may proceed directly to the Stage 2 Design (S2D) stage.

Advancing the preferred option to the advanced Stage 1 Design (S1D) phase requires project management and work management activities.

3.3.3.2 Development phase – Stage 2 (S2D) Design costs

The development phase Stage 2 Design, also known as the detailed design stage, encompasses the completion of Stage 1 Design (S1D) activities and the production of detailed project drawings alongside a Stage 2 Design (S2D) estimate, which is essential for creating a construction contract.

For all major projects and OnQ Types 1 and 2, developing cost estimates from a first principles cost estimating method is mandatory in tandem with a probabilistic approach to assess project risks. Furthermore, the cost estimations for both stages 1 and 2 need to attain a confidence level of P90 to comply with the Project Cost Estimating Policy.

3.3.3.3 Contract documentations costs

The contract delivery methods are established within the approved business case, and the costs for preparing the contract documentation are included in the business case cost estimate. However, for Major Projects there are 2 distinct stages:

PAF supply strategy development stage: This stage is initiated after approval to move to the development stage is received. The activities in this stage include, but are not limited to, all preparatory work before the release of offer documents to the supply market. These activities correspond to Gate 4 of the PAF process.

PAF supply source suppliers' stage: This stage occurs post-Gate 4 approval and involves the procurement process. It encompasses the release of offer documents to the supply market, evaluation of offers or tenders, report development, revising the business case,

and obtaining the necessary approval to proceed, which corresponds to Gate 5 of the PAF process.

3.3.3.4 Procurement costs

The procurement stage costs include the preparation of tender documentation, advertising, responding to RFIs, preparing NTTs, tender analyses, obtaining financial approvals, and appointing and engaging the successful contractor(s). These costs can be determined by first principles costing or from benchmarked values and should consider increased use of interactive bidding in tenders as Transport and Main Roads moves from price only, heavily price weighted criteria.

For guidance on procurement of works, refer to *Transport Infrastructure Project Delivery System* (TIPDS).

3.3.4 Implementation phase costs

The Implementation phase costs encompass expenses associated with delivery management activities, such as project management, work management, project supervision, and administration of construction contracts, as well as costs for site visits and meetings.

Most of these costs are categorised as Capital Expenditure (CapEx), however, depending on specific project circumstances, there could be Operational Expenditure (OpEx) as well, including demolition, public utility plant relocations, and training.

For more information refer to the department's Cost Classification Guide on the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

3.3.5 Finalisation phase costs

The project finalisation phase of infrastructure projects within the Transport Infrastructure Portfolio (TIP) is essential for the transition to ongoing maintenance and operations of assets.

It is crucial that the costs associated with finalisation activities be assessed early and incorporated into the initial cost estimates presented in the business case. Failure to allocate budget for these activities can lead to their alteration or omission.

Key requirements at the finalisation stage encompass generating as-built plans, updating asset management systems, developing maintenance and operational plans, finalizing state road declarations, maintaining records of project variations and decisions, securing forensic data, compiling project learnings, handover, completion, surplus property reports, establishing returned works agreements, unsolved insurance claims and liability.

3.3.6 Principal’s obligation costs

The principal's obligations regarding a project can entail various responsibilities, including the acquisition of right-of-way, which involves property resumptions as detailed in Section 3.3.6.1. This process may involve land acquisition at early stages under an *Early Acquisition Policy*, or through formal resumption typically after project approval, or it can occur due to hardship cases even during the concept phase.

Additionally, the principal may also undertake some tasks associated with the management of Public Utility Plants (PUP), as per Section 3.3.6.2, which may require coordination and relocation of utilities such as electricity, gas, telecommunication, water, and sewerage services. Changes related to PUPs may also be necessary during the implementation phase to facilitate construction activities.

The principal might also supply some materials to the contractor which need to be recovered during the contractor payments. The principal may be involved in various project stages like investigation, design, and making alterations, as mentioned under Section 3.3.6.3.

3.3.6.1 Property resumption costs

Unless the land required for project delivery purposes has been purchased at the early planning stages under its *Early Acquisition Policy*, the department acquires the property via the resumption (compulsory acquisition) process. Due to the complexity and potential cost risks associated with the property resumption process, advice should be sought from the department’s Property Acquisitions and Disposals (PAD) unit whenever a need identified for a project.

To commence the property resumption process, the PAD unit requires a clearly defined project scope (including all alignment options) and associated drawings showing property impacts. The early consultation with the PAD unit is highly desirable because the property acquisition costs may influence the alignment selection, and the fixed statutory timeframes associated with the property resumption process may influence the project timeframes.

The property resumption process consists of 2 main procedures: formal resumption, which occurs post-project approval for construction, and early acquisition via sales negotiation if construction is not imminent.

The PAD unit conducts market valuation for cost estimation and landholder compensation, accounting for the full or partial impact of the project on property values. Compensations include disturbance allowances, covering related expenses like relocation, repurchase costs, professional fees, and business disruptions.

Land resumption costs must factor in PAD management expenses, including negotiation or post-resumption compensation costs such as external valuations and legal fees. Additionally, the PAD team's commission for property acquisition services is a separate budget item.

Property resumption may also incur other Environmental considerations like contaminated land remediation, biosecurity, and waste management incur further costs, as do ongoing costs for land managed for environmental offsets.

The implications of land resumption must be analysed prior to the business case approval, including dewatering expenses and contamination assessments for sensitive areas. Such evaluations are crucial to avert late-stage project hurdles or halts.

In financial terms, property purchase costs are recorded as capital expenditures (CapEx), while resumption compensation, disturbance payments, and administration expenses are operational expenditures (OpEx).

A sample of property resumption costs for a typical project is provided in Table 3.3.6.1. For further information on land acquisition process, contact DTMR.early.acquisitions@DTMR.qld.gov.au.

The Transport Corridor Acquisition Fund (TCAF)

The Transport Corridor Acquisition Fund (TCAF) is managed by the Corridor Preservation Investment Program team in the Portfolio Investment and Programming division which provides funding for property acquisition under Transport and Main Roads *Early Acquisition Policy* when other funding is not available.

The policy requires that from 1 July 2022, infrastructure projects over $5M include early acquisition costs in the total project budget. TCAF funds used are expected to be reimbursed to TCAF once project delivery funding is received. This is to maintain transparency in infrastructure costs, ensure the sustainability of TCAF, and continue fair subsidization to landowners affected by early acquisitions.

Detailed information on the TCAF Cost Recovery Policy, such as eligibility, exclusions, and procedures, can be found on the department’s internal PIP SharePoint page. External parties can request copies from estimating.support@tmr.qld.gov.au.

Table 3.3.6.1 – Example property resumption costs

1 Smith Street – Total $746 900			
Owner Costs		**Tenant Costs**	
Property value	$500,000	Business losses	$75,000
Disturbance items	$50,000	Disturbance items	$15,000
PAD team costs	$20,000	PAD team costs	$15,000
PAD commission	$55,000	PAD commission	$9,000
Sub Total	$625,000	Sub Total	$114,000
10% Contingency	$62,500	10% Contingency	$11,400
Total	**$687,500**	**Total**	**$125,400**

3.3.6.2 Management of Public Utility Plant (PUP)

Public Utility Plant (PUP) refers to essential service assets such as electricity, gas, telecommunication, water, and sewerage which are owned by service authorities but allowed by State Legislation or a Commonwealth Act, to be in the road or transport corridors.

From time to time, these utility assets may need to be moved to facilitate road or rail construction projects.

For projects over the $25M threshold, PUP adjustment costs must be identified at planning stages including principal costs (which may involve departmental investigation, design, supervision, and contract management), contractor costs (when contractors manage PUP relocation), costs incurred by utility companies, and traffic management costs.

The Projects under $25M may report PUP costs in a single line item.

Providing an accurate estimate for PUP relocation is challenging at the early planning stages. Therefore, obtaining quotes from relevant utilities is important to create suitable contingency allowances. Adjustments to utility services could involve protecting existing assets, relocating old ones, or installing new and subsequent removal of old assets.

The costs should cover both direct expenditures, such as those with service providers (including subcontractors), and indirect costs like design, project management, traffic management, auditing, testing, contingency, civil construction, and potential property resumptions.

The department maintains memoranda of understanding MOUs with various service authorities, which are accessible on the department’s internal SharePoint site under the

Utility Management Information Hub, to guide utility asset alteration processes. External parties can request copies from estimating.support@tmr.qld.gov.au.

All these expenditures for utility services adjustments must be classified according to the department's Cost Classification for Transport Infrastructure Projects 2023. The EP 174 *Utility Infrastructure Relocation and Protection Management: Policy and Procedures* outlines the relevant legislation and procedures for managing both contestable and non-contestable PUP works in departmental projects. PUP Functional Specifications C7521 and C7522 PUP Addendums, located on the departmental Webpage Consultants for Engineering Projects (Department of Transport and Main Roads), provides the template to engage consultants.

Energex's 'Estimating with Pictures Manual' provides useful hints developing initial cost estimates for relocating power assets. However, the Energex representatives must be consulted for more precise power asset relocation costs for inclusion in business case estimates.

3.3.6.3 Other payments and costs

The principal's costs in a project not only contain direct construction-related expenses but also a variety of other expenditures. These may consist of Principal Arranged Insurance (PAI), payments toward the Portable Long Service Leave (PLSL) also known as QLeave, fees related to Workplace Health and Safety (WH&S) and the environment, as well as costs arising from community engagement.

Additional miscellaneous charges can also accrue, which could include expenses for lighting, cultural heritage considerations, and other similar matters. Additionally, any compensation needed for road infrastructure development, along with performance incentives or bonuses, should be factored into the principal's costs.

3.3.6.3.1 Principal arranged insurance (PAI)

The Principal Arranged Insurance (PAI) program protects against risks associated with infrastructure construction for the department and its contractors. It encompasses a range of policies covering contract works, public and product liability, professional indemnity, and environmental liability.

The PAI includes 3 categories based on contract characteristics:

- Major contracts: with a construction value over $250M.
- Referral contracts: exceeding a 36-month construction period, bridge components over $30M, or marine / tunnel / wet-work components above $10M, and

- Bulk contracts: valued between $1M and $100M, construction periods under 36 months, bridge components below $30M, and marine / tunnel / wet-work components under $10M.

PAI levies are a percentage of the construction costs without GST, and the rates may change over time. For up-to-date levy rates and additional PAI information, the department's internal SharePoint site and Annexure F of PCEM should be consulted. External parties can request copies from estimating.support@tmr.qld.gov.au.

3.3.6.3.2 QLeave – Portable Long Service Leave (PLSL)

The Portable Long Service Leave Scheme (PLSL) in the building and construction industry, known as QLeave, provides long service leave entitlements to contract workers. PLSL is funded by a levy on building and construction work costs. QLeave also collects additional levies, specifically, the Work Health & Safety Levy to fund WH&S Queensland, and the Construction Skills Queensland Levy to fund Construction Skills Queensland.

For projects exceeding $150,000 in costs (including GST), notification to QLeave must be made before starting construction, and the QLeave payment must be remitted for work done by construction contractors, sub-contractors, and RoadTek.

As of February 2025, the specific levies are as follows:

Portable Long Service Leave Scheme levy: 0.350%

Construction Skills Queensland levy: 0.100%

Building & Construction Work Health & Safety levy: 0.125%

This results in a combined total PLSL levy of 0.575% of the construction costs.

This amount should be included in all cost estimates for projects valued over $150,000. Further information can be found on the QLeave section of the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

3.3.6.3.3 Community engagement costs

The Community engagement costs are the expenses associated with activities required to inform and communicate with the community affected by a project throughout all phases of the project life cycle. These costs should be specifically attributed to the relevant phase as per the project schedule or program.

3.3.6.3.4 Service Roads, Local Roads and Demaining

When incorporating new constructions or upgrading existing assets like local roads or service roads that are managed by third parties such as local government authorities, careful planning is critical.

Department of Transport and Main Roads and the Local Government Association of Queensland Inc., for and on behalf of Queensland Local Government, have worked in partnership in formulating this agreement on cost sharing responsibilities for works on state-controlled roads. It recognises that, while local roads, towns and cities are managed by local government and state-controlled roads are managed by the department, roads do not exist in isolation and must integrate smoothly and efficiently and complement the surrounding environment. Therefore, this agreement is aimed at facilitating and providing for the needs of local government and Transport and Main Roads while at the same time enhancing the good operational relationship which already exists. See Cost sharing based on responsibilities within state-controlled roads for more details.

This process should encompass pre-construction, construction, public consultation, environmental assessment, design, land acquisition, and traffic management, ensuring these elements are integrated into the overall project scope.

Additionally, it is important to include demaining costs associated with the local government network within the total project cost estimate. The department is responsible for improving, refurbishing, or upgrading these existing road assets before they are transferred to the local government.

Consequently, proactive engagement with local government authorities is essential to identify any such assets and assess the potential cost implications to allocate appropriate funds in the project estimate accurately. All costs related to demaining road infrastructure or spending on Local Government controlled roads should be classified as Operating Expenditure (OpEx) as these assets will not be owned by Transport and Main Roads.

3.3.7 Risks and contingencies

Project estimates should realistically reflect the costs of the scope of work, including both the base estimate and a contingency component to cater for uncertainties in the project delivery process.

The contingency allowance represents the residual risks and is a gauge of the level of uncertainty or confidence in achieving the project objectives. Formal risk management processes are crucial in project success, requiring an effective, collaborative approach and innovative strategies to comply with policies, standards, and processes. It is essential that

risk managers ensure adherence to departmental regulations and standards by all stakeholders throughout the project.

The department's *Project Risk Management and Contingency Development Process Manual* offers detailed guidance on necessary policies, requirements, and processes for comprehensive project risk management.

Table 3.3.7 below provides the information on typical contingency ranges expected at different project stages.

Table 3.3.7 – Expected contingency range

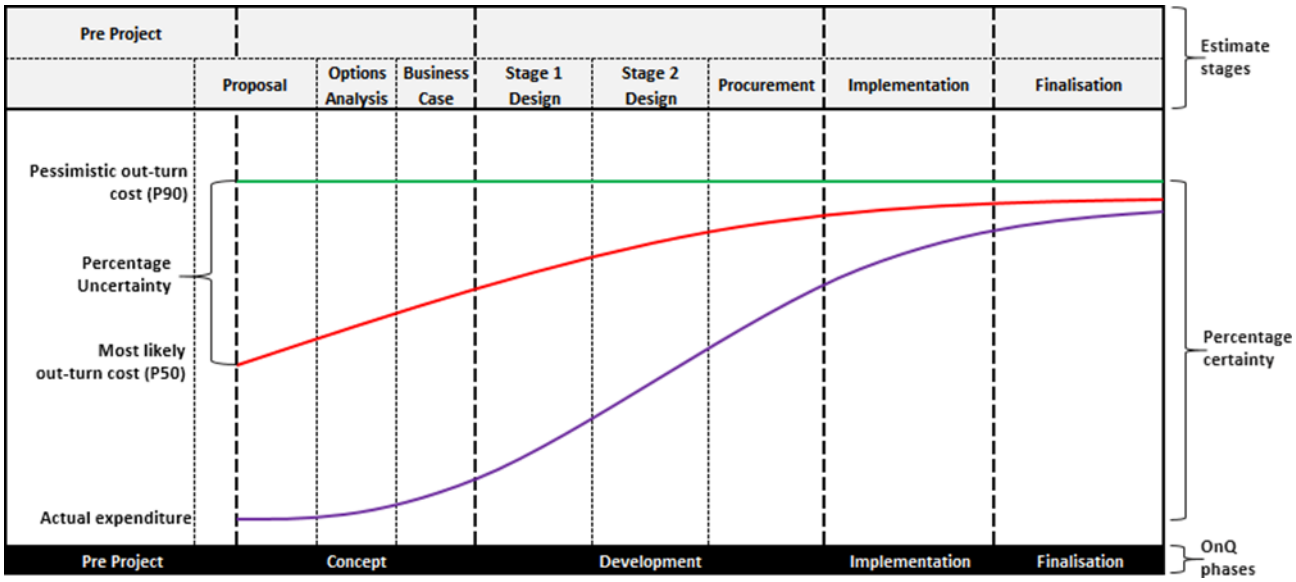
Estimate type and category	Project definition level	Typical contingency range	Contingency* for extra-ordinary local cost pressures (sample only)
Strategic/Detailed planning – Category 1	less than 2%	greater than 70%	Additional allowance*
Project proposal – Category 2	from 2% to 10%	40% to 70%	Additional allowance*
Options analysis – Category 2	10% - 25%	40% - 70%	Additional allowance
Business case – Category 3	10% to 40%	30% to 40%	Additional allowance*
Development Phase Stage 1Design (S1D) – Category 4	40% to 65%	20% to 30%	Additional allowance*
Development Phase Stage 2 Design (S2D) – Category 5	65% to 85%	10% to 20%	Additional allowance*

*Note: The contingency for extra-ordinary cost pressures percentages indicated above are calculated as a percentage from the total project cost, depending on the scope, site location, project mode and the scope.

The purpose of determining the appropriate contingency range is to gain confidence in the cost estimate at any given project stage. It is outlined in Annexure G of PCEM that a detailed description of each estimate category is provided to assist with this.

As the project progresses through its life cycle, the level of confidence in the estimate is expected to increase, which is depicted in Figure 3.3.7 below.

Figure 3.3.7 – Estimate confidence profiles in the program life cycle for traditional project delivery



3.3.8 Escalation

Escalation is a factor applied to project estimates to ensure that there is adequate capital funding to cover increases in costs attributable to inflation over the life of a project. This process, referred to as presenting estimates in out-turn dollars, considers the change in costs due to economic and market conditions from planning stage to project finalization stage.

There are various factors that drive escalation, as detailed in Table 3.3.8 below. These drivers include inflation and CPI changes, market condition changes, supply constraints, and project complexity among other factors.

Table 3.3.8 – Escalation drivers

Item	Description
Inflation and CPI	Referred to as rise and fall and entails inflation for key commodities such as labour, plant and material.
Changes in market conditions	Global economic pressures lead to changes in tender box prices and contractor margins due to factors such as global monetary tightening, economic slowdown in major economies, and uncertainties caused by global conflicts. These external pressures can impact the construction industry which in turn influences how much contractors will charge for their services.

Item	Description
Supply constraints	Unexpected events such as natural disasters can create artificial demand for resources, leading to additional costs and time constraints in the supply market. There are also competitive challenges from the department's projects and the construction industry vying for the same labour and resources.
Project complexity	Significant costs arise from the need to manage construction interaction strategies and measures efficiently to mitigate or prevent risks associated with network breakdown.

Cost estimates for QTRIP projects, including those receiving national funding, need to be presented in outturn dollars at the business case stage. Outturn costs are calculated by adjusting estimated cashflow expenditures using escalation factors.

The department uses escalation rates set by the Australian Government for consistency as detailed in the federal Project Cost Breakdown (PCB) template. Additional information on escalation can be found in the federal *Guidance Note 4 – Escalation* and the federal Notes on Administration.

4 Estimating process

The streamlined estimating process provided below must be employed for developing cost estimates for all QTRIP projects at any project stage or estimate type.

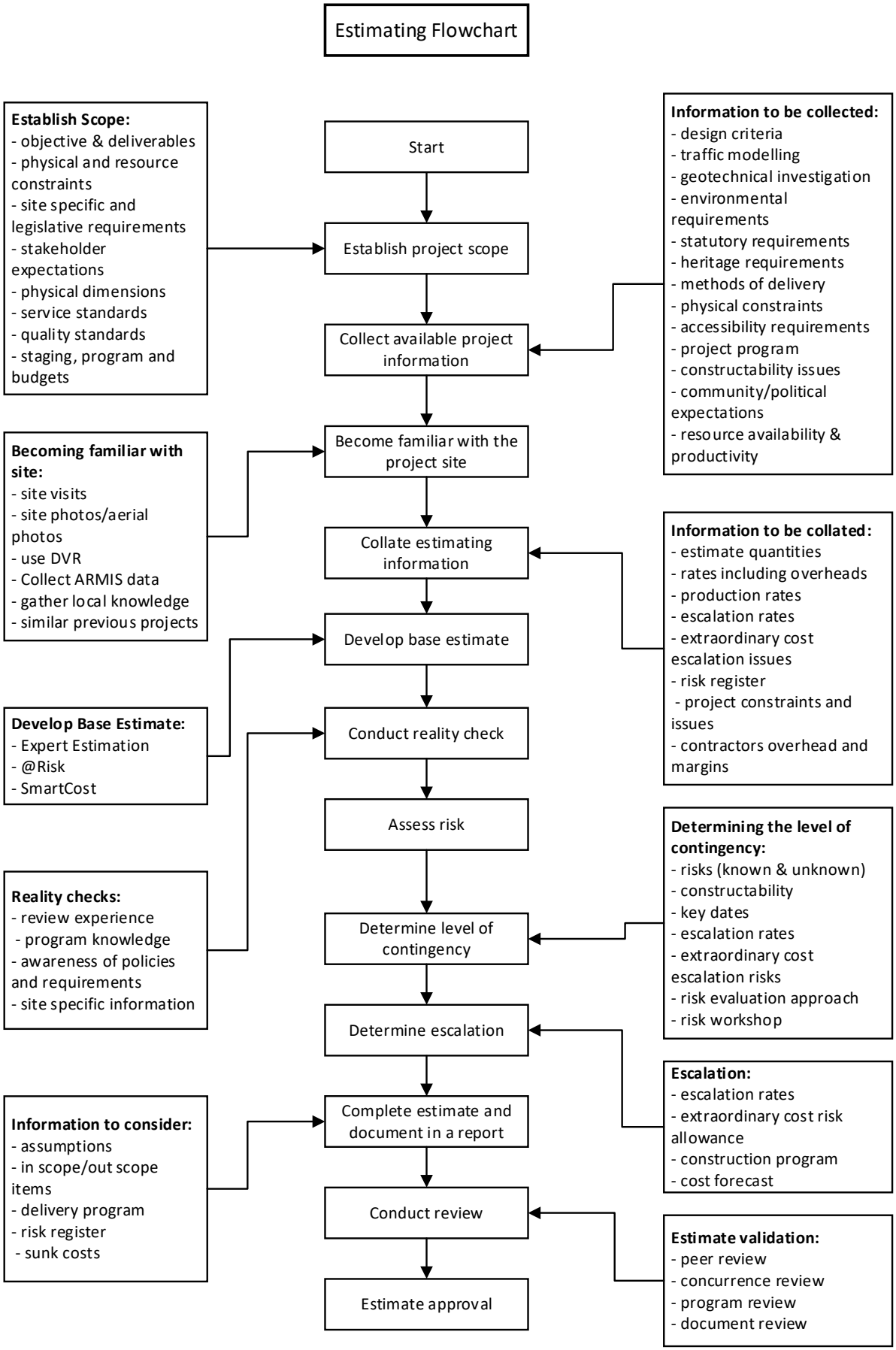
4.1 Process overview

The recommended estimating process includes the following key activities:

- establish the project scope and verify key milestones
- gather relevant project information through detailed site assessment to establish and verify physical and environmental constraints
- gather local knowledge on available resources and the site location
- estimate and resource planning
- cost estimate development
- conduct reality checks
- risk identification and evaluation
- contingency quantification using deterministic or probabilistic methods
- escalation (applicable rates and extra-ordinary cost pressure items), and
- review and approval.

This process is shown as a flow diagram in the Figure 4.1.

Figure 4.1 – Generic estimate flowchart



The detail description of each step of this process flowchart is detailed below.

4.1.1 Establish project scope

A well-defined project scope is crucial for developing realistic cost estimates and controlling the costs throughout the project lifecycle. Inadequate scoping, leading to vague project definitions, can result in decreased estimate accuracy, increased assumptions, cost overruns, project delays, and contract disputes.

Early project estimates, which are often based on incomplete scope definitions, may falsely set stakeholders' expectations and misalign with subsequent estimates required for making investment decisions. Therefore, clarity in defining the project scope—encompassing objectives, performance criteria, context, and physical parameters—is essential for accuracy in cost estimates.

Effective project scope definition involves stakeholder engagement, established leadership, collection of site information, early contractor involvement, and well-structured contracts to manage scoping issues.

Attributes such as stakeholder expectations, site location, environmental constraints, service standards, and project timing are integral. A scope change control process should be in place to manage and document scope alterations, ensuring all changes align with the project's essential functions.

The scope statement documents a common understanding between the project team and its stakeholders. It provides the estimator with the understanding, confidence, and ability to confirm the limitations in the estimate, especially when supplemented by the project plan, design drawings and technical specifications.

Design refinements and associated adjustments to the base cost estimate throughout the project phases are common in the project management process and the project contingency is expected to cover such costs as the project moves through its phases.

A scope change control process is a useful mechanism to document and manage the actual scope changes. It ensures that project changes are identified, evaluated, controlled, reviewed, approved, and documented. Scope control requires that the proposed scope of a project, as well as any proposed scope changes, be continually evaluated against the essential functions necessary to accomplish its intended purpose.

Major scope changes necessitate a revision and reissue of the base cost estimate. The department’s Infrastructure Cost Estimating Policy addendum stipulates the requirements for updated estimate before investment decision-making.

However, if no significant changes occur within that timeframe, a streamlined process can be used to uplift the estimate.

For additional guidelines on project scope development and management, refer to *Estimate Guidance Note 1 – Project Scope*, issued by the Australian government.

4.1.2 Collect available project information

Developing a robust base estimate is contingent on the clarity and comprehensiveness of the project scope, as well as the availability of detailed documents and historical data. When estimators work with an ill-defined scope and lack supporting documentation, they are forced to make unpromising assumptions, negatively impacting the estimate accuracy. Adequate data collection and the application of proper estimating methodologies lay a solid foundation for rational estimates.

To compile a precise and thorough estimate, an estimator must conduct comprehensive information gathering, including the following:

- An accurate scope description, with explicit clarifications on what is included and excluded.
- A complete project schedule and schematics or design drawings of the proposed project.
- Construction methodology and staging.
- Constructability issues.
- Geotechnical information and reports if any.
- Information on past and current budgeting and expenditure details.
- A thorough risk assessment to anticipate and account for potential uncertainties.
- Insight into the availability of materials, their sources, and the logistics such as haulage distances.
- A clear staging plan delineates the sequencing and execution of project phases, if applicable.
- Awareness of environmental and cultural heritage constraints, and approvals / conditions they entail.
- Compliance with Work Health and Safety (WHS) requirements.
- Understanding of concurrent projects in proximity that could affect the project in question.
- Insight into issues that may affect the constructability of the project.
- Proposed contracting strategy (for example design and construct, early contractor involvement, open tender, sole invitation and so on).
- Prior research, studies or reports on influential factors such as soil conditions or environmental concerns like PFAS.

- Potential early works restrictions that federal environmental approvals may impose on their start.
- Comprehensive site visit records, photographs, and general assessments.
- Considerations pertaining to sustainability, climate change, and accessible design.
- A risk assessment, completed costed risk register.
- Site location such as accessibility, higher transportation costs and traffic constraints.
- Market conditions such as prices for materials and labour, and
- Historical data.

The estimator also must record all gathered data and assumptions made to support future adjustments and aid in planning the work.

4.1.3 Become familiar with the project site

Each Site-specific issues are crucial in the estimation process, affecting the overall cost of a project. It is important for estimators to identify and account for these issues as they can significantly influence the budget, and cross check with known risks in the project risk register. Some common site-specific factors that can impact cost estimates include:

- Geotechnical conditions such as embankments, ground structure, rough terrain, and flood plains that may complicate construction methods.
- Climate or weather factors like cyclones, storm events, droughts, floods, or water shortages that could delay or disrupt the project schedule.
- Access challenges including logistical barriers to the site, provisions for heavy plant machinery, and necessary storage facilities.
- Proximity to residential areas and associated stakeholder issues like noise, dust, vibration, constraints on working hours, blasting restrictions, and the need to use local roads for transporting large items.
- Environmental considerations such as managing contaminated land, addressing the risk of PFAS, and dealing with protected fauna, flora, and wetlands.
- Cultural Heritage agreements and engagement with the correct traditional owner group on cultural heritage risk early.
- The sourcing of construction materials, which includes the location of supply pits, quarries, and providers of concrete and bitumen.
- Resource availability, particularly in remote locations, which may require site-specific camps, transportation, and additional living allowances for workers.
- Utilities and services – availability of resources and requirement of relocations, upgrades and connections.

- Recognition of heritage and culturally significant areas which might necessitate road realignment to prevent impact or harm to cultural heritage, and
- Government-imposed mandates, including waste levies, speed restrictions, and measures in response to public health concerns like Covid restrictions.

To enhance the accuracy of estimates, it is highly recommended that an estimator conducts a site visit, ideally with the project manager, to gain a firsthand understanding of the conditions, risks, and uncertainties. All findings from site visits should be documented in Annexure A of PCEM.

If a physical visit is infeasible, alternative methods like reviewing aerial photographs and Digital Video Road (DVR) images can be employed.

4.1.4 Collate estimating information

When preparing an estimate for road projects, it is imperative to prioritise the collection of high-quality information and a structured approach to ensure reliability. The foundational information required includes:

- The purpose of the estimate, which guides the level of detail needed and may vary from early strategic planning to detailed design or tender comparison.
- The origin of the estimate data, which can be drawn from internal team assessments or the panel of external estimating consultants.
- An appropriate Work Breakdown Structure (WBS) to define the scope of work methodically.
- A comprehensive project scope, incorporating required deliverables and any constraints or limitations.
- The application of suitable estimating software and risk analysis tools, such as Expert Estimation and @Risk, which assist in formulating the base estimate and addressing potential uncertainties.
- Reference to relevant benchmarking and cost databases, like SmartCost, which offer standardised metrics for cost comparison and assessment, and
- An appropriate estimate review process, the inputs used, and the resources available for the project.

This structured approach to estimate preparation is essential for generating a robust and dependable financial plan for road projects in the QTRIP.

Determine the program of works

The development of a realistic and detailed program of works, validated by client-side programmer, is crucial to the accuracy of a project's estimate. This program should

incorporate activities across all project phases, with durations that reflect practical expectations based on the available information and the current stage of the project:

Planning Phase: In this phase, the estimate should align with the department's Work Breakdown Structure (WBS) and include activities at sequence levels 1 and 2, as detailed in Section 7.1 and Section 3.3.1.

Concept Phase: The activities to include in the project program during the concept phase should follow the guidelines of Section 7.1 and Section 3.3.2 on Planning Phase Costs. Scheduling should utilize the WBS structure at sequence levels 1, 2, and 3 for a comprehensive breakdown.

Development Phase: During this phase, the project program should encompass activities as outlined in Section 7.1 and Section 3.3.2, regarding Concept Phase Costs, adhering to WBS structure and sequence level 1, 2, and 3, to ensure a fully developed schedule.

Implementation Stage: Key activities such as tendering and appointing contractors, which are sometimes overlooked, should be accounted for. They must be recognized for their significant potential to impact project costs if not properly anticipated and included in the planning.

The construction method chosen significantly influences the allocation of time, resources, and the overall project efficiency.

A thorough construction program is indispensable for framing a cost estimate based on core principles. It is also necessary for estimators to calculate the duration of activities at each project stage based on past experiences, specific project requirements, and established milestones.

Furthermore, the program of works also helps to present the cost estimate in 'outturn dollars', which means applying escalation rates to project the current costs to their future equivalent, considering inflation and other economic factors over time.

4.1.4.1 Information required for rail projects

Rail construction projects often involve substantial tasks like major upgrades, duplications, or enhancements to existing rail infrastructure, including stations and buildings. When planning and estimating these projects, it is critical to coordinate around "possessions"—the specific intervals when regular train services are temporarily halted to grant construction crews safe access to the worksite.

Prior to initiating cost estimation for certain rail projects, it is necessary for the department to collect information and achieve concurrence on the Project Certification Baseline with Queensland Rail. This baseline encompasses vital Rail Safety Requirements and the contractor's Safety & Environment Management System (SEMS) elements.

For more specific details on rail estimating, refer to Section 11.1, of this document.

4.1.5 Determine the Work Item types

In preparing a cost estimate schedule for a project, estimators are required to employ a range of work item types that align with the technical specifications outlined in the department's MRS01 *Introduction to Technical Specifications*. Each of these work items must be referenced by a unique identifier known as a 'Work Item Number' to ensure consistency and accuracy when assigning costs within the estimate.

To obtain these identifiers, estimators can access and download the list of Work Item Numbers from the department’s internal SharePoint site. Alternatively, the Work Item Numbers are also available on the department’s Specifications webpages.

4.1.5.1 Standard Work Items

All work items listed in the department's Technical Specifications suite are known as Standard Work Items. All Standard Work Items used in the department have a work description, work operation and unit of measure. The Standard Work Items are detailed in the department’s MRS Specification (Measurement) documents suite.

4.1.5.2 Supplementary Work Items

In some cases, project-specific conditions necessitate modifications to the Standard Work Items stipulated by the department to accommodate changes in work operation or technical specifications. When these Standard Work Items are modified accordingly, they are then classified as Supplementary Work Items. These are identified by appending an 'S' suffix to the original Work Item number.

To clearly communicate these changes, the modified work items must include a detailed explanation of the changes made. This explanation, known as the supplementary specification or 'supplementary requirements', should be included in the appropriate Technical Specification Annexure.

4.1.5.3 Provisional Quantity Work Items

Provisional Quantity Work Items are designated for components of work that cannot be accurately quantified ahead of time due to practical reasons. These items are marked with a 'P' suffix to indicate their provisional status.

When preparing cost estimates, it is important to limit the use of both supplementary ('S') and provisional ('P') items as much as possible. Over-reliance on these types of work items can lead to complications during the tendering process, as they tend to be seen as adding extra risk.

Potential tenderers, mindful of these risks, might inflate their prices to mitigate the uncertainty associated with many 'S' and 'P' items in the tender schedules.

Table 4.1.5.3 below provides different provisional items used in the department and expected limit of accuracies.

Table 4.1.5.3 – Categories of provisional quantity items

Provisional Category	Limit of Accuracy	Remarks
Provisional Quantity	±50%	The quantity in the tender schedule can vary within the limit of accuracy. If it exceeds the limit of accuracy, the contractor can negotiate a new rate of excess work to be carried out.
Provisional Quantity, as directed	±50%	The contract administrator will direct or mark out the extent of the work. The Contractor shall not proceed until the extent of the work is agreed.
Provisional Quantity, if ordered	±100%	Work can be undertaken by the contractor only if instructed in writing by the contract administrator.

4.1.5.4 Provisional Item, if ordered Work Items

Contractors are eligible for compensation for 'Provisional Item 'if ordered' Work Items exclusively upon receiving written instructions from the Contract Administrator to proceed with those specific tasks. Without such directive, contractors forfeit the overhead costs they would include for 'Provisional Item 'if ordered' items. This is because overhead costs are not distributed across these provisional items in anticipation of the potential non-execution of such tasks.

4.1.5.5 Provisional Sum Work Items

A Provisional Sum is an allowance set aside in the tender schedule, as estimated by the principal for work elements that may or may not be required during the execution of the project. These work elements encompass tasks that are either not possible to quantify at the outset due to their unclear scope or pertain to aspects of work that might be subcontracted.

Key categories of work that can constitute Provisional Sum work Items include:

- Work that has an indeterminate scope and cannot be quantified in advance.
- Work assigned to a subcontractor, and
- Nominated subcontract work where specific subcontractors may be appointed.

It is important that the contractor refrains from executing any work covered by a Provisional Sum unless given explicit instructions by the Contract Administrator to do so. Furthermore, the Contract Administrator is under no requirement to issue such directives for work relating to the Provisional Sum category.

Should such instructions be provided, and the contractor undertakes the work, they are entitled to payment for the completed Provisional Sum Work Items, inclusive of their profit and overheads.

Refer to Clause 11 of the *General Conditions of Contract* (C7830) of the department for more information on Provisional Sum Work Items.

4.1.5.6 Non-Standard Work Items

In certain instances, cost estimators may encounter unique issues or specific circumstances during project delivery that are not encompassed by the existing Standard Work Item descriptions or the department's Technical Specifications. These situations necessitate the consideration of Non-Standard Work Items. For such items, estimators must develop tailored descriptions, articulate the specifications of the work that needs to be delivered, and determine the appropriate measurement criteria.

The Non-Standard Work Items should be carefully documented and integrated into the cost estimate schedules as 90000 series items, each with its own distinct description, to ensure that they are easily identifiable and properly accounted for throughout the estimation and project execution process.

4.1.6 Understand historical data

The historical data from projects previously delivered by the department is invaluable for offering insights into potential risks and challenges that may arise in new projects. Even though every project is distinct, with its own work environment, goals, and objectives, utilising past project data and learning from previous experiences is instrumental for effective planning. This is the key benefit of client-side cost planner and programmer roles.

Such historical information helps in understanding include:

- Market conditions, including cost pressures and trends that have developed over time.
- Specific characteristics of projects of a similar nature, allowing lessons learned to be applied to current planning.
- The legal environment relevant to the timeframe when the data was collected, which could affect regulatory compliance and requirements.

- Departmental requisites in place when the data was gathered, ensuring current projects align with contemporary departmental standards, and
- The project delivery methods employed in the past, which can influence choices made for current and future projects.

Leveraging this comprehensive view of past experiences fosters better-informed decision-making processes for new projects and can lead to more accurate forecasting and mitigation of issues.

4.1.6.1 Adjust historical data

When utilizing historical data to estimate current projects, it is essential to adjust this data to align with the contemporary needs and conditions of the current project. The adjustments may include the following elements:

- Cost uplift to update the historical costs to current market values before applying escalation factors.
- Consideration of the site location requirements, project-specific needs, and situational conditions.
- Accommodation for any project variations that might differ from the historical projects.
- Adapting to the legislative changes that have occurred since the historical data was collected.
- Updating the estimate based on any changes in departmental policies and Technical Specifications at the time of project delivery.
- Revising the overhead costs for contractors, for on-site or off-site activities, and their profit margins.
- Reflecting the method of project delivery, which can affect costs, such as design and construct, early contractor involvement, and other procurement strategies, and
- Accounting for inflation that might impact the overall project costs over time.

By applying these adjustments to the historical data, estimators can ensure that their current project estimates are as accurate and relevant as possible, considering the dynamic nature of market conditions, legal requirements, and project specifications.

4.1.7 Develop base estimate

The base estimate is the cornerstone of the estimating process which encompasses the estimator's best assessment of the quantities and the current market rates for a given scope of work.

This initial assessment focuses solely on the costs attributed directly to the specified work, without factoring in potential variances stemming from unforeseen risks or future economic changes. Therefore, allowances for contingency, which cover both inherent and contingent risks, along with cost escalations due to inflation or other economic factors, are excluded in the base estimate. These elements are considered separately to ensure that the base estimate remains a reflection of the current understanding of the project's direct costs.

4.1.8 Undertake the reality checks

Before the peer review process, the estimator must perform a reality check on the base estimate to identify any significant discrepancies. This vital step ensures that the estimate is reasonable and aligns with industry standards and historical data. Standard reality check methods utilised in this verification include:

- The cost per kilometre, or alternatively, per lane-kilometre of the road, which benchmarks the roadwork costs comprehensively.
- The cost per square meter of structures, which provides an analysis of construction-related expenses for bridges or other structures.
- Principal costs expressed as a percentage of the total project cost, offering a perspective on major cost components in relation to the overall budget, and
- The proportion of the development phase cost in comparison to the total project costs, which helps in understanding the allocation of resources during the preliminary stages of the project.

These reality checks are not just a one-time requirement but should be performed consistently at every stage of the project to maintain the integrity of the estimate throughout the project's lifecycle.

4.1.9 Assess project risks

At the base estimate stage of a project, there are several key risks that the estimator must be cognisant of:

- Scope change: There is always a risk that the project scope could evolve. Even with a clearly defined initial scope, subsequent changes may occur due to various factors, such as stakeholder input, regulatory changes, or unforeseen site conditions.
- Incorrect information: Decisions made at this stage are typically based on the best available data. However, there is a potential risk that the information could be inaccurate. Mistakes or outdated data can lead to significant errors in the estimate, and

- Early estimation risks: Estimating costs at the preliminary stages of the project life cycle inherently involves a greater degree of uncertainty. The less information available, the more the estimator relies on assumptions, benchmarks, and historical data, which can introduce risk to the accuracy of the estimate.

These risks highlight the importance of thorough risk assessment and management throughout the estimating process to deal with uncertainties and to refine estimates when more detailed information becomes available.

4.1.10 Determine level of contingency

The inclusion of an appropriate contingency allowance is a crucial aspect of the project estimation process, serving to account for residual risks that cannot be fully eliminated or predicted. The size of the contingency component should be calibrated to the quality and reliability of the information upon which the estimate is based and must be aligned with the project's associated risks.

Table 3.3.7 provides guidance on the expected contingency ranges for various types of projects. However, it remains the responsibility of the project manager to verify that the level of contingency set forth within the estimate is suitable and adequate for the specific project circumstances.

Department's *Project Risk Evaluation and Contingency Development Process Manual* should be referenced for more nuanced information on developing contingencies.

4.1.11 Determine the cashflow and escalation

For all QTRIP projects, it is imperative that a comprehensive forecast of the project cashflow and associated escalation is applied. This financial planning is essential as it ensures there are sufficient capital funds to cover the projected cost increases that could occur over the lifespan of the project.

Within this process, the onus is on the estimator to accurately forecast the project's cashflow. This includes providing a detailed account of the scheduled outlay of project expenses, based on the best possible estimations of when and how capital will be used throughout the project timeline.

Subsequently, it is the project manager's responsibility to verify the cost forecast. This role involves critically reviewing the projected cashflow to guarantee its validity and to ensure that it aligns with the project's timeline and funding approvals. This dual-check system serves to maintain the integrity of the financial planning process, aiding in avoiding shortfalls in funding or misalignments with scheduled project activities.

4.1.11.1 Cashflow

Cashflow management in a project is integral to maintaining financial control and ensuring that the total project costs, which comprise the base cost estimate and contingency, are allocated correctly over the project duration. The distribution of these costs over time, known as the cashflow, dictates when the funds are expected to be utilised and is significantly influenced by the implementation schedule and the expenditure profile during construction.

To create realistic cashflow estimates and mitigate optimism bias, it is essential to base assumptions on practical commencement dates for construction, realistic construction durations, and a credible expenditure profile. Importantly, the timing of construction commencement often hinges on a myriad of factors, notably the timing of funding approvals, which can be a critical driver for the project's cashflow timeline.

Before settling on the anticipated project cashflow, there must be a thorough verification of the planned construction start date and the pattern of outlays. This step is vital to spotlight any potential limitations in funding that could impact project execution.

In practice, project cashflow often deviates from the initial targets, with funds being drawn down more slowly than projected due to various reasons such as delays in project or funding approvals, complexities in land acquisition, adverse weather conditions, and unforeseen shortages of labour or materials. Such factors can decelerate cashflow and must be taken into consideration when formulating cashflow forecasts.

Estimates must consider the expected contingency demand over time. The Cashflow must represent expected contingency demand during the project phases. This requires risks to be allocated a time sensitivity to ensure the profiling of quantified risk is calculated as part of cashflow profiling.

4.1.11.2 Escalation

Proper financial planning requires the inclusion of an escalation allowance that compensates for inflationary factors impacting the project throughout its lifecycle. This process transforms the current cost estimates into out-turn costs, presenting an inflation-adjusted value to reflect future costs.

The escalation is applied to both the base estimate and contingencies. By applying escalation on these cost components, the project budget will represent what the actual costs are likely to be in the future when the expenditure is to occur.

Example escalation rates for road and rail projects for 2025-26 to 2031-32 are depicted in Table 4.1.11.2(a).

Table 4.1.11.2(a) – Queensland cost escalation rates for roads and rail from 2025-26 to 2031-32 *(Construct only)

Financial year	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32
Escalation rate for Roads	2.28%	3.05%	3.47%	3.97%	3.78%	3.01%	2.44%
Escalation Rate for Rail – Above ground	2.56%	2.79%	2.91%	3.19%	3.20%	2.95%	2.79%
Escalation Rate for Rail – Below ground	2.78%	2.73%	2.97%	3.32%	3.29%	2.98%	2.81%

Table 4.1.11.2(b) – Queensland cost escalation rates for roads and rail from 2025-26 to 2031-32 *(Design and construct)

Financial year	2025-26	2026-27	2027-28	2028-29	2029-30	2030-31	2031-32
Escalation rate for Roads	2.2%	3.06%	3.61%	4.17%	3.96%	3.09%	2.44%
Escalation Rate for Rail – Above ground	2.58%	2.81%	2.93%	3.24%	3.26%	2.99%	2.82%
Escalation Rate for Rail – Below ground	2.79%	2.74%	2.99%	3.36%	3.35%	3.03%	2.84%

The Strategic cost estimates are typically presented in current dollars because specific details such as the exact start date of the project and the total duration are often not determined when the initial cost estimates are being prepared. This represents the costs

in terms of today's financial value, providing an initial benchmark for planning and budgetary discussions.

As the project develops and progresses through its lifecycle, the estimates are refined. It is essential to revisit and update these costs to account for new developments, including more precise timing, refined project scopes, and updated cost forecasting and escalation rates.

The escalation rates provided by the Australian Government in the PCB for Queensland are applied to QTRIP project estimates to present them in outturn dollars. These rates are updated each year and published on the department's internal SharePoint site and in the QTRIP Governance Principles document. External parties can request copies from estimating.support@tmr.qld.gov.au.

The escalation spreadsheet in Annexure H – Escalation Calculator, which is also available electronically from the department's internal SharePoint site, can be used to calculate the escalation. External parties can request copies from estimating.support@tmr.qld.gov.au.

4.1.12 Presentation of costs

When creating estimates for departmental projects, it is imperative that they are structured in accordance with the department's approved standard estimate format. This ensures that all estimates are consistent and comprehensive. The standard format should encompass all essential attributes, including:

Base estimate: This is the primary estimation of the project's costs based purely on the scope of works without considering any future changes, risks, or inflation.

Contingency allowance: This accounts for potential unexpected costs due either to inherent risks (those predictable through experience) or contingent risks (those that are unforeseeable).

Escalation: This adjusts the estimate to predict future costs, taking into consideration inflation and other economic factors that could affect the project's price over time.

Additionally, the estimate should clearly articulate the project scope by specifying what is included (in-scope) and what is not included (out of scope) in the estimate. Furthermore, any assumptive bases that have influenced the estimate must be detailed to provide clarity and justification for the figures presented.

To guide the estimate documentation process, Annexure J – Estimate Report Format is provided within PCEM. It lays out the exact template that should be used when preparing cost estimate reports, ensuring uniformity and ease of understanding across all estimates prepared by the department.

4.1.13 Estimate validation

Both the department's cost estimating policy, and the federal *Notes on Administration for Land Transport Infrastructure Projects* underscore the importance of a rigorous validation process for all cost estimates before they are used to inform investment decisions. This allows for a greater degree of confidence and reliability in the financial planning for projects.

For all QTRIP projects, there are 3 types of estimate review processes:

- Peer Review: This involves an assessment by a professional with a similar level of expertise ensuring that the cost estimate is scrutinised for accuracy, completeness, and consistency.
- Concurrence Review: Conducted by an independent party, typically with a higher level of authority, this review serves as a secondary level of assurance for the validity of the cost estimate, and
- Program Review: This broader review evaluates the cost estimate within the context of the entire program to ensure it aligns with overarching program goals and funding.

The estimate reviews must be conducted in compliance with the requirements laid out in Annexure B – Project Cost Estimate Review Checklist.

In line with the Federal *Notes on Administration for Land Transport Infrastructure Projects*, provided by the Australian Government, it is mandatory for all jurisdictions, without exception, to furnish evidence affirming that project costs have undergone a thorough review and have received approval as per the directions contained in their cost estimating guidance documents.

4.1.13.1 Peer review

A peer review of cost estimate is an essential internal control mechanism, through which an estimator—who is not the one originally responsible for the estimate—conducts a comprehensive and detailed examination of the estimate. This process involves a meticulous, line-by-line scrutiny of the cost estimate to verify accuracy and alignment with the project's goals.

The peer reviewer is typically an independent party, either an experienced estimator, a project manager, or a specialist officer, designated by the regional or district director of the department.

The responsibilities of the peer reviewer encompass a broad range of checks and verifications, including:

- Computational check: Verification of all arithmetic calculations to ensure there are no numerical errors.
- Estimating method used: Assessment of the estimation approach to confirm that it is suitable for the project scope and complexity.
- Quantities and rates used: Review of all quantities alongside the unit rates applied, ensuring they are reasonable and market reflective.
- Schedule and escalation rates used: Examination of the project timeline assumptions and whether the escalation rates applied are accurate and in line with current economic projections.
- Currency of the estimate: Ensuring the estimate reflects the present-day or specified future cost valuations, keeping in mind the project timeline.
- Scope Analysis: Evaluating if the project scope is captured in the estimate, including checking that the objectives are met and that the assumptions, inclusions, and exclusions are logical and valid.
- Appropriateness of Allowances: Confirming that the estimate has included proper allowances for all key assumptions to cover the identified project scope fully, and
- Contingency for Cost Escalation Risks: Assessing if adequate contingency has been included to address potential cost escalation risks, particularly under extraordinary economic conditions.

If the peer reviewer identifies any issues or irregularities, the findings must be formally communicated to the project manager. This is facilitated by including such concerns in the estimate peer review checklist, which is then submitted as a part of the required actions to address any discrepancies identified.

4.1.13.2 Concurrence review

A concurrence review involves an exhaustive third-party examination of project estimates, bringing together the estimator, sponsor, and reviewer to reach a consensus on the estimate metrics. This type of review is mandated for specific project categories, often as an additional layer of scrutiny following a peer review.

The individual responsible for conducting a concurrence review should be significantly experienced and independent of the project team. Suitable candidates include a practiced estimator affiliated with the department or an external estimating consultant from an approved prequalified panel.

The concurrence review process must adhere to AS/NZS ISO 9001 *Quality management systems – Requirements*, which uphold stringent requirements to guarantee that detailed estimate deliverables satisfy the necessary specifications.

The concurrence reviewer's responsibilities are included:

- Comparing rates for construction and principal costs.
- Establishing benchmarks against similar projects to provide comparative construction costs.
- Evaluating the project scope, methodologies, schedule, and any activities that are dependent on other factors.
- Appraising risk-related quantification inputs like inherent and contingent risk probabilities, distribution types, value ranges, and correlations.
- Verifying the inclusion and accuracy of appropriate escalation factors and projected final project costs.
- Clarifying and refining costs as well as reinforcing major assumptions for greater transparency regarding project expenses.
- Ensuring the estimate is compliant with the department's estimating policies and standards.
- Confirming that the estimate accurately reflects the project's construction methodology, staging, constraints, and scheduling requirements, and
- Evaluating changes in project scope relative to previous stages and verifying that these have been duly accounted for.

The concurrence review documentation must be presented on the Project Estimate Review Report format (Annexure J) with supporting checklists Annexure B and Annexure I of PCEM.

This review is essential for all projects where the estimated cost exceeds $25M, irrespective of whether they are funded by state or Australian government funds. Additionally, it applies to any projects deemed to be of high risk or possessing significant complexity.

Any issues or deviations identified during the concurrence review must be recorded in the estimate review report. These findings necessitate corrective measures to be taken by the project manager.

4.1.13.3 Documents requirement for estimate review

To facilitate a comprehensive cost estimate review, the following documentation must be provided:

- A detailed explanation of the project scope and the business case associated with it.
- Cost Estimate Report.
- An outline of the construction program accompanied by key project dates.

- The construction schedule, presented in a spreadsheet format for easy review and analysis.
- Civil Drawings.
- Project summary and construction cost summary.
- Copy of Expert Estimation file of the project construction cost estimate.
- A copy of the risk register, also in a spreadsheet format, which substantiates the contingency amount included in the cost estimate, particularly important where a probabilistic cost estimation approach has been employed. This register serves as the foundational data for cost estimation tool risk inputs.
- Output report files from the cost estimation tool, which should include visual charts depicting the probability distribution of project costs and the corresponding cumulative probability distribution (S curve). Additionally, the reports should encapsulate simulation summary details such as sampling type, number of iterations, random number generator settings, a tornado diagram, regression and rank information table, and summary statistics for the project costs. These statistics must reflect the range in cost estimations at varying confidence intervals, specifically from 5% up to 95% confidence levels, without escalation.
- Input data files for the cost estimation tool, formatted in a spreadsheet that retains all relevant data to allow the estimate reviewer to replicate the probabilistic cost estimation simulation if needed.
- A comprehensive bibliography listing of documents referenced during the cost estimation process, including specific details such as version number / date, the correct title, format, and authorship, and
- The properly completed Project Cost Estimating Control Checklist which can be found in Annexure I of PCEM.

The provision of these items ensures that the cost estimate review is performed with the most accurate and detailed information, facilitating a trustworthy and reliable estimation validation process.

4.1.13.4 Program review

The program review serves as a strategic evaluation of all projects within a given program. Its key objective is to comprehensively review project costs at this aggregated level, which then enables informed decision making regarding the prioritisation of projects. This is based on the availability of data, including project information and estimates that are on hand.

Should it be determined that there is inadequate funding to facilitate all planned projects within the program, it becomes necessary to make critical decisions regarding project

timelines and execution. In such scenarios, certain projects may be either postponed or removed from the program. To facilitate this, a review process is undertaken whereby the scope of each project is scrutinised and cost estimates are adjusted accordingly. These adjustments allow for a reassessment of each project's feasibleness within the context of the available budget and overall program objectives.

Such program-level reviews are vital; they ensure that each project is continually aligned with financial realities and programmatic goals, thus maintaining fiscal responsibility and strategic coherence across the program's lifecycle.

4.1.14 Estimate approvals

The approval of cost estimates is a critical step before their submission for the purpose of making investment decisions. This validation process ensures that the QTRIP has sufficient capital funding to deliver the listed projects effectively. Additionally, it guarantees that the cost estimates prepared at various investment gating points are in strict adherence to the procedures defined in this document.

For the approval process, the following documents must be submitted:

- Annexure L – Project Cost Estimate Summary: This document provides a summarised view of the cost estimate, concisely capturing the essential elements of the projected costs of the project, and
- Annexure I – Project Cost Estimating Control Checklist Form F4906: This form is a comprehensive checklist that ensures all critical aspects and controls of the cost estimating process have been addressed and duly considered.

The cost estimates developed within the 3PCM solution are subjected to the electronic approval process which applies at every estimate stage. Once the cost estimates are developed, they undergo this approval process and, upon approval within the 3PCM system, it becomes possible to link the approved estimates to generate tender prototype documents.

The requirement for obtaining approval for cost estimates is consistent across each stage of a project's development, which ensures ongoing rigor and oversight.

Specific roles responsible for the approval at various stages of the project are delineated in Table 4.1.14, reflecting a structured hierarchy and division of responsibilities within the approval framework.

Table 4.1.14 – Approval responsibility for cost estimates

Estimate certification	Responsibility
Prepare estimate	Estimator
Review estimate	Peer or independent reviewer
Endorse estimate	Project manager
Approve estimate	Project customer / regional / district directors

Projects that receive Australian Government funding and are listed in the Federation Funding Agreement Schedule (FFA) must navigate through a series of approvals that are contingent on the project's level of complexity, sensitivity, or its national significance. These projects are subject to thorough evaluations by state-level financial or infrastructure advisory bodies which operate according to the established Queensland gateway processes.

The gateway and assurance review processes encompass a collection of assessments performed by independent experts at pivotal moments throughout the project's lifecycle. The aim of these reviews is to carefully evaluate how the project is progressing and to estimate the probability of achieving the anticipated project or program outcomes successfully.

It is important to note that while the Australian Government's proclamation of national funding for a specific project and its addition to the FFA Schedules signifies a commitment to the project's results, it does not constitute an absolute guarantee of funding.

Further details on 2-pass funding approach refer to Section 2.6.13 of this document, or the federal *Notes on Administration for Land Transport Infrastructure Projects* covering the period from 2024 to 2029.

Estimating responsibilities

The development of a cost estimate for a project is a collaborative process that demands inputs from various experts. Each contributor's knowledge, expertise, and perspective are crucial for ensuring the accuracy and comprehensiveness of the final cost estimate.

4.1.15 Estimate development responsibilities

In the cost estimating process, the project manager plays a central role with several responsibilities to ensure that the estimate is accurate and complies with all relevant regulations and expectations. The specific duties of a project manager in this context are as follows:

- Scope establishment: Defining the project scope in accordance with approved documentation, such as road link plans, project proposals, federal project proposal reports, business cases, and aligns these with the expectations of both customers and stakeholders.
- Information provision: Delivering all the necessary details required for the estimation process, including work methods, drawings, studies, and modelling works, including escalation factors.
- Risk workshop panels: Setting up specialised panels that consist of members with the appropriate knowledge and background to conduct risk assessment workshops.
- Process compliance: Ensuring that the estimating process follows the guidelines of this document and that cost estimates are appropriately captured in the 3PCM system.
- Facilitation of estimating process: Facilitating communication and supporting collaboration between the customers, stakeholders, and the estimator to ensure that the estimating process goes smoothly.
- Prepare the risk register leveraging from the risk context profile in participation with all stakeholders, update, monitor and establish residual risks for contingency.
- Capturing cost estimates in the 3PCM solution. If the estimate is prepared by an external service provider.
- Cost elements separation: Establishing appropriate CapEx / OpEx separation of cost elements.

The estimator has critical responsibilities in the cost estimating process that contribute to the development of a reliable and comprehensive project estimate. The responsibilities of the estimator are outlined as follows:

- Estimate development: Developing the cost estimate in accordance with the processes and requirements specified in this document and other established guideline in the department.
- Seeking clarification: If there are any ambiguous elements in the information provided or in the project scope, the estimator must consult with the project manager to gain clarity and ensure the estimate is based on an accurate understanding of the project specifications.

- Communication of discrepancies: The estimator is responsible for promptly notifying the project manager about any discrepancies, errors, or changes in risk assumptions that become apparent during the estimation process. This is important to address potential issues early and adjust the estimate accordingly, and
- Documentation in 3PCM: The estimator must capture all cost estimates accurately within the 3PCM solution, which is the designated system for managing projects and programs. If an external service provider is tasked with preparing the estimate, the responsibility of ensuring the estimate is captured in the 3PCM system falls on the project manager.

The estimator plays a pivotal role, ensuring that the cost estimates are meticulously developed, verified, and documented, facilitating a reliable basis for subsequent project planning, budgeting, and decision-making processes.

4.1.16 Estimate review responsibilities

In the cost estimating process, the estimator has specific responsibilities related to the review of their work. These responsibilities are critical for ensuring the credibility and accuracy of the cost estimate prior to peer review or approval. The estimator is tasked with:

- Conducting reality checks: Before the estimate is submitted for peer review or approval, the estimator must perform reality checks to identify any obvious errors or inconsistencies within the estimate.
- Ensuring documentation completeness: The estimator needs to check that all relevant documentation that supports the estimate is complete and accompanies the estimate upon submission.
- Validating risk evaluation: The risk evaluation and modelling approach used in the estimate must be verified to ensure it is suitable for the type of project being estimated. This includes assessing whether the risk evaluation aligns with the project's complexities and uncertainties, and
- Facilitating reviews: The estimator assists the project manager in organising the peer and concurrence reviews of the cost estimate. After these reviews, the estimator is responsible for updating the estimate to incorporate the findings and recommendations from these reviews.

These review responsibilities enable the estimator to refine the estimate, assuring that it represents a thorough and well-vetted appraisal of the potential project costs before proceeding to the decision-making stages.

The project manager's responsibilities in the estimate review process are significant to uphold accuracy and maintain project integrity which include:

- Benchmark comparisons: The project manager is responsible for comparing the project estimate against benchmark data or similar projects to ensure that the numbers are realistic and competitive.
- Review process oversight: Ensuring that the estimate goes through the proper review processes, such as peer and concurrence reviews. This also involves appointing qualified and experienced individuals to conduct these estimate reviews.
- Compliance with manual requirements: The project manager must verify that the appropriate reviews are completed in accordance with the specific requirements outlined in the document.
- Integration of review feedback: Following the reviews, the project manager must ensure that any recommendations and observations from the peer / concurrence review are reflected in both the estimate and the accompanying report, and
- Approval endorsement: Once the estimate review process is complete, the project manager should seek further endorsement as per project protocols and captured it within the 3PCM system.

The project manager acts as a gatekeeper, verifying that every facet of the cost estimate is scrutinised, assessed according to industry standards, and improved upon the feedback before seeking final endorsement.

The program manager's responsibilities in the context of estimate reviews are focused on addressing broader changes and ensuring that high-value projects receive the necessary level of scrutiny and validation.

Specifically, the program manager is tasked with:

- Communicating significant changes: It is the responsibility of the program manager to advise the project manager or estimator of any significant changes in the program that are likely to affect the project estimate. These changes could stem from alterations in strategy, scope, scale, or resource availability within the broader program and could have material implications for individual projects, and
- Endorsement for high-value projects: The program manager must arrange additional endorsements for large-scale projects (such as projects with a budget exceeding $25M) due to the substantial financial implications and risk associated with such projects. Extra scrutiny ensures that estimates for such high-value initiatives are as accurate and dependable as possible.

Overall, the program manager's role in the estimate review process helps to ensure that project estimates remain aligned with program objectives, are responsive to any changes

in the program environment, and are subject to further validation, especially when there is significant capital at stake.

The project customer or regional / district director holds critical oversight responsibilities in the cost estimating process, ensuring adherence to established procedures and the final approval of the estimate. Their specific duties include:

- Process adherence: The regional / district director must ensure that the estimation process has been conducted in full compliance with the procedures outlined in this document. This includes verifying that the proper methods, techniques, and standards have been applied during the estimation.
- Document completion and attachment: It is their responsibility to confirm that all necessary supporting documents are completed and attached to the estimate before the approval process for traceability and accountability, and
- Estimate approval and capture in 3PCM system: The regional / district director is responsible for formal approval of the cost estimate and capturing the approved estimate in the 3PCM system for tracking, and project learning purposes.

By fulfilling these responsibilities, the project customer or regional / district director plays a key role in maintaining the integrity of the cost estimating process, from adherence to procedures through documentation to the final approval within the department's 3PCM system.

4.2 Optimism bias

Optimism bias can significantly skew the cost estimating process, presenting a rosier financial picture than may be the case and potentially leading to inaccurate projections. To curb the detrimental impacts of optimism bias on project cost, schedule, and expected benefits, the following control measures are advised:

- Benchmarking: Compare cost estimates against a known contingency range appropriate for each phase of the project. This benchmark should be informed by both the estimator's own experience and a wider understanding of industry trends and historical data.
- Assumption verification: Regularly validate the assumptions upon which the cost estimate is based by engaging in risk workshops and other relevant review meetings that interrogate these assumptions and ensure they are reasonable, and evidence based.
- Frequent short risk reviews: Instead of singular, extensive risk workshops, conduct multiple abbreviated risk reviews that involve a diverse group of experienced professionals. This approach encourages more frequent reassessment of risks and allows for collective input from various perspectives, and

- Adopting industry-wide cost ranges: Utilise established cost ranges for key project elements that are recognized across the industry. This helps to ground the estimate within a broader context and ensures that it remains within typical thresholds.

By implementing these strategies, the estimating team can effectively manage the propensity for optimism bias, bringing about more realistic and reliable project cost estimates, which are crucial for project planning and decision-making.

5 Estimate development by phase

This section details how to apply estimating processes by the OnQ project management project phases.

The OnQ framework recognized that the depth and reliability of a cost estimate depend heavily on the project's phase and the associated degree of knowledge and detail available. The understanding of a project—coupled with its design and other vital documentation—tends to grow over time as the project progresses through its life cycle. Consequently, as this level of detail and depth of knowledge increase, improvements in the quality and accuracy of the cost estimate should naturally follow.

Table 5 below is designed to capture and define the levels of supporting detail necessary for creating cost estimates at various stages of the project. This guidance ensures that estimates are based on a structured and phased approach.

Table 5 – Level of supporting information requirement for developing cost estimates by phase

Estimate Content	Strategic Planning	Project Phase		
		Concept Phase	Development Phase	Implementation Phase
Estimating approach	Global estimate, composite rates, historical rates	First principles, and unit rates	First principles, and unit rates	First principles, and unit rates
WBS levels used	WBS 2 supported by level 3 items	WBS 1, 2, 3 with some Level 4 rate build up	WBS 1, 2, 3 & 4 used throughout	WBS 1, 2, 3 & 4 used throughout

Throughout the life cycle of a project, it is essential to keep stage estimates current and reflective of the latest information and project development.

The stage estimates need to be updated and presented on Annexure J – Estimate Report Format.

5.1 Factors influencing cost estimates

When developing cost estimates for projects, it is crucial to consider a broad spectrum of factors that can influence the estimate's accuracy and reliability.

These major factors influencing road projects include:

- Project scope definition: The clear definition and understanding of the full scope of the project, including the extent of the work that needs to be accomplished.
- Project constraints: These may include the level of design information available, outcomes from related planning, modelling, and investigative work (such as geological or pavement studies), and other unforeseen issues.

- Constructability: An assessment of the ease or complexity of constructing the project, based on design, project specifications, and site conditions.
- Construction program: The detailed plan that outlines the timeline, sequence, and duration of construction activities.
- Environmental and Heritage Issues: Factors pertaining to the environmental impacts including the management of PFAS (per- and polyfluoroalkyl substances) and heritage considerations.
- Traffic management issues: The challenges and strategies related to maintaining traffic flow and ensuring the safety of road users during construction.
- Location issues: Site-specific challenges such as ground conditions, proximity to residential areas, accessibility, and environmental sensitivity.
- Contract delivery method: The method of construction and contract services.
- Sustainability and climate change issues: Incorporating costs related to sustainability practices and the impact of climate change, including incorporating Climate Resilience as per EP170 *Climate Change and Natural Hazards Risk Assessment*.
- Key operational policies: Policies that may affect operational aspects of the road project, including maintenance and service delivery, and
- Public Utility Plant (PUP) – works related to public utilities that may be affected by the project, such as relocation or protection of existing utility infrastructure.

Factors affecting rail cost estimates

Rail projects come with distinct risk factors that can influence cost estimates, often rendering them more complex than those for roads. Cost estimation for rail infrastructure must consider the following unique factors:

- Proprietary manufactured items: The specialised, proprietary components like turnouts, signalling, communications, power equipment, rolling stock, track, and sleepers used in rail projects can significantly increase project costs.
- Work planning around possessions: Rail construction activities must be scheduled around possessions, which are pre-determined periods when normal train operations are suspended to allow site access for construction. This impacts the planning and cost estimating process.
- Cost implications of safety and operational constraints: Estimations need to account for the constraints and requirements of the operating railway and safety protocols which can add to costs.
- Non-standard working hours: Rail projects often necessitate work during nighttime or weekends when train operations are less frequent. The higher labour costs associated with these shifts need to be factored into the estimated costs.
- Specialist knowledge for system costs: Estimating costs for complex rail systems like signalling and communications is not straightforward and requires input from specialists, as well as consideration for the interim stages and commissioning of these systems, and

- Challenges of narrow sites (rail reserves): Rail reserves often present limited physical access and strict safety requirements, which can extend the duration of the project. This can lead to increased indirect costs associated with site management and worker accommodation.

Due to the intricate nature of work and the detailed planning requirement, additional care and specialist knowledge are required when developing cost estimates for rail projects compared to road construction.

5.1.1 Project scope for roads

Well defined project scope is one of the key factors affecting the accuracy of any cost estimate. This scope articulates the entirety of work to be carried out and the stages involved in the project. An articulate project scope is crucial because it:

- allows for a precise and thorough cost estimation process with reduced reliance on assumptions
- facilitates effective monitoring and control of project costs, especially when there are scope changes, and
- helps to ensure that initial estimates are closely aligned with the actual costs.

If a functional and physical description of the project is not clearly defined, monitoring and controlling costs arising from scope changes can be difficult during the subsequent project phases.

To create an accurate cost estimate for a road project, estimators must account for the full range of activities across the project's life cycle as shown in Table 5.1.1 below.

Table 5.1.1 – Cost estimating activities

Inputs	Activities	Outputs
Plans and specifications Work breakdown structure Schedule of rates Program of work Risk register Project cost records Benchmarks	Estimate planning Site visits Risk assessment Contingency assignment Escalation Estimating review	Total project cost estimate in current dollars and outturn dollars. Supporting details Assumptions Cost management plan (cost make-up) Archived records

5.1.1.1 Scope definition, objectives and performance requirements

All projects should have well defined objectives which should be carefully considered during the project scoping stages to achieve the desired balance between the level of services to be provided, and the cost.

Developing a good project definition and context is essential to set out key parameters and constraints under which the project is to be delivered. These parameters can affect

the direct costs, indirect costs, and the contractor's risk and margin allowances of the cost estimate.

For example, some projects may require temporary work and staging which could attract significant cost.

In addition to the scope definition, project performance requirements (or the functional requirements) are also a key part in the project scoping document. The key performance requirements include vehicle carrying capacity, train path capacity, functionality of an intersection on a highway or rail track, pavement or track life, axle load capacity and operations requirements for structures, tracks, pavements etc.

Examples of key scope definitions and measurable performance criteria to be considered in projects are:

- construction program (both pre-construction and construction phases)
- requirements for temporary works
- type of project (OnQ project types) to establish the level of rigour, risk, and complexity
- project constraints (on access / possessions, staging, continuity of traffic flow, etc)
- key interfaces and conditions applying at such interfaces, and
- delivery method (construct only, design and construct, alliance and so on).

Not specifying measurable performance criteria in the early project stages may result in unreliable cost estimates. Often additional scope items are included in the project scope that were not originally contemplated or budgeted for resulting in cost overrun.

5.1.1.2 Physical scope criteria

When preparing a reliable cost estimate for a construction project after developing a scoping definition, performance criteria, functionality requirements, and understanding the project context, it is crucial to define the physical scope of works. Following are some key physical scope criteria to consider:

- Nature of work: Type of project activities, such as construction of new roads, expansion, or duplication of existing roads, building or refurbishment of bridges and culverts, and updates to traffic signals.
- Extent and limits of work: Clear delineation of the project area, including work boundaries, to minimise uncertainty about the extent of work that needs to be included in the cost estimation.
- Design assumptions: Understanding of key design features such as the pavement design, earthwork volumes, and the expected presence and extent of rock or hard materials etc.

- Interfaces with other elements: Identification of how the project connect with existing properties, infrastructure like roads and rail, or elements like grade separations.
- Public Utility Plant (PUP): Relocating or protecting existing utility infrastructure such as water, sewer, gas, electric lines, and telecommunication cables are often extremely expensive, and
- Defined out-of-scope work: Identifying any work that are considered outside the project scope helps prevent inadvertent inclusion in the cost estimate and assists with controlling project boundaries.

These criteria guide the estimator in understanding the full scale of the project, leading to more accurate cost predictions and aiding in the efficient allocation of resources.

5.1.1.3 Additional project scope requirements for rail

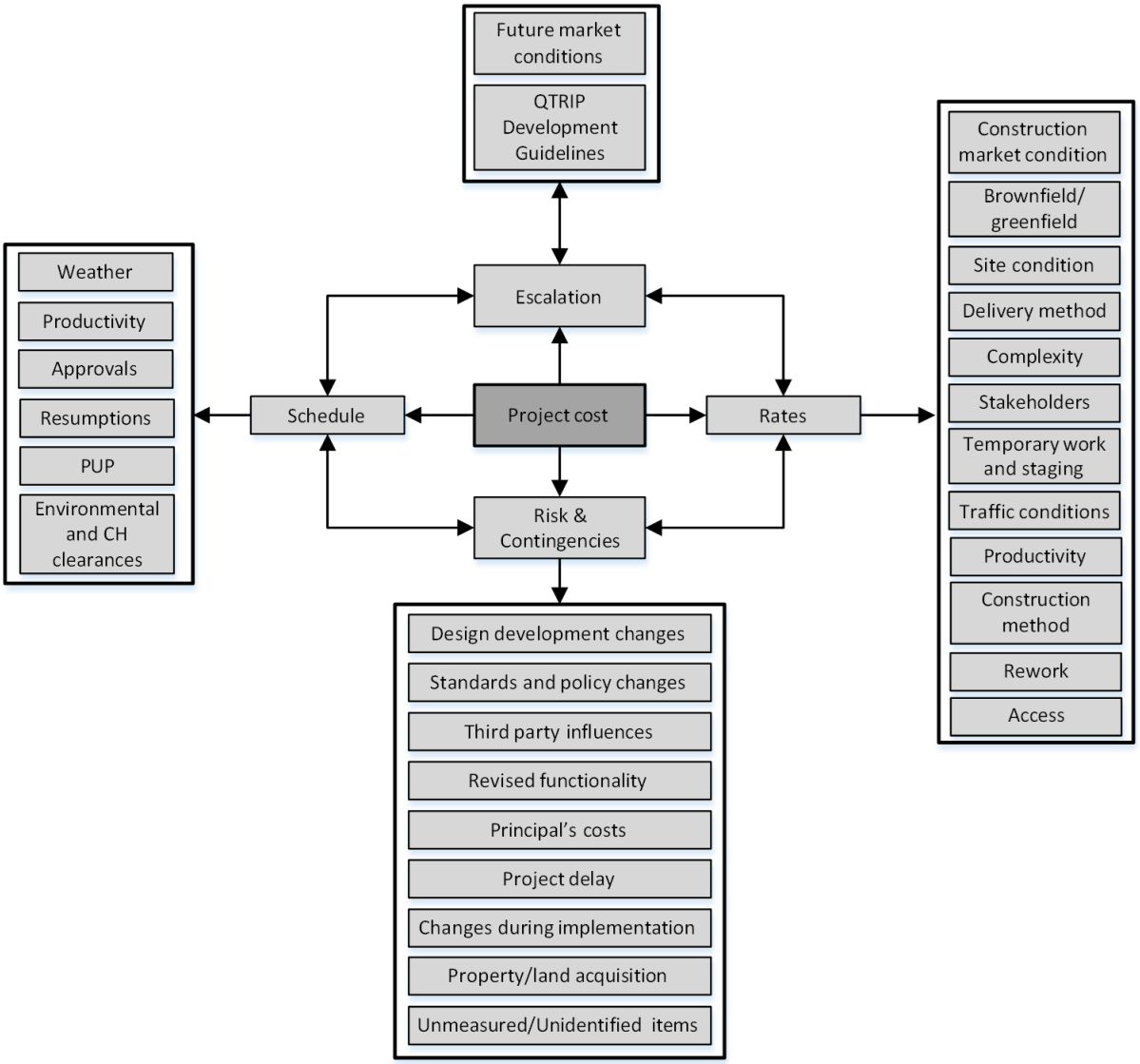
When scoping rail projects, whether they are new developments (greenfield projects), major upgrades, duplications, or expansions of existing rail infrastructure, the process is particularly intricate due to the multifaceted nature of rail systems. This complexity arises from numerous specialised activities that need to be precisely defined to ensure an accurate cost estimate. Some of these additional activities include:

- Track work: This entails the geometry, formation, and alignment of the tracks with the consideration of level crossings and other intersection points with existing infrastructure.
- Power supply and distribution: The project may involve the installation and maintenance of overhead power lines, associated structures, and wiring to ensure reliable power delivery for the operation.
- Signalling and communications: Vital for the safety and efficient operation of rail systems which include the placement of gantries, signalling equipment, communication networks, and cable systems.
- Stations and buildings: The infrastructure surrounding railway stations, ticketing facilities, waiting areas, and interchanges with other forms of transport, all need scrupulous planning, and
- Rolling stock: Types of trains and carriages with varying requirements for station access points, platform clearances, and setbacks, which must be factored into the design and accessibility.

For a comprehensive understanding of how these elements affect the development of the project scope and, subsequently, cost estimates, it is recommended to refer to the Section 4.1.1 of this document.

Also refer to Figure 5.1.1 for all other factors influencing cost estimates.

Figure 5.1.1 – Factors influencing an estimate



5.1.2 Project constraints

Project constraints are factors (physical, environmental, regulatory or visual) that may limit or influence the project delivery approach and the project outcome. For accurate cost estimation, these limitations must be recognised early and adequately accounted for. Most common project constraints affecting cost estimating process include:

- Property acquisition issues: Costs associated with the purchase or compulsory acquisition of land required for the project can be significant and complex to predict.
- Noise barriers and air treatment: To comply with environmental standards, the project may need to include noise reduction measures or air-treatment facilities, which incur additional expenses.
- Stormwater treatment: Environmental regulations may require treatment of stormwater runoff before it can be discharged into local waterways, adding another layer to project costs.

- Access difficulties: Construction in heavy traffic areas necessitates strategies for managing vehicle access and maintaining passage for pedestrians and access to properties, potentially escalating costs.
- Environmental and cultural heritage: Protecting sensitive ecological habitats or cultural heritage sites often involves additional planning, mitigation measures, and potential costs. Managing these risks is part of project scope.
- Work limitations: Restrictions on working hours to minimise disturbance or using certain types of equipment can necessitate more prolonged project timelines or alternative methods, increasing costs.
- Occupational health and safety requirements: Ensuring workers' health and safety, and adherence to health new regulations for Covid-19, can require additional resources and impact costs.
- Rail possessions uncertainty: Gaining access to rail property ("possessions") for construction purposes can be unpredictable, often requiring flexibility in scheduling and budgeting, and
- Public Utility Plant (PUP) related work: Cost estimating for PUP related work is notably challenging. Utilities often have incomplete or outdated records, leading to unexpected adjustments, relocations, or replacements of services. An allowance must be factored into cost estimates locating these utilities and the subsequent relocation.

Moreover, the enforcement of environmental controls can necessitate to deploy less efficient construction methods. For instance, if vibration-causing equipment like rollers cannot be used in sensitive areas, cost estimators must consider and incorporate the price of alternative methods into the overall estimate.

Additionally, specific equipment may be restricted in certain environments, such as marine ecosystems or active rail corridors, further impacting method selection and associated costs.

A thorough and flexible approach to cost estimating is required to manage these myriad constraints effectively, which must be balanced against the need to comply with all regulatory, environmental, and social obligations.

5.1.3 Constructability issues

Constructability assessment integrates the construction knowledge and the experience early into the project planning, design, procurement, and field operations to optimise the project's execution and meet its objectives. Constructability assessment is a process of identifying obstacles before the project commencement to reduce or prevent errors, delays, and cost overruns. Within the constructability assessment framework, there are several issues may arise and impact the cost estimates, which are:

- Access for heavy machinery: Accessibility issues of large machines / bridge components (beams) to a bridge construction site.

- Access requirements: for temporary retaining walls or sidetracks can be additional cost.
- Urban environmental control costs: for suppressing noise and dust in urban or residential areas to meet environmental and health regulations.
- Statutory requirements: compliance with additional statutory rules such as speed limits during construction or the allowance for night works can also inflate the project's expenses, and
- Environmental constraints: environmental considerations such as creating passages for koalas, adhering to water-sensitive urban design requirements, or compensating for environmental offsets.

Research and studies are often used to determine the feasibility and efficiency of alternative production methods such as reviewing earthworks mass haul diagrams to analyse haulage details or determining the most efficient construction fleet. For projects in high-traffic areas, the development of traffic management and construction staging plans are essential to estimate the impact of these activities on both cost and schedule.

There is a fundamental link between the effort invested in preparing an estimate and the expected accuracy of that estimate. Estimators must balance the resources allocated for estimating with the precision required for the project's stage and complexity.

Constructability reviews are a mandatory requirement for all design engagements. The constructability assessment is a mandatory requirement for projects seeking Australian Government funding over $250M.

5.1.4 Construction program

Preparing a construction program in advance of the cost estimating process is essential for establishing a well-organized, detailed, and executable project plan. It provides the estimator with a structured framework based on several critical elements:

- Work Breakdown Structure (WBS): The WBS breaks down the project into smaller, distinct components or tasks, offering clarity on the scope from which a more accurate estimate can be derived.
- Intended delivery method: Determining whether the project will be delivered as construction only or design and construction etc.
- Project scope: A clearly defined project scope ensures that all necessary work, from inception to completion, is included in the estimate.
- Key construction tasks: An outline of tasks that must be completed or arranged in the order in which they must be completed (sequencing), is fundamental to establish an accurate estimate.
- Task relationships: Understanding how tasks are related to and affect one another (i.e., dependencies), and
- Resource requirements: Ascertain the labour, equipment, materials, and other resources needed for the project, tied to individual tasks within the WBS.

The extent of detail in the estimate aligns with the level of specificity provided by the scoping, staging, and construction program documentation. A collaborative approach between the project manager and the estimator is key to determine the construction program's components like activity durations, constructability reviews, production rates, etc.

Certain activities in the project may take longer duration to complete so they must be placed in the critical path in the construction program. For example, environmental approval conditions may limit construction to outside the breeding season for migratory birds if works are near a wetland area. Therefore, approval must be sought early to ensure such information is available for the estimating process.

5.1.5 Environmental issues

Transport and Main Roads *Environmental Process Manual* sets out the process for assessing and managing the environmental impacts of all department's infrastructure projects and is the key document within the Transport and Main Roads Environmental Management System (internal system). The Environmental Team within your area (District, Region, MSQ, Rail or Translink) can assist with any questions on these processes or copies of these templates (ENV documents) or guidance notes (GN documents). The PMD Environment Team can also be contacted on environment@tmr.qld.gov.au.

The environmental process requires that all projects have a desktop assessment, and this is recorded in ENV02 Rapid Desktop Checklist and ENV03 Preliminary Environmental Assessment. Depending on the outcome of the desktop assessment some projects will also require a detailed assessment which is recorded in ENV04 Review of Environmental Factors and ENV05 Environmental Management Plan (Planning). Guidance Notes explaining how each of these templates are to be completed are provided on the Transport and Main Roads Environmental Management System.

Estimates of future costs to manage environmental constraints are identified in both the desktop assessment (ENV03) and the detailed assessment (ENV05).

The following key environmental constraints can have significant impacts on project timeframes and costs:

- Impacts to Matters of National Environmental Significance (MNES) under the *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999, and*
- PFAS (Per and Polyfluoroalkyl Substances).

Where these constraints are identified in the desktop assessment, a targeted assessment on these matters will be required and a detailed environmental assessment should be completed prior to completion of the Business Case to ensure reasonably accurate estimates of future costs can be included. The Environmental Team within each District / Region, MSQ, Rail or Translink can provide more information on what costs

should be included in the desktop assessment and detailed assessment estimates for both matters.

It is important to start the desktop assessment on these key matters in the first stage of Concept Phase to ensure:

- time impacts are accounted for in project schedules
- costs are included to undertake detailed assessments during Business Case development if required, and
- project costs in the Business Case adequately cover costs to deliver all management requirements.

5.1.5.1 Waste levy

In Queensland, the implementation of the waste levy serves as an economic incentive to reduce waste generation and increase recycling and recovery efforts. The key points related to the waste levy and the management measures are:

A waste levy applies to most of the waste disposed of in landfills, affecting general waste streams such as municipal solid waste, commercial and industrial waste, and construction and demolition waste.

The levy is applicable to waste generated within a waste levy zone or sent to a landfill within a waste levy zone, irrespective of where it was produced.

Certain types of waste are exempt from the levy. For further information on exemptions, see the Transport and Main Roads Environmental Management System. For more information on levy rates, refer to https://www.qld.gov.au/environment/circular-economy-waste-reduction/disposal-levy/about/levy-rates.

The Environmental Team within each District / Region, MSQ, Rail or Translink can assist with any further information on waste types not attracting levies.

5.1.6 Cultural heritage issues

Transport and Main Roads *Cultural Heritage Processes Manual* sets out the process for assessing and managing the potential cultural heritage impacts of all department's infrastructure projects and is the key document within the Transport and Main Roads Cultural Heritage Management System (internal system). The Cultural Heritage Team within your area (District / Region, MSQ, Rail or Translink) can assist with any questions on these processes or copies of these templates (CH documents) or guidance notes (GN documents). The PMD Cultural Heritage Team can also be contacted at tmr.heritage@tmr.qld.gov.au.

It is important to note that low value projects may still have significant cultural heritage risks, and it is important for the estimating team to engage with the District Cultural Heritage Officers early so that that early engagement with the Traditional Owners can be completed to help inform the estimate costing.

The cultural heritage process requires that all projects have a desktop assessment in the concept phase, and this is recorded in Cultural Heritage Risk Assessment (CHRA). Depending on the outcome of the desktop assessment some projects will also require further site investigations and survey with the Aboriginal Party and recorded in a Cultural Heritage Agreement (CHFA, CHMA, CHMP).

The following key cultural heritage constraints can have significant impacts on project timeframes and costs:

- Impacts to Aboriginal and Torres Strait Islander cultural heritage protected under the *Aboriginal Cultural Heritage Act 2003*, *Torres Strait Islander Cultural Heritage Act 2003* and *Aboriginal and Torres Strait Islander Heritage Protection Act 1984*, and
- Impacts to State, National and World heritage-listed places protected under the *Queensland Heritage Act 1992* and *Environment Protection and Biodiversity Conservation Act 1999.*

Where these constraints are identified in the desktop assessment, further assessment, consultation and agreements will be required prior to completion of the Business Case to ensure reasonably accurate estimates of future costs can be included. The Cultural Heritage Team within each District / Region, MSQ, Rail or Translink can provide more information on what costs should be included in the estimates for desktop assessments, surveys and agreements.

It is important to start the desktop assessment on these key matters in the first stage of Concept Phase to ensure:

- time impacts are accounted for in project schedules
- costs are included to undertake detailed assessments, surveys and agreements during Business Case development if required, and
- project costs in the Business Case adequately cover costs to deliver all management requirements.

5.1.7 Traffic management issues

Estimating the costs associated with traffic management is a crucial step in the planning of road or rail infrastructure projects because the costs can be quite significant.

The *Queensland Guide to Traffic Management* (QGTM), issued under the authority of Section 166 of the *Transport Operations (Road Use Management) Act 1995* (Qld) provides guidance on traffic management.

The department has adopted Austroads *Guide to Traffic Management* (AGTM) as part of national harmonization, which enabled the QGTM to provide requirements specific to QTRIP projects.

Some of the common traffic issues to be considered during the project cost estimating process include:

- Develop a traffic management plan (TMP): A TMP will include all necessary measures to ensure safe and efficient movement of traffic around the construction site. It should detail the methods by which traffic will be managed, any associated costs, and how it adheres to the relevant guidelines.
- Analyse modifications and diversions: Examine any alterations or rerouting of existing traffic patterns which may occur in stages, requiring multiple plans or adjustments, and induce varying operational costs at different project phases.
- Construction access: Determine the requirements for site access by construction vehicles, including the potential need for temporary roads or modifications to existing routes.
- Working days and hours: There can be time restrictions which can affect project timelines and may result in increased traffic management costs due to extended project duration.
- Construction truck routes: Identify allowable routes that construction trucks can use within urban areas, and assess any costs related to upgrades or maintenance of these routes, and
- Upgrading existing facilities: Determine if part of the project entails upgrading existing facilities and what traffic management is needed to accommodate this.

The nature of the traffic issues and traffic management approach is project-specific and the cost for traffic management differs from project to project. The historical traffic management costs from other projects should not be directly applied to any cost estimate without rigorous review and appropriate adjustment.

5.1.8 Location issues

In infrastructure project cost estimating process, the complexity and uniqueness of each site demand a thorough analysis of many influencing factors, particularly for those associated with location and preliminary works. An understanding of these factors and how they impact productivity rates and unit costs is essential for developing an accurate budget. Below are some location issues that may affect cost estimates:

- Geotechnical factors and ground conditions such as soil composition, rock features, floodplains, topography, and tidal flows have significant implications on the construction methods. Geotechnical surveys and reports provide data critical to estimating costs tied to excavation, shoring, foundation work, and potential remediation measures.
- Site accessibility affects the movement of materials, equipment, and personnel. Restricted access, limited storage or staging areas, and obstacles like high-tension power lines can increase costs due to extended haul distances, smaller load sizes, and additional safety measures.

- Environmental regulations to protect ecosystems, flora, fauna, wetlands, and historical features can impose constraints that may lead to higher project costs. This includes specialised work methods, additional oversight, habitat relocations, and mitigation measures.
- Working near urban and residential areas often leads to restrictions on noise, vibrations, construction times, and usage of local roads, which can reduce work hours, slow down the project, and necessitate community engagement initiatives.
- Frequency of extreme weather events, or general climatic conditions (like prolonged rainy or dry seasons), can interrupt construction activities and stretch project timelines leading to increased costs.
- The distance to quarries, batching plants, and other material sources influences transportation costs. Haul distances might also affect the schedule and carbon footprint of the project.
- In remote or resource-constrained areas, there may be additional costs related to recruiting and housing personnel, setting up supply chains, and transport of unskilled labour. Wage differences due to local conditions or the scarcity of specialised workers may also impact costs.
- Presence of contaminants like PFAS or other hazardous materials impacts handling and disposal, potentially requiring specialised contractors and affecting overall project schedules. Dust control, noise abatement, and restricted work hours due to environmental concerns are additional cost drivers.
- Sites with cultural or historical significance can influence the project scope due to the need for archaeological surveys, monitoring during construction, and protection measures for sensitive areas, and
- Delays or complexities in delivery of manufactured rail items such as turnouts, signalling equipment, or power systems might cause project hold-ups. Also, the need to maintain live rail operations during construction can limit work times and increase safety measures.

An estimator must evaluate the above location-specific factors carefully, using site surveys, stakeholder consultations, and expert analysis, to modify historical cost data appropriately. This involves collaborating with geotechnical engineers, environmental scientists, logistics experts, and other specialised professionals to account for conditions that could affect productivity rates. The estimator's local knowledge, combined with these expert insights, enables them to adjust costs based on site-specific data rather than relying solely on regional averages or historical costs.

5.1.9 Method of contract delivery

The contract delivery method chosen for an infrastructure project heavily influences the total project cost due to variations in risk allocation, transparency, pricing, and the degree of collaboration between the involved parties. It is crucial for estimators to comprehend the nuances of each contract delivery method prior to beginning the estimating process.

The most common contract delivery methods used by the department at the publication of this document are:

- Transport Infrastructure Contract – Construct Only (TIC – CO)
- Transport Infrastructure Contract – Sole Invitation (TIC – SI)
- Transport Infrastructure Contract – Design and Construct (TIC – DC)
- CPA (D&C) – Collaborative Project Agreement for major projects where design options exist
- Early Procurement Construction and Management (EPCM)
- Minor Infrastructure Contract – Construct Only (MIC – CO)
- Minor Infrastructure Contract – Sole Invitation (MIC – SI), and
- Rail related contracts – Rail Collaborative Project Delivery Agreement (CPDA)

5.1.10 Sustainability and climate change

In recognising the importance of sustainability in the development of infrastructure projects, the department integrated comprehensive sustainability assessments into its cost estimation process of projects. The sustainability considerations impact various aspects of infrastructure development, calling for a multifaceted approach as described below:

- Stakeholder engagement: Effective communication with stakeholders is essential in ensuring that sustainability goals are understood and shared by all involved. This contributes to social sustainability by fostering inclusive decision-making and minimising community impacts across the project lifecycle.
- Cultural heritage assessment: Assessments and consultations should be conducted to protect and preserve Indigenous and non-Indigenous heritage, ensuring that the transport system's development does not lead to the loss of historical or cultural sites without due process and stakeholder agreement.
- Environmental assessment: This involves evaluating the project's potential impact on local ecosystems, water quality, air quality, and the overall environment. The aim is to mitigate negative impacts through smart design choices, which can lead to long-term savings and ecological benefits.
- Landscape design assessment: Integrating sustainable landscape design contributes to the ecological and aesthetic value of infrastructure projects, which includes planting native vegetation, reducing maintenance needs, and enhancing biodiversity.
- Road design: Sustainable Road design elements, such as optimising materials use, minimising land disturbance, and enhancing runoff management, are vital. Considering transportation modes that reduce emissions and congestion, like public transit, walking, and cycling is an essential part of the project planning process.

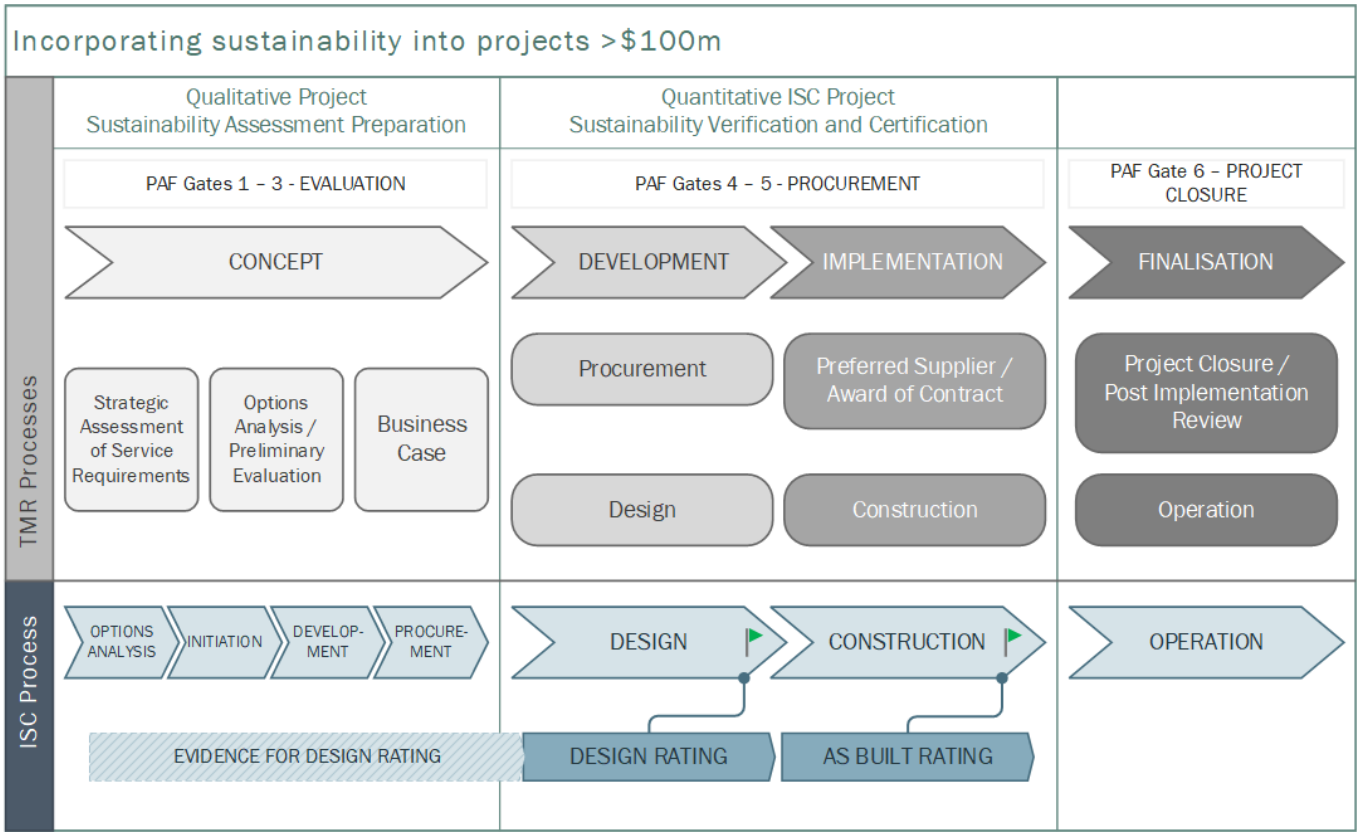
- Hydraulics: Sustainable hydraulics management, including water-sensitive urban design (WSUD), ensures that water resources are managed effectively, reducing flood risk, and preserving water quality, and
- Impacts of Climate Change: completion of EP170 *Climate Change and Natural Hazards Risk Assessment*.

To avoid double counting costs, the above sustainability measures need to be integrated with the overall project costing. They are not extraneous add-ons but are fundamental aspects of the total project cost that can lead to improved performance, reduced maintenance, and longer-term cost savings over the whole asset life.

Departmental projects with estimated total costs over $100M, require incorporating a sustainability assessment, using the Infrastructure Sustainability Council (ISC) Rating Tool. Registration, annual support and verification fees for the Rating are to be factored into cost estimates.

The sustainability assessment undertaken through the ISC Rating Tool involves 2 complementary ratings, for Design and As-built (construction). Evidence for the ratings is captured and collated during the concept / planning phase to be submitted for subsequent verification, as illustrated in Figure 5.1.10.

Figure 5.1.10 – ISC Rating Tool application



When integrating sustainability assessments into projects with Design and Construct (D&C) contracts, a combined rating from the Infrastructure Sustainability Council (ISC) rating scheme is typically pursued. This rating evaluates the project on sustainability criteria, taking into account measures across both design and construction

phases as a unified process. The assessment looks at a myriad of sustainability aspects, from the protection of natural habitats to long-term economic impacts and community benefits.

In contrast, projects that are delivered through separate contracts for design and construction mandate distinct ISC ratings. This separation means that the project's sustainability performance is evaluated at both the design phase, which yields a design rating, and then again upon project completion, which yields an 'as built' rating, considering all elements from both phases.

Further advice on sustainability assessment requirements can be obtained from the Infrastructure Sustainability unit of the department at sustainability@tmr.qld.gov.au.

5.2 Strategic planning / Detailed planning cost estimates

Department's Transport Infrastructure Portfolio Plan and Schedule (TIPPS) serves as a vital instrument for translating broad policy directives, strategic objectives, and long-term planning frameworks into a coherent and financially viable 10-year investment vision for transport infrastructure. It effectively sets the stage for prioritising and making informed decisions on transport infrastructure investments at the national, state, and regional levels.

Developing Strategic Planning cost estimates are intended to guide early-stage prioritisation and decision-making. They are based on an assumed solution to meet the identified need, with the understanding that more detailed project definition and cost refinement will follow.

The information generated at the strategic planning stages should provide sufficient details to determine the priority, the affordability and whether the project should proceed to the next phase. The strategic planning cost estimates do not typically require presentation in P50 and P90 confidence levels, as they are preliminary and are refined as projects advance through the planning and delivery process.

For more information on TIPPS costs and how to generate strategic cost estimates, refer to Section 2.6.10 and Section 3.3.1 of this document.

5.3 Concept phase estimates

The concept phase of a project plays a critical role in transitioning prioritised projects into actionable investments with allocated budgets. It sets the foundation for informed decision-making process by delving deep into the project's objectives and fleshing out the necessary details for a robust business case. The key objectives and cost estimates associated with the concept phase are:

- Understand the problem or opportunity: Clearly define what issue the project intends to address or what opportunity it aims to capture. This understanding guides the scope and direction of the project.

- Articulate functional requirements: Determine the core functional requirements that any proposed solution must meet to solve the identified problem or exploit the opportunity effectively.
- Identify and evaluate options: Cast a wide net to consider all potential solutions, assessing them against the functional requirements and other relevant criteria, to ensure an unbiased evaluation process.
- Select the preferred option: Choose the most appropriate solution based on the evaluation. This selection should balance effectiveness, feasibility, cost, risks, and alignment with strategic objectives, and
- Develop the preferred option: advance the preferred option to a level where its costs and risks can be quantified with sufficient accuracy for inclusion in the forthcoming business case.

Three cost estimates are developed during this stage:

- project proposal estimates
- options analysis estimates, and
- business case estimate.

The estimates prepared at the strategic planning stages are further expanded with the improved scope definition and level and quality of project information available at this stage.

5.3.1 Project proposal estimates / SASR

In the early stages of infrastructure project development, the focus should be on defining and understanding the desired outcomes and objectives, rather than pre-emptively prescribing specific solutions. This allows for the consideration of a broad range of potential options to achieve project objectives and caters for innovative and more cost-effective options.

The project proposal estimates lay the foundation for improved project scope and enable the development of business case. All project proposals need to be supported with an estimate to be included in the unfunded years within the QTRIP (years 3 and 4). The OnQ project management methodology provides templates for developing and presenting project proposal estimate documentation.

For Major Projects this stage is the Strategic Assessment of Service Requirements (SASR), refer to the PAF Strategic Assessment of Service Requirements guidelines for more information.

5.3.2 Options analysis estimates

A key product from the project proposal / SASR project stage is a set of viable project options to meet the desired outcome. Several factors need to be considered during the options analysis stage because each option may pose different physical challenges (for

example tunnel vs open-cut option), environmental challenges or risks, regulatory issues, delivery timing, and costs.

To make an informed decision on the most appropriate option, the key benefits and costs for each option should be identified and valued wherever possible. This allows project options to be compared on the same basis and assists the decision makers in selecting the option that provides the greatest net benefit to the community.

The alternative solutions identified during this stage are carefully analysed and reduced to shortlisted project options with the greatest potential to provide value for money outcomes. The shortlisted project options must be compared in terms of their relative effectiveness and their relative costs to ensure the least cost option will not outweigh the desired benefits.

A critical element to be considered during the options analysis process is the development of robust preliminary cost estimates for all shortlisted options. Each option may require a different delivery approach, risks, resources, and costs.

For PAF projects, this is the Preliminary Evaluation stage. The purpose of this stage for a PAF project is to provide sufficient information to government decision makers such as the Cabinet Budget Review Committee (CBRC) or Infrastructure Australia to make an informed decision as to whether the project is worthy of further investment to develop a business case.

As the costs associated with fully developing a business case can be significant, particularly for large or complex projects, only those projects deemed affordable, and a priority should be progressed to this stage.

For all Major projects and state funded projects with total estimated costs (outturn) exceeding $50M, require cost estimates with P50 and P90 confidence levels and demonstrate the selected option has clearly the most cost-effective solution and provides the greatest net benefit to the community.

The standard process for developing estimates for each option in the options analysis is described in Section 4 of this document. Refer to the PAF Preliminary Evaluation Guidelines for more information on the processes associated with cost estimates for Major projects.

5.3.3 Business case estimates

The development of a business case builds on the work completed at the options analysis stage to select the preferred option and demonstrate that the project is deemed to be a priority and potentially affordable. The business case forms the basis of advice to make an informed decision regarding whether to invest in the proposed project. An approved business case provides justification for a project and allocation of funding and other resources to deliver products to meet a specified business need.

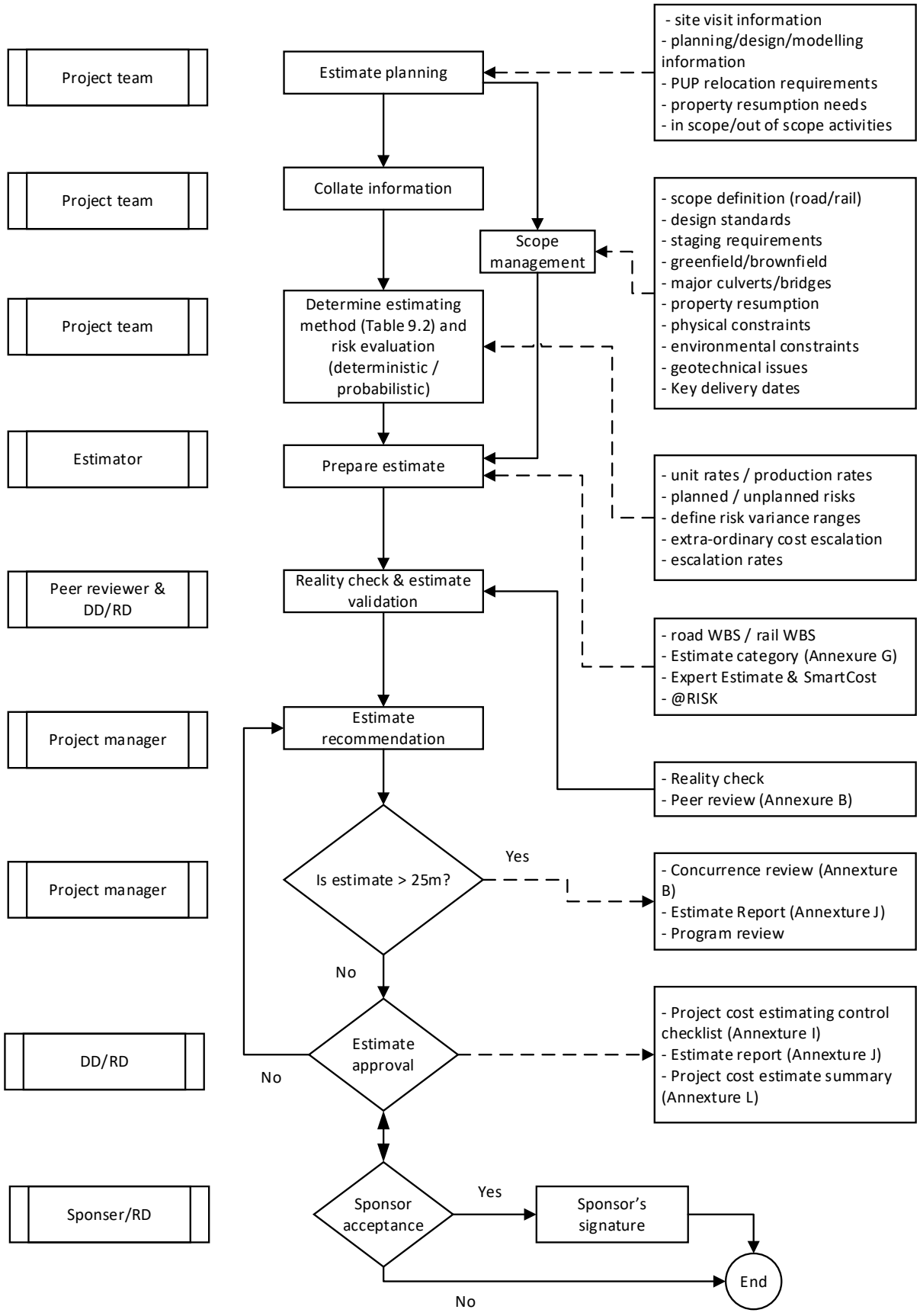
Approved business case is required for all projects to include in the funded years of the QTRIP (that is years 1 and 2) with cost estimates with P50 and P90 confidence levels. Therefore, the business case cost estimate is the most critical cost information to be developed across the entire project life cycle.

The process for developing a business case estimate should consider the following as a minimum:

- Developing cost estimates using a recommended method (as recommended in Table 9.2)
- Risk analysis using a recommended method (as recommended in Section 10)
- Financial and economic analysis (Cost benefit analysis)
- Legislative / whole of government requirements (environmental / planning / cultural / heritage / native title)
- Procurement and delivery strategy, and
- Cost escalation.

From 1 January 2025, Major Project Strategic Assessment of Service Requirements also should include consideration of enabled and upfront embodied carbon emissions using the National Carbon Values (or higher). Refer to the department's Environment Team for more information on cost associated with the consideration of enabled and upfront embodied carbon emissions.

Figure 5.3.3 – Procedure for development of estimates, validation and approval



5.4 Development phase estimates

The development phase is the stage where the project investigates the finer details. In this phase, detailed investigations are undertaken to check the details on site to identify any risks or constraints. It has direct links with the implementation phase, which includes the following activities happening in parallel:

- Project Administration and Management
- Project Plan
- Detailed Design
- Contract Management / Tendering, and
- Project Approvals.

Three cost estimates are developed during this phase, which are:

- Stage 1 Design (S1D) estimate
- Stage 2 Design (S2D) estimate, and
- Estimate for Comparison with Tender (EFCT). The details of each cost estimate are given below.

5.4.1 Development phase Stage 1 design (S1D) estimates

The Stage 1 Design (S1D) cost estimate is an integral part of the project's early planning and design phase, serving as an initial financial evaluation to gauge the project's feasibility against the approved budget. To compile an effective S1D estimate, certain steps must be followed:

Business Case and Option Review: Reassess the project's business case and the selected option to ensure alignment with overall project objectives and strategic fit.

Technical feasibility assessment: Evaluate whether the chosen option is technically viable considering design, technological, and operational factors.

Risk register update and Safety Audit: Update the risk register to reflect current project understanding and conduct a road safety audit informed by thorough site and project investigations.

Access and resumption requirements: Determine and finalize any required land access and acquisition needs, particularly relevant for new (greenfield) projects where the establishment of access is a critical factor.

Preliminary Design development: Progress the preliminary design for the chosen option, establishing a foundation for subsequent design stages.

The methodology for putting together the S1D estimate parallels the business case estimate process, as detailed in Section 5.3.3 of PCEM. However, at the S1D stage, additional information about the project may become available, allowing for a more refined definition of the project scope, finer quantity take-offs, more accurate unit rate information, improved risk profiling, updated escalation figures, and improved project development information.

Figure 5.3.3 of this document provide the process for developing and approving the S1D estimate, and Table 9.2 provides the recommended estimating method.

5.4.2 Development phase Stage 2 design (S2D) estimates

The Stage 2 Design (S2D) acts as a critical juncture in the project lifecycle, refining the preliminary estimates that were developed during Stage 1 Design (S1D) and transitioning into a more precise cost estimation stage that serves as a foundational element for subsequent tendering.

The importance and roles of the S2D estimate include:

Refinement of construction details: S2D provides a detailed and intricate understanding of the construction phase, allowing for a refined and highly probable construction costs.

Impact on the tender schedule: The accuracy of the S2D estimate holds significant weight as the tender schedule is formulated based on it. The reliability of this estimate influences the tendering process and the selection of contractors.

Verification and adjustment of assumptions: The S2D phase facilitates a review and verification of assumptions made during the S1D stage. Assumptions related to costs, resources, and project timelines can be revisited and revised to reflect the status and insight gained post-S1D.

Update of quantities, rates, and production rates: As the project design becomes more concrete, there is an opportunity to update the estimated quantities of materials, prevailing rates, and production rates to mirror real-world conditions and cost forecasts more accurately.

Risk register update: The risk register should be reevaluated to include any newly identified potential risks, including extraordinary escalation risks, which may have not been evident during the S1D stage. This identification and assessment permit better contingency planning and risk mitigation.

Escalation revisions: With economic factors continually changing, escalation rates need to be updated to ensure they are reflective of the current economic environment and forecasts. This ensures that the outturn costs are as close to the actual as possible.

In summary, the S2D estimation process plays an integral role by providing the most accurate cost estimates before the start of construction, offering a sound basis for the procurement phase, and setting the stage for efficient financial control and management as the project progresses toward its implementation phase.

Figure 5.3.3 provides the procedure for preparation of the S2D estimate and the concurrence and approval processes.

5.4.2.1 Estimate verification

Upon the completion of the S2D design, the following must be made available for verification:

S2D estimate report: the S2D estimate is central to verifying the final projected costs which should include all aspects of the cost estimate developed during the S2D phase.

Updated risk register: This allows for the assessment of potential project uncertainties and provides insight into needed contingencies.

Proposed delivery strategy: This includes how the project will be delivered, including contract types, construction scheduling, and resource allocation.

Updated design plans: Any revisions made to design plans during the S2D phase need to be incorporated into the final set of updated design documents. These plans should reflect the most current understanding of the project's specifications.

Additional Relevant Information: Any other information that has been collected during the S2D process that could impact the project estimate should be gathered and reviewed.

The estimator must verify that no unaccounted scope creep events occurred since approval of the business case and the preparation of the S2D estimate. If an event or latest information causes a change to the values and the assumptions made, appropriate adjustments must be made to the estimate.

This diligence helps guard against inaccuracies and potential budget overruns caused by unexpected deviations from the planned scope, ensuring the project maintains financial viability and alignment with its objectives as it progresses.

5.4.2.2 Quantities and rates

The quantities and rates used to develop S2D cost estimate need to accurately reflect the scale, complexity, and specific requirements of the project. Any costs entered should directly correlate with the defined project work. The sources of information used to calculate quantities for each item must be documented for verifiability and transparency.

Recognizing that there might be a substantial time gap between the initial business case preparation and the development of the S2D estimate, estimators are required to adjust their cost projections to reflect current values. This time lapse could see changes in market conditions, inflation, or availability of resources impacting the earlier estimates. In such situations, the estimator must adjust the rates and validate the cost estimate through quotations obtained from the local suppliers or subcontractors.

5.4.3 Pre-tender estimates

The department deploy multiple contract delivery mechanism to engage contractors to deliver project as described in Section 5.1.9. This section outlines the various cost estimates prepared at the pre-tender stages in each contract type. For guidance on procurement of works, refer to *Transport Infrastructure Project Delivery System* (TIPDS).

5.4.3.1 Design and construct

In a design and construct contract (or D&C contract), the reference designs form part of the design and construct tender package and the corresponding cost estimate is the pre-tender estimate. Therefore, pre-tender cost estimate must be completed and approved before the design and construct tender opening to ensure the approved funding is sufficient to cover the works.

5.4.3.2 Estimate for comparison with tender (EFCT)

While the S2D cost estimate provides sufficient information to develop the tender and the contract schedules, the estimate for comparison with tenders (EFCT) ensures the submitted tenders are comparable with the project budget and any cost changes occurred between the estimate base date to the tender issue stage.

The EFCT development process only considers the "contract scope," not the project scope. It is an extract from the S2D Construction Contractors estimate considered during the S2D cost estimating process. The exclusions in the EFCT cost estimate are:

- principals' costs (design development, project management, contract management, project finalization and principal-supplied materials)
- principal's retained risks / contingencies
- principal arranged insurance
- S2D and documentation costs unless specifically included in the contract
- property acquisition costs unless specifically included in the contract
- PUP costs unless specifically included in the contract, and
- price escalation adjustments (CPI, other).

The purpose of the EFCT is to:

- Compare tender submissions and identify variances in unit rates and quantities.
- Ensure the unit rates in the S2D cost estimate are aligned with current market conditions by validating against recent tender data.
- Review potential time-dependent costs such as contractor's camp, site facilities, traffic management, and environmental management for require additional costs if time extensions are likely to occur during the delivery stages. If time-related cost items in the tender schedules are unusually high, the bidders may look for financial advantage on principal-caused delays.
- Ensure the extraordinary cost risks are addressed in the project budget prior to tendering, and
- Assist in the scrutiny of bids that appear unusually low, elucidating whether these bids are realistically sustainable or if they may conceal risk factors that could lead to cost escalations later.

5.4.3.3 Factors to be considered in developing estimates for comparison with tenders

The Estimate for Comparison with Tender (EFCT) plays an essential role in the tendering process of transport infrastructure projects, although it is not a new cost estimate. Instead, it builds upon the extensive work of previous project phases.

A significant amount of information was gathered, collated, and reviewed during the planning, business case development, and S1D / S2D design stages. Also, a significant effort and costs invested in developing the cost estimates across the project phases leading to the tender stage. Therefore, the project team has a clear idea about the expected project delivery costs at the time of tender.

The cost estimator who developed cost estimates for previous stages has a good understanding of the project scope, key project details (such as environmental modelling, traffic modelling, PUP issues, land acquisition challenges) constraints, challenges and significant assumptions made during the previous estimate development process. Also, the same estimator retains access to the computer programs used to develop the first principles cost estimate and the probabilistic risk model.

Given the importance of the EFCT in the tendering process, it is typically prepared by the same cost estimator responsible for the previous cost estimation stages, ensuring consistency and a deep understanding of the cost basis as it has evolved throughout the project lifecycle. This continuity allows for a more accurate and cohesive comparison of tenders relative to the well-established project cost estimates.

Also, it is pivotal to keep the EFCT reflective of any changes in the project scope, updated unit rates, and any new or evolved risks identified in the risk register.

5.4.4 Agreed project delivery value (APDV)

The Agreed Project Delivery Value (APDV) is a crucial step in validating and reviewing the costs necessary to deliver a project according to its approved scope. This process helps mitigate the risk of over or under expenditure by identifying potential costs and risks early on. It provides a snapshot of the project's future deliverability, considering the approved scope, timing, cost, contingency, and risk. Additionally, it highlights key variances between the business case estimate and the delivery phase (tender award estimate).

The APDV process typically begins in parallel with the Contract Award KM10, though it may vary depending on the delivery method or risk profile of individual projects. All projects undergoing the APDV must:

- Conduct a peer review.
- Ensure a robust estimate is made with the same level of rigor as the business case.
- Document any scope changes since the approved business case.
- Review and evaluate project risks, and
- Assess contingency and escalation allowances to ensure project deliverability.

For further information about the APDV process, please contact the PMD Program Controls Team at PCAR_Team@tmr.qld.gov.au.

5.5 Implementation phase estimates

Following from the development phase post-detailed design, the project is handed over to the procurement team to plan, prepare and complete contract tendering. The Implementation phase has a definite scope of works, construction start and completion dates, separable portions and the project team is ready to procure a contractor(s) or the supplier(s).

The key objectives of this phase are to manage the project in accordance with the project plan and deliver the intended benefits. The focus of estimating in the implementation phase is on regular updating of the cost estimate, cost forecasting and contract variations.

5.5.1 Project commencement approval

All QTRIP projects must seek project commencement approval in accordance with Queensland Treasury and Trade’s Project Commencement Approval Policy prior to commencing the project implementation phase activities such as awarding a contract or incurring expenditure against a project.

This policy requires to:

Seek approval to commence a project covering the thresholds of the department and the whole-of-government, depending on the value of the total project cost.

Provide most robust estimates available to determine the project value (inclusive of GST). The proposed project value should be based on a business case, or approved project value

variation post-business case, which includes a plan and budget as put forward in the Project Assessment Framework or OnQ project management framework:

- including allowances for options to extend contracts and maximum allowable cost variations, based on past experiences and current economic conditions, and
- excluding subsequent maintenance following completion of the project.

The project commencement approval is undertaken through 2 types of submissions:

- a project-level approval, where one or more individual projects are captured in one submission, and
- a program approval, where project commencement approval is sought for projects within a specific program of work.

Refer to the Part D of the department's Integrated Project Management Framework for more details.

5.5.2 Periodic forecasting

The project forecasting ensures that costs can be monitored and controlled ensuring that the management decisions made around programming and/or funding adjustments are accurate, and the overall QTRIP funding envelope remain balanced. Period forecasting needs to include contingency allocations.

During the life of the project, the project manager must exercise cost control by periodically forecasting the expected project expenditure based on current information.

Periodic forecasting also can be used to identify and capture residual, anticipated, future variations and contingent project costs, and if added to completed project costs and approved variations, then provides an updated project cost.

The budget forecast for projects is carried out in the department's 3PCM system. It serves as the platform for initiating the cost sheet at the beginning of the project and for forecasting the budget into detailed Work Breakdown Structure (WBS) components, which include Capital Expenditure (CapEx) and Operational Expenditure (OpEx) across the entirety of the project's lifecycle. The inclusion of contingency and escalation allowances within this forecast is also essential. Refer to Section 7.1.3 Project Cost Breakdown Structure for details.

During all project stages, the actual project expenditure must be recorded against the WBS elements and across the project duration enabling the project manager to keep an eye of the cost against the budgetary allocation. This process is known as the 'end of the month validation' of costs against the project budget.

The department's business rules require the actual costs to be validated against the forecast on monthly basis for every project in 3PCM system.

5.5.3 Estimating contract variations

The methods and principles applied during the initial pre-contract estimate preparation must be consistently applied when handling contract variations, whether initiated by the department or requested by the contractor. This ensures continuity and coherence in the management of contract costs.

All variations are managed within the 3PCM system's contract module, which allows for systematic tracking and processing of any changes to the contract.

The contract variations must be documented in a format that is clear and unambiguous, laying out the details of the change in a straightforward manner. This includes relating the variation to specifics of the construction method and the timing and context of the requested changes.

Contract variations may occur due to various reasons:

- Adjustments to the volume of work, either by increasing, decreasing, or omitting portions of it.
- Alterations in the character / quality of materials or work to suit revised project needs or specifications.
- Changes to physical aspects of the project, including levels, lines, positions, or dimensions.
- Inclusion of additional work that is necessary to achieve project objectives, and
- The demolition or removal of materials or constructions that are no longer required.

The calculation of indirect costs, overheads and profits should only be addressed when the direct cost pricing has been completed and the additional time involved (if any) is calculated.

5.5.3.1 Scope variations

The same principles used in the development of early estimates can be adopted to prepare the cost changes may occur during the implementation phase. It is imperative that any variations in the project, whether proposed by the project manager or the contractor, are meticulously documented at every stage. This recording helps track changes and their implications.

When preparing cost estimates for scope variations, allowance must be made for additional costs associated with principals' costs (investigation and design, development phase, project management, contract administration, property acquisition, environment and heritage management amendments and PUP adjustment costs, in addition to the construction component.

When scope variations are put forward, it is essential that these changes reflect the impact on both the cost and the project timeline. Adjustments in scope necessitate a reassessment of the budget and the schedule, and approval for these changes should encompass both elements.

All proposed project variations require approval, and this process must be congruent with the business program's applicable rules. These guidelines ensure that any adjustments align with the broader objectives and limitations of the business programs.

5.6 Finalisation phase estimates

Project cost information serves as a critical data point for future project planning and for assessing the accuracy and efficacy of cost estimations. The practice of evaluating project costs through benchmarking against actual data and pre-defined performance standards is essential in ensuring both current and future project success.

Regular benchmarking of project costs allows estimators to compare estimated values to actual costs, providing insight into estimating accuracy and identifying areas for improvement, as stated in Section 2.4 – Performance Standards and Measurement.

For Major Projects and the projects funded by the Australian Government are subject to further reporting requirements. These reports often include comprehensive cost summaries and an analysis of the realized benefits, which can assist in accountability and in justifying continued or future funding.

5.6.1 Project learnings

Analysing the final project cost against the initially approved budget and the P90 business case estimate is a potent learning tool for any project team. This comparative exercise can yield valuable insights, particularly when there are significant discrepancies. Such disparities necessitate a comprehensive evaluation to uncover the reasons behind them, and the findings should be meticulously documented in a project learning report.

The potential reasons for large variations between cost estimates and actual project costs may include:

Project cost estimating errors: Mistakes or oversights during the initial estimating process, such as underestimating the required resources or not factoring in market price fluctuations.

Project cost management errors: Failure to properly monitor and control costs throughout the project could lead to a budget overrun.

Project risk management errors: Inadequate identification, assessment, or mitigation of potential project risks could manifest in unexpected costs.

Contract management issues: Mismanagement within the contractual agreements such as poor definition of scope, ineffective negotiation, or inadequate responses to changes can be costly.

Project delivery issues: Challenges encountered during the implementation phase of a project, like technical difficulties, labour shortages or delays, can lead to increased costs.

These learnings are crucial for future project planning and estimation accuracy. They aid in refining processes and strategies by understanding what went wrong and what could be improved.

By systematically capturing this knowledge, the department can evolve its approach to project cost estimations and risk management and to avoid similar mistakes in future projects.

5.6.2 Post implementation review (PIR)

The Post-Implementation Review (PIR) is a critical assessment mechanism that serves the essential purpose in project management and organizational learning. It is conducted after a project has been completed and operational for a certain period, during which it assesses the outcomes of the project against its original objectives and needs.

This review focuses on ascertaining whether the project has achieved its stated objectives and has delivered on the intended benefits including evaluation of the effectiveness of various project components.

A central goal of PIR is to extract learnings and identify areas for improvement. This process involves scrutinizing project results to understand the strengths and weaknesses and to inform future strategies which contribute to a more informed approach to decision-making regarding the selection and management of future projects.

For projects that have received funding from the Australian government, completing PIR is a prerequisite before the release of the final payment. This condition underscores the importance of PIR in the governmental project governance framework.

More information on PIR can be found on the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

5.7 Exceptions with maintenance and operations

Compliance with requirements in this document is mandatory for all cost estimates for departmental projects in QTRIP with an exception to OnQ Type 3 projects, asset maintenance projects less than $10M and the projects in the Maintenance, Preservation and Environment (MPE) and Road Operations (RO) Investment Programs, as defined in the *Transport infrastructure asset management policy*.

This exemption relates to the requirement for developing cost estimates with P90 confidence level.

Special consideration should however be given, to identify any items of the estimate where a minor change could have a major impact on the final costs.

It is strongly recommended that estimates for maintenance are still prepared using the information skills and resources available to understand intended costs associated with such projects.

6 Roles and responsibilities

Effective project cost estimation is a comprehensive process that hinges on collaboration across various disciplines and sectors to ensure the information gathered are accurate, targeted, fit for purpose and the resulting cost estimate is worthy for investment prioritisation.

6.1 Roles and responsibilities of the senior executives

The senior executives of the department have a pivotal role in steering the successful delivery of the QTRIP, and the cost estimating function is integral to this success. As key decision-makers, these officers convey high-level information to the teams responsible for cost estimates and project delivery on overarching policy directions and decisions from the cabinet, both state and federal, ensuring that project objectives align with political priorities and legislative frameworks. The most senior officers in the department directly involved in the development of QTRIP are:

- General Manager (Portfolio Investment and Programming)
- General Manager (Program Delivery and Operations)
- General Manager (Transport Strategy and Planning)
- Deputy Director General (Translink Division)
- Deputy Director General (Rail Division), and
- Chief Engineer (Engineering and Technology).

Each executive officer plays a key role in creating a culture that delivers the QTRIP program and embedding the effective cost estimating practices across the department.

The General Manager (Portfolio Investment and Programming) is the accountable officer for developing, publishing, and administering the QTRIP and obtaining ministerial approval for implementation of projects in it. Therefore, the General Manager (Portfolio Investment and Programming) is the functional owner and policy owner of the project cost estimating and risk evaluation functions.

This role is also responsible for maintaining, updating, promoting and implementation of department's program and project management methodologies and guidelines (PAF and OnQ), estimating policy, risk evaluation and management, project scheduling practices, including associated systems, tools, manuals (PCEM, Transport and Main Roads Project Risk Management and Contingency Development Guidance) and processes.

The General Manager (Project Delivery and Operations) is responsible for delivering projects to approved budgets, developing (and updating) procurement strategies, seeking additional funding to complete QTRIP projects, it they exceed approved budgeted funding and maintaining effective contract delivery mechanism.

This role is also responsible for planning and delivering value-for-money transport infrastructure programs and projects, ensuring the safe management of Transport and Main Roads assets and operating the state's road network.

The General Manager (Transport Strategy and Planning) is responsible for integrated planning portfolio to define and advance the future transport system investments and function as the policy owner for land use planning, development assessment, third party corridor use and legislation for transport planning and infrastructure in Queensland.

The Deputy Director General (Translink) is responsible for delivering rail public transport infrastructure projects led by the department ensuring the estimating practices for rail infrastructure are met.

The Chief Engineer (Engineering and Technology) branch provides technical expertise to support the department's innovative and value-for-money design solutions for QTRIP projects. They develop and maintain the Transport and Main Roads Main Roads Specifications (MRS) which are mandatory to use when preparing cost estimate for road and rail infrastructure.

6.2 Roles and responsibilities regional / district directors

Regional / district directors are responsible for developing project proposals, OA’s / PE’s and business cases to enter candidate projects into the funded years of the QTRIP and delivering projects and programs in their region.

The planning and design staff as well as the staff who are entrusted with developing business cases and tender prototype documents are required developing cost estimates for their projects. Therefore, they are key users of the department’s estimating policies processes and practices.

The regional / district directors also responsible for approval of estimates for project leading to inclusion within the QTRIP and for projects that in the delivery program. To ensure the accuracy of estimates prepared at all stages in the project life cycle, the regional / district directors must take reasonable effort to upskill the delivery staff on estimating processes, policy requirements, tools, and systems. They also ensure the compliance of the cost estimates prepared for projects delivered by the region / district by their staff.

It is the responsibility of regions / districts to deliver the projects and programs in accordance with the processes outlined in the OnQ framework and develop cost estimates as per the PCEM.

6.3 Roles and responsibilities of program / project managers

The cost estimators are responsible for preparing cost estimates in accordance with the requirements of this document and developing necessary documentation for approvals ensuring the processes in this document have been complied with. The program / project managers are responsible for creating the estimating context, providing key information, defining the scope, facilitating risk workshops and coordinating estimate approvals process.

The program / project managers must ensure that the cost estimates are based on:

- a sound scope agreed to by the principal
- appropriate work methods
- all relevant local factors
- appropriate risk evaluation methodology (e.g. Probabilistic) as necessary
- appropriate contingency component including extraordinary cost risk allowance, and
- requirements of this document.

Project managers are also responsible for facilitating the review of the cost estimates as recommended in the Section 4.1.16 of this document.

7 Presentation of estimates

Communication plays key role in every project which needs to be planned to ensure that the correct information is passed on to the target audience. Some cost information and data may be sensitive in nature, and not always suitable for broader distribution.

Certain circumstances, unapproved cost estimates form part of the deliberation process during the project development however they have no status as an approved project cost estimate. Such estimates are restricted to internal communications only as part of the project estimation and management processes.

The estimates must be presented on established proformas and templates at all estimate stages. The recommended template to use is Annexure L – Project Cost Estimate (Summary) Form M4755 which is a key deliverable in the cost estimating process.

The estimate presentation must contain the following minimum information:

- The estimate report.
- Estimate Summary Form – M4775.
- Risk outputs including ranges.
- Project estimate in Excel with rates on latest Transport and Main Roads Main Roads Specification (MRS) standard pay items. Where supplementary, lump sum, provisional sum or non-standard items are used, cost breakdown of those items is to be provided separately. For supplementary work items, the supplementary clause also must be submitted.
- Key resource rates.
- Risk register (in Microsoft Excel format).
- Expenditure cash flow profiles including outturn dollars in financial years, and
- Estimate report.

The estimate report must contain the following information as a minimum:

- a detailed scope statement accompanied by current plans
- in scope and out of scope items
- a current risk log
- a construction program showing staging and significant activities
- assumptions
- options analysis (including comparative cost analysis)
- constraints
- significant issues
- a breakdown of the cost estimates by WBS
- summary tables presented as described in the PCEM Section 3

- current approval status
- estimate review reports (if any)
- the Cost Estimate Review Checklist (Annexure B)
- duly completed Project Cost Estimating Control checklist (Annexure I), and
- submit project costs in the Project Estimate Review Report (Annexure J) format.

7.1 Work Breakdown Structure (WBS)

The importance of a well-structured Work Breakdown Structure (WBS) in project management cannot be overstated. By specifying project scope in terms of deliverables and activities, a WBS ensures that all facets of the project are appropriately organised and that the project team has a thorough understanding of the project's components.

The standard WBS is the cornerstone of the cost estimating process because it defines in details of work necessary to accomplish the end goal and provides the structure to guide the disciplined preparation and presentation of cost estimates at granular levels.

Some benefits in developing standard WBS includes:

- Clearer delineation of major cost items in the project planning stages through to delivery stages.
- Providing a structure to inform the quantitative risk assessment.
- Enable collection of key cost data for analysis later for benchmarking purposes, and
- Enable "rolled up" subordinate items into high-level summary which provides more strategic overview of the project.
- The department has a comprehensive Technical Specification suite known as MRS for common construction work elements and MRP for principal's work items. They provide high level of consistency, transparency, and quality of the transport infrastructure that it delivers. These specifications benefit several business functions in the department including:
- Planning, scoping, developing, and delivering infrastructure projects.
- Communicate with the industry to understand and respond about variety of delivery mechanisms.
- Undertaking cost estimate reviews and project assurance reviews at all phases of the project, and
- To gather business intelligence of individual work items for future planning activities.

The construction items WBS and the principles items WBS in infrastructure projects can be deconstructed the into 4 levels as illustrated in Figures 7.2(a) and Figure 7.2(b) below.

Figure 7.2(a) – Example extract of a construction work breakdown structure for roads

MRS LEVEL	GROUP LEVEL	SUB GROUP LEVEL	ITEM LEVEL
MRS03 Jan 19	**Drainage**	*Drainage Removal / Demolition*	Removal or demolition of culverts, complete
			Removal or demolition of culvert end structures
			Removal or demolition of culverts, excluding end structures
			Removal or demolition of concrete kerb including kerb crossings
		Supply and Installation of Culverts	Supply and installation of steel-reinforced concrete pipe culvert
			Concrete bases in culverts
			Supply and installation of concrete box culvert components
MRS04 Nov 20	**General Earthworks**	*Preparation*	Clearing and grubbing
			Stripping of topsoil (Provisional Quantity, as directed)
			Excavation and disposal of Unsuitable Material
		Excavation	Excavation, all materials
			Excavation for culvert, pipe and conduit trenches
			Excavation for structures, all materials [description]
			Excavation for diversion channels, all materials
			Excavation of non-rippable material in Road Excavation,
		Embankment	Embankment filling
			Levees, catch banks and diversion blocks using earthfill material
			Supply and installation of geotextile

However, not all estimates use all 4 levels for all items at once. For example, the strategic planning cost estimates may use only the group Level and subgroup Level in the above WBS, where Business Case estimates should contain the level 4 rate build up details.

Figure 7.2(b) – Example extract of a principal's work breakdown structure

MRP LEVEL	GROUP LEVEL	SUB GROUP LEVEL	ITEM LEVEL
MRP02 Jul 17	**Concept**	*Project Proposal*	Prepare Benefits Realisation Plan
			Prepare Environmental Scoping Report (ESR) / Heritage Plans
			Produce Project Proposal
			Prepare Project Proposals Report (PPR)
		Option Analysis	
			Prepare Options Analysis Estimates
			Produce Options Analysis Report
			Prepare Preliminary Risk Management Report
MRP03 Jul 17	**Development**	*Design Planning (Preliminary and Detailed)*	Design meetings
			Review previous planning studies and road asset data
			Prepare planning briefs
			Engage and manage design consultants
		Engage and Manage Design Services	Pavement design
			Geometric design
			Intersection design
			Drainage design
			Road design

7.1.1 Work Item numbering system

The work items in the construction WBS and principles WBS are defined by a unique number, description and unit of measurement according to the standard work items numbering system detailed in the MRS01 *Introduction to Technical Specifications* and Section 4.1.5 of this document.

This numbering system is used as the basic building block to develop the construction activities. The MRS system describe the work activities and define quality standards measurement for each item of work. All cost estimates prepared for departmental projects must reference to the MRS numbering system.

7.1.2 Transport and Main Roads Estimating Import Template

The Estimate Import Template contains existing MRP, MRS and Non-Standard work items, which can be aligned to the estimate line items. The cost estimators are encouraged to use this template which consists of most up to date work items for construction activities and principles items to prepare cost estimates.

The Transport and Main Roads Technical Specifications (MRS) are updated on a bi-annual basis and as a result, some work items may get changed or become obsolete over the time due to various reasons. The Estimate Import Template is also updated at the same time to align with the updated MRS. Therefore, the cost estimators are advised to download the most up to date version of the template from the department's internal SharePoint site under the PMI Estimating webpage just before commencing the estimating process. External parties can request copies from estimating.support@tmr.qld.gov.au.

7.1.3 Project cost breakdown (PCB) template

The Australian Government has developed spreadsheet-based Project Cost Breakdown (PCB) templates for road and rail projects which reflect the principles of estimate preparation and presentation for nationally funded projects. The federal Notes on Administration (NOA) requires that all estimates included in Project Proposal Reports (PPR) for projects with an Australian Government contribution above $25M to be accompanied by a completed PCB template. The structure of the PCB reflects the cost estimates prepared for Scoping, Development Phase and Delivery Phases of projects.

8 Estimate quality assurance

Quality assurance in cost estimates refers to a process of verifying and validating the accuracy of cost estimation processes for road construction projects, ensuring they are reliable, realistic, and based on sound data, to minimize the risk of cost overruns and make informed project decisions throughout the planning and development stages.

Some of the key considerations in quality assurance process are:

- Project complexity – more complex projects require detailed planning, better scope definition and rigorous cost estimation and quality assurance processes, and
- Local regulations - adherence to local construction standards and cost estimation guidelines.

8.1 Estimate confidence categories

The estimate confidence categories listed in Table 8.1 assist cost estimators to gauge the certainty of cost estimates which be read in conjunction with the Estimate Categories provided in Annexure G of PCEM.

Table 8.1 – Estimate confidence categories

	Category 1	**Category 2**	**Category 3**	**Category 4**	**Category 5**	**Category 6**
Level of project definition	<2%	up to 15%	10% to 40%	30% to 65%	40% to 80%	up to 100%
Estimate basis	No formal scope	Simple scope and strategy	Agreed scope, preferred option	Schematic design	Developed design	Contract details
Input to	Initial budget	Project phase or detailed budget	Detailed budget	Basic cost management	Detailed cost management	Implement phase budget and cost control
Information available	Historical projects	Planning project details	Project plan, option analysis, investigations	Schematic design	Development phase Stage 2 design, full drawings and documents	Accepted tender
Estimate confidence	Very low	Low	Low to Medium	Medium	Medium to high	High

		Category 1	Category 2	Category 3	Category 4	Category 5	Category 6
Estimate usage		Strategic Planning / Detailed planning	Project Proposal	Business Case & budget creation	S1D design stage	S2D design stage	Comparison with tender
Expected at project stage	**OnQ**	Strategic planning / Detailed planning	Project proposal / option analysis	Business case	Supply strategy development / source suppliers		Implementation
	Major Projects	Strategic planning / Detailed planning	Strategic assessment of service requirement / Preliminary evaluation	Business case			Establish service / deliver service
	Federal	Identification phase		Scoping phase	Development phase		Delivery phase

8.2 Benchmarking cost estimates

The benchmarking refers to the practice of comparing the projected cost of a new project to the costs of similar, completed projects in the same region or with comparable features, to assess the accuracy and competitiveness of the new project's cost estimate and identify areas for potential cost optimization.

The key aspects of benchmarking infrastructure cost estimates are:

Data collection: Gathering cost data from completed projects including details like project scope, design elements, materials used, labour rates, equipment costs, and geographical location.

Project similarity analysis: Identifying projects most comparable to the new project based on factors like road type (highway, arterial, local), terrain, traffic volume, and design complexity.

Cost breakdown analysis: Breaking down the cost of the benchmark projects into key components (earthworks, pavement, drainage, signage) to compare individual cost elements with the new project estimate.

Cost per unit comparison: Calculating the cost per kilometre or lane-kilometre of the benchmark projects to compare with the new project's estimated cost per unit.

Identifying cost drivers: Analysing the variations in cost between benchmark projects to understand factors influencing cost, like soil conditions, design complexity, or local labour rates.

Comparative cost analyses: The following are some examples for comparative rolled-up cost analyses:

- indirect job cost vs direct job cost
- design cost vs construction cost
- •design consultant fees vs project / phase cost
- traffic management cost as a percentage of direct job cost
- pavement area vs structures area (indication of the complexity of the project), and
- project management / principal costs as a % of the total project cost.

The cost estimates prepared for all QTRIP projects are expected to be captured within the department's 3PCM system. Once captured, the cost information for projects will be stored within the 3PCM data warehouse including estimate line items, tender responses and contract schedules.

Item level cost data in construction items can be extracted and analysed using the analytical tool in built within the 3PCM system. This data provides valuable benchmarking input for analysis of current market rates for construction items and principal's cost.

In addition, the department compares unit rates for individual projects against the information in SmartCost data library.

8.3 Project benchmarking by the Australian government

For projects exceeding $25M in value that are funded by the Australian Government, the completion and submission of a Project Cost Breakdown (PCB) spreadsheet form an essential part of the project funding submissions (PPR) process. The PCB enables the Australian Government to conduct benchmarking analyses, which are instrumental in evaluating the cost-effectiveness and financial integrity of the proposed projects.

Even though the PCB is not a mandated requirement for state-level projects, its use is strongly recommended. The inclusion of a PCB as part of the project documentation can enhance the transparency and detailed understanding of the cost components of the project. It also facilitates more straightforward comparison and assessment of project costs, ensuring that the Queensland Government project aligns with best practices regarding fiscal responsibility and accountability.

9 Estimating methods and tools

9.1 Estimating methods

As a rule, the cost estimating process incorporates the following basic concepts:

- divide the project into sufficiently smaller WBS elements to allow an individual unit cost to be applied to each work item
- extend the quantities and rates to determine a cost for each element
- sum up the resulting elemental costs, and
- apply additional costs to obtain a complete estimate.

The basic difference between different estimate types is the degree to which a project is divided into elements as well as the estimating method used to apply rates and additional costs. The more rigorous the process used, the greater the certainty of estimate outcome and accuracy of the estimate.

The standard methods used for estimating costs for infrastructure projects include:

- global (order of magnitude) estimating
- unit rates estimating
- first principles estimating, and
- hybrid unit rates and first principles estimating.

The method chosen for the preparation of a base estimate depends on both the purpose of the estimate (and therefore the required accuracy of the estimate) and on the level of detail of available data.

9.1.1 Global estimating (benchmark rates)

The Global estimating, also known as order of magnitude estimating, is an approach used during the very early stages of project development. This method provides a rough estimate of the project costs by applying broad unit costs—such as the cost per kilometre for road and rail projects, or the cost per square meter of deck area for bridge projects—to the entire project to calculate an overall cost estimate.

The primary utility of global estimating is to offer a first-cut, strategic perspective when a project is in its conceptual or scoping phase. It allows stakeholders to gain an insight into the potential scale of a project's budgetary requirements without the need for detailed planning or design work, which may not be feasible in the earliest project stages.

These estimates are based on very general data and past project costs and typically do not include a contingency allowance. Therefore, they are less reliable and carry a low level of confidence, especially in departmental estimating standards.

If an estimate is to be prepared using this method, it is essential that the composition of a historic global rate be understood prior to adoption and application of that rate to a new

project. The global rate must be reviewed and adjusted, if necessary, for the new project's particular circumstances. The criteria for checking against include time, location, government legislation requirements and other project-specific factors of the new project against historical projects.

9.1.2 Unit rate estimating

Unit rate estimating is the most prevalent estimating practice across the department which uses the historical rates and computed / design quantities of the current project to derive elemental costs. This is a quick method of estimating but lacks precision, especially in the interpretation of what exactly is provided for in the unit rate. Accuracy of an estimate requires emphasis on scope, reflected in a comprehensive schedule of work items that is unique to the project.

Unit rates estimate traditionally obtain unit rate information from previous tenders for similar projects at similar type locations. These are commonly selling rates, which include direct rates, indirect costs and contractor's contingencies, margins and allowances. Since each project has unique constraints and requirements, such an approach contains inherent inaccuracies. These inaccuracies result from factors and allowances developed for previous projects being applied for the unit rate, even though they might not be applicable or appropriate to the project being estimated.

Care must be exercised to ensure that appropriate unit rates are selected when developing tender submissions to avoid the skew of low bids and front-loading practices of some bidders. It is important that the makeup of those rates is understood. The historical rates might require adjustment to take into consideration the specific characteristics of the project and global changes.

9.1.3 First principles cost estimating

First principles estimating is a comprehensive approach to calculating project-specific costs that involves a detailed analysis of resources required for each activity within a project's work schedule. This method builds up the unit rate cost from the bottom up for each work item by factoring in costs associated with labour, equipment, materials, and subcontractors.

For example, to develop a cost to build a concrete bridge deck, the activities are subdivided into formwork, reinforcement, concrete supply, placement, finishing and apply resource rates to each activity such as labour, plant and materials with appropriate production rates.

The first principles method enables the development of far more accurate cost estimates compared to unit rate method. However, prior to using first principles estimating methods, the cost estimators without sufficient experience or knowledge, should seek assistance from peers about key factors such as production rates, resource rates and construction methodologies.

The department deploys the Expert Estimation estimating software with SmartCost unit rate database to develop estimates from first principles. This database contains detailed cost estimate breakdowns for sub work components based on Transport and Main Roads work operations for various construction elements and the users can adjust the inputs to suit the project specific parameters to develop the cost estimate.

9.1.4 Hybrid estimating

The hybrid unit rate and first principles estimating is an alternative approach that uses some features from each estimating method. It can be an effective method for lard infrastructure projects to maintain the estimate accuracy without requiring the no-critical work elements to use the full first principles estimating approach.

This method relies on the availability of direct cost unit rates (rates that are equivalent to those derived from the first principles approach) for minor and non-critical work elements.

For example, a business case with limited project development detail may use the first principles method for high value, high risk components and the unit rates method for low-risk work items.

9.2 Selecting the appropriate method

The selection of an estimating method depends on both the purpose of the estimate is to be used (and therefore the required level of confidence of the estimate) and the level of detail available.

It is the project manager’s responsibility to select the estimating method suitable for the project type and the estimate stage in consultation with the estimator. Table 9.2 should only be used as a guide.

Table 9.2 – Recommended estimating methods

Estimate stage	Major project	Type 1 project	Type 2 project	Type 3 project
Strategic or Detailed planning	Unit rate method	Unit rate method	Global estimate	Global estimate
Project proposal	Unit rate method	Unit rate method	Unit rate method	Global estimate
Options analysis	80% value at unit rates estimate, 20% value at first principles estimate of shortlisted options	60% value at unit rates estimate, 40% value at first principles estimate of shortlisted options	Unit rate method	Global estimate
Business case	Estimate from first principles at WBS Level 5	Estimate from first principles at WBS Level 4 or 5	Approx. 60% value of estimate by unit rates, 40% by first principles	Unit rate method
Development phase Stage 1 design	Estimate from first principles at WBS Level 5	Estimate from first principles at WBS Level 4 or 5	Approx. 20% value of estimate by unit rates, 80% by first principles	Not applicable
Development phase Stage 2 design	Estimate from first principles at WBS Level 5	Estimate from first principles at WBS Level 4 or 5	Estimate from first principles at WBS Level 3	Estimate from first principles at WBS Level 3

9.3 Estimating tools

The use of an appropriate software tools to assist in developing and presenting cost estimates is essential. The department uses the following estimating and risk evaluation tools to ensure consistency across project cost estimates developed for its infrastructure projects and programs:

- Expert Estimation – a first principles cost estimating tool
- SmartCost – a unit rate database which aligns with standard MRS work items used of the department, and
- @Risk – a probabilistic risk evaluation software based on Monte-Carlo analysis.

9.3.1 Expert estimation

The Expert Estimation software is the department recommended software to develop cost estimates from first principles. It extracts data from the SmartCost database to develop cost estimates.

Some of the key features in the Expert Estimation software include:

- compatibility and transportability – data is easily imported from other programs such as Excel
- collaboration – multiple users can work on a single project from multiple locations
- formulae – it has a range of inbuilt formulae to utilise during estimate creation
- reporting – this has a broad range of customisable report formats which can be exported into Excel, and
- has an inbuilt capability for carbon estimating & reporting SmartCost.

9.3.2 SmartCost

The SmartCost database contains over 6,000 work items coving most common scenarios of MRS Work Items and 6,800 resources that can be tailored to department's cost estimating needs. The data can be extracted using the Expert Estimation software to develop first principles estimates for department's road infrastructure projects.

The resources in the SmartCost database are linked by rolling formulae which enable the users to develop detailed cost estimates with speed and accuracy. The resource rates are updated twice a year using widely available tendered data. The department is using an internal project team and a mechanism to ensure the unit rate in this database is fit for purpose and accurate before releasing it for broader use.

This database also contains resources that are tailored into 5 specifics geographic SmartCost Regions in the state of Queensland as shown in Table 9.3.2.

Table 9.3.2 – SmartCost regions

SmartCost region	Regions and districts of the department	Database identifier
Southeast Queensland	Metro, South Coast, North Coast	SEQ-SmartCost
Central Coast Queensland	Mackay / Whitsunday, Fitzroy, Wide-Bay / Burnett	CCQ-SmartCost
Southern Inland Queensland	Darling Downs, Southwest	SIQ-SmartCost
Central Inland Queensland	Central West, Northwest	CIQ-SmartCost
Tropical North Queensland	Far North, Northern	TNQ-SmartCost

The data in the SmartCost data library are available for accessing, viewing and analysing by all staff in the department through the Tableau environment, in the Estimating Resources area of the department’s internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

9.3.3 @Risk

Traditionally a P90 estimates for all projects in the QTRIP are prepared using a quantitative approach which employs probabilistic tools, techniques, templates, and specialist software such as @Risk for risk evaluation.

@Risk is the recommended risk evaluation software by the department and the Australian Government for probabilistic (or Monte Carlo) analysis of project risks. It is also the main tool used by the road contracting industry for high risk / high value projects.

For projects that are funded by the Australian Government and over $25M (total project cost, including contingency), probabilistic cost estimation techniques must be used to develop P50 and P90 outturn costs. The Australian Government also requires supporting information such as @Risk files with probability distributions, simulation details, Tornado diagrams, and summary statistics at 5% intervals from 5% to 95% with funding submissions.

Section 10.1.4 provides details of the probability distributions to be used when applying the probabilistic method is used for risk evaluation process.

For more details on project risk management can be found in the department's *Project Risk Management and Contingency Development Process Manual*.

10 Risk management and contingency development

Risks and uncertainty are inherent in every project at every stage. The contingency P50 and P90 estimate is a measure of anticipated detrimental financial impact to cater for residual project risks defined as remaining risks after treatments (controls and mitigation actions) are applied.

The contingency allowance provides required buffer which must be included in every stage of the cost estimate to offset project risks. This Section provides an overview of the principles to be considered in risk management and contingency estimation process.

For more details refer to the department's *Project Risk management and Contingency Development Process Manual*, published on the internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

10.1 Risk Management Process

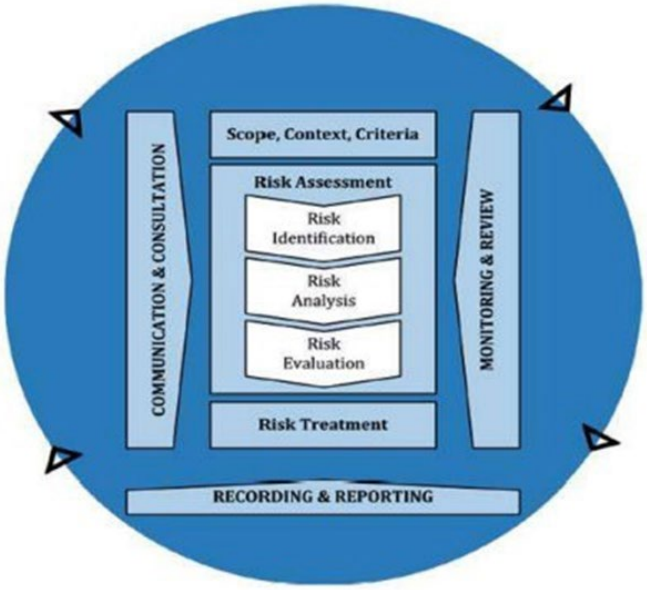
The department recognises that the definition for project risk is:

- the effect of uncertainty on project objectives, or
- the chance of something happening that will influence achieving the project intent, or
- the possibility that the expected outcome is not achieved / replaced by another, or
- a combination of some / all.

Project risks are 2 dimensional, meaning they are measured in terms of likelihood and consequence. The likelihood is the probability or chance of risk occurrence during the project delivery. The consequence is the possible result or impact of an event, often expressed as a qualitative rating which is expressed quantitatively in cost estimates.

The department's overall risk management process was streamlined in accordance with the Transport and Main Roads Risk Management Framework, and the procedures and practices outlined in AS/NZS ISO 31000 *Risk Management* (refer to Figure 10.1).

Figure 10.1 – Risk management process



Reproduced from the *ISO 31000:2018, Risk management — Guidelines* with the permission of SAI Global Ltd

Project risk management is a feature in every phase of the project life cycle and the responsibility for assessing, treating, reviewing, and reporting risks is the responsibility of the project manager.

In the context of estimating, risk management is the systematic application of principles, methods and processes for identifying, analysing and evaluating risks and then followed through with the planning, implementing of appropriate risk treatments and quantifying the change in likelihood and consequence.

It is important to recognise that inputs to the cost estimate variables are not always available in all circumstances. As the project progresses through the project lifecycle, the aim is to improve the availability and quality of the inputs to the cost estimate variables to improve the quality of the risk and estimation analyse outputs.

As formal risk management processes have a vital role in project success, effective and collaborative approach and innovation strategies are necessary in the overall risk management process, to ensure compliance with policies, standards and processes.

The risk managers in the department must ensure that departmental regulations, specifications, systems and standards are understood, upheld and applied throughout the project delivery process by all stakeholders.

Risk management is not a one-size-fits-all process aimed at satisfying compliance criteria. The key focus in implementing the most appropriate risk management mechanism is to meet the department's objectives.

Sometimes managing risks requires a combination of varied techniques and methodologies.

The Transport and Main Roads Risk Management Framework, the policy and strategy can be found on the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

10.1.1 Establish the risk context

AS/NZS ISO 31000 *Risk Management* requires risk managers to consider the scope, the context in which the risk assessment takes place and set the criteria as appropriate to the risk management process from the project outset.

The scope related detail for managing project risks include:

- objectives and decisions that need to be made
- outcomes expected from the steps to be taken in the process
- time, location, specific inclusions and exclusions
- appropriate risk assessment tools and techniques, and
- resources required, responsibilities and records to be kept.

Setting the context ensures that risks are clearly defined and appropriate for the project, prior to implementing controls and treatments. It also determines the environment in which the project operates and the basic parameters for risks to be managed. The project risks that may occur are likely to create significant impacts on project intent, objectives and economic performances such as schedule, cost and quality key performance indicators (KPIs).

As defined in the department’s Risk Management and Ratings Matrix, each identified project risk must be categorised into risk dimensions which ensures that all related risks are considered and included in the project risk register.

The risk dimension areas defined in the Risk Management and Ratings Matrix are:

- workplace health and safety
- time or schedule delay
- assets, operations and services
- performance and capability
- historical and Indigenous heritage
- environmental / climate, and
- media and reputation.

Once the risk dimension areas are clearly defined, the risks can be classified into risk context profiles (RCPs) according to the department’s EP153 *Project Risk Context Profiles*.

This policy requires the project specific risks are to be categorised into the following RCP risk categories:

- Geotechnical
- Environmental and Cultural Heritage
- Weather
- Stakeholders
- Procurement
- Project Management
- Preconstruction
- Contract Administration
- Construction, and
- Finalisation.

The above RCP risk categories provide useful prompts for project managers to identify appropriate risks associated with individual projects in all project phases.

Where project approval is sought, and the approval requires a project cost estimate to be submitted, the project cost estimate should be supported by a risk register developed in accordance with the RCP process.

10.1.2 Risk identification process

This process includes identification of risks that could impact on the project. It documents these risks and produces a list of risks that can be monitored throughout the project development and delivery process.

Risk identification is a continuous process across the project life cycle and there should be a continual search for new risks requiring inclusion in the process.

10.1.3 Risk analysis process

Risk evaluation uses the understanding and agreement of risks obtained during risk analysis to make decisions about future actions. This process can lead to make decisions on whether to undertake further analysis of risks. The cost of the treatment of some risks outweighs the risk impact, or the probability of risk eventuating is negligible, so it is economical not to treat such risks and maintain the existing controls.

The qualitative risk analysis approach is usually a rapid and cost-effective way of establishing priorities for risk treatment, which lays the foundation for the quantitative risk analysis process.

The quantitative risk analysis approach is performed on risks that were prioritised through the qualitative risk analysis process. It is the process of identifying and analysing critical project risks within a defined set of costs, schedules and constraints that assists the project manager to balance the consequences of failing to achieve a particular outcome.

The purpose of the quantitative risk analysis approach is to capture uncertainty using available information and to go from a deterministic point estimate to a probabilistic estimate.

The probabilistic approach for risk evaluation must be used for shortlisted options of the cost estimates prepared at the options analysis stage for projects valued over $25M (Major Projects and OnQ Type 1 and 2).

All major projects and OnQ Type 1 and Type 2 projects must use probabilistic approach for risk assessment from the concept phase onwards.

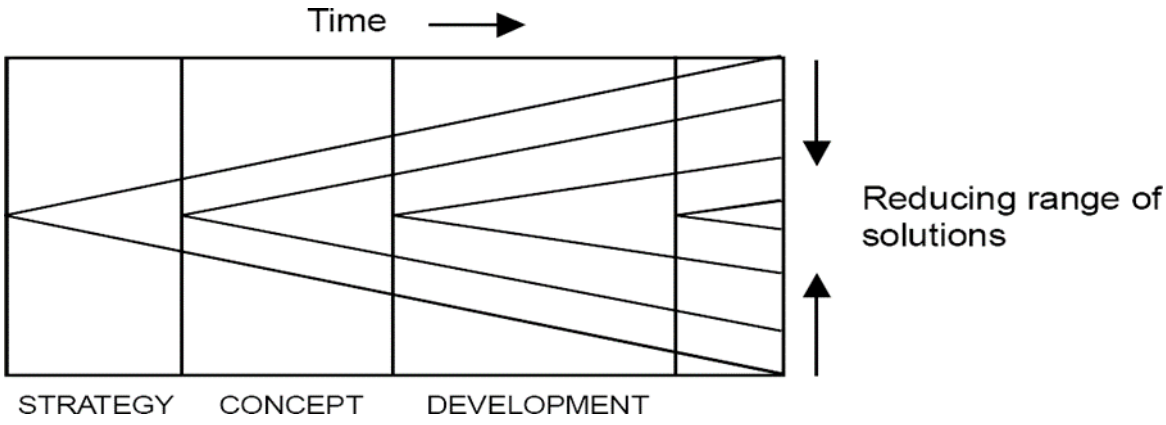
Projects with a total Outturn cost (including contingency) under $25M may use the deterministic approach, however the Australian Government recommends using a probabilistic risk evaluation method wherever possible.

10.1.4 Risk assessment process

Risk management is a multi-faceted process, some aspects of which are often best carried out by a multi-disciplinary team. It is an iterative process designed to progressively diminish risk as uncertainty about the project outcomes is reduced.

The concept of a cone of accuracy in Figure 10.1.4 shows how the risk uncertainty changes with time.

Figure 10.1.4 – Cone of accuracy



As the project moves through the phases, the range of solution options diminishes as uncertainty is reduced. The uncertainty cone is truncated as the project progresses through time (moves to the right).

The risk assessment process includes risk workshops, reviews of past project documentation, and talking to the experienced project managers.

For projects that are assessed as extreme or high risk, the project manager must ensure that regular risk management workshops are facilitated on regular basis, a risk management plan and risk register are prepared and implemented.

10.1.5 Risk workshops

A risk workshop is an essential tool to get the whole project team involved in identifying, analysing and determining the treatment options of the risks that are likely to impact the project. The risk workshops must be conducted at every key project milestone for all large and complex projects to assess risks in an open and live environment.

The purpose of the risk workshops is to:

- establish the risk context by determining the priority risk dimension area for the project
- determine the risk items under each risk dimension area, as detailed in Section 10.1.1
- determine the consequence rating
- determine the likelihood rating
- develop a treatment to mitigate risks, and
- determine the residual risk financial impact which informs the contingency.

It is important to choose workshop attendees from all key areas such as planning, design, construction, environmental, PUP and communication, ensuring each area is well represented and providing insight into specific business operations.

A facilitator may be arranged, if required, to conduct the risk workshop in a structured and systematic manner, tailored to individual project needs and operational risk profile.

10.1.6 Risk evaluation process

After potential risks are identified and analysed, the project team must evaluate risks based on the likelihood and potential consequence associated with risk events. Not all risks are equal: some risk events are more likely to occur than others with the risk impact varying greatly.

The risk evaluation uses the understanding and agreement of risks obtained during the risk analysis stage to make decisions about future actions. These decisions are based on a comparison of the consequence and likelihood of risks eventuating using the criteria developed earlier in the risk management process.

Risk evaluation uses the understanding and agreement of risk obtained during risk analysis to make decisions about future actions. Ethical, legal, financial and other considerations, including perceptions of risk, are also inputs to the decision-making process.

In some instances, evaluation can lead to a decision to undertake further analysis. In considering the cost of treating the risk or other considerations, compared to the level of the risk and a low probability of the risk eventuating, it may be determined not to treat the risk other than by maintaining existing controls.

Information gathered during the risk assessment phase should be recorded. Risks should be documented in clear and understandable terms together with the assessment results (consequence, likelihood, risk level, actions to be taken, risk owner, completion dates, reporting schedule) as well as a target level which includes the level of risk acceptance or the retained level.

Once the risk evaluation process is completed, the information should be updated in the risk register.

10.1.6.1 Qualitative approach for risk evaluation

Qualitative risk analysis is usually a rapid and cost-effective means of establishing priorities for risk treatment and lays the foundation for quantitative risk analysis.

The outcomes from this analysis are used as inputs to the quantitative analysis. Once the project risks are identified and subjected to appropriate treatment (avoid, treat or minimise), the base estimates are prepared with residual risks. From these estimates, residual risks are modelled for each element of the project. This process leads to the quantitative aspect of the risk assessment which is undertaken using the department's risk assessment and rating matrix found on the department’s internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

10.1.6.2 Quantitative approach for risk evaluation

This is the process of identifying and analysing critical project risks within a defined set of costs, schedules and constraints. It is performed on risks that were prioritised through the qualitative risk analysis process. For further details on prioritisation, refer to the department’s *Project Risk Management and Contingency Development Process Manual*.

Quantitative risk analysis employs probabilistic tools and techniques such as @Risk for risk evaluation and to develop estimate contingency. This approach allows for a range of values of each input variable, namely lowest likely, most likely, or highest likely values, and is based around the modelling of individual risks, to provide greater levels of certainty and confidence.

10.1.6.3 Planned (inherent) and unplanned (contingent) risks

In the risk management process, there are 2 different models to be applied to cover planned and unplanned risks.

- Planned (inherent) risks relates to measured items, that is, items that are specifically identified within the various elements of the base estimate and which contribute to project cost. Planned risks are one dimensional, that is, they relate to

cost items that form part of the base estimate. Planned risks have 100% certainty but the consequences are variable (quantities, rates and so on). The accuracy of the quantity and rate remains uncertain or reliability of the amount in the base estimate is low.

- Unplanned risks are 2 dimensional as they may not eventuate and so both likelihood and consequence are variable. Risk can be treated independently to the quantity used and to the rate applied for each measured item (measured cost component) or simply be applied to both the quantity and rate combined.

Inherent risks can contain not only in direct costs but also in indirect costs, margin and principal's costs.

Items with no information but known to be required should be included as lump sum allowances in the base estimate and not rely on the contingent risk assessment process to make up differences. Referencing Section 4.1.5.5, provisional sums are included in the base estimate and should be treated as 'planned' risk items for contingency estimation, noting that 'if ordered' provisional items as per Section 4.1.5.4 are included in the base estimate but may not eventuate, and so their risk profile is 'unplanned'. So provisional sums and 'if ordered' provisional items within the estimate Schedule are assessed differently when developing contingency estimates.

Unplanned (contingent) risks relate to the risk attached to unmeasured items (i.e. those items not listed in the base estimate because they are unknown or loosely identified. They may or may not occur and thus may or may not contribute to project cost. Typical contingent risks include adverse weather impact, industrial issues, safety, planning approval conditions, design development, changes to design standards, client requirements, unknown geotechnical conditions, and potential claims from contractors.

10.1.7 Risk treatment

Decisions made during the risk evaluation phase will have determined which levels should be treated formally and which are within the tolerance level of the department and will be managed. This should be recorded in a risk register, along with the assessment of contingency amounts to be provided for in the project cost estimate.

The risk rating determined through the assignment of a likelihood and consequence relates to level of management or action required in managing each risk.

The risk workshop attendees are expected to validate the risk treatment response to each risk based on SMART approach which is, Specific, Measurable, Assignable, Realistic, and Time-related.

Table 10.1.7 below provides standard risk treatment methods used in the department.

Table 10.1.7 – Options for risk treatment

Treatment options	Description
Avoiding risk	The simplest and most effective way to treat risks to decide not to proceed with the activity likely to generate the risk, where it is practicable.
Reduced risks	This risk treatment deals with reducing either the likelihood or the severity of a risk through contingency planning, contract conditions, disaster recovery and business continuity plans, off-site back-up, public relations, emergency procedures, etc.
Sharing risks	Risk sharing is the process to share risks between one or more parties, ideally based on who is in the best position to control the risk. Mechanisms for risk sharing include using special contract methods, insurance arrangements and/or implementing organisational structures such as partnerships and joint ventures to spread the risk responsibility.
Transferring risks	Risk transfer is a risk management and control strategy which involves another party bearing or sharing some part of the risk using contracts, insurance, outsourcing, joint ventures or partnerships etc.
Accepting risks	Risk acceptance is an informed decision that the risk is at an acceptable level, or that the cost of the treatment outweighs the benefit.

Options for risk treatment are detailed in Section 7.5 of the department's *Project Risk management and Contingency Development Process Manual*.

10.1.8 Determine the financial impacts of the residual risks

Once the identified projects risks are subjected to risk analysis, assessment, evaluation and treatment, the financial impact of the residual risks is determined with collaboration with the attendees of the risk workshop. An appropriate allowance (or contingency) is then made in the project budget to manage the risks that are accepted (retained), should residual risks eventuate. The allowance for residual risks is the basis for probabilistic risk evaluation approach and to determine the project contingency.

The cost of risk treatment needs to be factored into the cost estimate. For example, a project may reduce the financial consequence of a risk by $1M by introducing additional controls. However, the controls may cost $500K. The cost of the controls then needs to be added to the base estimate (and will have its own inherent pricing risk).

Categories of project risks

Based on historical data, there are several major risk categories causing cost change in major projects in the department. These categories may be relied upon as a standard management tool to identify regular issues that cause change to estimated costs and help

find ways of managing them on future projects. These major risk categories form part of the overall RCP risk categories as defined in Section 10.1.1.

10.1.9 Design development change risks

Cost estimates are prepared at early project stages with limited project information available. As the project advances through the project life cycle, changes may be required to address the previously unidentified performance requirements in the scope, including the advancement of the design. Design development change risks often occur through the lack of investigation (for example, geotechnical, pavement design, environmental) and are typified by the term 'scope creep'.

The department's historical data suggest that the design development risk category can be 3%–8% of the estimated construction costs per design stage (that is, 3%–8% from strategic and detailed planning stages to business case stage to completion of development phase Stage 1 Design estimate (S1D), then another 3%–8% from S1D to development phase Stage 2 Design estimate (S2D).

Therefore, cost estimators are required to factor an appropriate risk allowance in the early cost estimates to cater for changes that may happen to the design at development and delivery stages of the project.

10.1.10 Standards and policies change risks

The specific policies or standards that may change during development, implementation and finalization phases could be unknown during the project's early stages. Therefore, designers and estimators should remain vigilant to pending standards or policy changes, so the project meets current standards before moving it through to the implementation stages.

This risk category focuses on the changes that may be required in the standards or the policies imposed by state or federal governments at later project stages. These changes are a result of continuous improvement based on ongoing research and evaluation.

The department publishes updated Technical Specifications bi-annually or, rarely, by exception, some of which incur changes to existing conditions, or impose additional requirements during project delivery phases.

One of the most critical policies with significant cost implications relates to environmental issues such as PFAS and carbon emissions trading. History has shown that PFAS costs are one of the top three cost blowouts on projects and must be calculated in detail prior to business case. This requires an agreed management planned and associated costing.

10.1.11 Third party influence risks

The costs (and time) required to investigate and manage the relocation process of third-party assets (utility adjustments) can be a significant cost to the project. It is imperative

that as much information as possible is obtained as early as possible in the early project stages and include in the cost estimates.

It is often difficult to ascertain the potential costs of adjusting existing utilities in early project stages so care must be taken to ensure that the correct scope of utility adjustments is developed and encompassed within the main construction contract. It is desirable that, at the strategic stage, the existence of utilities be investigated by visiting the site, noting evidence of services and contacting the utility authorities to confirm site observations, or obtain information that could not have been established during a site visit.

The details of utilities must be fully investigated and, where required, quotes for utility relocations must be obtained from the relevant authorities throughout the project life cycle.

Even with such quotes, still there can be a risk that costs can vary at the time of implementation. The utility authority may require the relocation costs to include an upgrade of an old pipe or to underground the electricity service in the vicinity. Therefore, appropriate contingency allowances should be made to address such situations, particularly in the early stages of a project in metropolitan areas.

10.1.12 Revised functionality risks

This risk category accounts for scope change that results in revised project benefits (either increased or reduced) at development and/or implementation phases of the project.

These changes are caused by social, economic and safety reasons, such as varied requirements for traffic capacity, axle loadings, access points, or design speed compared to that originally described at project definition. A cost-benefit analysis will determine if these changes are warranted and justifiable.

To address this risk category, substantial changes may be required in the design already completed or, alternatively, a redesign of the entire project. The appropriate allowance must be determined in consultation with the project manager and the designer to cater for this risk category and included in the contingency.

10.1.13 Principal's costs risks

The principal’s costs comprise the expenditure that the principal incurs when planning, conceptualising, developing, delivering and finalising a project. These costs apply to non-construction activities and may occur in more than one phase.

Often, the principal's cost component found to be underestimated in the project budgets. The principal's costs are expected to be developed using the first principles approach for QTRIP projects. Where an external party is engaged to estimate principal's costs, the principal should actively be engaged to guide this first principals estimate and understand unique cost profile of Principal's costs for each project. For example, rail projects will often have significant alternative transport costs which are not typical in roading projects.

However, if the principal's costs are estimated as a percentage of construction costs during early project phases, it is highly likely that such costs can change over time and therefore, a sufficient contingency allowance should be allowed for in the estimate, to reflect the risk and uncertainty in the overall project cost.

Historical data from previous projects suggest that the impact of this risk category is 30% of the unspent portion in the early stages of the project, depending on the project's complexity.

10.1.14 Project delay risks

Project delays can occur at any stage of the project's life cycle. The most common project delays occur when there are difficulties in securing funding, election caretaker periods, impact of adjacent projects, reprioritisation of project components, staff turnover, environmental issues and unforeseen natural events such as flooding and pandemic (for example, COVID-19).

Project delay risks can also be caused by changes required by the principal at later stages, such as delays in preparing and approving design drawings, underestimation of project complexity and unrealistic construction duration imposed on the project. While the project delay risks associated with the resources arise in the implementation phase, stakeholder and process-related risks are more often distributed along the project phases.

Research work undertaken in the United Kingdom (Flyvbjerg, 2004) found that projects, on average, are delayed by 20% from the date announced in the business case, to the actual practical completion date.

Project delays can cause significant impact on project budgets. For example, a $100M project that is scheduled for completion in 5 years from the business case approval date, may attract over $10M in escalation. If the project is completed in 6 years, this may increase to $17M.

This risk category is difficult to assess, so project managers and estimators should use historic data and experience to determine the appropriate contingency amount in the estimate.

10.1.15 Changes during the implementation

Some projects may undergo unplanned changes during its implementation stages. Such changes occur due to a change in tools, technologies, processes, reporting structures and resources. These changes may also result from the requests made by the principal and the contractor.

Therefore, the cost estimates must make reasonable contingency allowance to cater for any changes may happen during implementation, noting this allowance should not duplicate the category of Section 10.1.17 Unidentified Risks covering other categories such as standards changes, project delay, principal's costs risks, third party cost risk, all of which can occur during the Implementation Phase as well.

10.1.16 Property acquisition risks

Identifying risks associated with property acquisition is a complex process which is unknown in the early estimating stages. Due to this uncertainty, an appropriate level of contingency must be allowed in the business case estimate to cater for the risks associated with property acquisitions.

The risks in property acquisition may include likelihood of the value of land increasing, prolonged legal costs, time required to acquire the land changing and exceptional hardship costs.

Apart from the direct costs associated with the land to be acquired for project purposes, there can be other costs in the land acquisition process which are:

- compensation paid to landowners due to project impacts on their land
- the residual value of land temporarily acquired, or made available by demolishing existing infrastructure replaced by the project works, and
- adjustments to property access, footpaths, fences and so on.

Once the property is acquired or accommodation works finalised, the risks associated with this category may be removed.

10.1.17 Unmeasured / unidentified items risks

Despite the best efforts made to prepare P90 cost estimates at the budget setting stages of the project, there can be missing work items which were not identified or measured during strategic planning, concept and development phases; therefore, it is recommended a contingency allowance be included in the cost estimate to cater for this risk as follows:

- S2D – allow 1% to 3% of total construction cost
- business case estimate – allow 3% to 5% of total construction cost, and
- strategic estimate – allow 5% to 7% of total construction cost.

These contingency allowances account for any unidentified or unmeasured items in the work schedule, which enable the estimate to reach the required confidence level. The level of acceptable risk is dictated by the type of risk, the project and the overarching divisional risk profile.

10.1.18 Project specific risks

In addition to these main risk categories, project managers may also need to focus on project-specific risks impacting project delivery which may differ from one project to another.

Measures for these risks are not known at early project stages. The link between project-specific risks and cost impacts is more easily understood than systemic risks. These risks are amenable to individual understanding and quantification, using expected value or simulation techniques. For example, it may be possible to estimate the impact of adverse wet weather on earthworks activities accurately.

Typical project-specific risks may include:

- site subsurface conditions
- delivery delays
- constructability
- extraordinary cost impact issues to meet the rapid rise of commodity prices – Refer to the Cost Estimation and Escalation Brochure (Located on the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.) which provides guidance on how to address extraordinary cost escalation in contingency estimates
- resource availability issues, and
- contract conditions – limits of accuracy, latent condition, rise and fall, and so on.

There may be instances where the project site is located on an environmentally sensitive area or adjacent to a major railway line. In such circumstances, there can be restrictions for work operations and/or additional works may be required to satisfy the authorities' requirements.

Methods of risk analysis

There are 2 ways to analyse project risks which are:

- Deterministic approach, and
- Probabilistic approach.

10.1.19 Deterministic approach for risk evaluation

The deterministic method can involve applying a flat-rate percentage of construction to the base estimate to allow for risks and be applied to the individual RCPs to identify at early Planning Phase what the key areas of risk are likely to be, before a more detailed risk identification and assessment can be undertaken. A deterministic estimate can also be used as a comparison check of the probabilistic approach outcomes.

The contingency amounts under this approach are derived through the linear multiplication of the risk severity value and the likelihood of actual risk occurrence. These methods do not encompass the conditional nature of risk occurrences and can potentially deliver very inaccurate contingency provisions.

Under the federal policy setting prescribed in the Notes of Administration, a probabilistic cost estimation process (see Section 10.3.2) must be used for all projects seeking Commonwealth funding which have a total anticipated outturn cost (including contingency) exceeding $25M. For projects under this threshold a deterministic methodology can be used to estimate contingency although probabilistic methods are recommended if possible.

10.1.20 Probabilistic approach for risk evaluation

A probabilistic risk evaluation approach is a form of quantitative risk analysis which uses the Monte Carlo simulation to develop a contingency component to account for residual risks. This simulation process is a technique that allows cost estimators to account for risks using a quantitative risk analysis approach.

The rationale behind the probabilistic approach is the project's final costs are better depicted by a range of values with associated probability, rather than a single deterministic value due to the variance that this single deterministic outcome has from the range of potential final cost outcomes, when risks with differing likelihood and consequence are present. This is because when multiple risks with differing likelihood and consequence are present, the range of potential final cost outcomes can vary significantly from the single deterministic outcome.

Monte Carlo simulation is a statistical sampling technique used for probabilistic risk evaluation which generates a sample of several outcomes of a model, all of which are possible. The likelihood of outcomes in each range is determined by the probability density functions of the inputs and is taken to reflect the likelihood of an outcome in that range arising.

It runs many iterations of different cost combinations for an estimate element to build up a probability distribution of overall project cost.

The probabilistic risk evaluation approach provides following advantages over deterministic approach:

- Probabilistic results show not only what could happen but also how likely each outcome is to occur.
- The graphical results that it generates for different outcomes and their chances of occurrence are an effective communication tool for use with stakeholders.
- Sensitivity analysis provides a tool for ranking inputs that will have the biggest impact on final outturn cost. In single point estimates it is difficult to see which variables are likely to impact the outcome most, and
- In deterministic models it is difficult to model different combinations of values for different inputs to see the effects of different scenarios. Monte Carlo simulations address this issue.

Prior to applying this model for risk evaluation process, the estimators must define appropriate cost variation ranges for both planned and unplanned risk elements. These ranges must be determined based on the understanding of the project stage and the likelihood of the risk to be eventuated.

Refer to the department's *Project Risk Management and Contingency Development Process Manual* for more details on the selection of appropriate ranges for Monte Carlo modelling.

10.1.20.1 Choice of probabilistic distributions

Most probabilistic risk evaluation software such as @Risk provides a variety of probability distributions for risk modelling. However, the most common distribution types used to model risks associated with transport industry are Uniform, Triangular, Pert, and Discrete.

The estimated quantities and rates can vary in the base estimate and therefore, they must be subjected to a probability distribution to allow for uncertainty and variation in their quantitative value.

This variation is known as quantity and rate risks (or planned risks) which are analysed using continuous probability distributions such as Triangular and Pert.

Unplanned risks have 2 risk dimensions (risk severity and the likelihood) which can vary independent of the other and can have significant impact to the overall costs.

Due to 2 dimensional nature of the unplanned risks, they are modelled using Discrete, Bernoulli or Binomial distributions.

The probability distribution adopted must be based on historical records, industry performance, technical capabilities and other relevant performance information. The probability distribution must be chosen to represent the variance of the estimated value in a probabilistic model of the estimate.

Refer to the department's *Project Risk Management and Contingency Development Process Manual* for more details on the probability distributions used for Monte Carlo modelling.

Contingency development, management and reporting

The contingency component in the cost estimate is determined to reflect the confidence and the reliability of the information used to prepare the estimate by taking into account the risks associated with the project.

The contingency component is determined from the risk management process described in Section 10.1 of this document. The contingency derived from the risk management process includes costs associated in managing:

Planned Risks – contingency for Construction Contractors and the Principals Costs components.

Unplanned Risks – project wide contingency component which refers to the Cost Estimation and Escalation Brochure which provides guidance on how to address extraordinary cost escalation in contingency estimates and is reported separately within the project cost estimate presentation for transparency.

Table 3.3.7 of this document outlines the expected range of contingency for a typical project, but it is the project manager's responsibility to ensure the contingency applied to project is at appropriate level.

Refer to the department's *Project Risk Management and Contingency Development Process Manual* for more details on how to develop contingencies.

10.1.21 Reporting contingencies

The contingencies that were included in the early project estimates must be regularly reviewed and adjusted as the project progresses through the project life cycle.

The regular reporting of project contingencies has several benefits to the project, which are:

- enabling the project team to control the contingency usage during project lifecycle
- forecasting that prevents overspend of contingency and overall project budget
- rescoping or descoping project tasks or activities early enough so the overall project budget will not be exceeded, and
- identifying potential shortfalls for contingency during the lifecycle of the project.

Key items to include in the contingency monitoring are:

- initial contingency budget allocation
- contingency expenditure to date (contingency utilisation),
- contingency available (unutilised contingency)
- forecasted future contingency utilisation (contingency demand)
- contingency demand baseline

- remaining contingency and unallocated contingency (potential contingency surplus)
- opportunity value offsetting contingency demand
- issues or ineffective treatments requiring ownership and remedial attention, and/or
- a statement on project risk and overall contingency health to the completion of the project.

Please refer to the *QTRIP Savings Management Policy* available on the department's internal PIP SharePoint site for more information on contingency reporting. External parties can request copies from estimating.support@tmr.qld.gov.au.

11 Estimation of non-road infrastructure

This document has an increased emphasis on cost estimating for all modes of transport projects spanning road, rail, maritime, public transport and active transport infrastructure on freight, commuter, and recreational networks. The purpose of this chapter is to provide rules and standards for the preparation of cost estimates for infrastructure projects in the QTRIP other than roads and bridges including:

- rail transportation systems (including light rail)
- marine environment infrastructure
- Intelligent Transport Systems (ITS), and
- bus transport infrastructure.

The contents in this section should be considered as additional information on rail and other infrastructure projects compared to the previous sections of this document.

11.1 Rail infrastructure

The department is responsible for planning, developing, and delivering large rail infrastructure projects. To support this new responsibility, the departmental staff (districts, Rail Division and Translink Division) are required to develop cost estimates for rail delivery projects. This document was updated with rail specific information to support this function.

Rail projects use manufactured items of a proprietary nature such as turnouts, signalling, communications, power equipment, rolling stock and so on. As with any type of project, the cost estimators are required to gather information on items of proprietary nature before commencing the cost estimating process.

Rail construction works carried out within the operating rail networks must be planned and estimated around possessions, which are windows of time when normal train operations are shut down and site access is provided to enable work to take place. Therefore, the production rates will have to be considered from project to project.

The influence of planning around possessions makes rail construction cost estimating different to cost estimating for roads construction and more variable. For rail infrastructure projects compared to road infrastructure, risks exist specific to rail (such as possession planning) that need to be considered. Refer to Section 10 of this document.

From pre-planning stages through to project delivery, there are many factors that differentiate rail projects from road infrastructure projects that can have considerable impact on the costing outcomes.

Section 5.1 of this document details the factors influencing road projects. The key factors affecting rail cost estimates are:

Costing of rail systems such as signalling, and communications requires specialist knowledge and needs considering the interim staging of the works, especially in brownfield, operating railway environments.

Projects in brownfield rail reserves tend to result in extended program duration due to access restrictions – as work needs to be scheduled around operational requirements. This results in the proportion of indirect costs being higher when compared with a road project.

Additional requirements from the operator including maintaining continuity of rail operations throughout the construction adds to the complexity of site works and significantly increases the indirect job costs.

Rail construction requires services of specialist rail approved contractors who are accredited under the Rail Safety National Law (RSNL) by the Office of National Rail Safety Regulator (ONRSR) to undertake work in rail corridors. This added regulatory requirement adds to the complexity of undertaking rail projects and needs to be considered when estimating rail projects.

Rail projects require a significant level of proprietary or manufactured items such as turnouts, signalling, communications and power equipment which may be produced overseas and have long lead procurement timeframes. These items are specialist in nature and can contribute significantly to the cost of rail construction and extend delivery timeframes.

Working within a live railway network corridor may require either night-time or weekend closures of the operating railway via the Scheduled Corridor Access System (SCAS). Depending on the frequency and duration of the SCAS regime, this will impact on productivity of labour and plant. These items would incur additional costs for unproductive utilisation (standby hire charges), as well as increased labour costs due to night-time, weekend works.

The SCAS regime may also attract Alternative Transport Costs (ATC) to maintain passenger transport services. When rail passenger transport services cannot operate (for example, during a SCAS) Alternative Transport Services (ATS) are required. Projects are required to fund the ATS if the SCASs occur outside of Queensland Rail’s maintenance regime (included in the Transport Services Contract (TSC) funding.

Therefore, the rail cost estimates for projects in brownfield environments must be broken down by possessions rather than work type.

Working on or near energized rail lines require specialised equipment controls, isolations and an approved contractor.

Working close to a live railway requires additional supervision from track protection officers (spotters) and lower productivity as works need to be stopped while trains are passing through.

Rail project sites are linear and with restricted access which can have significant impact on construction methodologies, haulage of construction materials, and dimensions of plant that can be utilised.

The rail corridor has increased risk of subsurface obstructions and/or soil contamination, due to historical usage of the corridor.

There is a risk of late hand-back and/or delay risk if planned works are not completed within SCAS windows.

Where possessions require the cessation of certain rail services during construction, cost estimates need to include estimates for operating substitute bus services.

The additional costs of complying with rail operator's safety, access and methodology requirements needs to be considered and can add significantly to a project estimated costs.

The following should be referenced when developing cost estimates for rail projects:

- Transport and Main Roads *Project Cost Estimating Manual*
- the OnQ Project Management Framework
- the Queensland Rail Project Management Framework, and
- the Best Practice Cost Estimation for Publicly Funded Road and Rail Construction Guide.

List of Queensland Rail reference documents for rail projects available on the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

The Project Certification Baseline (PCB) agreed with Queensland Rail at the time of project commencement (See a sample PCB on the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.)

In addition to scope definition requirements specified in Section 5.1.1, the following additional requirements also should be considered for rail projects:

- requirements for enabling works, staging and commissioning strategy
- constraints (available possessions, access to the existing infrastructure, current traffic, existing rail systems technology, commissioning strategy), and
- key interfaces with current and future projects – as it is understood at the time of preparation of the estimate.

11.1.1 Physical scope criteria

Rail specific physical scope criteria that need to be considered include:

- the nature of work (new track and systems infrastructure, integration / modification of existing rail and system infrastructure and platforms / passenger services)
- the extent or limit of works (so there is less uncertainty as to the extent of works costed)
- any assumptions made in the design of key features
- any / all interfaces, such as property, connection to the existing track (turnouts), existing overhead and signalling infrastructure and so on, and
- PUP and signalling services relocations as these are significant cost elements.

The condition of existing assets if integration / modification of existing rail infrastructure is within scope.

Where information is not provided for the preparation of the estimate, the assumptions made must be recorded in the estimate report and adequate risk allowances considered in the estimate.

11.1.2 Work breakdown structure for rail projects

Historically the cost estimates for rail projects were developed using the benchmark cost information. The cost estimates and tender schedules prepared using benchmark information lacks granularity and consistency and have high risk of cost overruns at the delivery stages.

To provide the same level of consistency, transparency, and quality as in road projects, the department has developed and released the construction WBS for rail infrastructure projects on following rail disciplines:

MRS330 – *Trackwork*

MRS331 – *Overhead Line Equipment* (OHLE)

MRS332 – *Power Supply and Distribution*

MRS333 – *Signalling and Communication*

An extract of a work breakdown structure for rail is given below in Figure 11.1.2.

Figure 11.1.2 – Example extract of a construction work breakdown structure for rail

MRS LEVEL	GROUP LEVEL	SUB GROUP LEVEL	ITEM LEVEL
MRS330	Trackwork	Trackwork Removal / Demolition	Removal or demolition of track, complete
			Removal or demolition of turnouts and catch points
			Removal or demolition of diamonds
			Removal or demolition of ballast
		Trackwork Modifications / Renewals	Removal or demolition of sleepers
			Removal or demolition of guard rail vees
			Removal or demolition of derailers
		Trackwork Construction	Construction of turnouts and catch points
			Construction of diamond
			Installation of ballast
MRS331	Overhead Line Equipment	OHLE Removal / Demolition	Removal or demolition of OHLE foundations
			Removal or demolition of OHLE masts
			Removal or demolition of OHLE bonds
			Removal or demolition of OHLE wiring
MRS332	Power Supply and	Power Supply and Distribution Supply	Supply of booster transformer, [description]
			Supply of auto transformer, [description]
			Supply of power transformer, [description]
MRS333	Signalling and	Movement Control System	Supply of signal telephones
			Installation of signal telephones
			Supply and installation of signal telephones

The 4 rail disciplines listed above are also aligned with the federal PCB template. The full rail WBS can be found in Annexure M of PCEM.

11.1.3 Work Item numbering system

The work items in the construction WBS and principles WBS for rail projects also defined by a unique number, description and unit of measurement according to the standard work items numbering system detailed in the department's MRS01 *Introduction to Technical Specifications* and the Section 4.1.5 of this document.

This numbering system is used as the basic building block to develop the construction activities. The MRS system describe the work activities and define quality standards measurement for each item of work. All cost estimates prepared for departmental projects must reference to the MRS numbering system.

11.1.4 Principal's costs

For rail projects, principal's costs include the costs incurred by both the department and Queensland Rail across all phases of the project life cycle.

Those costs include items such as project management, consultancy, community consultation, public utility plant, rail enabling works, track protection, Queensland Rail supplied plant and equipment, commissioning, ticketing and wayfinding and land resumption.

Table 11.1.4(a) details benchmark client costs based on historical data to assist in preparing pre-business case project cost planning and reviewing post business case estimates.

Table 11.1.4(a) – Benchmark principal's costs at development phase

Phase activity	Complexity	Agency	Benchmark costs
Project management	All	Department	1 - 2% of the construction costs
	All	Queensland Rail	3 - 4% of the construction costs
Development phase Stage 1 and Stage 2 design	Typical	Department	3 – 4% of the construction cost
	Complex	Department	6 – 8% of the construction cost
Civil Stage 1 and Stage 2 design	Typical	Queensland Rail	7.5 - 10% of the civil construction costs.
	Complex	Queensland Rail	10 - 15% of the civil construction costs
Track Stage 1 and Stage 2 design	Typical	Queensland Rail	7.5 - 10% of the track construction costs
	Complex	Queensland Rail	10- 15% of the track construction costs
Signalling and telecommunications Stage 1 & Stage 2 design	Typical	Queensland Rail	7.5 -12.5% of the signalling and telecommunications construction costs
	Complex	Queensland Rail	12.5 - 20% of the signalling and telecommunications construction costs
Overhead Stage 1 and Stage 2 design	Typical	Queensland Rail	8 - 12% of the overhead construction costs
Commissioning (costs associated with bus replacement and TPO's)	Typical	Queensland Rail	10 – 12% of the construction costs.

The relevant project delivery method will be determined in consultation between the department and Queensland Rail.

The costs and time required to investigate and relocate rail structures and rail systems must be kept separate from the costs of the proposed scope of works, as relocating rail structures and rail systems are rail enabling works. The works required prior to the implementation phase must be understood early in the development of the project life cycle.

Table 11.1.4(b) below provides benchmark principal's costs at implementation for rail projects.

Table 11.1.4(b) – Benchmark principal's costs at implementation phase

Implementation phase activity	Type	Agency	Benchmark costs	Comments
Project management	All	Transport and Main Roads	1 – 2% of the construction cost	Both percentages to be applied.
	All	Queensland Rail	3 - 4% of the construction costs	
Contract administration	Typical	Transport and Main Roads	5.5 – 6.5% construction cost	Both percentages to be applied.
		Queensland Rail	3 – 4% construction costs	
	Complex	Transport and Main Roads	10% construction costs	Both percentages to be applied.
		Queensland Rail	5 - 7.5% construction costs	
Environmental management	Typical	Transport and Main Roads	1 – 4% of the project costs	Environmental cost can be highly variable and higher especially if a project triggers land contamination, extensive offsets, complex erosion control or extensive fauna mitigation is required.
		Queensland Rail	Needs to be determined	
	Complex	Transport and Main Roads	5% +-	
		Queensland Rail	Needs to be determined.	
Materials	All	Transport and Main Roads	Not applicable	Materials provided by Queensland Rail and costed to the project.
		Queensland Rail	Queensland Rail to provide sleepers and rail	

Implementation phase activity	Type	Agency	Benchmark costs	Comments
Enabling works	All	Transport and Main Roads	Not applicable	
		Queensland Rail	Scope of works to be determined & priced.	
WHS & PLSL	All	Transport and Main Roads	0.575% of the project total less resumptions plus GST.	Check WHS website for the current rate.
Principal arranged insurance	All	Transport and Main Roads	Refer to the Annexure F – Principal Arranged Insurance of this document.	Contract works professional indemnity Public liability
Project management	All	Transport and Main Roads	1% of the construction cost	Both percentages to be applied.
		Queensland Rail	1% of the construction costs	

11.1.5 Property acquisition (resumptions)

Rail project property resumption costs may include:

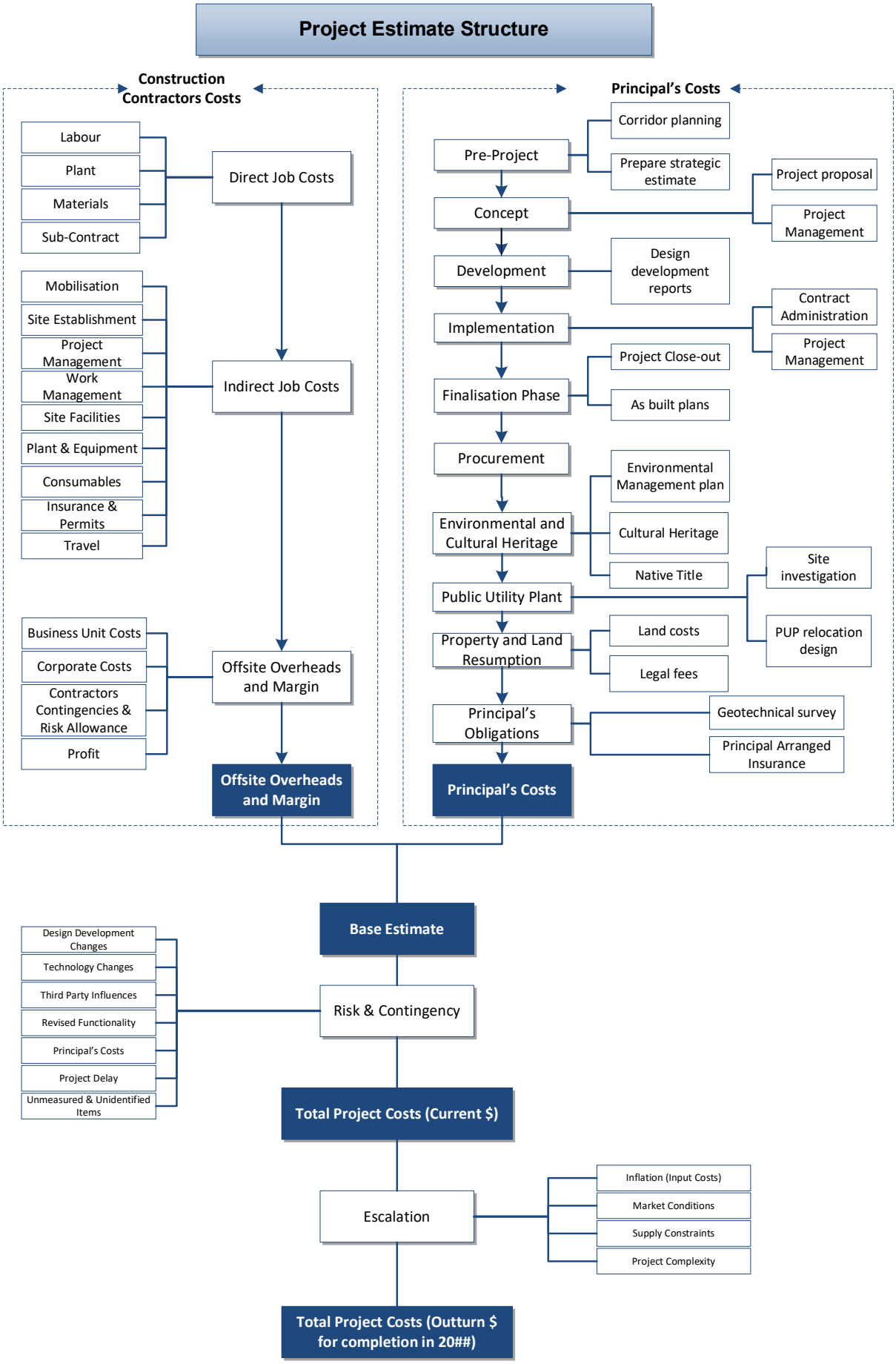
- actual areas acquired or utilised permanently for the project, including easements and acquisitions
- land that permanently / temporarily required for compensatory habitats and contractor’s work sites
- the department and Queensland Rail site offices and facilities area (if separate from the contractors' site), and
- land required by the department and Queensland Rail, to be undertaken as part of the project. Refer to Section 3.3.6.1 of this document for more details on resumptions.

11.1.6 Rail project estimate structure

Figure 11.1.6 illustrates the standard project estimate structure for a rail project. This structure is provided within an overarching elemental allocation of estimated costs across:

- Rail Corridor (at grade / elevated)
- Track (rail / sleepers / ballast / turnouts)
- Stations (platforms / building / structures / concourse)
- Cross corridor access (pedestrian / traffic)
- PUP relocations
- Signalling (ETCS), and
- Traction Power.

Figure 11.1.6 – Rail project estimate structure



11.1.7 Time critical activities

The following time-critical activities should be considered when preparing cost estimates for rail projects:

- timeframes to access the corridor as per SCAS
- ordering key material and/or equipment that is specific to rail such as custom-made turnouts, signalling equipment, points and so on, and
- timeframe required to complete enabling works, if applicable.

11.1.8 Track closures

Track closures will be required to undertake maintenance, and upgrade works on operating rail lines. There can be 2 types of track closures:

- night-time closures required for planned and corrective works on all asset types, and
- SCAS for major maintenance and construction works.

SCAS involves the closure of a section of track at planned times throughout the year and are broken down in to network zones. There are 7 network zones across the network and there are designated weekend shutdowns, which vary depending on the rail line, per network zone per year.

The following SCAS timeframes need to be considered from a time and cost perspective when developing cost estimates for rail projects and should include consideration of broader processes such as extended possession handbook:

12+ months prior – Initiation of a SCAS possession bid, plus the timeframe when Queensland Rail respond to possession bids. The subsequent approval steps are operational and only proceed if Queensland Rail awards a possession slot after the initial bid phase.

Once a possession bid has been approved, the following timeframes apply:

- 10 to 6 weeks prior – Expression of interest
- 6 weeks prior – Planning and site meeting
- 6 to 4 weeks prior – SCAS approval process
- 30 days prior – SCAS application work changes cut-off date
- 4 to 2 weeks prior – Plotting of works
- 5 days prior – SCAS coordination package
- 3 days prior – pre-SCAS meeting, and
- 0 days – SCAS closure.

These are latest possible dates and preferably submissions are received earlier to allow time for resubmission if necessary.

11.1.9 Risk and contingency assessment

Refer to risk categories of Section 10.1, and extra-ordinary local contingency items covered in the Cost Escalation and Estimation Brochure, to cover rail specific risks.

Based on historical trends in cost data, the categories of cost change for rail projects are:

- Rise and fall in material costs.
- Procurement risk (specialist overseas equipment).
- Additional governance risks.
- Specialist resources availability (protection, signalling design).
- Technology / standards change (covered in Section 10.1.10).
- Possession planning and associated delay risk.
- Limited number of approved / qualified suppliers.
- Risk adverse contracting strategies.
- Increased demand for rail performance requirements.
- Additional rail safety requirements.
- Modern technology.
- Increased minimum design standards as below:
  - adoption of 6 m track centres
  - increased requirement for head hardened rail
  - increased axle loads
  - increased curve radius, and
  - adoption of Q100 flood immunity.

Figure 11.1.6 illustrates the standard project estimate structure for a rail project.

11.1.10 Escalation

The escalation for rail projects is estimated in a similar way to the road projects as described in Section 4.1.11.2 of this document.

The Australian Government has developed spreadsheet-based Project Cost Breakdown (PCB) templates which reflect the principles of estimate preparation and presentation for nationally funded rail projects. It has inbuilt escalation rates for rail projects which must be used to produce outturn costs for rail projects.

An adjustment may be adopted for project-specific local risk factors, known as the extraordinary cost risk contingency buffer. Extraordinary escalation risk is treated as part of the risk and contingency estimate, not as part of the escalation calculation. Refer to the Cost Estimating and Escalation Brochure for further detail.

The rail PCB template is a standardised high-level summary of key cost data which draws on the same data sources used to develop the project's base estimate. The WBS headings for rail construction costs in the rail PCB template identifies elements for rolling stock, rail systems, stations, trackwork, and so on.

The federal Notes on Administration (NOA) requires that rail estimates included in Project Proposal Reports (PPR) for projects with an Australian Government contribution above $25M to be accompanied by a completed rail PCB template.

The escalation rates for rail projects can also be downloaded from the department's internal SharePoint site. External parties can request copies from estimating.support@tmr.qld.gov.au.

11.2 Marine infrastructure

11.2.1 Types of marine infrastructure

Marine infrastructure also has a unique set of challenges and costs that are not associated with land-based transport.

The department also delivers and maintains a variety of marine infrastructure projects such as:

- boat ramps / barge ramps
- pontoons and floating walkways
- aids to navigations
- dredging
- beach nourishment
- breakwaters
- jetties
- berthing dolphins and fender piles, and
- ferry terminals.

11.2.2 Locality

The estimator must consider how remote the facility is, tide availability at the proposed time of construction, the accessibility of the facility and how this affects contractor establishment costs and the transportation of materials to site. The remoteness also affects the costs for administering the contract / witness.

11.2.3 Availability of site information

Depending on the nature of the work, the availability of site information affects costs (risk management). This typically includes geotechnical information, sediment sampling analysis, wave climate information, wind climate, hydrographic bathymetry data, and land survey data. If these data sets are not available at the time of the cost estimate, then

allowances must be made for the risks associated with the lack of available information. Undertaking of any site investigation / analysis tasks if required must be included in the cost estimate.

11.2.4 Risk and contingency allowance

There are several risks that are common to marine projects that should be assessed and used to determine a suitable contingency allowance. These risks include:

- Poor geotechnical properties affecting pile embedment depths and settlement, which may increase the rock volumes.
- Water levels impacting on construction timing and method - tidal and freshwater (flooding and weir levels).
- Existing users at the site that may need to be accommodated in the scope of works, design changes or timing of the works e.g. recreational boats, commercial barges, commercial fishermen, etc.
- Limited number of experienced / suitable marine contractors particularly for dredging works and remote locations.
- Lack of alternative facilities, meaning an existing ramp cannot be fully closed during construction requiring extra traffic management, safety considerations, complex construction method and extended contract period. Alternatively, site works may only be allowable outside school holidays to avoid the peak usage time by boats.
- Risk adverse contracting strategies (e.g. sole supplier).
- Marine Park and Fish Habitat Area (FHA) and protected marine plants constraints – costly and time-consuming revocations may be required, and
- Land tenure – complexities involving the land tenure for new or upgraded facility can impact on delivery timing.

11.2.5 Statutory approvals required

For works that will require statutory approvals (for example, Development Approval, Tidal Works Approval, Marine Park Permits, Sea Dumping Permits, Environmental Authority), the estimator must price in the work required to prepare approval applications and associated fee payments.

Aids to navigation are typically exempt from tidal works approvals and Marine Park approvals.

11.2.6 Complexity of design

For projects that are considered complex (that is, not routine, difficult site situations such as exposed to extreme weather events, unusually imposed load spectrum, or unprecedented design situations), the estimator must make allowance for the higher-level design development required.

11.3 Intelligent transport systems

Intelligent Transport Systems (ITS) represent a transformative approach in managing and improving transport infrastructure. The incorporation of advanced technologies through ITS projects enhances traffic flow, decreases congestion, and boosts the safety and overall efficiency of the transport network. ITS facilitates sweating the asset, allowing roads to accommodate higher volumes of vehicles over a longer period by optimising the available pavement capacity – delaying the need for large scale capital investment to add lanes. ITS encompasses a broad range of elements from managed motorways features to en-route traffic and traveller information systems and traffic monitoring tools.

Examples of ITS include Managed Motorways (ramp metering, lane use management systems and variable speed limits), En-route Information Systems (such as variable message signs), traffic control (such as traffic signals), and vehicle detection, classification and monitoring (such as CCTV, loops, Bluetooth, weigh in motion and so on).

ITS projects involve a complex combination of the provision and/or alteration of:

- information technology systems
- field device technologies
- business systems
- technical documentation (including O&M manuals, asset data through BIM and ROAR and to support asset management processes, and commissioning configuration & testing information)
- various power supplies (including mains and solar) & telecommunication services (including other than fixed services), and liaison with numerous other services, and
- network operating plans, standard operating procedures, workflow documentation, field device status monitoring and maintenance requirements.

Changes to one component of an ITS project may have a significant impact on another area, for example, a change of communications hardware at one site may affect the transfer of data back to the server for multiple devices.

Additionally, recent technology solutions will need to be evaluated against ITS application and technology roadmaps, including potential integration / interfacing with, and/or replacement of, existing legacy systems. Each of these changes typically requires lead times ranging from 6 months to 2 years (or more). Option analysis will need to consider the whole-of-life cost implications of each of these changes, including operation and maintenance implications during the project lifespan and beyond (particularly enforcement and traffic management implications).

ITS projects can be delivered either as stand-alone projects or as part of an overall civil road infrastructure project, where careful coordination is required to ensure construction staging considers ITS hardware integration to limit project delays and cost over-runs.

Understanding the various disciplines required to implement ITS along with the iterative design and implementation process is required to maximise value and achieve the most cost efficiency ITS solution.

Most typical ITS projects require civil works such as the installation of underground cable pits and ducts or mounting structures such as gantries and poles on which to attach and access roadside ITS hardware.

Further information about ITS treatments can be found in the department's Smarter Solutions: Network Optimisation Framework, which provides direction about what should be considered when making planning and investment decisions to ensure the department is getting the most from existing assets and using infrastructure smarter and more efficiently than before.

A detailed concept of operations for the operation of new or existing infrastructure, including systems integration should be developed and agreed to prior to undertaking detailed design of any ITS equipment, to ensure appropriateness of any technology delivered.

11.3.1 Procurement

It is important that an ITS procurement strategy considers the volume of work, budget, reliability and maintainability and involves asset management and operations from the very start of the project.

Procurement planning needs to consider the most suitable delivery / works packaging as well as procurement / contract methods.

When determining work packages for a project, thought should be given to:

- the full range of risks, such as equipment lead times, not just coordination between contractors on a site
- the entire sequence of delivering quality data (which many systems rely on)
- existing departmental technical specifications for ITS equipment and processes
- whether any ITS, in particular performance monitoring devices, should be deployed prior to civil works to allow project monitoring, and
- how new devices will integrate with legacy Transport and Main Roads systems.

11.3.2 Resources

Human resources involved in ITS projects include:

- project management / contract management
- electrical trades
- electrical engineering / civil engineering
- structural engineering

- telecommunications experts
- information technology / computer science engineering
- traffic / transport engineering
- systems engineering, and
- vendor resources.

It is important that continuity of key technical staff to support the project are maintained throughout the process, including the finalisation and handover stages.

11.3.3 Principal's costs

For ITS projects, principal's costs will include the costs incurred by department throughout the project life cycle. Further to that mentioned in the previous sections of this document, thoughtful consideration also needs to be given to:

- commissioning costs
- ongoing operations
- asset management, and
- systems integration.

11.4 Busways and tunnels

A typical busway or tunnel project will incorporate pavements, mechanical and electrical systems, structures, and ITS features. Thorough planning is required to ensure that all systems are integrated correctly. Estimation of these projects should consider the following items:

- fire, life and safety devices
- heating, ventilation, air conditioning
- ITS
- hydraulics (such as stormwater pumps)
- closed-circuit television and other communication systems
- emergency gates
- traffic control systems and software
- dynamic signs
- encoders, sensors, switch boards
- electrical systems, and
- station, tunnel and road lighting systems.

After construction is complete, the department is expected to develop a routine maintenance regime for handover to the applicable maintenance contractor.

The estimates and budgets for these systems should consider costs associated with intensive planning, design by specialist staff, preparation of maintenance regimes and contracts and developing asset management systems.

12 Glossary of terms

Term	Definition
3PCM	Portfolio, Program, Project and Contract Management (3PCM) system of the department which is based on the Oracle Primavera suite of products. It incorporates Oracle Primavera Portfolio Management (OPPM), Oracle Primavera Unifier (Unifier) and Oracle Primavera P6 – EPPM (P6).
Accountability	The final responsibility for completion of tasks and achievement of results within delegated authority and to established performance standards.
Activity	An element of work performed during a project. An activity normally has an expected duration, cost and resource requirement. Activities can be subdivided into tasks.
Actual cost	The final outturn dollar expenditure on a project.
Anticipated final cost	The sum of expenditure to date, plus the forecast expenditure, in outturn dollars, to complete the project.
Agreed Project Delivery Value (APDV)	Agreed Project Value is the revised project budget at contract award.
Base date	A base date is a reference date from which changes in conditions, including rates and standards can be assessed. In the context of a base estimate, it is the date for the cost estimate reflect current market conditions.
Base estimate	The sum of the construction costs and principal's costs which represents the best prediction of the quantities and current rates for a given scope of work. It does not include any allowance for risk (contingency) or escalation.
Benchmarking	Gathering, collating, and analysing historical data and storing it for future use.
BIM	Building Information Modelling – a process that uses digital representations of physical and functional characteristics of a building to facilitate planning, design, construction, and management throughout its entire lifecycle.
BPIC	Transport Best Practice Industry Capability policy which is now partially made redundant
BPP	Best Practice Principles under the Queensland Procurement Policy and Key Result Area (KRA) reporting requirements
Budget	The budget is the approved amount of funding for a project. This may be different to the estimates throughout the project life cycle.
Business case estimate	An estimate prepared during the concept phase to support the project's business case which is also used for setting budgets.

Term	Definition
Candidate project	A body of work identified in TSM Phase 3 that with approval may become a project.
Cashflow	Cash flow is the projected costs of a project across the project duration.
CBRC	Cabinet Budget Review Committee.
Component	A definable part of a project, including stages of planning, design and construction that contribute to the total project cost.
Concurrence review	An independent third-party review of a project estimates where the estimator, sponsor and reviewer agree regarding the estimate metrics.
Construction estimate	An estimate produced after acceptance of the successful tenderer just prior to the implementation phase.
Contingency	A contingency reserve is money or extra time included in the project's budget or schedule to assist the project successfully navigate uncertainties or unforeseen events that might occur during the implementation.
Development Phase Stage 1 Design (S1D) cost estimate	The estimate of all components of a project prepared based on preliminary design. It provides a check of the alignment between the project estimate and the approved scope / budget. It occurs immediately prior to the S2D and is expressed in outturn dollars. (Formerly preliminary design).
Development Phase Stage 2 Design (S2D) cost estimate	The estimate prepared prior to calling tenders and based on detailed designs, construction specifications and project documentation. It is expressed in outturn dollars. (Formerly detailed design).
Enrich Investment	Enhancing the quality, value, and readiness of a proposed transport infrastructure project so that it meets the criteria for inclusion in QTRIP involving careful planning, rigorous analysis, and strategic alignment with the Queensland Government's transport objectives.
Escalation	The allowance included in the cost estimate to cater for factors such as inflation, market conditions, supply constraints and market fluctuations. Escalation is added to the project cost to obtain the outturn cost
Escalation rate	A rate derived from actual or forecast composite index series by the Australian government that reflect the characteristics of infrastructure projects.
Estimated final cost	See anticipated final cost.
Estimate for Comparison with Tenders (EFCT)	The estimate prepared at the tender stage to assess tenders' bids. This estimate only considers contract scope, not the whole project.

Term	Definition
Estimate probability	Ensuring that estimates have been prepared as prescribed and in accordance with the requirements and appropriate ranges for the different project phases and stages – either P50, P75 or P90.
Estimated total project cost	The total project cost is the sum of the base estimate plus contingency plus escalation, expressed in P90 values. This is also referred to as the total outturn cost. See also total project cost.
Expert Estimation	Department's preferred software application to compile estimates from first principles.
Estimate report	A report containing the estimate and details of the estimating processes, assumptions, inputs and so on.
FFA	Federation Funding Agreement Schedule on Land Transport Infrastructure Projects
First principles estimate	The method of preparing a cost estimate by breaking down the project into a work breakdown structure and determining rates and quantities for each component. The cost estimate is the summation of each component
Global estimating	An estimating method based on an all-inclusive unit rate, such as $/km of road. Also known as order of magnitude estimating.
Indirect costs	These are costs not directly attributable to work items. For construction activities these costs include on-site overheads (such as site supervision) and off-site overheads (contractor’s corporate / business costs). They are exclusive of contractor’s contingency and profit.
Inflation	An allowance for the rising cost of the project due to rise and fall factors external to the project definition.
Integrated Project Management Framework	The department's integrated operational model for qualifying, selecting and managing projects through their life cycles.
ISC	Infrastructure Sustainability Council.
Margin	An allowance that includes the contractor's corporate overheads and profit.
NoA	The Notes on Administration for Land Transport Infrastructure Projects 2024-29 (NOA), issued by the Department of Infrastructure, Transport, Regional Development, Communications and the Arts.
OnQ	Department's project management framework that provides direction and guidance for effective management and delivery of projects.
NTT	Notice to Tenderers.

Term	Definition
Optimism bias	The tendency for people to be overly optimistic regarding project costs and planned durations.
Oracle Primavera Portfolio Management (OPPM)	Comprehensive portfolio management solution that allows organisations to manage the project portfolios effectively, ensuring that they align with their strategic objectives and deliver the expected results.
Oracle Primavera Unifier	Oracle Primavera Unifier is a cloud-based project lifecycle management solution that provides comprehensive capabilities for managing programs, capital projects and contracts
Oracle Primavera P6	It is an integrated project management and work scheduling solution, used to deliver capability that will enable integrated planning, project schedule and resource management across the solution.
P50 estimate	An estimate with a 50% confidence of not being exceeded at project completion, while not being overly conservative.
P90 estimate	An estimate with a 90% confidence of not being exceeded at project completion, while not being overly conservative.
Pareto principle	Pareto principle, also known as the 80/20 rule, is a theory maintaining that 80% of the output from a given situation or system is determined by 20% of the input.
PCB	The project cost breakdown developed and managed by the Australian government which contains escalation rates.
PFAS	PFAS are per- and polyfluoroalkyl substances which is highly mobile in water, travel long distances from their source-point, do not fully break down naturally in the environment, and toxic to human and animals.
Peer review	A review of the project estimates by an independent, experienced estimator from within Transport and Main Roads.
Portable Long Service Leave (PLSL)	As the building and construction industry is project driven, it would be impossible for most workers to accrue enough service with one employer to be eligible for long service leave. Portable long service leave provides long service leave entitlements to workers in the building and construction industry as they move between projects.
Portable long service leave levy	This levy is collected solely to fund the building and construction industry Portable Long Service Leave Scheme. If the work is being done for a local government or non-Queensland Government entity, the local government or entity is responsible for payment of the levies and fee.
Preliminary design estimate	See development phase stage 1 design estimate.

Term	Definition
Principal Arranged Insurance (PAI)	Principal arranged insurance is insurance arranged by an agency representing a principal to cover the agency, principal, contractors and subcontractors and other service providers in respect of risks under contracts let by the principal. The premiums may be paid by the agency or by each contractor to the principal.
Principal's costs	Principal's costs are those costs which the department incurs to conceptualise, develop, deliver and finalise a project. These may include community consultation, environmental assessment, design planning, services relocation, resumptions, accommodation, site investigations, and principal supplied material and so on.
Probabilistic estimating	A method of generating estimates which takes into consideration that quantities measured (or allowed for) can change, rates assumed can vary and risk with a probable outcome can materialise.
Program	A group of related projects managed in a coordinated way to obtain benefits and control not available from managing them individually.
Program manager	The person responsible for leading and managing a group of projects. The program manager interacts with each project manager to provide support and guidance on individual projects.
Program of works	The planned durations for performing activities and the planned dates for reaching milestones.
Project	A temporary endeavour undertaken to create a unique product, service or result. It has a clearly defined scope, start and end time, a structured set of activities and tasks, a budget and a specified business case.
Project manager	The person responsible for managing a project and achieving its objectives. Manages all activities necessary to deliver the project or services to the required quality standard and within the time and cost constraints.
Project life cycle	All the activities necessary for a project throughout its life, from beginning to end, normally dissected into several sequential phases. The generic project life cycle has 5 stages: planning, concept, development, implementation and finalisation.
Project Proposal Report (PPR)	A proposal detailing the scope and benefits of the project submitted to the Australian government as part of the project approval process.
Project schedule	A listing of a projects works activities and their associated costs.

Term	Definition
Provisional items	Items included in an estimate which cannot be accurately quantified.
Public Utility Plant (PUP)	The third-party infrastructure assets such as communications, electricity, water, sewerage, gas and so on that may be in the road reserve.
QGTM	Queensland Guide to Traffic Management (QGTM)
Queensland Transport and Roads Investment Program (QTRIP)	The QTRIP is the program of works the department produces and plans to deliver over the upcoming 4 years.
Range estimate	An estimate which reports the pessimistic, optimistic and most likely values.
Reality check	The action of comparing an estimate and/or its items to previous benchmarked values.
Residual Risk	Risk remaining after mitigation treatments (actions or controls) have been applied.
Risk	A project risk is the effect of uncertainty on project objectives; the chance of something happening that will have an impact upon project objectives. Risk is measured in terms of consequences and likelihood.
SASR	Strategic Assessment of Service Requirements.
SCAS	Scheduled Corridor Access System that Queensland Rail utilises for any works (including infrastructure projects) to access the rail corridor.
Schedule of rates	The list of all envisaged project work activity items, quantities and rates, whether the rates have been entered or not.
Scope	The scope is the work that must be undertaken to deliver a product, service or result with the specified features and functions.
Scope creep	Increase in project scope not anticipated at the start of the project.
SEMS	Safety & Environment Management System refers Queensland Rail’s documented system that outlines requirements for environmental and sustainability management, as well as safety procedures for staff and contractors.
SmartCost	SmartCost is a library of resource costs used by the department for developing first principle’s cost estimates.
Stage	A logical construct to describe the division of work within a project phase.
Strategic estimate	A high-level estimate prepared to support the department's strategic network planning processes, presented in current dollars.

Term	Definition
TIPDS	The Transport Infrastructure Project Delivery System (TIPDS) for those who have the responsibility for obtaining value for money in the delivery of a project. The aim of TIPDS is to provide guidance for the procurement of works including: • developing the best delivery strategy • how tenders should be called, compiled and assessed, and • who should be eligible to tender.
Total project cost (outturn dollars for completion in 20XX).	Total project cost in outturn dollars is used for planning and budgeting purposes and relates to the period in which the work will be performed. Estimates prepared at a particular date can be converted to outturn dollars by applying the appropriate escalation rates to the project's planned cash flow.
Uncertainty	Uncertainty represents unknown or ill-defined variables causing a loss or profit. The point is that the agency causing the loss or profit cannot be named.
Variation	Approved change to the scope of work.

13 References

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