Procedure

Sydney WATER

Safety in Design

1. Overview

1.1. At a glance

What

Sydney Water and its service providers undertake design work in constructing its assets. It is crucial that these assets are safe to construct, use, operate, maintain and dispose of at the end of their life.

Design decisions are required to ensure that Sydney Water's assets are free of hazards and risks so far as reasonably practicable. This procedure outlines the risk management process in ensuring an adequate safe design.

1.2. Scope

Who

This procedure applies to all activities and projects involving the creation and modification of Sydney Water assets. An asset could include:

- structures,
- the installation of plant and equipment, and
- the use of substances both during construction and in operation

The procedure applies to the design of both permanent and temporary works.

All designs must be carried out by suitably qualified designers with the appropriate level of experience in the pertinent area of engineering practice.

The risk management process described in this procedure must be used. However, the extent of the necessary documentary evidence may vary from project to project. The determining factors are the likelihood of hazards and the degree of harm to people and property that they can cause.

Sydney Water expects that there will be a balance between the required effort, time and cost, and the benefit derived from the process. For works with hazards of low risk and consequence, the process may be appropriately abridged.

1.3. Objective

Why

The Work Health and Safety (WHS) Act 2011 and Regulation 2017 imposes duties on designers to ensure, so far as is reasonably practicable, that structures are designed to be without risks to the health and safety of persons who:

- construct, alter, convert, fit-out, commission, maintain, refurbish, renovate, repair, demolish, dismantle or dispose of the structure
- use the structure as a workplace for the purpose for which it was designed
- are at or in the vicinity and are exposed to the structure.

Similar requirements are also found in the WHS Act for the installation of plant and in the use of substances such as hazardous chemicals.

In addition to complying with legislation, early assessment during design helps to eliminate risks rather than mitigate them at a considerable cost later, during construction, operation or maintenance.

2. Procedure in detail

Designers shall consider how their design will affect the health and safety of those who will interact with the asset throughout its life. This means thinking about design solutions for reasonably foreseeable hazards that may occur as the asset is built, commissioned, used, maintained, repaired, refurbished or modified, decommissioned, demolished or dismantled and disposed or recycled.

For example, when designing a watermain the designer should consider the location of the valves for their future operation as well as access requirements for maintenance work.

2.1. Risk Management Process

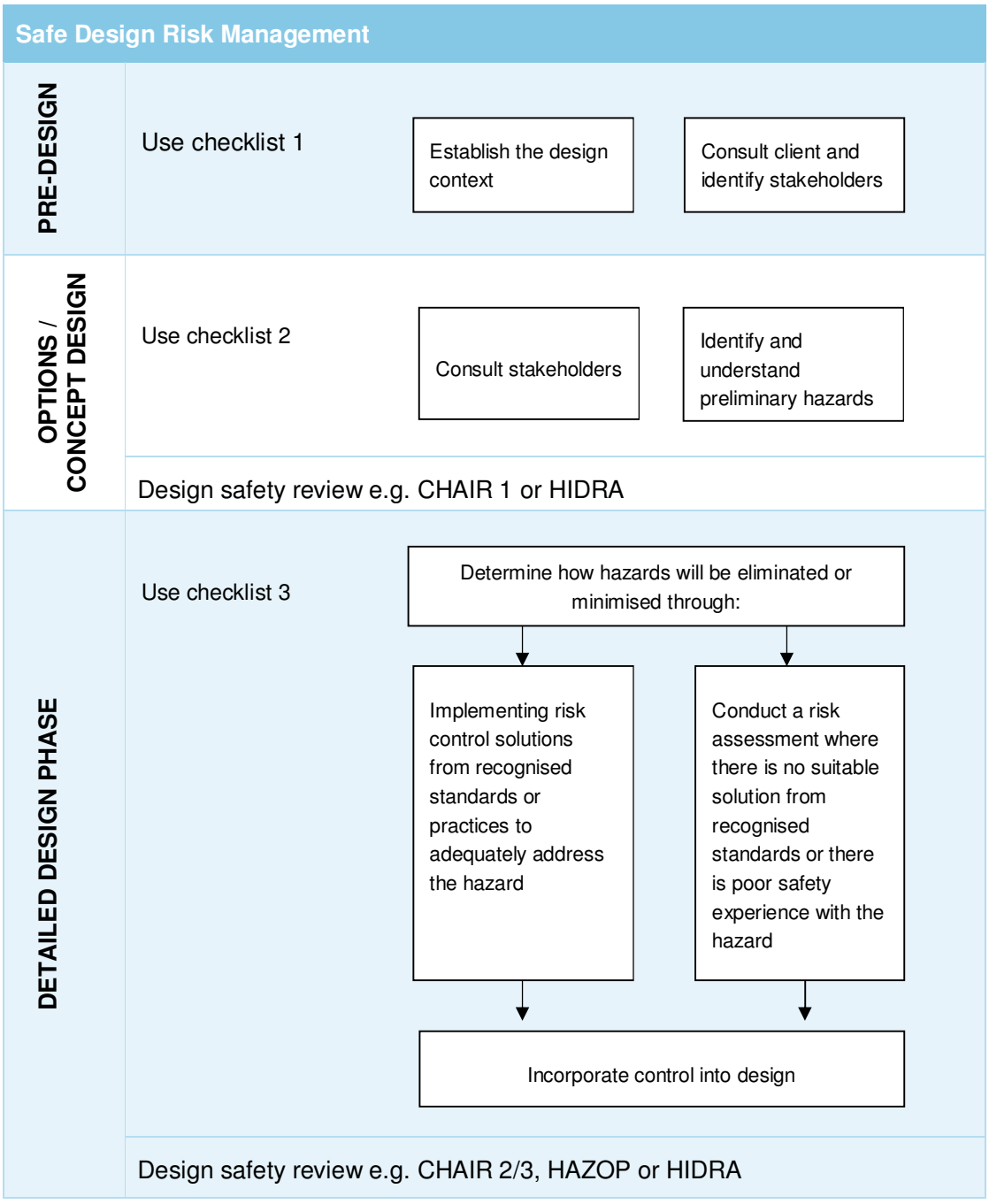
A risk management process is a systematic way of making an asset as safe as practicable and it shall also be used as part of the design process. It involves the following broad steps:

- identify reasonably foreseeable hazards associated with the design,
- assess the risks arising from the hazards,
- eliminate or minimise the risk by designing control measures,
- re-assess the risk with the identified control measures implemented, and
- monitor and review the control measures.

Designers must integrate risk identification, assessment and control into the design process.

Designers must follow the systematic approach represented in Figure 1 or an alternative equivalent process that meets the intent of the Work Health and Safety Act.

Figure 1 – A systematic approach to integrating design and risk management



Notes: HIDRA – is the most basic form of risk assessment required and should be used when there is any change to the form, fit or function of an asset

CHAIR – is used where there is construction involved and should be carried out at both concept and detailed design phases.

HAZOP – is a structured and systematic technique for examining a defined system, section by section, usually on the basis of flow/process and instrumentation diagrams. It should be used when there is a facility/plant design aspect.

2.2. Consult Client

In the pre-design stage, clients must instruct the designer regarding:

- the intended purpose of the asset
- any health and safety related information that they have
- any hazard and incident information relevant to the proposed asset
- any targeted work health safety risks that need to be addressed in the design
- any previous similar risk assessments relevant to the asset.

Designers must work in consultation with clients about how to ensure risks are eliminated or minimised.

2.3. Consult Stakeholders

The designer must consult with stakeholders. These should include the stakeholders responsible for different phases of the asset life cycle including constructors, operators and maintainers. A safe design is more easily achieved when people involved at the design stage communicate with each other about potential risks and work together to find solutions.

By drawing on the knowledge and experience of stakeholders, including constructors and users, more informed decisions can be made about how assets can be designed to eliminate or minimise risks.

2.4. Hierarchy of Controls

During the development of the design, the designer shall minimise risk by considering controls in the following specific order.

- Elimination – The most cost-effective control measure involves eliminating the hazard and associated risk. By designing-in or designing-out certain features, hazards may be eliminated.

If it is not reasonably practicable to eliminate a hazard the following control measures should be considered:

- Substitution – replace a hazardous process or material with one that is less hazardous to reduce the risk.
- Isolation – separate the hazard or hazardous work practice from people
- Engineering controls – use engineering control measures to minimise the risk
- Administrative controls – if engineering controls cannot reduce the risk sufficiently, then administrative controls should be used
- Personal protective equipment (PPE) – Personal protective equipment (for example hard hats, respiratory protection, gloves, ear muffs) should be used to protect the worker from any residual risk.

In many cases a combination of control measures will be required to minimise the risks to health and safety.

2.5. Codes of Practice and Standards

A code of practice provides detailed information on how a person conducting a business or undertaking can achieve the standards required under the work health and safety (WHS) laws. These do not replace the WHS laws, but provide practical guidance on how compliance may be achieved in relation to the subject matter of the code.

Under the Work Health and Safety Act 2011, codes of practice are admissible in court proceedings. Courts may regard a code of practice as evidence of what is known about a hazard, risk or control, and rely on it to determine what is 'reasonably practicable' in the circumstances to which the code relates.

It is recognised that equivalent or better ways of achieving the required work health and safety outcomes may be possible. For that reason, compliance with codes of practice is not mandatory providing that any other method used provides an equivalent or higher standard of work health and safety than suggested by the code of practice.

Where designers require further guidance in relation to the design of structures, plant or use of substances, the following codes of practice may be referred to.

Safe Design of Structures - Code of Practice – SafeWork NSW July 2014

Managing the risks of plant in the workplace – Code of Practice – SafeWork NSW – July 2014

Guide for safe design of plant – Safe Work Australia – July 2014

Managing risks of hazardous chemicals in the workplace – SafeWork NSW – July 2014

In addition to codes of practice, standards and guidelines produced by government authorities, Standards Australia and other professional bodies may also be used. Designers must be aware that these standards and guidelines may not in themselves adequately control all risks if applied in situations outside those contemplated in them. Designers must show due diligence in managing foreseeable risks and not indiscriminately follow standards and guidelines.

Sydney Water also produces WHS standards and procedures for high consequence risks commonly encountered by its staff and contractors such as confined spaces and hazardous chemicals. Designers can refer to these to understand how Sydney Water typically manages these risks. These can be found on Sydney Water's intranet, iConnect.

2.6. Design Safety Review

As the design progresses and details are developed to the next level, there are opportunities for reviewing and validating the decisions to confirm the effectiveness of controls adopted in the design solution. It is usually easier to correct or eliminate risks at the earliest possible time.

These design safety reviews shall involve people who will eventually construct, use and maintain the assets. The review shall focus on the various stages of the life cycle, including:

- design for safe construction
- design to facilitate safe use
- design for safe maintenance
- design for modification, demolition, dismantling and disposal.

Tools available are CHAIR, HAZOP, CHAZOP, HIDRA and others. Designers shall utilise the tools most appropriate to the design phase and complexity. These tools should be followed by a multi-disciplined team, preferably led by an experienced person independent of the facility being studied.

Checklists (**Attachment 1**) have been developed for each of the design phases to assist designers in the process.

Key information about identified hazards and action taken or required to control risks should be recorded and transferred from the design phase to those involved in later stages of the lifecycle. Communicating this information to other duty holders, such as constructors and operators, will make them aware of any residual risks and minimise the likelihood of safety features incorporated into the design being altered or removed by those engaged in subsequent work.

It should be noted that safety in design is more than just conducting, for example, a CHAIR workshop at a specific point in the design phase. Consideration of the safety aspects of a design are integral with the whole design process.

2.7. Safe Design Report

A safe design report must be prepared for designs that have unusual or atypical features which present hazards and risks that are unique to the particular design. The report is to be prepared and submitted with the finalisation of the detailed design.

If another designer is to be engaged to carry out the detailed design following the completion of the concept design, the designer completing the concept design must also prepare a safe design report on the concept design for handing over to the succeeding designer.

The information in the safety design report is not to dictate the way the asset is to be constructed or operated. It should not tell the contractors or operators what to do but should tell them about the safety issues, the expected hazards and risks, and the incorporated control measures. Examples are confined space, steep roof, hazardous chemicals, hazardous building materials (asbestos) etc.

The report must give adequate information:

- concerning the purpose for which the asset was designed
- about the results of calculations, analysis, testing and examination, if any, relating to safety risks
- on conditions under which the asset would be constructed or used without safety risks
- outlining any unusual or atypical hazards during construction, use, maintenance, modification and demolition.
- about special hazards that are associated only with the particular design and not with other designs of the same type of asset.

To assist this, a template has been developed to assist designers (**Attachment 2**).

Designers must also include safety notes on construction drawings such as intended use, design loadings, etc. These help in conveying safety information that is immediately available to construction workers, and also provides a record of the information on the as constructed drawings.

2.8. Post Implementation Review

On the completion of construction, the effectiveness of safety in design control measures should be evaluated. This will enable identification of improvement to control measures in place. If control solutions are found inadequate, the cause must be addressed and the component of the asset re-designed, and rebuilt or modified to correct the situation as far as is reasonably practicable.

This review may be carried out as part of the post-implementation review workshop attended by all parties involved in the project.

3. Definitions

Term	Definition
Asset	All pipes, associated maintenance structures/appurtenances, fittings and equipment, pumping, treatment, storage and disposal facilities (including mechanical, electrical and electronic equipment) employed directly in conveying and/or processing water, wastewater, recycled water and stormwater. (Asset Creation Policy AMQ0033.02 July 2015)
Client	A person conducting a business or undertaking that commissions construction work. For the purpose of projects delivered on behalf of Sydney Water and the application of this procedure, the Client shall be the nominated Project Manager.
CHAIR	Construction Hazard Assessment Implication Review. The primary aim of the CHAIR is to identify and eliminate or minimise risks in a design as soon as possible in the life of an asset.
CHAZOP	Control Systems Hazard and Operability Study, is a form of HAZOP with specific focus on the control system used to control the process.
Designer	A Designer is a person conducting a business or undertaking whose profession, trade or business involves them in: • preparing sketches, plans or drawings for a plant or structure, including variations to a plan, • making decisions for incorporation into a design that may affect the health or safety of persons who construct, use or carry out other activities with the plant or structure. A person who alters or modifies a design without consulting the original or subsequent designer will assume the duties of a designer.
Hazard	Any situation or thing that has the potential to cause harm (physical or psychological) or damage to people, property and the environment.
HAZOP	Hazard and Operability Study. Is a form of hazard identification used to examine components within a system to determine what would happen if the component were to operate outside its normal design mode. It requires the comprehensive and systematic scrutiny of a facility, section by section, usually on the basis of flow/process and instrumentation diagrams (P&IDs), in most cases using guide words. AS IEC61882 provides guidance for conducting HAZOP studies.
HIDRA	Hazard Identification and Risk Assessment – a risk management tool used to assess the risks associated with a particular activity.
Plant	The WHS Act defines plant as including: • any machinery, equipment, appliance, container, implement and tool, and • any component of any of those things, and • anything fitted or connected to any of those things.
Project Manager	For the purpose of this procedure, the Project Manager is any person that commissions construction work on behalf of Sydney Water. They shall act as the Client on behalf of Sydney Water and accept the accountabilities of the Client as outlined in this procedure.

Term	Definition
Reasonably practicable	Deciding what is 'reasonably practicable' to protect people from harm requires taking into account and weighing up all relevant matters including: • the likelihood of the hazard or risk occurring • the degree of harm that might result from the hazard or the risk • knowledge about the hazard or risk • ways of eliminating or minimising the risk, and • the availability and suitability of ways to eliminate or minimise the risk.
SiD	Safety in Design. The SiD acronym is commonly used in the construction industry for similar procedures.
Structure	The WHS Act defines a structure as anything that is constructed, whether fixed or moveable, temporary or permanent. A structure includes: • buildings, masts, towers, framework, pipelines, transport infrastructure and underground works (shafts or tunnels), for example noise reduction barriers on a freeway, communications masts or towers, electricity transmission towers and associated cables, flying cables and supports, guyed towers such as a ski-lift tower • any component of a structure • part of a structure.

4. Context

4.1. Accountabilities

Position	Accountabilities
Project Manager	Acts as Client on behalf of Sydney Water and has specific duties under the WHS Regulations to: • consult with the designer about how to ensure that health and safety risks arising from the design during construction are eliminated or minimised, and • provide the designer with any information that the client has in relation to the hazards and risks at the site where the construction work is to be carried out
Designer	Undertake safe design in accordance with this procedure including: • consulting with the client and stakeholders • communicating any risks that may be inherent in the design to the client and constructors Ensure, so far as is reasonably practicable, that plant or structures are designed to be without risks to the health and safety of persons who: • construct, alter, convert, fit-out, commission, maintain, refurbish, renovate, repair, demolish, dismantle or dispose of plant or structures • use the structure as a workplace for the purpose for which it was designed • are at or in the vicinity and are exposed to the plant or structure.

4.2. Training and competencies

Position	Training or competency
Project Managers	In addition to core project management capabilities, a project manager shall also have: • knowledge of work health and safety legislation, codes of practice and other regulatory requirements • knowledge of risk management processes • knowledge of Sydney Water's work health and safety standards and procedures
Designers	In addition to core design capabilities relevant to the designer's role, a designer shall also have: • knowledge of work health and safety legislation, codes of practice and other regulatory requirements • an understanding of the intended purpose of the plant or structure • knowledge of risk management processes • knowledge of technical design standards • knowledge of Sydney Water's work health and safety standards and procedures • an appreciation of construction methods and their impact on the design • the ability to source and apply relevant data on human dimensions, capacities and behaviours.

4.3. References

Document type	Title
Legislation	Work Health and Safety Act 2011 (NSW) Work Health and Safety Regulation 2017 (NSW)
Policies and procedures	Work Health and Safety Management System o WHSMS0053 Risk Management Procedure Capital Project Delivery Management System o CPDP7 Design and Development Procedure
Other documents	Safe Design of Structures - Code of Practice – SafeWork NSW July 2014 Guide for safe design of plant – Safe Work Australia – July 2014 Managing the risks of plant in the workplace – Code of Practice – SafeWork NSW – July 2014 Managing risks of hazardous chemicals in the workplace - SafeWork NSW – July 2014
Templates	HIDRA Template

4.4. Attachments

Attachment	Title
1	Checklists
2	Safe Design Report Template

5. Document control

5.1. Document details

Record	Detail
Procedure title	DOC0000653 Safety in Design Procedure
Registered file no.	NA

5.2. Ownership and approval

Role	Name	Position title	Date
Author	Tony Petrevski	Technical Assurance Leader	26 September 2017
Owner	Ken Wiggins	Urban Design and Engineering Manager	27 September 2017
Approver	Ken Wiggins	Urban Design and Engineering Manager	27 September 2017

5.3. Consultation

Stakeholder	Position title	Date
Milan Rubcic	Lead Engineer	11 September 2017
Robert Lau	Lead Engineer	11 September 2017
Robert Loncar	Lead Engineer	11 September 2017
Christie Sebaratnam	Lead Engineer	11 September 2017
Daryl Gilchrist	Design & Environmental Manager	11 September 2017
Shaun Nadin	Senior Project Engineer	11 September 2017
Justin Drinkwater	Human Factors Advisor	11 September 2017

5.4. Review

Stage	Date
Original procedure	27 September 2017
This review	27 September 2017
Next review	27 September 2019

5.5. Change history

Version	Key changes
1	New document

ATTACHMENT 1 - CHECKLISTS

Name of Project: _____

_____

Checklist 1 – Pre-design stage

Designer:_____ ***Date:*** _____

Item	Description	State Yes or NA, and provide details or describe actions (if required)
▪ **Purpose of the plant or structure**	Understand intended function, scope and complexity of the plant or structure	
▪ **Permanent plant, equipment and machinery**	Assess availability and impact on safety. Consider alternatives if needed.	
▪ **Temporary heavy construction plant and equipment**	Assess availability and impact on safety.	
▪ **Potential users and anticipated activities**	Identify users and activities and potential misuse opportunities	
▪ **Industry safety profile and statistics relating to similar structures (consult health and safety authorities if necessary)**	Collect key information about hazard controls, hazard alerts/reports from relevant statutory authorities; industry statistics regarding injuries and incidents.	
▪ **Consultation, co-operation and co-ordination**	Obtain from client safety issues and requirements. Identify stakeholders	
▪ **Breadth of hazards**	Consider major hazards the structure may be exposed. Note usual safety issues and impact.	
▪ **Research**	Collect past research or testing data done on similar designs, if applicable.	
▪ **Legislations, code of practice and standards**	Identify codes and standards that need to be considered and complied with.	
▪ **Design disciplines, skills and competence required**	Ensure the design team members have the necessary qualification and relevant experience in the pertinent disciplines.	
▪ **Consultation with clients and identification of stakeholders**	Identify roles and responsibilities of various parties. Establish collaborative relationships with clients, designers and stakeholders.	

Checklist 2 – Options/concept design stage

Designer:_____ ***Date: _____***

Item	Description	State Yes or NA, and provide details or describe actions (if required)
▪ **Siting of the plant or structure**	Location, formation level	
▪ **Physical environment**	Adjacent properties, roads, land use, topographical features, underground and overhead services.	
▪ **Access**	Ease of permanent access, and temporary construction access	
▪ **Traffic**	Exposure to related hazards	
▪ **Site condition**	Ground features, geology, proximity to water, known or suspected contamination	
▪ **Public safety**	Exposure of public, unauthorised access, security.	
▪ **High consequence hazards**	Dangerous goods, hazardous substances, hazardous building materials, health hazards, confined space.	
▪ **Systems of work**	Materials, construction technique, pedestrian and vehicle segregation, manual tasks, working at height, over water, noise.	
▪ **Environmental conditions**	Floods, earthquakes, high winds, thunderstorms, noise, ventilation, lighting.	
▪ **Incident mitigation**	Adequate emergency egress, sabotage, vandalism, crime prevention and terrorism .	

Checklist 3 – Detailed design stage

Designer:_____ ***Date: _____***

Item	Description	State Yes or NA, and provide details or describe actions (if required)
▪ **Asset Isolation**	Consider flow isolation and flow management requirements, LOTO, proof of isolation.	
▪ **Electrical safety**	Electrical earthing, location of underground and overhead power cables, protection of cables.	
▪ **Fire and emergencies**	Fire risks, detection, fighting, emergency routes and exits, emergency facilities	
▪ **Movement of people and materials**	Safe access and egress, disability access, traffic, security, lifting access	
▪ **Working environment**	Ventilation, air quality, sanitary facilities, lighting, dust.	
▪ **Acoustics and vibration**	Noise from plant or surrounding areas, noise pollution, vibration from machinery	
▪ **Plant and Machinery**	Location, access for maintenance, lifting provision, crane location, guards.	
▪ **Amenities and facilities**	Storage, first aid, rest rooms, accommodation requirements.	
▪ **Earthworks**	Excavation, geology, ground water, underground services.	
▪ **Structural safety**	Stability and integrity of existing, temporary and new structure, load bearing and deflection requirements, construction procedures, demolition, dismantling.	
▪ **Manual tasks**	Methods of material handling, accessibility of material handling, storage facilities, space and layout, use of mechanical aids.	
▪ **Substances**	Exposure to materials, liquids and gases, trade waste, storage of chemicals, hazardous building materials (asbestos).	
▪ **Fall Prevention**	Guard rails, anchorage points, safety grills, access for maintenance, temporary work platforms, scaffolding, slips, trips and falls,	
▪ **Confined Space**	Prevent creation of confined space if possible, reduce the need to enter into confined space, access, egress, atmospheric testing, ventilation.	

ATTACHMENT 2 - SAFE DESIGN REPORT TEMPLATE

The report should be brief and concise to ensure hazards and risks are clearly communicated. The level of detail in the report must be appropriate for the client, the nature of hazards and degree of risk. Do not produce undue lengthy documents.

1. Introduction

Provide context and background to the design. Briefly describe:

- Purpose of the report

  This report focuses on critical or unusual hazards relating to the construction, use, operation, maintenance and demolition/disposal of the plant or structure. It is not intended to address typical or common hazards that would be expected to be managed by the client, the Principal Contractor, constructor or users of the plant or structure.

  The information in this report is not to dictate the way the plant or structure is to be constructed or operated. It does not tell the contractors or operators what to do but inform them about the safety issues and the control measures incorporated in the design.
- Project team (client, project manager, designers, etc)
- Scope of designer's work covered by this report

2. Description of the Plant or Structure

Provide a brief general overview of the plant or structure. (e.g. size, shape, materials, capacity or other general features). Clearly describe the intended purpose of the plant or structure and why the plant or structure is required (e.g new infrastructure to service development, rehabilitation of deteriorated infrastructure, amplification etc.)

3. Design Intent & Limitations

Outline critical safety related design criteria and assumptions adopted in the design, and any limitations of use. Highlight any critical or unusual elements of the design (e.g. critical dimensions, special materials, areas where highly specialised or experience constructors are required etc.)

4. Stakeholder Consultation

Outline key aspects of client consultation with the designer. List all stakeholders consulted during design development, and state key safety related issues.

5. Critical Hazards and Control Measures

List all critical hazards and risks associated with the construction (including site preliminary and establishment works), use, maintenance, modification and demolition of the structure. Briefly describe the associated risk control measures built into the design.

6. Supporting Documents and Standards

List or attach relevant supporting documentation including, but not limited to:

- Design drawings, specifications and any other relevant design documentation
- Risk assessments (e.g. CHAIR)
- Operations and maintenance manual
- Investigation reports (e.g. geotechnical, contamination, survey)

Reference any applicable standards including:

- Regulations, standards, codes of practice
- Sydney Water policies, procedures, guides, process etc.`