DRINKING WATER RESERVOIRS AND TANKS

TMS1581

Revision Table

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1. PURPOSE

This Technical Specification sets the minimum requirements for the design and construction of drinking water reservoirs and tanks. The purpose is to standardise and reduce variability in designs. It is also to be used as a reference document for assessing the maintenance and upgrade requirements of existing reservoirs.

2. SCOPE

This Specification covers the Urban Utilities requirements on design and construction of ground level drinking water reservoirs and tanks. Where the word "reservoir" is used in this specification, it should also be read as applicable to "tank".

This document is not applicable to reservoirs and tanks used to store recycled water.

3. OBJECTIVES

3.1 Design

The objectives of this Technical Specification are to set the design requirements to store and supply drinking water that is safe to drink and acceptable to the customers in terms of aesthetics, taste, and odour.

The designs must minimise the risks of accelerated corrosion, contamination, and labour-intensive maintenance and operational requirements for the design life of the reservoir.

The design should be fit for purpose, simple to construct and visually pleasant.

3.2 Functional Requirements

The functional design requirements shall include in particular compliance to:

- The design capacity shall allow for continuous storage and operation with minimum downtime requirements for scheduled maintenance and service.
- Meet regulatory compliance.
- Reliable, effective, and automated operation. (Operators will not normally be on site.)
- Minimise adverse environmental and community impact.
- Provide safe working conditions for operation and maintenance personnel.

3.3 Water Quality Requirements

The water quality design requirements shall include consideration to:

- Efficiently receiving and storing drinking water with minimal adverse impacts to the stored water quality prior to its supply.

- Prevention of contamination by sealing off rainwater, debris and vermin from ingress into the reservoir.
- Prevention of leaf and debris build-up on the reservoir roof, especially under raised platforms, and making it easy for maintenance activities to remove the build-up.
- Site security measures.
- Remote monitoring and control.
- Products and materials to be brought inside the reservoir, whether in contact with water or otherwise, shall comply with AS/NZS 4020 and be proven in service. The water quality requirements of Section 8.7 shall apply.

3.4 Reliability Requirements

The reliability design requirements shall include particular compliance to:

- Standard designs of components and assemblies to reduce spare parts inventory and improve interchangeability.
- Equipment and components specified shall be readily available and parts shall be easily replicable and replaceable.
- Low maintenance plant and equipment with scheduled maintenance practice.
- Instrumentation and Controls and reliability of alarms.
- Adequate ventilation to minimise corrosive environment.

3.5 Maintenance Requirements

The maintenance design requirements shall include particular compliance to:

- The maintenance implications throughout the design life need to be accounted for in the design including methods for maintenance and materials replacement in the future.
- Maintenance includes regular inspections, cleaning floor sediments, cleaning the roof areas, ventilation systems, external and internal coating systems, recoating systems, repairs, replacement and upgrades of pipework, valves, pumps and control equipment.
- Designs must include the ability for all maintenance functions to be carried out safely and cost effectively for the design life of the reservoir with particular attention to locations with perishable attributes or considered high risk to water quality integrity.
- Designs should include initiatives to minimise safety requirements, including minimising safety equipment requirements, for routine services.
- Third party equipment, access and maintenance will be provided at a separate allocated area independent from the reservoir site if specified in the project documentation.

4. DEFINITIONS/GLOSSARY OF ITEMS

Definitions of terms used in this document can be found in Table 4-1.

Table 4-1 Definitions

Item	Definition/Description
Accountable Party	Is the responsible person nominated within an Inspection and Test Plan (ITP) or verification document or procedure as responsible to certify completion of a task or step within the quality assurance process.
Certifying Engineer	The RPEQ engineer responsible for design and/or construction verification of the associated infrastructure.
Contractor	The entity responsible for the delivery, or part thereof, of the required infrastructure including design, manufacture, supply, installation and/or demolition. This may include, but is not limited to, a developer or the successful tenderer to a bid.
Project Documentation	Documentation that outlines the requirements of Urban Utilities infrastructure being established through a project. This documentation will form part of the agreement between Urban Utilities and the entity responsible for the development of the relevant infrastructure.
Shall or must	Where 'shall' or 'must' is used in this document the associated requirement is a mandatory requirement.
Ultimate peak flow	Maximum design flow through a pipeline with respect to the ultimate projected development and its associated water demand.

5. ABBREVIATIONS

Abbreviations used in this document can be found in Table 5-1.

Table 5-1 Abbreviations

Abbreviation	Description
AEP	Annual exceedance probability
BTEX	Refers to benzene, toluene, ethylbenzene and xylene
NATA	National Association of Testing Authorities
SEQ Code	South East Queensland Design and Construction Code
VOC	Volatile Organic Compound
WQAP	Water Quality Assurance Procedures

6. TYPES OF RESERVOIRS

The reservoirs for the storage of drinking water shall comprise one of the following:

6.1 Cast In-situ Reinforced Concrete

Reinforced concrete slab and wall with a metal roof with or without internal columns.

6.2 Cast In-situ Post Tensioned and Pre-Cast Post Tensioned

Cast in-situ post tensioned slab and wall with a metal roof or cast in-situ post tensioned slab with a pre-cast post tensioned wall with a metal roof with or without internal columns.

6.3 Bolted Steel Panel

Prefabricated steel panel wall on a sand bedding base with a loose fit liner and a metal roof without internal columns.

6.4 Welded Mild Steel

Site welded mild steel wall and base with a metal roof with or without internal columns. Cathodic protection required.

Welded mild steel reservoirs are not the preferred option and will only be considered for a specific project where they have an exceptional benefit over the use of other construction materials.

6.5 Polyethylene Tanks

Polyethylene water tanks are not the preferred option and will only be considered for a specific project where they have an exceptional benefit over use of other construction materials. The maximum capacity of a polyethylene water tank shall be 40,000 L.

7. LOCATION REQUIREMENTS

7.1 Site Selection

The location of the reservoir will be specified by Urban Utilities and will be influenced by hydraulic considerations. The site selection by the designers shall be suitable and adequate to accommodate the following:

- Aesthetics of the area to be maintained.
- Buffer area from existing developed areas and future development in the vicinity of the proposed infrastructure.
- Proposed infrastructure and its appurtenances.

- All-weather, sealed access, including access around the perimeter of the reservoir for maintenance vehicles, parking and egress for vehicles. The access area should be adequate to allow routine maintenance and emergency work to the infrastructure, vegetation clearance (or ability to remove) and appurtenances.
- Future expansion of the infrastructure and its appurtenances.
- Electrical grid power supply or whether solar/battery power is feasible.
- Signal access for radio communication.
- Security from existing developed areas and future development in the vicinity of the proposed infrastructure.
- Adequate site access requirements and work areas during construction, including for future construction of a possible second reservoir or major rehabilitation works.
- Noise control compliance in existing developed and future development areas.

7.2 Easements

The following factors shall be considered during the site selection:

- Easement requirements for access to the site.
- Easement requirements for services, pipework, stormwater drainage, and power supply to the site.

The site layout shall minimise the number of easements required to the site.

7.3 Supporting Systems

The requirements for supporting systems to comply with the efficient and safe operation of the reservoir shall be included in the design. These include:

- Water supply for maintenance.
- Power supply for maintenance.
- General lighting for security, operation and maintenance.
- Security and signage to match corporate requirements.
- Disinfection systems.

8. DESIGN

8.1 Site Survey

The site survey is required to locate the reservoir with regards to operating levels, pipework routes, water service, power supply, surface drainage, overflow and scour drainage, and access road. The site survey shall identify the surface contours, boundaries and existing services. It shall also identify the adjoining properties and particularly those which may be impacted upon during construction and operation of the reservoir.

Two stable and durable survey marks to the 4th order accuracy, one on the roof adjacent to the level electrodes and one on the ground outside the reservoir are to be recorded in the design drawings. A brass plug inscribed with the level, in AHD, to three decimal places and GDA2020 coordinates are to be fixed adjacent to the survey marks. The details inscribed on the survey marks are to be included in the 'As Constructed' drawings. The description of the location and type of survey mark are to be included in the 'As Constructed' information.

8.2 Geotechnical Investigation

A geotechnical investigation shall be undertaken to determine the ground conditions. The report shall provide details of the investigation and findings including design requirements for the foundations, slab, ground movement and settlement, pipework excavation, pipe thrust restraints, road, and pavement design criteria. The report shall also include construction requirements.

8.3 Road Access

An all-weather, sealed access road shall be provided that is suitable for operations, maintenance, and supply and emergency vehicles. The perimeter of the reservoir and appurtenances shall also be accessible by these vehicles. The access and egress design from the reservoir shall take account of potential bushfires.

The road design and construction shall be in accordance with TMS1731 General Civil and Structural Specification.

The minimum design criteria for the road shall be as follows:

- Vehicle pavement widths for one-way and two-way roads to be 4 m and 6.2 m respectively.
- Vehicle access required around perimeter of reservoir.
- Pavement design life 40 years.
- Growth is not assumed for the 40-year design life.
- Lane distribution factor: 1.
- Number of Heavy Vehicles (HV) with single lane (one visit results in two passes of the HV).
    - Austroads Vehicle Class 3 - 12 per year for maintenance.

- Austroads Vehicle Class 5 - 8 per year for maintenance.
- 25 tonne Franna Crane - 1 per year for maintenance.
- ESA (Equivalent Standard Axle)/HV as per the Table 5.16 (a), RPDM (Road Planning and Design Manual) Chapter 5 (2004).
- Austroads Vehicle Class 3 - 3.0.
- Austroads Vehicle Class 5 - 4.4.

8.4 Asset Security

The security of any Urban Utilities assets will be in accordance with the Urban Utilities' security standards detailed in the document, TMS176 Security Design Guidelines.

The Manager, Business Resilience and/or Security Coordinator is required to conduct a security risk assessment of the reservoir to determine its appropriate security category rating, as well as the subsequent baseline security requirements to appropriately secure the asset. It is necessary to determine if the land, where the reservoir is located, is owned as this will affect security controls. The minimum, security controls required will be in accordance with best practice security methodologies and Urban Utilities security standards, as outlined in Table 8-1 below.

Table 8-2 Security Measures

SECURITY MEASURE	TITLE
Perimeter Fencing	Refer Appendix E – Drawing - Chain Wire Security Fencing for Urban Utilities Sites, Drawing no 486/1/25-0004-001 (Note that in special circumstances a 2.1m high *Hercules Spearmaster* type of tubular fencing may be specified by Urban Utilities.)
Perimeter Fencing Entry Points	• Refer Appendix E – Drawing - Chain Wire Security Fencing for Urban Utilities Sites, Drawing No. 486/1/25-0004-001 Gate/s to be secured via chain and vandal proof padlock arrangement.
Internal Fencing	• Internal fencing is not required if a perimeter fence is installed. If pump building is a separate detached building outside the perimeter fence: • 1,800 mm high chain wire mesh fence topped with 300 mm three strands of barbed wire to enclose pump building and dosing equipment. • Gate construction to match fence type and secured via chain and vandal proof padlock arrangement.
Security Signage	• Security Fence "Trespassers Prohibited" signage at 30-meter intervals along perimeter fencing facing a public road and at 50-meter intervals along other boundaries. "CCTV Surveillance" signage located at entrances and public waiting areas. • Safety signage as applicable to the hazards present on site. • Urban Utilities signage instructing staff and contractors to contact the Control Room on entry to the site.

SECURITY MEASURE	TITLE
External Security Lighting	Permanent or sensor lighting with onsite controls compliant with Australian Standards must be installed to cover the following areas: • Site entry gate. • Over entry point to pump and dosing building. • SCADA telemetry and security systems. • Reservoir access points and/or stairs.
Internal Security Lighting	Internal lighting compliant with Australian Standards shall be provided within relevant onsite buildings.
External Doors	• Reservoir hatch access points are to include reed switches, tamper proof bolts and be secured as per Urban Utilities secured keying system. • Pump building doors to be solid core timber clad with steel on external side or, steel louvered doors and no glass insets. •Access to roof of reservoir to be restricted by anti-climb measures appropriate to structure and secured via vandal proof padlock. •All bulk water access points to be secured as per Urban Utilities secured keying system.
Pump and Dosing Buildings - External Windows/Glass	•Minimise the use of external windows to the maximum extent possible. •Where windows are required, they shall be non-operable and fitted with a reflective tinting to prevent viewing of internal areas from outside. • If accessible, windows are to be fitted with an anti-shatter film. •External windows must utilise some means of security screening, to prevent unauthorised access. This could include window bars, crim safe security mesh or glass break detectors.
Intruder Alarm System	Off-site monitored security alarm system using one of two methods as follows: • Corporate Gallagher FT System (preferred). • Relevant on-site SCADA system. Either option must incorporate: • Reed switch monitoring of all building perimeter doors, glass break detectors, access hatches and doors to critical plant areas. •Other detector coverage of critical areas as recommended by risk assessment.
Electronic Access Control System	Nil, unless recommended via security risk assessment. If installed, the Gallagher FT System is required to be installed in accordance with Urban Utilities security standards.
CCTV System	A CCTV system is required to provide coverage of key areas; at the site entry gates, door to the stair tower (or ladder) access to the roof, water/instrument hatch access points, entry points to communication hut/building and switchboards at a minimum. Other areas may be recommended determined by a security risk assessment.

SECURITY MEASURE	TITLE
Key Management System	All keys to be implemented in accordance with the Urban Utilities secured keying system, including key management system.
Landscaping	Landscaping must avoid the planting of trees along the fence lines which would facilitate access to persons entering the reservoir compound.

Where a security install/upgrade project is required, the product specification and installation process will be overseen by the Security Coordinator.

8.5 Landscape Design

The landscape design shall maintain the aesthetics of the area. The landscaping plan shall blend the reservoir site into the local area and be designed for minimum ongoing maintenance.

Trees and shrubs shall be selected such that surveillance of the site is easily managed and at a height such that leaves are not easily blown onto the reservoir roof. Lawns shall not be included as part of the landscape plan. Only native and drought tolerant trees and shrubs endemic to the area shall be used.

8.6 Signage

Mandatory signage and labelling including caution, prohibition, security and safety shall be supplied and installed to current legislation and Urban Utilities requirements. Equipment shall have identification numbers fixed to them for operation and maintenance requirements. Instruments shall be identified with tags mounted adjacent to the instrument and not on the instrument.

Equipment labels and tags shall be made of Grade 316 stainless steel with engraved letters and numbers.

8.7 Water Quality

8.7.1 AS/NZS 4020 Compliance

Any products utilised within the reservoir shall comply with the relevant requirements of AS/NZS 4020, demonstrated in the form of a test report provided by a certification body or Accredited Testing Laboratory, in accordance with AS/NZS 4020. This also applies to cleaning products brought in temporarily; and roofing products that have the potential of falling into the reservoir, such as compressible foam products used for filling gaps between the roof sheeting.

Note that even with AS/NZS 4020 certification, complications may arise in achieving water quality serviceability, particularly with the use of Polyurea and Epoxy based products where the solvents used may leach into the stored water initially for a few days. In such cases, conditions

for the application of products and return to service of the reservoir will apply as specified in Section 10 of this document.

In addition to AS/NZS 4020 certification, all products used not meeting the 'preferred materials list' (in development) must be accompanied with the manufacturer's post application methodology to prepare (cleaning, etc.) the material for use in a drinking water system. In the absence of this, an RPEQ signed preparation methodology shall be provided.

8.7.2 Mixing of Stored Water

The water mixing and circulation design shall eliminate stagnated areas and promote optimal conditions to minimise disinfection losses, sedimentation build up, and bacteriological survival. The design shall consider and include the following as appropriate for each site's specific requirements:

- The conventional arrangement of a tangential inlet (with a directional nozzle, if required) near the wall of the reservoir and the outlet located in the centre of the reservoir shall be used to avoid short circuiting of incoming flows.
- Water re-circulation systems including mechanical mixers for the operating ranges of the reservoir.
  - Reservoirs ≥ 2.5ML capacity shall have a floating mixer such as the WEARS ResMix Vital or a submersible PAX Mixer or an accepted equivalent. The mixer shall be of a size that fits through the inspection hatch.
  - Mechanical mixing is not normally required in small reservoirs less than 2.5ML capacity unless a chemical dosing unit is required at the reservoir site.

If requested in the Project Documentation; a Computational Fluid Dynamics (CFD) analysis shall be carried out to determine the mixing efficiency and hydraulic performance of the reservoir with refinement of the conventional arrangement (without a mixer) and with the inclusion of specific mixers.

8.7.3 Roof Ventilation and Vermin Proofing

The roof ventilation system shall be designed to minimise build-up of corrosive environment (humidity, chlorine gas) within the reservoir and reduce condensation of water on the roof structure and underside of roof sheeting. The desired outcome is to reduce corrosion of the reservoir roof structure and improve the durability of the reservoir. Ventilation is also required for personal access for inspection and maintenance of the reservoir.

A passive ventilation system design that achieves ventilation flows due to buoyancy effect and differential pressure due to wind movement is preferred.

The ventilation system design shall exhaust rising warm air through roof mounted vents and draw in fresh cooler air through inlets distributed around the perimeter wall or eaves of the reservoir. The ventilation design must provide for air movement across the total reservoir internal area.

The ventilation design shall be based on the following minimum criteria:

- Capacity to expel or intake air at a rate greater than or equal to the water inflow or outflow rate of the reservoir.
- Capacity to provide a minimum of six (6) air changes per hour based on the air volume above the Upper Operating Water Level.

Roof mounted rotary ventilators can be considered in instances where the required performance from passive ventilation cannot be practically achieved.

All ventilation openings to the reservoir shall be designed to:

- Prevent the entry of rainwater, roof surface water and wind driven rain.
- Prevent entry of wildlife and vermin, birds, insects and airborne dirt and debris which can contaminate the water and cause water quality incidents.
- Prevent birds from roosting on the perimeter ventilation and roof mounted vents.
- Provide sufficient physical security to minimise the potential for contamination due to vandalism or sabotage.

All inlet and outlet ventilation openings shall be covered with secure vermin screens manufactured from marine grade aluminium or grade 316 stainless steel mesh. The mesh shall have a maximum aperture size of 2 mm to prevent vermin and contaminants from entering the reservoir. The mesh shall be designed and detailed to allow for ease of cleaning and maintenance without the risk of dislodging debris into water.

The roof mounted ventilators shall have a minimum design life of 15 years. They shall be manufactured from corrosion resistant material such as marine grade aluminium or stainless steel as required. Moving parts shall be suitable for exposure to condensation and the corrosive, chlorine environment of the reservoir headspace.

The roof mounted vents shall be provided with removable vermin screens (with a maximum aperture size of 2 mm).

8.7.4 Chemical Dosing on Site

An operation and maintenance facility shall be provided on site where chemical dosing is required. The design shall include requirements for access to the facility, delivery and storage of chemicals and adequate space for maintenance and repairs as specified in TMS1636.

8.7.5 Water Sampling Points

Water sampling points shall be installed on the inlet and outlet pipes at the reservoir. Online monitoring shall include:

- Inlet Pipework: Flow Meter; Total Chlorine; Free Chlorine (where required).
- Outlet Pipework: Total Chlorine; Free Chlorine (where required); Conductivity; Turbidity; pH.

8.8 Hydraulic Design

The hydraulic design shall be specific for each reservoir, include the P&IDs and shall consider the following preferred requirements. However, other options may be considered should they result in efficient designs.

Each reservoir shall have provision for double isolation for maintenance purposes by closure of two isolation valves on each of the inlet and outlet pipes at the reservoir site.

8.8.1 Inlet Pipework

The inlet pipe diameter shall be sized for the maximum operational flow from the supply source(s) based on the ultimate development scenario. The inlet and outlet pipes shall be two separate services with dedicated inlet/outlet network configuration.

The selected pipe sizes must comply with the hydraulic design requirements of Section 3 of the Water Supply Code of Australia, WSA 03-2011 (SEQ V1.4-2024), where the pipe elements must not exceed the maximum allowable head losses, and must not exceed the maximum allowable velocities, unless otherwise approved by Urban Utilities.

The inlet pipe-end shall be located at low level, with pipe entry through the reservoir floor slab or with pipework over the top of the reservoir wall and down to low level. The inlet pipe discharge direction, in plan view, shall be oriented at least 90 degrees away from the outlet pipe and directed away from the outlet pipe location. The discharge point may also incorporate a directional nozzle if required. The inlet pipe shall be raised at least 100 mm above the reservoir floor level to prevent disturbance of any sediment.

Where the pipe entry is through the floor slab and the inlet discharge point is at floor level, the pipe opening shall be covered with a stainless-steel safety screen bolted to the reservoir slab. The safety screen mesh openings shall not be larger than 100 mm x 100 mm. The safety screen should have a solid perimeter frame approximately 150 mm high, without holes, to prevent sediment falling into the pipe during maintenance activities. The safety screen design shall allow for ease of cleaning inside the screen.

8.8.2 Outlet Pipework

The outlet pipe diameter shall be sized for the ultimate, peak flow demand. The outlet should be located at the centre of the reservoir through the reservoir slab and shall incorporate a bell mouth.

The outlet pipe opening shall be covered with a stainless-steel safety screen bolted to the reservoir slab. The safety screen mesh openings shall not be larger than 100 mm x 100 mm. The safety screen should have a solid perimeter frame approximately 150 mm high, without holes, to prevent sediment flowing into the pipe. The safety screen design shall allow for ease of cleaning inside the screen. The safety screen shall also have an anti-vortex device.

Care shall be taken to ensure that the water depth below the outlet pipe bell mouth (if protruding above the floor level) or the top of the solid perimeter safety screen frame does not exceed 200mm.

8.8.3 Overflow Pipework

The overflow pipe diameter shall be sized for the maximum operational flow from the supply source(s) without reservoir outflow demands. The overflow and scour pipes shall discharge to a common energy dissipation pit.

The overflow pipe shall be fitted with a bell mouth. The top of the bell mouth shall be at the Top Water Level (TWL) and be 200 mm above the Upper Operating Level. The vertical space between the top of the bell mouth and the lowest roof member shall be 600 mm minimum.

The overflow pipe shall not have any valves except an approved and functional non-return valve such as a duckbill valve to restrict vermin and contaminants from entering the reservoir.

8.8.4 Scour Pipework

The scour pipe shall be sized to release water without causing erosion of the receiving landscape. The scour and overflow pipes shall discharge to a common energy dissipation pit. The outlet pipe from the energy dissipation pit shall discharge to an adequate stormwater or overland flow system. For overland flow discharge, the outlet shall be designed to prevent erosion.

The scour pipework shall be through the reservoir floor slab and located at the lowest point to optimise scour and cleaning of the reservoir. The scour inlet shall have a bell mouth. The top of the bell mouth shall be flush with the reservoir floor. The bell mouth shall be covered with a stainless-steel safety screen bolted to the reservoir slab.

The safety screen mesh openings shall not be larger than 100 mm x 100 mm. The safety screen design shall not restrict water discharge into the bell mouth. The safety screen shall have a solid perimeter section approximately 150 mm high, without holes to prevent sediment falling into the pipe. The safety screen design shall allow ease of removal of the whole or part of the screen to allow final emptying of the reservoir after all sediment has been removed.

The scour and overflow shall discharge into a pit prior to draining into the stormwater system. This will assist de-chlorination activities and cater for inspections of the overflow discharge flap.

8.8.5 Reservoir Bypass Pipework

The inlet and outlet pipework shall have fittings and connecting pipework to bypass the reservoir and isolate it when required. The bypass arrangement shall also allow connections for temporary tanks if the reservoir is not available.

8.8.6 Reservoir Top-up Pipework

The inlet pipework shall have fittings to allow water tankers to be connected for filling the reservoir where it is practical to supplement the reservoir's demand with tankers.

8.8.7 Wash-down Water Supply

Hydrants shall be installed on the inlet and outlet pipelines for operational purposes and wash-down water supply. One hydrant installed upstream of the inlet valves and another hydrant installed downstream of the outlet valves. The use of these hydrants shall be with check valves to prevent backflow into the water supply network.

A service connection shall also be provided off the inlet main, connected (via an RPZ device) to a tap for hand washing purposes.

8.8.8 Site Storm Water Management

The infrastructure, its appurtenances and access shall be positioned such that their floor levels are above the 1% AEP Flood Event (i.e., 1 in 100-year flood level). The site stormwater management and drainage design (including for reservoir scour and overflow discharges) shall be adequate to prevent flooding of the site and the access road.

The stormwater design shall be based on Urban Utilities' Civil and Structural Specification, TMS1731.

The reservoir roof rainwater shall flow off the roof to the hardstand area around the perimeter of the reservoir at ground level. It shall be drained away from the reservoir hardstand and be connected to the site drainage system using pits and pipes. The site drainage design shall provide adequate protection to the reservoir, its surrounds and access road and comply with local council and authorities' requirements. The under-floor drain pipework shall be connected to the site stormwater network and shall have inspection openings in pits or maintenance holes where it is connected to the site stormwater network. The pit levels shall be checked to ensure that there is no backflow to the under-floor drains.

8.8.9 Reference Points

The numbers of a clock face should be stencilled both inside and outside on reservoirs to reference inspection positions. This is to assist personnel carrying out inspections. Numbers should be placed 500 mm above the floor on the internal walls and above the top water line. Corresponding numbers on the outside of the reservoir wall should also be placed. The numbers on the outside should be above the 'normal graffiti line' area to avoid being covered over. Internal roof support columns and penetrations through the wall, floor and roof should also be labelled.

8.9 Structural Design

The design shall allow for fire risks and the potential impact from bush fires based on bushfire hazard area maps, distance from classified vegetation and other relevant bushfire risk factors at the reservoir location.

8.9.1 Regulations and Standards

All design, materials, equipment, and workmanship shall conform to the most recent requirements of the relevant statutory Local, State and Commonwealth authorities and current applicable Australian Standards. Alternatively, where no Australian Standard exists, work shall conform to the most current and applicable International Standard.

8.9.2 Design Basis

The design shall be based on the requirements and reference documents described in Tables 8-2 to 8-9 as follows:

Table 8-2 Design Service Life

DESIGN CRITERIA	MINIMUM DESIGN REQUIREMENTS
Concrete Reservoirs	100 years
Steel Panel Tank and Liner	20 years
Welded mild steel reservoirs	100 years
Polyethylene tanks	20 years
Rafters and columns	50 years
Purlins	30 years
Roof sheets (including fasteners)	30 years
Roof ventilators	15 years
Pipework	100 years
Mechanical Equipment	25 years
Electrical Equipment	25 years

Table 8-3 Structural Design Actions

DESIGN CRITERIA	MINIMUM DESIGN REQUIREMENTS	
Structure Importance Level	Importance Level 3	
	Panel Tanks; & Metal Roofs	**Concrete Tanks & Welded Mild Steel Tanks (Walls & Foundation)**
Wind	1/1000-year annual probability of exceedance	1/2500-year annual probability of exceedance
Earthquake	1/1000-year annual probability of exceedance	1/2500-year annual probability of exceedance
Wind (Serviceability)	1/25-year annual probability of exceedance	
Bushfire	Tank (and ancillary building) materials to consider bushfire zone mapping in the vicinity and bushfire risk shall be assessed according to AS3959	
Internal wall and slab concrete surface finish	Class 1 to AS 3610	
External wall concrete surface finish	Class 2 to AS 3610	

8.9.3 Reference Standards

The latest in-force editions of Australian Standards shall be used for the design and construction of the reservoir. The following Table provides identifies reference Australian Standards of most relevance.

Table 8-4 Reference Australian Standards

STANDARD	TITLE
AS 1012.9	Methods of testing concrete – Comprehensive strength testes – Concrete, mortar and grout specimens
AS 1163	Structural steel hollow sections
AS 1170.0	Structural Design Actions-General Principles
AS 1170.1	Structural Design Actions-Permanent, Imposed and Other Actions
AS 1170.2	Structural Design Actions- Wind Actions
AS 1170.4	Structural Design Actions –Earthquake Actions in Australia
AS 1214	Hot Dip Galvanised Coating on Threaded Fasteners
AS 1397	Continuous hot-dip metallic coated steel sheet and strip
AS 3990	Mechanical equipment - steelwork
AS 1314	Prestressing anchors
AS 1554.3	Structural steel welding – Welding of reinforcement
AS 1562	Design and installation of sheet roof and wall cladding - roof
AS 1657	Fixed platforms, walkways, stairways and ladders- Design, Construction and Installation
AS 1668	The use of ventilation and air condition in buildings
AS 1891	Industrial fall-arrest systems and devices
AS 2312	Guide to the protection of structural steel against atmospheric corrosion by the use of protective coatings
AS 2865	Safe work in a confined space
AS 3566	Self-drilling screws for the building and construction industries
AS 3600	Concrete structures
AS 3610	Formwork for concrete
AS 3735	Concrete structures for retaining liquids

STANDARD	TITLE
AS 3959	Construction of buildings in bushfire-prone areas
AS 4020	Testing of Products for use in contact with drinking water
AS 4040	Methods of testing sheet roof and wall cladding - Introduction, list of methods and general requirements
AS 4100	Steel structures
AS 4600	Cold-formed steel structures
AS 4671	Steel reinforcing materials
AS 4672	Steel prestressing materials
AS 4680	Hot Dip Galvanised (Zinc) Coatings on Fabricated Ferrous Articles
AS 4766	Polyethylene storage tanks for water and chemicals
AS 4792	Hot dip galvanised (zinc) coatings on ferrous hollow sections. Applied by a continuous or a specialised process

Table 8-5 Other Reference Standards

STANDARD	DESCRIPTION
ANSI/AWWA D100	Welded Steel Tanks for Water Storage
ANSI/AWWA D102	Welded Steel Tanks Coating and Painting Specification
ANSI / AWWA D103-09	Factory-coated bolted steel tanks for water storage
ISO 3506	Mechanical properties of corrosion-resistance stainless steel fasteners
SAA HB39	Installation code for metal roofing and wall cladding
SEQ Code	SEQ Design and Construction Code

Table 8-6 Urban Utilities Reference Documents

STANDARD	DESCRIPTION
TEM814	Drinking Water Quality Assurance Procedures Template
PRO307	Drafting And Drawing Management Guideline for Capital Project Delivery
PRO326	Reservoir Disinfection Procedure
PRO655	Reservoir Flood Test Procedure
PRO662	Safety in Design Procedure

STANDARD	DESCRIPTION
TMS 60	Low Voltage Switchboards and Enclosures Standard Technical Specification
TMS 62	Preferred Equipment List Electrical and Instrumental
TMS828	Standard Reservoir Site Functional Specification and Urban Utilities Preferred Equipment List
TMS1595	Cathodic Protection of Pipelines and Structures Specification
TMS1636	Asset Specification for Hypochlorite and Monochloramine Chemical Dosing Units
TMS1639	General Mechanical Works Specification
TMS1727	Trunk Water Main Code
TMS1731	Civil and Structural Specification
TMS1732	General Electrical & Instrumentation specification
TMS1733	General Controls Specification
Typical Reservoir Drawings	The drawings in Appendix A outline Urban Utilities' standards and are provided as guidance only for developing site specific design drawings for construction.
SEQ Code	SEQ Design and Construction Code

Table 8-7 Roof Cladding

MINIMUM DESIGN REQUIREMENTS	DESCRIPTION/MATERIAL
AS 1734, AS 1866, AS 1664	Permalite Alspan Aluminium Roof. Aluminium alloy 5251.
	Roof structure to be drained to the existing perimeter drain with a minimum roof overhang of 300 mm. Roof sheeting overhang and perimeter ventilation detail shall be designed to prevent driving rain entering the reservoir.
	Roof pitch 3 degree minimum
	Stainless steel grade 316, Roof Sheeting Fastener to be AS 3566.2 Class 4

Table 8-8 Ventilation

MINIMUM DESIGN REQUIREMENTS	DESCRIPTION/MATERIAL
Reservoir perimeter Vermin Proof Ventilation	Stainless Steel/Aluminium Mesh with a clear opening of 2 mm maximum
Additional ventilators at roof apex or slope mounted	Stainless Steel/Aluminium Mesh with a clear opening of 2 mm maximum

MINIMUM DESIGN REQUIREMENTS	DESCRIPTION/MATERIAL
	Roof pitch 3 degree minimum
	Stainless steel grade 316, Roof Sheeting Fastener to be AS 3566.2 Class 4

Table 8-9 Existing Roof Refurbished or Replaced

MINIMUM DESIGN REQUIREMENTS	DESCRIPTION/MATERIAL
Design	New design loads not to exceed existing roof and support structure design loads
	New roof connection to be compatible with the existing columns and walls.
	New roof design shall consider utilising minimum number of columns.

8.9.4 Cast In-situ Reinforced Concrete Reservoirs

The following details, as a minimum, shall be provided in the design documents:

- Nominal capacity of reservoir.
- Base, wall and roof detail design documents.
- Foundation design.
- Pipe penetrations, fixtures and fitting, and joints details.
- Under floor drains.
- Stormwater design.
- Appurtenances.
- Concrete casting sequence for floor slab and wall.
- Concrete curing procedure.

The floor slab and foundations for wall, columns and pipe foundations shall be unjointed reinforced concrete structures. Specific details for construction and movement joints with hydrophilic water seals that can be refurbished shall be specified.

8.9.5 Cast In-situ Post Tensioned and Pre-Cast Post Tensioned Reservoirs

The following details, as a minimum, shall be provided in the design documents:

- Nominal capacity of reservoir.
- Base, wall and roof detail design documents.
- Foundation design.
- Precast components design, manufacture, and quality control.

- Pipe penetrations, fixtures and fitting, and joints details.
- Under floor drains.
- Stormwater design.
- Appurtenances.
- Concrete casting sequence for floor slab and wall.
- Concrete curing procedure.
- Installation and sequence for post tension.
- Procedures for grouting stressing conduits and anchor zones.

The floor slab and foundations for wall, columns and pipe foundations shall be a continuous unjointed post tensioned reinforced concrete structure. The wall joints for precast panels shall have a keyed profile.

8.9.6 Prefabricated Steel Bolted Panel Tanks

The prefabricated steel panel tanks shall be manufactured using Galvabond steel for the walls with a replaceable internal liner. The design shall be based on a modular system enabling its capacity to be increased in the future if required. The roof structure and sheeting shall be manufactured using aluminium alloys.

The following details, as a minimum, shall be provided in the design documents:

- Nominal capacity of tank.
- Base, wall and roof detail design documents.
- Foundation design.
- Wall and floor liner material installation and testing specifications.
- Pipe penetrations, fixtures and fitting, and joints details.
- Appurtenances.

Internal Protection of Reservoir

The reservoir structure is to be protected internally with a liner for durability and watertightness. The liner used shall be designed for drinking water storage suitable for use in a bolted steel panel wall structure. The liner shall be made from high quality materials that meet the water quality requirements of Section 8.7.1. The liner shall be the primary containment and the steel structure the secondary containment. The liner material shall be flexible, tear-resistant and impervious for its design life. The material and fastening for the internal protection of the reservoir shall be performance rated for trafficking of maintenance personnel and abrasive contact with appropriate cleaning tools. Leak detection monitor valves shall be installed in the tank wall, above the floor level, to monitor liner leaks.

The liner shall preferably be supplied in one piece, factory fabricated using thermal fusion sealing of the sheet material. The weld seams shall have the same flexibility and strength as the

sheet material. All factory and site welds, if any, shall be integrity tested for the full length of the seam weld. The seam welders and testers shall be accredited for the specified work.

All field seams shall be dual track thermal fusion and air channel tested. The welding machine is to be set up to the pre-determined temperature and speed, with test samples made and tested before commencing the actual field seams. The temperature and speed of the machine are to be adjusted throughout the seaming process as ambient conditions change.

Repairs to the liner should be made with a piece of the membrane material by thermal fusion. The repair patches are to be cut with rounded corners and should overlap the damaged area by a minimum of 75 mm. The repaired area is to be tested for leaks.

8.9.7 Welded Mild Steel Tanks

Welded mild steel tanks shall be vertical, cylindrical, above ground with internal pressures approximating atmospheric pressure. The entire base of the tank shall be uniformly supported.

The material used in the construction of the wall and base shall be mild steel plate. The following details, as a minimum, shall be provided in the design documents:

- Nominal capacity.
- Base, wall and roof detail design documents.
- Foundation design.
- Appurtenances.
- Steel grades details.
- Design metal temperature.
- Design pressure.
- Corrosion allowance for wall and base plates.
- Painting specification.
- Cathodic protection specification.
- Maximum operating temperature.
- Size, arrangement and welding procedures for wall and base plates.
- Inspections and tests for wall and base plates.

Welded mild steel tanks shall comply with TMS1731 section 19 -Steel Tanks and Reservoirs for Water Storage.

8.9.8 Polyethylene Tanks

The polyethylene tanks shall be manufactured in one piece compliant to AS 4766.

The following details, as a minimum, shall be provided in the design documents:

- Nominal capacity of tank.
- Base, wall and roof thickness and detail design documents.

- Ultrasonic thickness testing report. Thickness testing to an accuracy of 0.1 mm.
- Impact testing report.
- Foundation design.
- Pipe penetrations, fixtures and fitting, and joints details.
- Appurtenances.

8.9.9 Under-Floor Drains

An under-floor drain system shall be provided. Its purpose is to prevent hydraulic pressure under the reservoir slab and foundations. The hydraulic pressure can result from the leakage of the reservoir slab, leakage of the pipework or ground water. Visual points of inspection shall be provided to identify leaks into the under-floor drain system. The under-floor drainage system shall be connected to the overflow and scour pipe discharge pipe.

8.9.10 Walls

If requested in the Project Documentation, a personnel access hatch may be provided at ground level in welded steel tanks. It shall not be provided in other types of tanks. The personnel hatch shall be 1.2 m diameter.

8.9.11 Internal Columns

Where possible the roof structure shall be designed without the use of internal columns. Internal columns shall be minimised with the preference of one central column. The columns design shall allow ease of future maintenance or replacement. Columns shall be reinforced concrete or stainless-steel grade 316. Welded stainless steel columns cannot be used. Stainless steel columns shall have a bolted connection to the slab.

8.9.12 Roof

The roof shall be designed with a minimum slope of 3 degrees (with 6 degrees preferrable). The roof shall be designed to over-hang the outside face of the wall by a minimum of 300 mm.

The roof shall be designed without the use of gutters and down pipes, allowing rainwater to fall onto the apron slab around the perimeter of reservoir. The roof run-off shall be drained away from the reservoir and connected to the site stormwater system.

The roof structure shall be designed and constructed to prevent water infiltration into the reservoir (including under windblown scenarios) and shall minimise ingress points for contaminants and vermin entering the reservoir.

8.9.13 Roof Structure

Concrete Roofs

Concrete roofs on reservoirs are not the preferred option and will only be considered for a specific project where they have an exceptional benefit over other construction materials.

Metal Roofs

The roof structure shall be designed and fabricated using aluminium or grade 316 stainless steel sections.

Structural aluminium shall be designed in accordance with AS 1664.1 using extruded alloys 6061-T6 or 6082-T6 or cold rolled alloys 5052-H36; or as advised by the structural (RPEQ) designer.

Purlins, plates, and cleats shall be fabricated from marine grade aluminium alloys.

Corrosion-protected steel may be used in exceptional circumstances such as refurbishing existing long-span trusses or heritage listed structures.

The roof structural members shall be selected and detailed to prevent accumulation of condensation in the members and joints. Design of roof structures must incorporate sliding connections with slotted holes to allow for thermal effects and wall movement. Fall protection mesh under the sheeting is not to be used.

Fasteners shall be stainless steel grade 316 with appropriate insulation between dis-similar materials and adequate sealing to prevent leakage.

Roof Sheeting

Roofing sheeting and associated flashings are to be manufactured from marine grade aluminium alloy 5251 or 5052 produced in accordance with AS 1734. The roof sheeting profile shall be as per the 'Permalite Alspan' profile with a minimum thickness of 0.9mm. The finish of all roof sheets and flashings shall be Stucco Embossed.

Full length roof sheets shall be used where practical. Roof sheeting connections to the roof structure and roof sheeting laps shall allow for thermal movement and shall be detailed in the design and installation procedure. Sample details are also included in the Typical Reservoir Drawings in Appendix A.

The installation of the roof sheeting and accessories shall be in accordance with current Permalite technical data and instructions. The gaps between the roof sheeting profile and the support structure around the reservoir perimeter shall be sealed to prevent vermin access into the reservoir.

All roof fasteners shall be stainless steel grade 304 with aluminium alloy 5251 formed washers and full-size durable rubber sealing washers to provide effective isolation from dissimilar metals and avoid galvanic reaction leading to corrosion. All fasteners, washers and sealing washers used are to be, in application and specification, as described in Permalite's current technical literature. Sources of supply from other than the roofing manufacturer are to be approved before procurement.

The flashing design shall allow movement of the roof and wall members. Flashings shall provide a seal against water, debris and vermin entering the reservoir. The flashing design shall meet these requirements without the use of sealants or other materials. Flashings shall be fixed with screws and not with rivets.

8.10 Roof Access

8.10.1 External Access to Roof

Access to the reservoir roof shall be provided by a free-standing steel stairway complying with AS 1657. Guardrails and toe boards shall be provided as required.

A vandal proof anti-climb security mesh enclosure shall be provided around the stairway access. The access door shall open outwards and be operated by electronic security access control on the outside and free access handle on the inside to exit. An EKA Cyberlock cylinder shall be installed as the key override.

8.10.2 Roof Platform

An aluminium treadplate platform shall be installed around the reservoir access hatch. The platform shall be large enough to provide easy and safe access to the hatch, internal ladder, and lifting davit. The platform shall be installed with a slight slope (for drainage) not exceeding 3 degrees in any direction as per AS 1657. An aluminium guardrail with a toe board shall be provided on the perimeter of the platform. The platform structure shall have three fall restraint anchor points located on three sides of the platform.

The fall restraint anchor points are to prevent workers from getting close to the hatch and are not to be used as fall arrest anchor points, however, they shall still be designed to withstand an Ultimate load of 15kN.

Refer to the typical platform layout in Appendix A which outlines the preferred arrangement for roof access platforms.

The platform and supporting structure shall be designed for on-platform mobile davits and tripods withstanding a fall arrest load of 15 kN, Ultimate load. (This may not be possible in the refurbishment of an existing roof where strengthening of the structure is not feasible.)

Where the roof platform has not been designed for fall arrest loads there shall be signage on the platform to caution against the use of fall arrest systems based off the platform (off mobile davits and tripods); and signage to specify the use of the 15kN rated Davit system provided off the reservoir wall or stairway columns.

8.10.3 Roof Access Hatch

Refer to the Typical Reservoir Drawings in Appendix A for details of the roof access hatch.

The access hatch shall be located near the reservoir wall and adjacent to the plant and equipment set down area at ground level. The access hatch shall have a clear, minimum opening size of 1,300 by 1,200 mm. Large reservoirs may require more than one access hatch for personnel and maintenance access.

The hatch perimeter frame shall be welded onto the platform floor and be at least 80 mm high above the platform level. The cover over the hatch shall have its edges curved over the hatch frame to prevent rainwater entering the hatch. A continuous watertight seal such as EPDM or an equivalent durable sealing material shall be applied between the cover and perimeter frame

to prevent vermin entering the reservoir. The hatch cover shall have handles for lifting and provision for a padlock.

The hatch frame, cover and hinged latches shall be fabricated from marine grade aluminium. The cover shall open to 110 degrees from the horizontal as a minimum and shall have a safety latch in the open position that prevents it from blowing or being knocked closed.

A safety mesh shall be installed under the cover as a safety measure to prevent personnel falling with the cover open. The safety mesh shall be hinged and open in the same direction as the hatch cover and have a safety latch in the open position.

The hatch shall be fitted with an approved contact limit switch to notify the Urban Utilities Control Room of any unauthorised opening of the cover. The contact limit switch shall be connected to the telemetry and SCADA system.

8.10.4 Davit

A davit shall be designed to be supported off the reservoir wall or off a standalone structure (e.g., a stair tower) to allow lifting of plant and equipment from the ground level to the reservoir roof platform and hatch. The davit shall be rated for a working load limit of 150 kg in addition to a one person fall-arrest load requirement of 15 kN, ultimate load. These load limits shall be displayed on the davit. The davit and lifting winch shall be manually operated.

The lifting point at ground level shall be a minimum of 900 mm clear from the reservoir wall. The davit shall be able to rotate 360 degrees and be able to be locked in a position overhanging the edge of the reservoir when not in use.

The lifting area below the davit shall include a concrete pad, 6 m long and 2.5 m wide incorporated with the road and concrete apron around the reservoir perimeter.

8.10.5 Internal Ladder and Access

Access into the reservoir shall be with the use of a fall arrest system off a davit (supported off the reservoir wall or a standalone structure) that is rated to 15kN Ultimate load capacity. This and other Urban Utilities accepted winch systems shall be risk assessed with Safe Work Method Statements prepared prior to their use.

A 316 stainless steel vertical ladder with extension stiles shall be provided, without a safety cage or landings. The ladder serves as an emergency access and is also used by the workers to steady themselves while being winched to avoid spinning. FRP ladders may be provided if a special RPEQ certified design is provided in each case to ensure the FRP members can support the extendable stiles.

8.10.6 Valve Pits

Valves shall be placed above ground where possible to accommodate above-ground operation, maintenance, and repairs. A secure enclosure may be required for the valves. Valves placed below ground shall be in valve pits as shown in the Typical Reservoir Drawings in Appendix A.

The valve pit covers shall be aluminium or approved equivalent to meet the site's traffic load conditions.

8.11 Pipework and Valves

The reservoir inlet and outlet pipework and valves shall be designed and installed to the SEQ Design and Construction Code, Urban Utilities Trunk Water Main Code TMS1727, Australian Standards and specific Urban Utilities requirements set out in project documentation. External pipework to the reservoir shall be DICL and/or MSCL Sintakote. Internal pipework shall be PE. The pipework design shall allow removal and maintenance of valves and flow meters.

Valves shall be designed to operate without cavitation over the complete range of the valve operating conditions.

8.11.1 Bolts, Screws and Dowels

All bolts, screws, studs, and nuts shall be manufactured from stainless steel in accordance with Australian Standards.

All bolts, screws, studs, and nuts shall comply with AS 1111 ISO metric hexagon bolts and screws, and AS 1112 ISO metric hexagon nuts, including thin nuts, slotted nuts and castle nuts.

All dowels shall be manufactured from grade 316 or equivalent stainless steel.

Galling prevention compounds shall be applied to all stainless-steel threads prior to assembly.

8.11.2 Butterfly Valves

Butterfly valves shall be installed with the spindle in the horizontal plane and the lower part of the disc shall move in the same direction as the flow with the valve open. The valves shall be heavy pattern double flanged valves of the seal on body type. The sealing surfaces of the valves shall bed on the metal face of the pipework flanges and not on the cement lining.

Butterfly valves shall be based on the requirements and reference documents described in Table 8-10 as follows:

Table 8-10 Butterfly Valve Requirements

VALVE CRITERIA	MINIMUM REQUIREMENTS
Valve Class	Class PN16
Valve Standard	AS4795; WSA PS 263
Valve Type	Seal on body, bi-directional, double flanged butterfly valve
Materials: • **Body** • **Disc** • **Shaft** • **Seating Design** • **Seat Material**	 • Ductile Iron • Stainless steel 316 or Aluminium bronze • Stainless steel 316 or 410 • Fully Vulcanised • Natural Rubber, EPDM, or similar
Wafer type	Not Accepted
End Connection	AS 4087 Class PN16 flange – Figure B5
Lifting lug	Yes

VALVE CRITERIA	MINIMUM REQUIREMENTS
Above or in-ground application	In ground in a valve pit
Valve operating temperature	Ambient
Input shaft configuration	Horizontal
Flanged joint bolting selection (fasteners)	Galvanised (as it is in a pit)
Flange gaskets, O-rings and lubricant	Full-Face fabric reinforced natural rubber gaskets 3mm thick, no O-rings.
Bactericidal lubricant	Required
Coatings	Thermo-setting epoxy or thermoplastic to WSA 201
Testing	Type test and production test comply to AS 4795
Additional testing	Pressure and leakage testing
Acceptable Product Verification Report	Manufacturers without Product Certificate to supply
Type Test Results	If no Australian Standard, manufacturer to supply
Certificate of Compliance to ISO Type 5 Product Certification Scheme or equivalent	Manufacturer to supply
Additional Requirements	• Torque Limiting Device • Disc position indicator • Positive Locking Device (fully open/ close) • IP68 Rated Gearbox • Stainless steel 316 Extension Spindles (where required)

8.11.3 Nameplates

A nameplate manufactured from grade 316 stainless steel in accordance with AS 1449 Wrought alloy steels - Stainless and heat resisting steel plate, sheet and strip shall be fixed to the body of the valve by means of grade 316 stainless steel screws and stamped or engraved with the following information:

- Tag Number (to be provided by Urban Utilities).
- Manufacturer's name.
- Model / Type descriptor.
- Size Designation Number (DN).
- Rated Pressure.
- Design flow rate.
- Weight.
- Date of Manufacture.

A second nameplate shall be installed on top of the slab near the valve spindle cover or access opening detailing:

- Valve number.
- Direction to open.
- Number of turns to fully open.
- "CONTACT URBAN UTILITIES CONTROL ROOM BEFORE OPERATING THIS VALVE PH 07 3856 7179".

8.11.4 Flowmeter

A flow meter shall be provided on the inlet and outlet pipes as required and shall comply with the following minimum requirements:

- The flow meter make shall be specified by Urban Utilities.
- The flow meter shall be suitable for the accurate and reliable measuring of water for the complete range of operating flows.
- The flow meter shall comprise an electromagnetic detector, power supply and converter providing an overall accuracy of +/- 1%. It shall use bi-polar pulse technology and have a configurable pulse output pre-set to 100 L/pulse.
- The detector shall have a stainless-steel metering tube lined with neoprene or EPDM to prevent wear and corrosion. The lining shall be designed for negative pressure if applicable.
- The transistor and sensor shall be remote mounted.
- The flowmeter internal coating shall be elastomer.
- The electrodes shall be stainless steel grade 316.
- Potential equalising fluid contact rings shall be used for metal pipe connections.

8.12 Durability

The design and detailing of the reservoir, its materials, finishes and protective coating systems shall consider the potential of accelerated corrosion due to humidity and the chemistry of the water to be stored. The current water analysis may be used as part of the detail design.

Refer also to the requirements of Section 10 (Concrete Liquid Retaining Structures) of TMS1731.

8.12.1 Coastal Area

The following additional durability criteria shall apply to the design of all concrete infrastructure within 5 km from the coast:

- Exposure classification B2
- Concrete strength S40 MPa minimum.
- Cover to reinforcement 50 mm minimum.
- Guardrails marine grade aluminium.

8.12.2 Inland Area

The following additional durability criteria shall apply to the design of all infrastructures more than 5 km from the coast:

- Exposure classification B1
- Concrete strength S40 MPa minimum.
- Cover to reinforcement 40 mm minimum.
- Guardrails aluminium.

8.12.3 Thermal Effects

The thermal effects to the concrete structures, steel structures and aluminium structures and their combined use must be detailed correctly. The temperature effects on the reservoir concrete wall between the inside temperature and outside temperature, the directional sun impact on the wall and roof with the use of different materials must be analysed and detailed in the design.

Heat of hydration in curing of concrete shall be controlled for thick and large pours to control temperature differential.

8.12.4 Concrete Requirements

Concrete design and construction shall comply with AS3735 and AS3600.

The concrete mix minimum requirements for the reservoirs shall be as follows:

- Concrete grade S40.
- Compressive strength at 28 days 40 MPa
- Minimum cementitious content 400 kg/m3 (minimum 25% fly ash)
- Water/cement ratio maximum 0.45
- Nominal slump 100 mm
- Drying shrinkage at 21 days 500 x 10-6
- Drying shrinkage at 56 days 600 x 10-6
- Total reactive alkali content not greater than 3.0 kg Na2O per cubic meter.

8.12.5 Steel Structures Painting & Corrosion protection

Steelwork shall be hot dip galvanised to AS 4680 system designation HDG 600 and threaded fasteners to AS 1214.

- The paint protection system for metallic structures shall be in accordance with WSA201 – Protective Coatings and the following:
- The atmospheric corrosivity category for internal paint protection system shall be category C4: High, to AS2312.
- The paint protection system durability shall last for a minimum of ten years until first maintenance to AS2312.
- The internal protective paint system shall be solvent less two pack epoxy high build to a minimum dry film thickness of 550 microns.

- The internal protection system shall comply with AS4020 – Testing of products for use in contact with drinking water.

Refer to TMS76 for the Urban Utilities List of Approved Protective Coating Products

Damaged galvanised coating shall be repaired with the following procedure:

- Power clean to AS 1627.2.
- Solvent clean/degrease to AS 1627.1
- Apply tin/zinc to pre-heated steel overlapping the galvanising coating.

Additional protection coating systems may be applied on the hot dip galvanised coating to increase the durability of the members. The additional coating system shall be:

- Surface preparation for the primer.
- First coat zinc rich primer to a dry film thickness of 75 microns.
- Second coat epoxy micacecous iron oxide paint to a dry film thickness of
- 125 microns.
- Third coat epoxy micacecous iron oxide paint to a dry film thickness of 125 microns.
- Colour grey.

Testing

The tests on paint protection systems shall be carried out by an independent NATA certified testing authority. Test results shall be recorded on approved test report sheets.

Coating System Trial test

Trial coating shall be applied and tested in accordance with AS 3894.9 – Site testing of protective coatings Method 9 – Determination of adhesion Clause 7 Method C – Pull-off Test. It shall be tested to the manufacturer's recommendation. The quality control authorised person will decide two locations at random for testing.

Coating System Pull-Off Test

The coating system shall be applied and tested in accordance with AS 3894.9 – Determination of adhesion Clause 7 Method C – Pull-off Test after approval of the trial tests. It shall be tested to the manufacturer's recommendation. The Accountable Party will decide two locations at random for testing.

Dry Film Thickness Test

The dry film thickness shall be tested in accordance with AS 3894.3 after the application of the coating system. The Accountable Party will decide two locations at random for testing.

Continuity Testing

Continuity testing on internal surface shall be carried out as per AS 3894.1 after curing of the coating system.

8.13 Concrete and Masonry

The external painting system for the concrete reservoirs shall comply with:

AS 2311 – Guide to the painting of buildings

AS 3730.1 – Guide to the properties of paints for buildings – Introduction and list of guides

AS 3730.5 – Solvent borne interior – Semi gloss

AS 3730.10 – Latex exterior – Gloss

AS3730.22 – Concrete and masonry sealer Solvent borne interior/exterior.

The external paint system to the reservoir walls and structures shall include an anti-graffiti product. The anti-graffiti product shall be a sacrificial treatment, non-sacrificial treatment, or part of a permanent two pack coating. It shall be compatible with the existing external paint system.

8.14 Joint Sealing

All expansion and contraction floor slab joints, and internal and external wall joints shall receive a joint sealant application.

Joint sealant works shall not commence until the concrete has had adequate time to cure in accordance with the manufacturer's recommendations (minimum 28 days).

Joints shall be sealed with an approved chemically resistant polyurethane sealant. Sikaflex Tank N is preferred or a suitably approved equivalent.

Primer shall be suitable for use with polyurethane sealants and concrete (Sika Primer -3N is preferred or a suitably approved equivalent).

Backing rods shall be extruded closed cell polyethylene foam, with a diameter 25 % larger than the joint (Sika Closed Cell Backing Rod is preferred or a suitably approved equivalent).

Joint filler shall be non-absorbent, semi-rigid, polyethylene joint filler.

8.15 Decorative Coating Systems

The reservoirs may require a decorative external coating system dependent on the site's aesthetic requirements. This coating system shall be a solvent borne acrylic topcoat. The colour shall be mist green/heritage green.

8.16 Rehabilitation of Reservoirs

Refer to Appendix C for concrete repair specifications for existing reservoirs which also includes concrete reservoirs with concrete roofs.

Structural steel members that have deteriorated to the extent that their design capacity is not adequate shall be replaced. The replaced members shall be compatible with remaining existing structural members, be of equal or greater capacity and have the same protective coating system as the existing structure.

9. ELECTRICAL

The reservoir design shall include the design of the electrical and telemetry equipment. It shall include, as a minimum, the following:

- Incoming power supply.
- Switchboard containing metering, main distribution, PLC and telemetry equipment.
- Radio pathway survey.
- Instruments for level monitoring.
- Area lighting and power.
- Security system.
- Lightning protection system.

Design and Construction of Electrical and Instrumentation systems shall be in accordance with TMS1732. Design and Construction of Controls and Telemetry shall be in accordance with TMS1733.

9.1 Power Supply

Liaise with Energex to co-ordinate power for the site and confirm sufficient capacity is available in the local Energex network.

9.2 Site General Purpose Outlets

General purpose outlets (GPOs), each GPO with a separate earth leakage circuit breaker, shall be provided at the following locations:

- One on the internal door of the distribution section of the main switchboard.
- Two inside the PLC/Telemetry/Instrumentation panel.
- One each inside the inlet and outlet valve pits.
- Roof area near access platform.
- Inside entrance door to the roof access structure.

9.3 Switchboard

The switchboard shall be designed to the requirements of TMS60 - Low Voltage Switchboards and Enclosures.

9.4 Telemetry and Instrumentation

Urban Utilities will provide model number of Standard RTU and Standard Instrumentation to be used at the site. The design of the switchboard must accommodate these selections.

9.5 Radio Path Survey

A radio path survey is required to identify any issues with the radio signal path of the Urban Utilities preferred RTU.

9.6 Level Instruments

The level instruments shall comply with the requirements of TMS 828 - Standard Reservoir Site Functional Specification and Urban Utilities preferred equipment list. The level instruments shall be hung from an electrode box mounted on the reservoir roof. The electrode box shall be accessible from the Roof Platform.

9.7 Lightning Protection

Design and construction of lightning protection systems shall be in accordance with TMS1732.

9.8 Security System

The security system for the reservoir shall be in accordance with TMS176 Security Design Guidelines.

9.9 Site Lighting

Site lighting facilities shall be provided within the reservoir site at:

- Site entry gate.
- Security enclosure for staircase to roof.
- Reservoir roof access points.
- Roof area near access platform.
- Over entry point to pump building.
- SCADA telemetry and security systems.
- Lighting levels shall comply with AS 1680.

9.10 Cathodic Protection

Cathodic protection for reservoirs is not normally required except for use with welded steel reservoirs. Should there be justification for cathodic protection for a particular location, the design shall be prepared by a specialist consultant. The design should provide an additional

protection of a minimum of 20 years over the design life of the reservoir. Structures to be considered for cathodic protection comprise reinforced concrete columns and steel structural members.

Where applicable, the sacrificial anode system must be linked with Urban Utilities existing Cathodic Protection system. The Cathodic Protection system supplied shall be in accordance with TMS1595.

10. RESERVOIR CONSTRUCTION, COATING, INSPECTION & TESTING, COMMISSIONING

10.1 Quality Assurance

A Quality Management System shall be implemented for all elements of the reservoir work. It shall include Water Quality Assurance Procedures, Inspection and Test Plan and associated quality control records to ensure acceptable quality assurance for each element of the work.

10.1.1 Water Quality Information Requirements

A Water Quality Assurance Procedures (WQAP) methodology shall be prepared by the Contractor and communicated to relevant stakeholders for review and acceptance.

The WQAP will outline the risk management and quality assurance framework to ensure the drinking water from the reservoir is safe and meets all regulatory requirements and Urban Utilities' customer service standards in providing aesthetically pleasing drinking water without taste and odour issues.

The information in the WQAP will cover, as a minimum:

- Reference the water quality performance criteria, including the reservoir design maximum water holding time and how this may impact any coating material selection. Articulate how the final product (asset as a whole or installed attribute) will be verified that it is suitable for controlling water quality risks. That is, flood test to prove ingress is mitigated, comprehensive photographic evidence of vermin proofing with rulers in the photos, relevant water quality test suites to demonstrate leaching is not excessive).
- Identify key details of the infrastructure being provided to achieve the water quality performance targets, including design standards, selection of materials etc.
- Identify all materials (including SDS and AS4020 certification) and equipment proposed to deliver the scope within the reservoir, including products to be used in the preparation and cleaning of materials and surfaces.
- Identify all significant hazards that may affect water quality.
- Methodology of the proposed works within the reservoir, including final cleaning requirements for materials in their final, cured state. The methodology shall include all controls and verification activities to ensure that significant risks are reduced to acceptable levels in the design and construction stages.
- Identify the quality assurance process to be applied to ensure that the reservoir is constructed and commissioned in accordance with the design intent and that all the actions arising from the previous Hazard Studies have been completed satisfactorily.

This includes to identify approach to verifying compliance with the procedures and the water quality criteria, including Inspection & Test Plan, documented procedures, information management and record keeping.

10.1.2 Inspection & Test Plan (ITP)

ITPs and Check Sheets shall be completed for all construction work to prove it has been satisfactorily inspected and, if required, tested to meet all specified requirements in the project documentation. The ITPs shall indicate the specification, procedure or standard to be applied.

The ITPs shall indicate all Hold and Witness Points where the Accountable Party may acknowledge that a step or procedure during installation has been achieved with acceptable quality.

10.2 Water Quality Management during Construction and Coating Applications

Products used in the construction and rehabilitation of reservoirs, especially coating and sealing products, can impact on the quality of drinking water after commissioning if the products have not been applied correctly, cured completely or thoroughly washed and soaked in water, resulting in leaching of chemical contaminants into the drinking water and causing taste and odour issues.

Particular attention must be given to the following aspects during construction of new reservoirs or rehabilitation and internal coating of existing reservoirs.

10.2.1 Sealing of the Inlet and Outlet Pipe Ends Within the Reservoir

Inlet and Outlet pipe ends within the reservoir shall be sealed during the construction works to avoid contaminants and wash water entering the pipe network. This may be in the form of a blank flange bolted onto the end of the inlet pipe and a plate over the outlet pipe sealed and bolted to the concrete floor or other methods as approved by Urban Utilities. A methodology shall be submitted for this activity as part of the WQAP for approval by Urban Utilities. The methodology shall include removal of the end plates and reinstatement of the concrete surfacing and pipe fittings.

10.2.2 Products Not Approved to AS/NZS 4020

Products not approved to AS/NZS 4020 (such as cleaning chemicals) must not be brought into the reservoir without the written approval of Urban Utilities or undertaking a risk assessment in conjunction with Urban Utilities' stakeholders. Approval in such cases will require strict control measures in avoiding spills and the requirement for multiple pressure washes of the internal surfaces to remove spills and sprays, and removal also of the VOCs from within the reservoir air space via forced ventilation systems well after construction is complete.

Elimination of the hazards by not allowing these products into the reservoir is the preferred protection methodology for water quality management, as a relatively minute quantity of solvent-based product not washed out completely after a spill can cause taste and odour issues in drinking water on commissioning.

10.2.3 Selection of Coating Products Approved to AS/NZS 4020

The coating products chosen shall be able to remain in contact with the drinking water over a 7-day holding period without adversely impacting the health or aesthetic quality of the drinking water.

Attention shall be given to the ratio of coated surface area to the immersed volume of water at which the products comply. The specified ratio of surface area to volume in the AS/NZS 4020 test certificate shall be equal to or greater than the actual structure ratio of surface area to volume applicable in service (at the Lower Operating Level of the reservoir). Where the soffit of a concrete-roofed reservoir is coated and/or if there is inadequate permanent ventilation, consider including the total coated area in the calculations to account for condensation effects on the unsubmerged surfaces.

10.2.4 Coating Inspector

Inspection and testing of coating shall be undertaken by certified coating Inspector(s) nominated by the Contractor and accepted by Urban Utilities. The coating inspector shall carry out inspections and testing and verify all works are performed in accordance with this specification and the coating supplier's requirements.

The Inspector shall be certified to Australasian Corrosion Association (ACA) Level 2, or National Association of Corrosion Engineers (NACE) Level 2 or an equivalent certification.

10.2.5 Temporary, Forced Ventilation System

A forced, mechanical ventilation system must be provided during surface preparation and coating applications to remove contaminated air from within the reservoir, replacing it continuously with fresh air. This ventilation system must be designed specifically with respect to the construction activity and the type of coating products chosen for application within the reservoir. This ventilation system is required to:

- reduce particulates and harmful fumes from around the workers.
- reduce the quantity of low-flashpoint solvents (if any) to a safe level.
- maintain temperature and humidity as required for optimal performance of the coatings.
- remove all pockets of trapped VOCs from within the reservoir.
- remain in operation after completion of the coating applications until the coatings have cured.

Note that reliance on the use of natural ventilation systems in existing reservoirs or the proposed natural ventilation designs for new reservoirs (including the 6 air changes per hour design criteria) will not be sufficient to remove VOCs from within the reservoir or address the above ventilation requirements.

After completion of the internal coating applications, the forced ventilation system shall be utilised for at least 7 days within the reservoir to ensure curing of the coating materials and removal of VOCs from the reservoir.

Note that during construction and coating applications it will be necessary to protect the workers from dust and fumes from coating applications with the use of supplied-air respirators and other personal protective equipment as recommended by the coating product supplier and as per the Contractor's safety procedures. That is, the workers must not solely rely on the forced ventilation system for personal protection.

10.2.6 Water Quality Procedures and Testing after Coating Application

Water quality procedures and testing shall be in accordance with the Water Quality Assurance Procedures and the Commissioning Plan, including any coating manufacturer's requirements. These procedures shall be reviewed and approved by Urban Utilities' Water Quality Specialist. At a minimum they shall include the following steps after completion of the coating works:

1. Maintain operation of the forced ventilation system for at least 7 days.
2. Clean and vacuum out all dust and debris.
3. On removal of the temporary ventilation system, carry out high-pressure washdown of the reservoir walls and floor; and the roof soffit if it has been coated. The pressure and flowrate for the washdown shall be as per the coating manufacturer's recommendations.
4. Fill the reservoir to 500mm above the highest applied coating level and leave in place, isolated for 7 days at least to ensure adequate soak-leach time is achieved. Fill to the overflow level if the reservoir is coated to the top of the wall.
5. During the above 7 days, test air samples on days 1 and 7; and perform water quality tests as specified by Urban Utilities' Water Quality Specialist, typically sampled on days 1, 3 and 7:
   - The water quality tests will include broad-spectrum testing which may specify BTEX Testing, GC VOC Testing, GC Scan, and other tests for chemicals as used in the coating layers or as cleaning agents.
   - The Urban Utilities Water Quality Specialist will assess the water quality analysis from the 3 sampling events and determine if leaching is complete, or if more soak time is required.
6. Empty the reservoir water after completion of leaching is confirmed.

10.3 Reservoir Integrity Testing

The reservoir design shall include a detailed testing procedure which shall include the Urban Utilities testing requirements as follows:

10.3.1 Foundations

The loads and settlement on the foundations shall be monitored during filling of the reservoir and compared with the design. The monitoring shall be done using the base line survey after construction of the reservoir. Should the settlement or differential, at any control point exceed the predicted design value, the water filling shall be immediately stopped. The design engineer shall investigate the cause for the additional settlements determine appropriate actions and remedial work if required before the foundations can be loaded further.

The survey work is to be completed by an independent registered surveyor. Note that the fill rate shall not exceed 2m in 24 hours as per AS 3735.

10.3.2 Floor

The concrete slab shall be checked to confirm that there are no cracks other than those permissible in the design. The floor joints sealants shall be tested as specified in the joint sealants section.

The liner for the steel panel tanks shall be inspected for any damage during installation of the reservoir and repaired as required.

All defective work shall be repaired and tested before the reservoir is filled with water. The under-floor drains inspection openings shall be checked for floor leaks while filling the reservoir.

10.3.3 Hydrostatic Test

A hydrostatic test plan shall be submitted for acceptance prior to the commencement of the testing activities. The plan shall include a detailed method statement and acceptance criteria.

The reservoir shall be tested for leaks by filling to the normal operating top water level. The hydrostatic test shall be started after all leaks in the slab and wall have been repaired.

For concrete reservoirs, hydrostatic testing shall comply with section 7 of AS 3735-2001.

10.3.4 Roof Testing

The reservoir roof, access hatches and vents shall be tested for leaks by spraying water onto the roof to simulate a 1 in 5-year rainfall event. All leaks and defects shall be repaired, and the roof re-tested for leaks. Refer to PRO655, Reservoir Flood Test Procedure.

10.3.5 Overflow and Scour Pipelines

The overflow and scour lines shall be tested after successful completion of the reservoir tests. The water from the reservoir shall be used to test the overflow and scour lines including the energy dissipation pits.

10.4 Reservoir Commissioning

The reservoir shall be commissioned in accordance with the approved Commissioning Plan with the following items confirmed as part of the commissioning process:

- All valves function correctly.
- All electrical work, telemetry and monitoring systems function correctly.
- All the safety equipment and procedures comply and function correctly.

If the scope includes coating applications or other extensive sealing applications, follow the procedures and testing requirements listed in section 10.2.6. prior to the final cleaning and disinfection of the reservoir.

10.4.1 Cleaning and Disinfection

Prior to filling the reservoir, the inside surfaces of the reservoir must be cleaned and vacuumed out to remove all swarf, dust, and debris. This includes cleaning of the purlin lipped channels and other recessed areas in the roof space.

The reservoir shall then be washed down to remove any remaining dirt and dust using high pressure washing equipment.

The final stage of reservoir commissioning requires the reservoir to be disinfected and water quality assessed for acceptable service. Refer to PRO326 (Reservoir Disinfection Procedure).

Note that this stage will require asset acceptance by Service Delivery before PRO326 is approved to proceed.

10.5 Completion and Commissioning Verification Requirements

Key Completion and Commissioning verification requirements to improve water quality risk management during capital projects and reservoir maintenance are summarised in Table 10-1 below for inclusion in the Contractor's Inspection and Test Plans.

Table 10-1 Summary of Key Verification Requirements

Ref. #	Process Verification	Documentation Required	Clause
1	**Water quality risk management**	Water Quality Assurance Procedures (WQAP)	10.1.1
	WQAP: • AS/NZS 4020 compliance of products in contact with drinking water • Coating Inspector Accreditation • Liner integrity • 7-day soak for leaching of coating products • Roof testing for water tightness • Cleaning and disinfection on completion	• AS/NZS 4020 test certificates for all products used within the reservoir. • Evidence of accreditation • Seam weld integrity test result • Leaching and water quality records • Roof test to PRO655 and record • Cleaning and acceptance by UU before disinfection to PRO326, *Reservoir Disinfection Procedure*	8.7 & 10.1.1 10.2.4 8.9.6 10.2.6 10.3.4 10.4
2	**Reservoir Integrity Testing:** • Concrete mixes and durability • Foundation monitoring during filling of the reservoir • Floor checks for cracks and leakage • Hydrostatic testing • Overflow/Scour pipelines test	• Concrete mix design and test reports • Survey results against baseline. Note maximum fill rate of 2m per 24 hours. • Inspection reports prior to filling. Leakage monitoring of underfloor drain outlets during filling. • Hydrostatic test plan and record • Test records	8.12 10.3.1 10.3.2 10.3.3 10.3.5

Ref. #	Process Verification	Documentation Required	Clause
	• Valves, Electrical, Control Systems, and Safety equipment testing	• Approved Commissioning Plan	10.4

The above records shall be included in the Contractor's Post Construction Report noted in Appendix B.

11. APPENDIX A: TYPICAL DESIGN DRAWINGS

The following is a list of available typical design drawings developed and regularly updated by Urban Utilities. These are to be used by the design team for guidance purposes only for developing site specific design drawings for construction. Refer to Urban Utilities for the latest versions of these drawings.

Drawing Title	Drawing Number	Revision
DRAWING INDEX AND NOTES	WR-CV-TYP-00001	B
SITE ARRANGEMENT	WR-CV-TYP-00010	A
PLAN AND ELEVATIONS	WR-CV-TYP-00011	A
ELEVATIONS AND SECTIONS	WR-CV-TYP-00012	A
PIPEWORK LAYOUT AT GROUND LEVEL	WR-CV-TYP-00013	B
PIPEWORK SECTIONS 1 OF 2	WR-CV-TYP-00014	B
PIPEWORK SECTIONS 2 OF 2	WR-CV-TYP-00015	C
TYPICAL VALVE PIT DETAILS	WR-CV-TYP-00016	A
ROOF PLATFORM - OPTION 1 (PREFERRED)	WR-CV-TYP-00030	B
ROOF PLATFORM SECTIONS - OPTION 1	WR-CV-TYP-00031	B
ROOF PLATFORM - OPTION 2 (NON-PREFERRED)	WR-CV-TYP-00032	A
TYPICAL INTERNAL LADDER DETAILS	WR-CV-TYP-00050	B
TYPICAL DAVIT DETAILS	WR-CV-TYP-00051	C
ELECTRODE BOX GENERAL ARRANGEMENT	WR-CV-TYP-00052	C
ELECTRODE BOX AND CUBICLE ASSEMBLY - GENERAL ARRANGEMENT	WR-CV-TYP-00053	A
ELECTRODE BOX - LEVEL HATCH BOX - GENERAL ARRANGEMENT	WR-CV-TYP-00054	A
LEVEL HATCH – PARTS DETAIL - GENERAL ARRANGEMENT	WR-CV-TYP-00055	A
TYPICAL ROOF DETAILS – ACCESS HATCH DETAILS	WR-CV-TYP-00056	A
TYPICAL ROOF DETAILS – EXTERNAL ACCESS	WR-CV-TYP-00058	A
TYPICAL ALUMINIUM ROOF SHEETING – EXPANSION JOINT DETAILS	WR-CV-TYP-00060	A
TYPICAL ALUMINIUM ROOF SHEETING DETAILS	WR-CV-TYP-00061	A
TYPICAL ALUMINIUM ROOF SHEETING LONGITUDINAL FLASHING DETAILS	WR-CV-TYP-00062	A

TYPICAL DRAWINGS
DRINKING WATER RESERVOIRS AND TANKS

DRAWING INDEX

DRAWING No	TITLE/DESCRIPTION
WR-CV-TYP-00001	DRAWING INDEX AND NOTES
WR-CV-TYP-00010	SITE ARRANGEMENT
WR-CV-TYP-00011	PLAN AND ELEVATION
WR-CV-TYP-00012	ELEVATION AND SECTIONS
WR-CV-TYP-00013	PIPEWORK LAYOUT AT GROUND LEVEL
WR-CV-TYP-00014	PIPEWORK SECTIONS 1 OF 2
WR-CV-TYP-00015	PIPEWORK SECTIONS 2 OF 2
WR-CV-TYP-00016	TYPICAL VALVE PIT DETAILS
WR-CV-TYP-00030	ROOF PLATFORM - OPTION 1
WR-CV-TYP-00031	ROOF PLATFORM SECTIONS - OPTION 1
WR-CV-TYP-00032	ROOF PLATFORM - OPTION 2
WR-CV-TYP-00050	TYPICAL INTERNAL LADDER DETAILS
WR-CV-TYP-00051	TYPICAL DAVIT DETAILS
WR-CV-TYP-00052	ELECTRODE BOX - GENERAL ARRANGEMENT
WR-CV-TYP-00053	ELECTRODE BOX AND CUBICLE ASSEMBLY - GENERAL ARRANGEMENT
WR-CV-TYP-00054	ELECTRODE BOX - LEVEL HATCH BOX - GENERAL ARRANGEMENT
WR-CV-TYP-00055	LEVEL HATCH - PARTS DETAIL - GENERAL ARRANGEMENT
WR-CV-TYP-00056	TYPICAL ROOF DETAILS - ACCESS HATCH DETAILS
WR-CV-TYP-00058	TYPICAL ROOF DETAILS - EXTERNAL ACCESS
WR-CV-TYP-00060	TYPICAL ROOF SHEETING - EXPANSION JOINT DETAIL
WR-CV-TYP-00061	TYPICAL ROOF SHEETING DETAILS
WR-CV-TYP-00062	TYPICAL ROOF SHEETING - LONGITUDINAL FLASHING DETAILS

NOTE

1. THIS SET OF TYPICAL DRAWINGS OUTLINE URBAN UTILITIES' STANDARDS AND ARE PROVIDED AS GUIDANCE ONLY FOR DEVELOPING SITE-SPECIFIC DESIGN DRAWINGS FOR CONSTRUCTION. URBAN UTILITIES ACCEPTS NO LIABILITY FOR THE USE OF THESE DRAWINGS, WHICH MUST BE ADAPTED TO THE REQUIREMENTS OF THE PARTICULAR SITE AND CERTIFIED BY THE RPEQ.
2. DETAILS SHOWN ARE TYPICAL. THE DESIGNER SHALL PROVIDE A SPECIFIC DESIGN FOR CONSTRUCTION OF THE RESERVOIR AND ASSOCIATED INFRASTRUCTURE.
3. DRAWINGS SHALL BE READ IN CONJUNCTION WITH TMS1581 - DRINKING WATER RESERVIORS AND TANKS SPECIFICATIONS
4. DESIGNERS TO INCLUDE CONSTRUCTION NOTES AND SPECIFICATIONS COVERING THE FOLLOWING ITEMS IN THE DESIGN DRAWINGS.
   - GENERAL
   - DESIGN CRITERIA
   - GEOTECHNICAL
   - NETWORK ACCESS PERMIT
   - CONSTRUCTION PROCEDURE
   - DEMOLITION
   - CIVIL WORKS
   - FOUNDATIONS
   - DRAINAGE
   - CONCRETE
   - REINFORCEMENT
   - PRECAST CONCRETE
   - TYPICAL POST TENSIONED CONCRETE
   - TESTING FOR WATER TIGHTNESS
   - STRUCTURAL STEEL
   - ALUMINIUM
   - STAINLESS STEEL
   - PROTECTIVE COATING

REV.	DATE	AMENDMENT	UU DELEGATE
B	18/10/24	Drawing Index Corrected / WR-CV-TYP-00040 Omitted	M Chandra

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

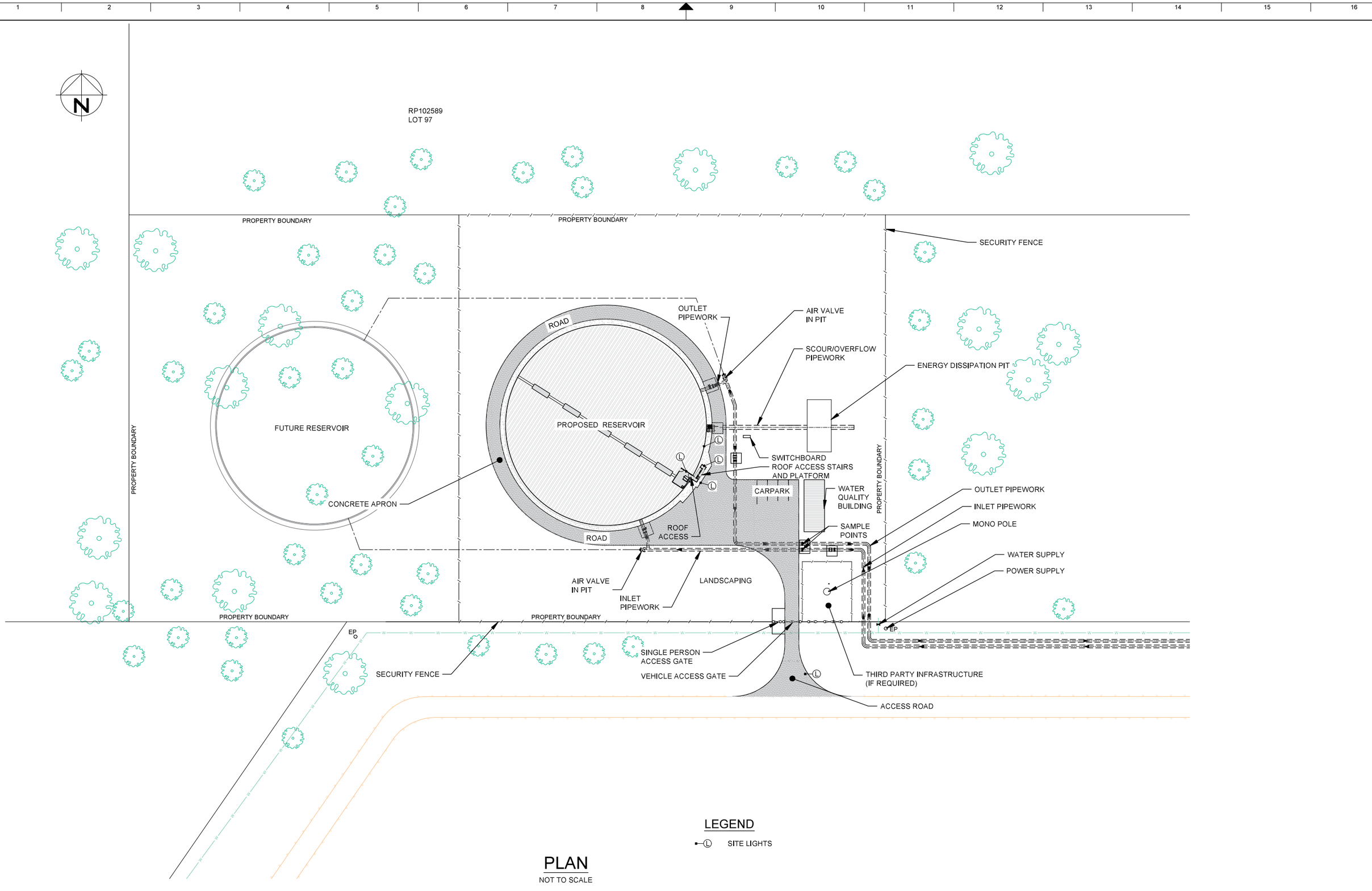
FACILITY/NETWORK TYPE: TYPICAL DRAWING DRINKING WATER RESERVOIRS AND TANKS

DRAWING TITLE: DRAWING INDEX AND NOTES

DRAWING STATUS: *FOR INFORMATION*

URBAN UTILITIES DRAWING No.: WR-CV-TYP-00001

REVISION: B



PLAN

NOT TO SCALE

REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

UrbanUtilities

FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

DRAWING TITLE
SITE ARRANGEMENT

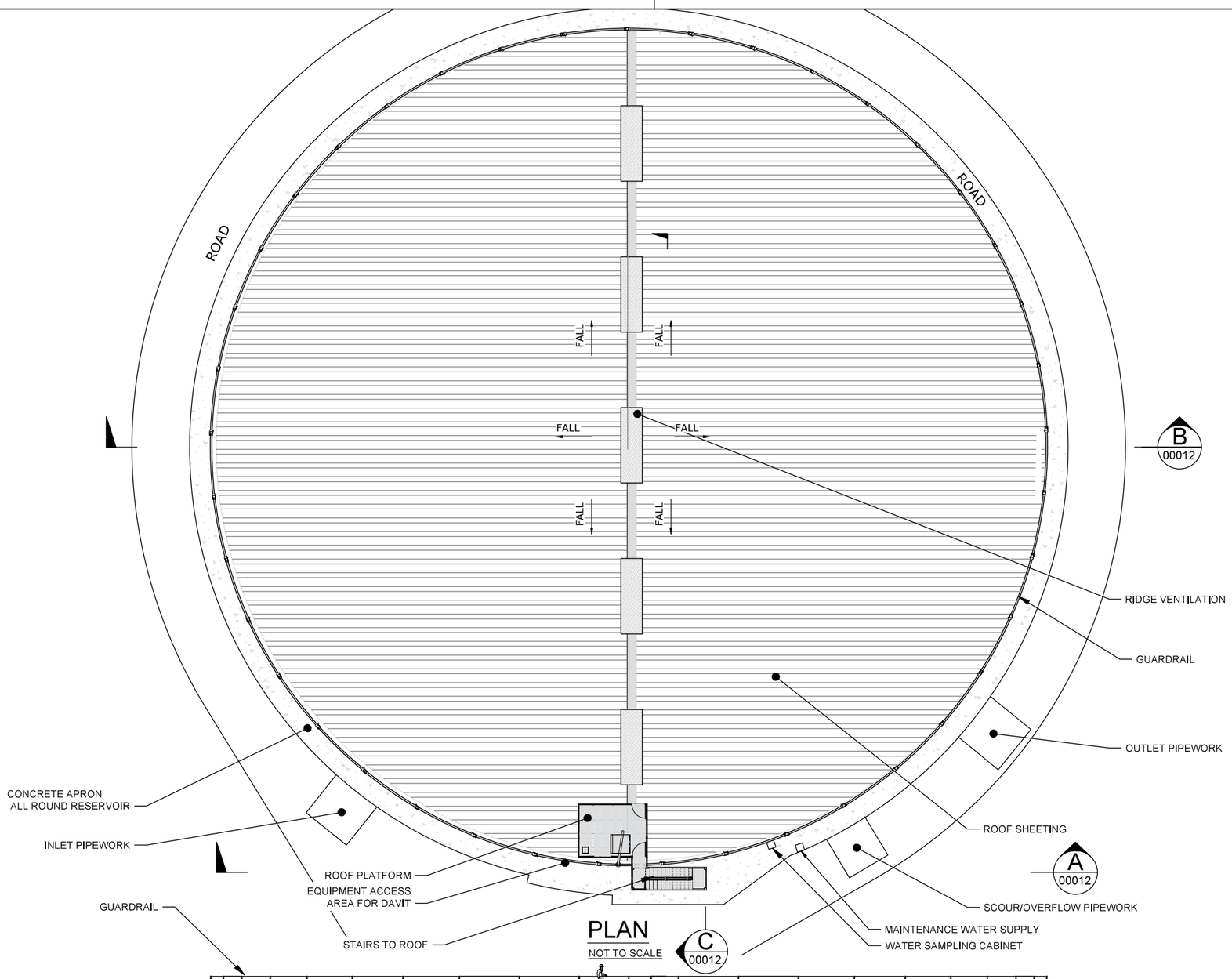
DRAWING STATUS
FOR INFORMATION

URBAN UTILITIES DRAWING No.
WR-CV-TYP-00010

REVISION
A

ROOF SHEETING NOTES

- LAPS IN ROOF SHEETS ARE TO BE AVOIDED WHERE POSSIBLE
- EXPANSION JOINTS ARE TO BE PROVIDED IN ACCORDANCE WITH THE MANUFACTURERS SPECIFICATIONS.



PLAN

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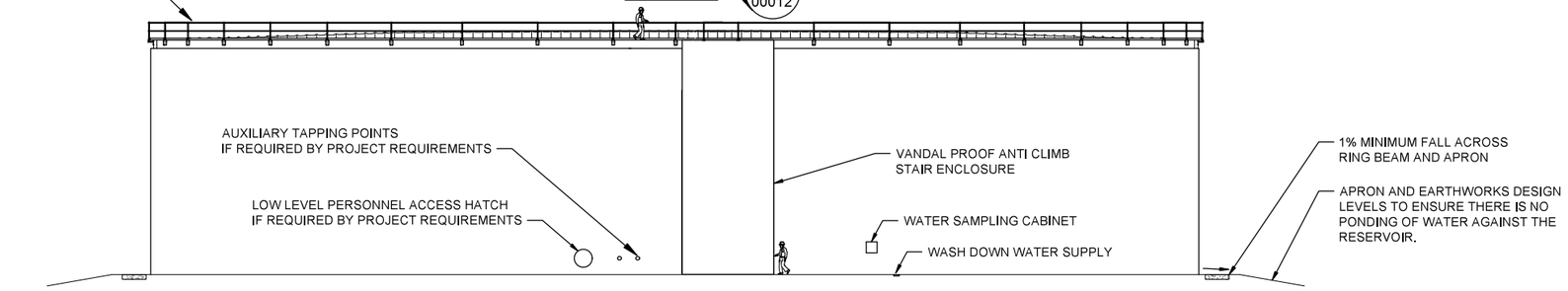


ELEVATION

NOT TO SCALE

REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

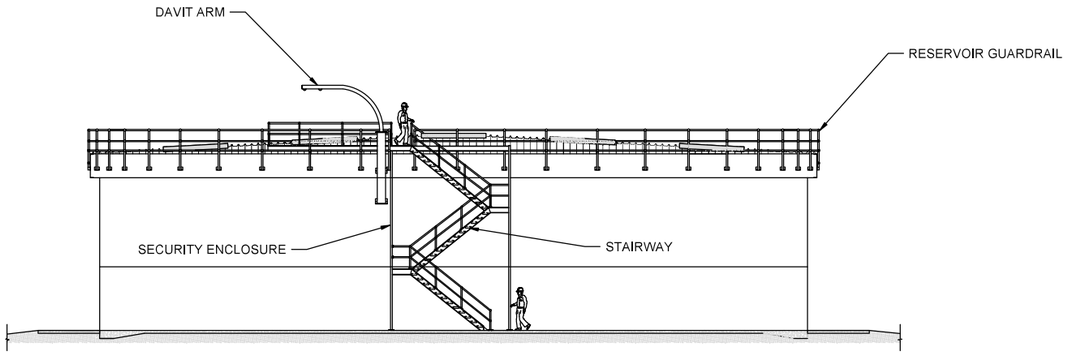
UrbanUtilities

FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

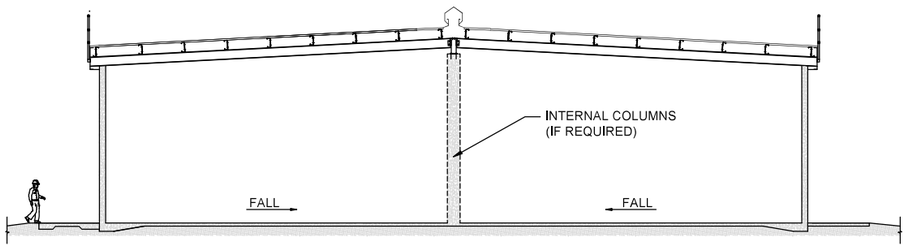
DRAWING TITLE
PLAN AND ELEVATIONS

DRAWING STATUS
FOR INFORMATION

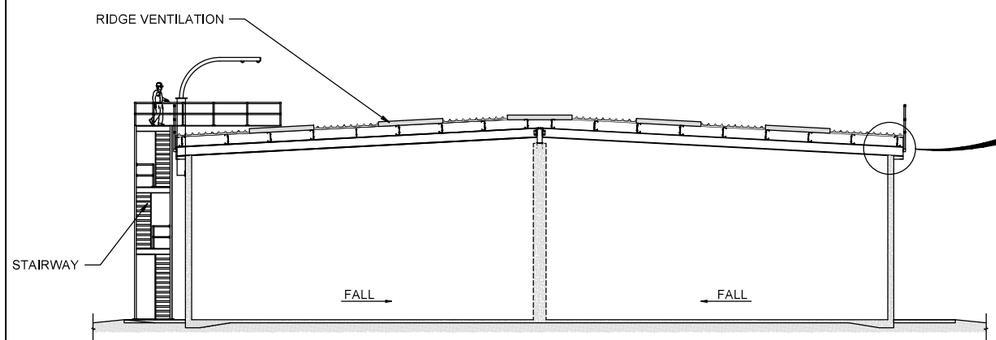
URBAN UTILITIES DRAWING No.	REVISION
WR-CV-TYP-00011	A



ELEVATION A
NTS 00011



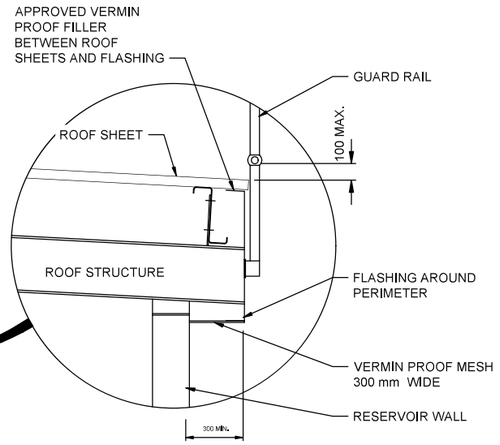
SECTION B
NTS 00011



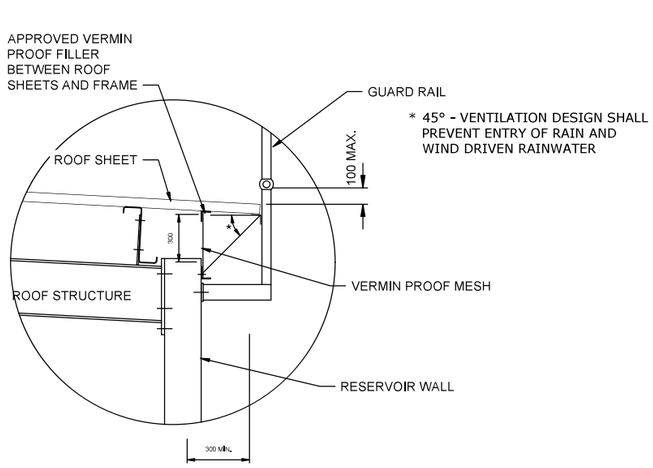
SECTION C
NTS 00011

VERMIN MESH NOTES:

1. WHERE MESH IS INSTALLED LESS THAN 6m ABOVE GROUND LEVEL IT SHALL BE VANDAL PROOF. REFER TO TS1581 FOR GUIDANCE.
2. LOUVRES WITH A SUITABLE MESH MAY BE CONSIDERED IN LOCATIONS WHERE AN OVERHANG IS NOT PRACTICAL. THE LOUVER SHALL BE DESIGNED TO AVOID DRIVING RAIN ENTERING THE RESERVIOR.



TYPICAL SIDE VENTILATION DETAIL (OPTION 2)



TYPICAL SIDE VENTILATION DETAIL (OPTION 1)

REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

UrbanUtilities

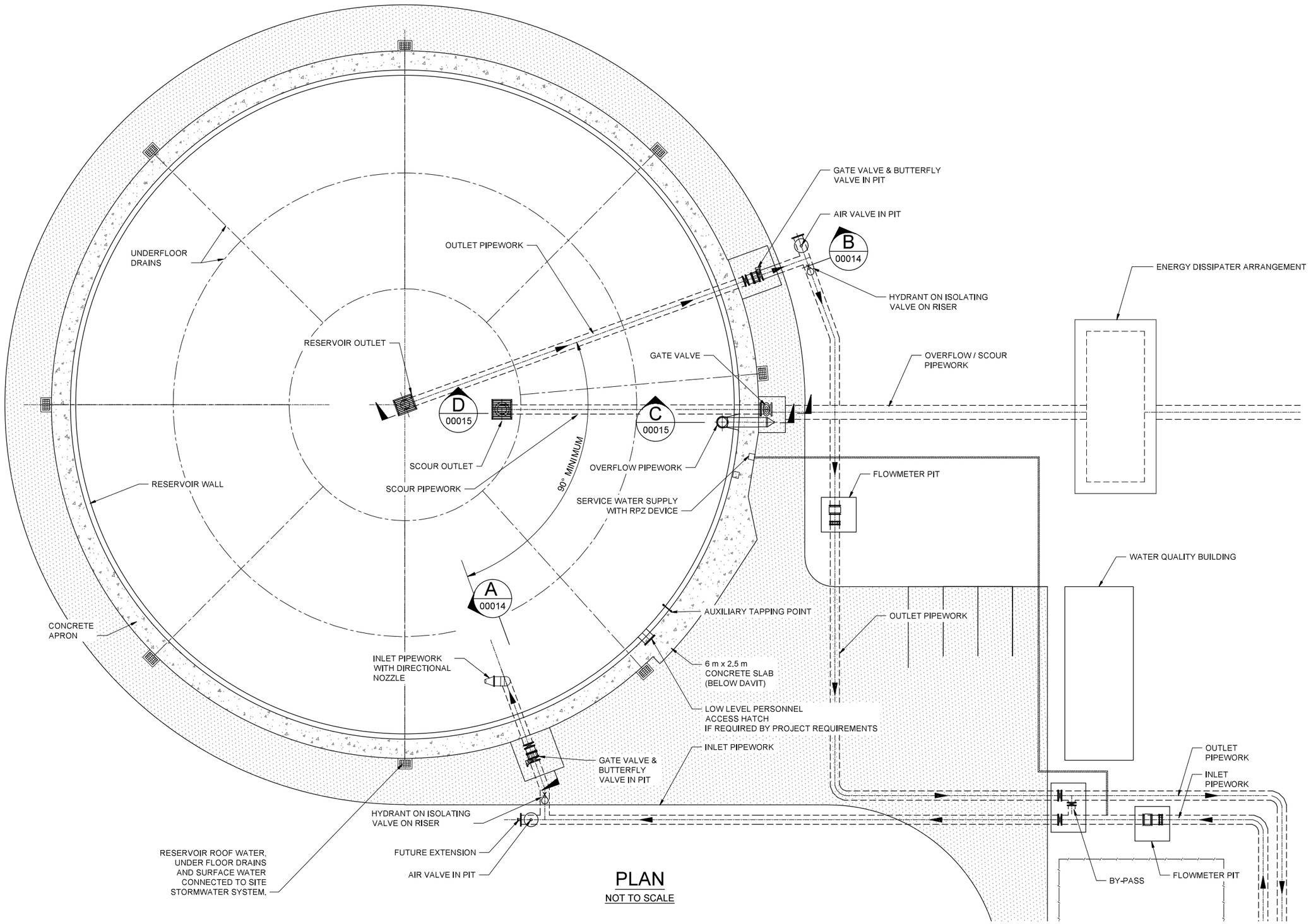
FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

DRAWING TITLE
ELEVATION AND SECTIONS

DRAWING STATUS
FOR INFORMATION

URBAN UTILITIES DRAWING No.
WR-CV-TYP-00012

REVISION
A



PLAN

NOT TO SCALE

REV.	DATE	AMENDMENT	
B	10/01/24	Hydrants Added, Maintenance Water Supply replaced with Service Line	MC
			UU DELEGATE

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

UrbanUtilities

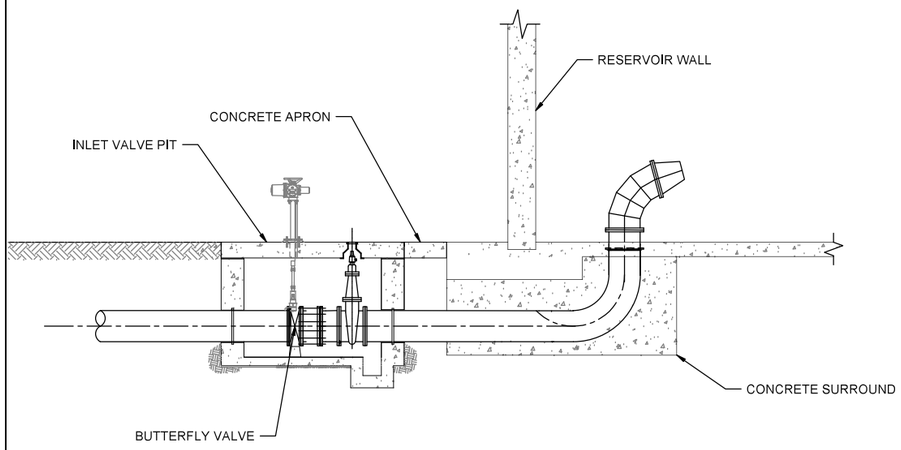
FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

DRAWING TITLE
PIPEWORK LAYOUT
AT GROUND LEVEL

DRAWING STATUS
FOR INFORMATION

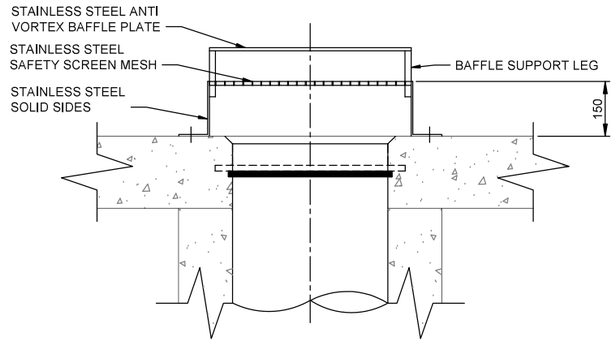
URBAN UTILITIES DRAWING No. WR-CV-TYP-00013

REVISION B



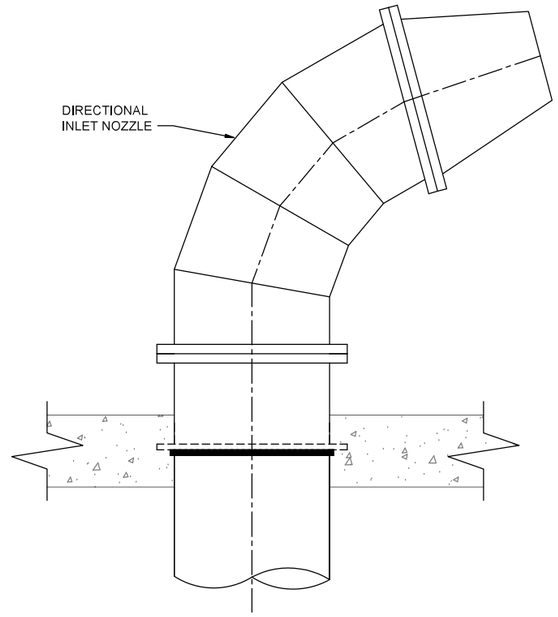
INLET PIPEWORK - BOTTOM ENTRY

SECTION A (00013)
NOT TO SCALE



OUTLET DETAIL

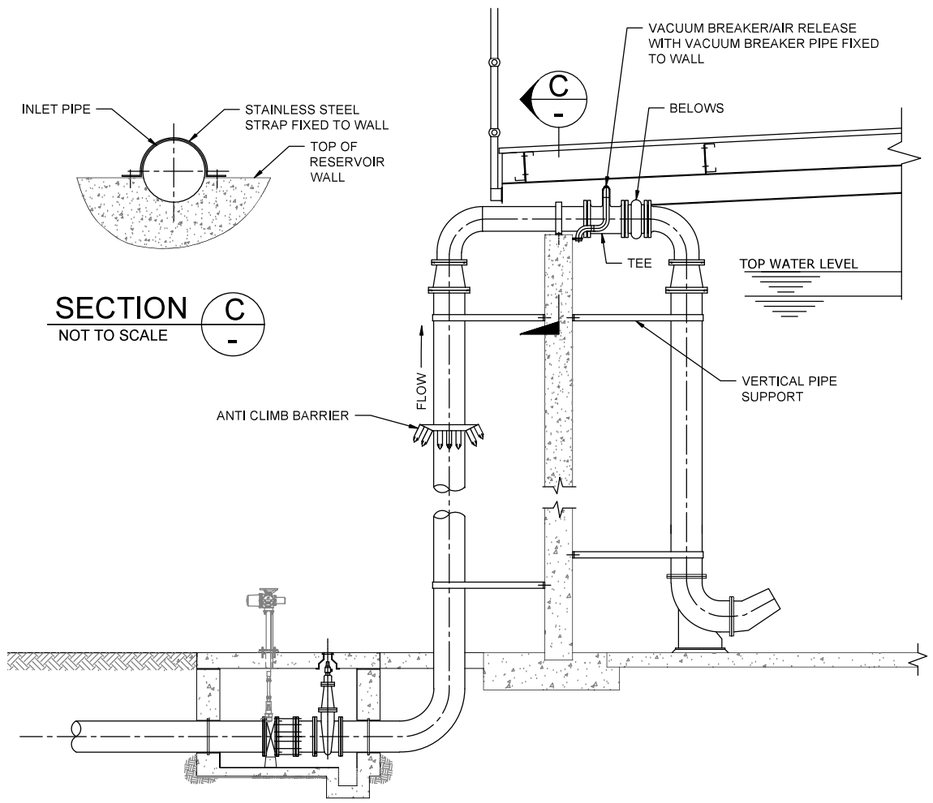
NOT TO SCALE



BOTTOM ENTRY INLET WITH DIRECTIONAL NOZZLE DETAIL

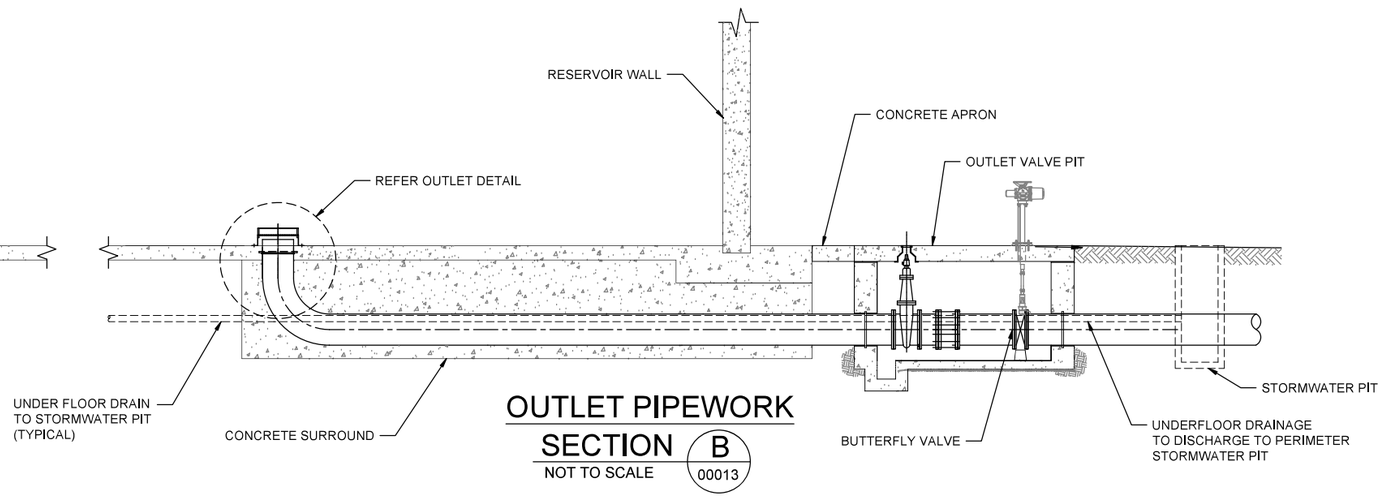
NOT TO SCALE

SECTION C (-)
NOT TO SCALE



INLET PIPEWORK - TOP ENTRY

SECTION A (00013)
NOT TO SCALE



OUTLET PIPEWORK

SECTION B (00013)
NOT TO SCALE

REV.	DATE	AMENDMENT	
B	18/10/24	Vacuum Breaker Outlet to discharge internally	M Chandra

DRAFTED BY — DATE
CHECKED BY — DATE
ENDORSED BY — DATE

UrbanUtilities

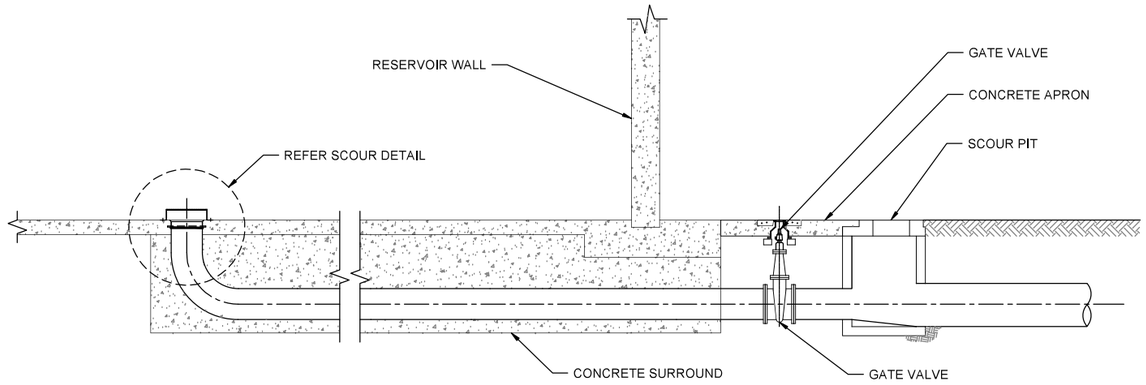
FACILITY/NETWORK TYPE: TYPICAL DRAWING DRINKING WATER RESERVOIRS AND TANKS

DRAWING TITLE: PIPEWORK SECTIONS SHEET 1 OF 2

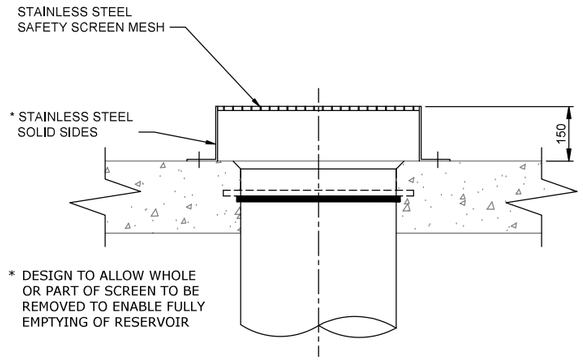
DRAWING STATUS: *FOR INFORMATION*

URBAN UTILITIES DRAWING No.: WR-CV-TYP-00014

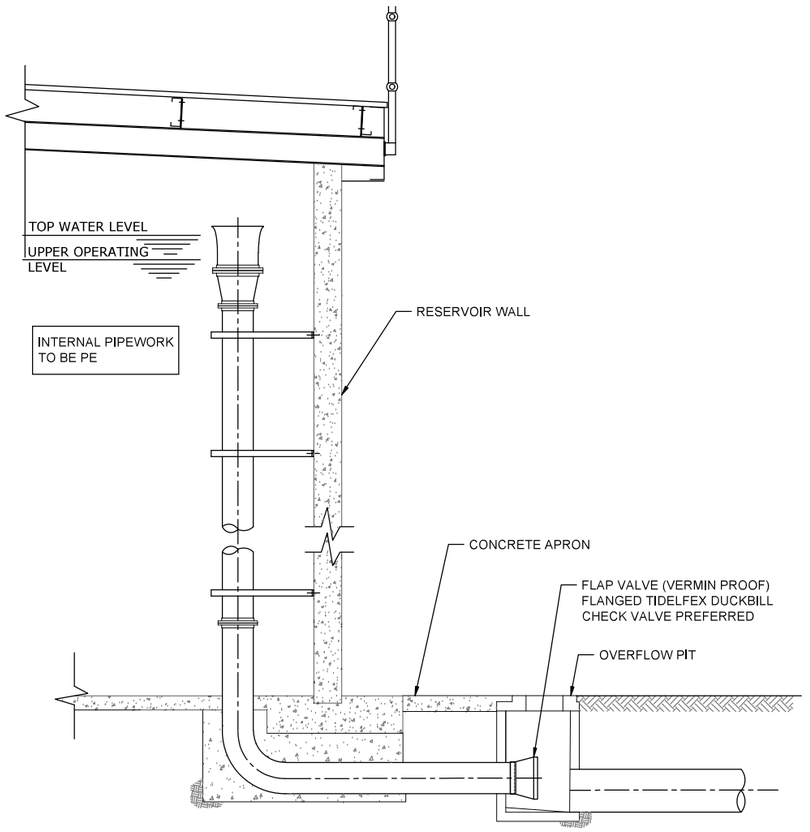
REVISION: B



SCOUR PIPEWORK
SECTION D
NOT TO SCALE
00013



SCOUR DETAIL
NOT TO SCALE



OVERFLOW PIPEWORK - INTERNAL
SECTION C
NOT TO SCALE
00013

REV.	DATE	AMENDMENT	
C	18/10/24	Displaced levels and dimensions corrected	MC
B	10/01/24	Typo corrected	MC

DRAFTED BY DATE
CHECKED BY DATE
ENDORSED BY DATE

UrbanUtilities

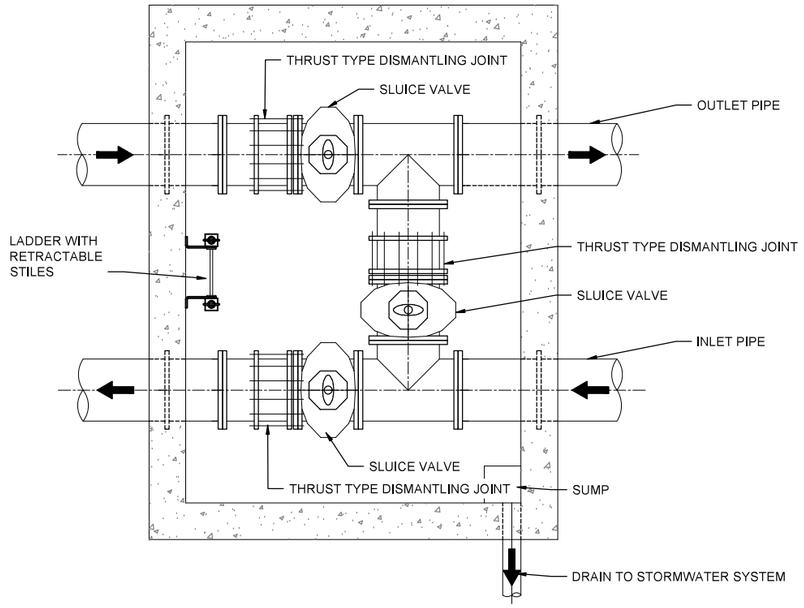
FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

DRAWING TITLE
PIPEWORK SECTIONS
SHEET 2 OF 2

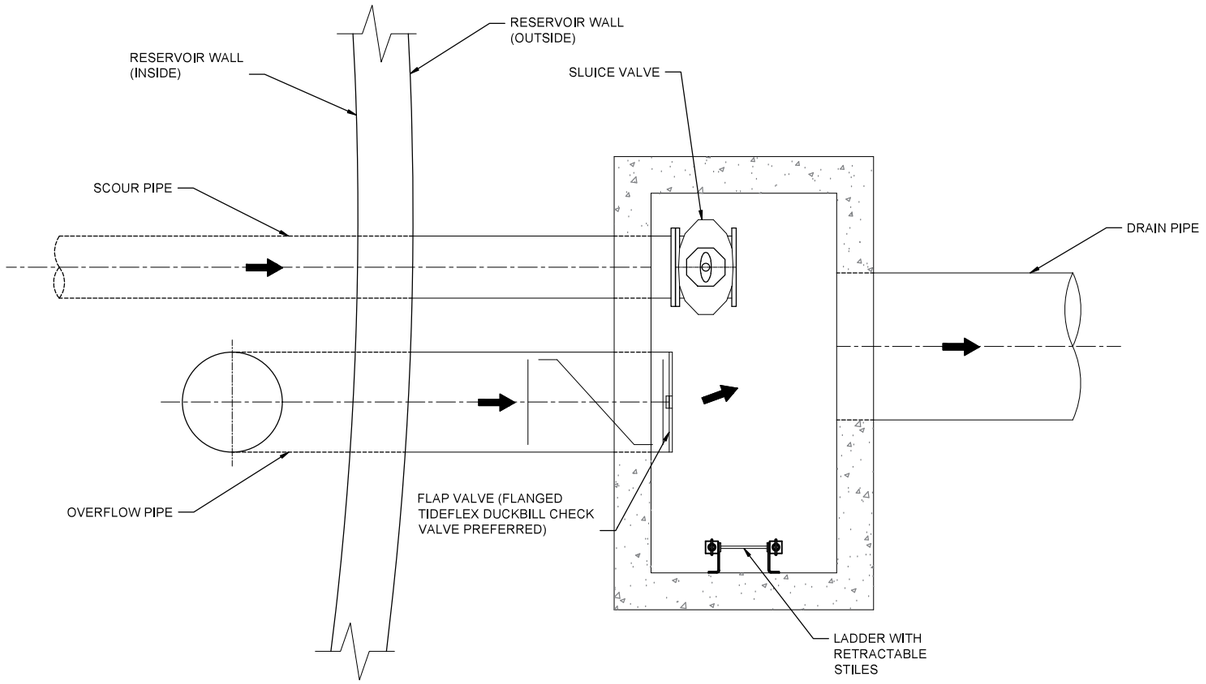
DRAWING STATUS
FOR INFORMATION

URBAN UTILITIES DRAWING No. WR-CV-TYP-00015

REVISION C

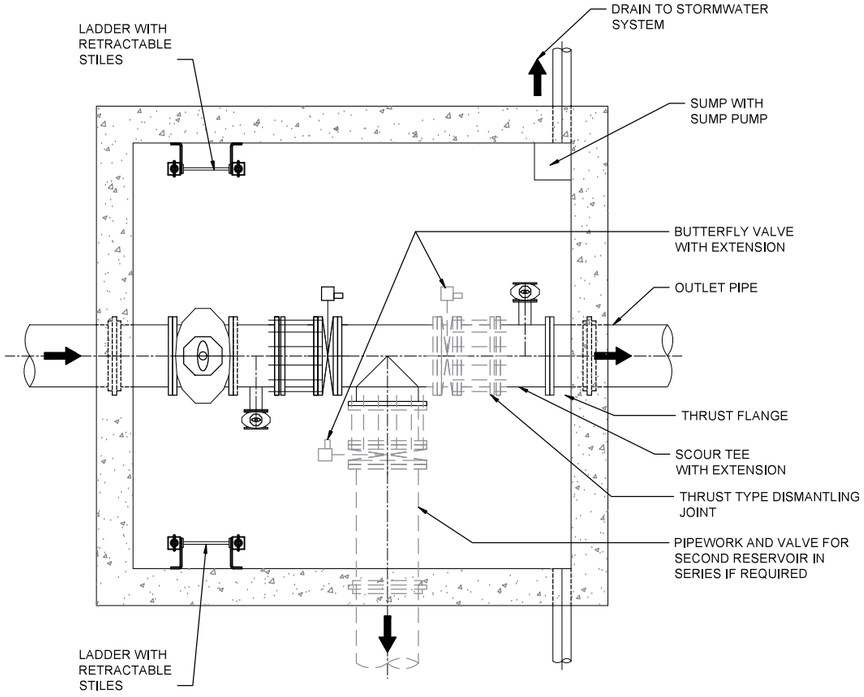


TYPICAL BYPASS VALVE PIT LAYOUT

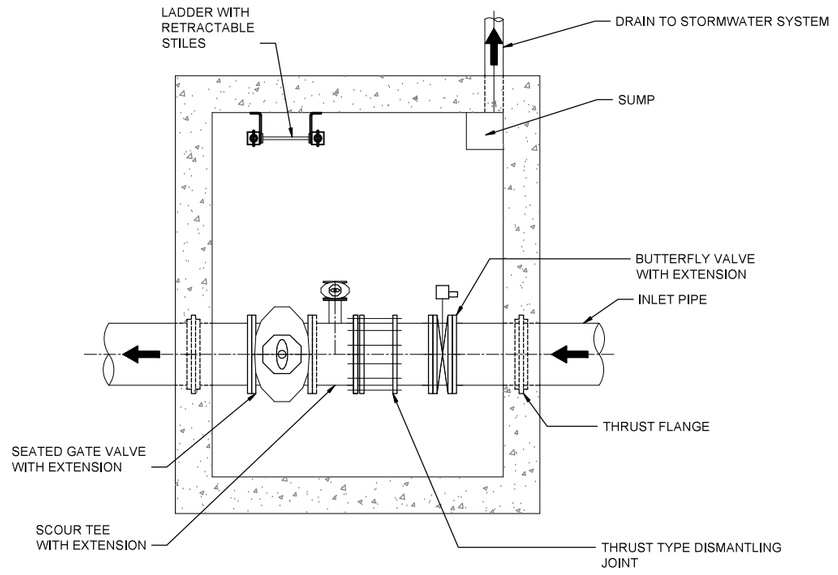


TYPICAL SCOUR / OVERFLOW PIT LAYOUT

FOR OVERFLOW DROPPER PIPE INSIDE RESERVOIR



TYPICAL OUTLET VALVE PIT LAYOUT



TYPICAL INLET VALVE PIT LAYOUT

REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY — DATE

CHECKED BY — DATE

ENDORSED BY — DATE

UrbanUtilities

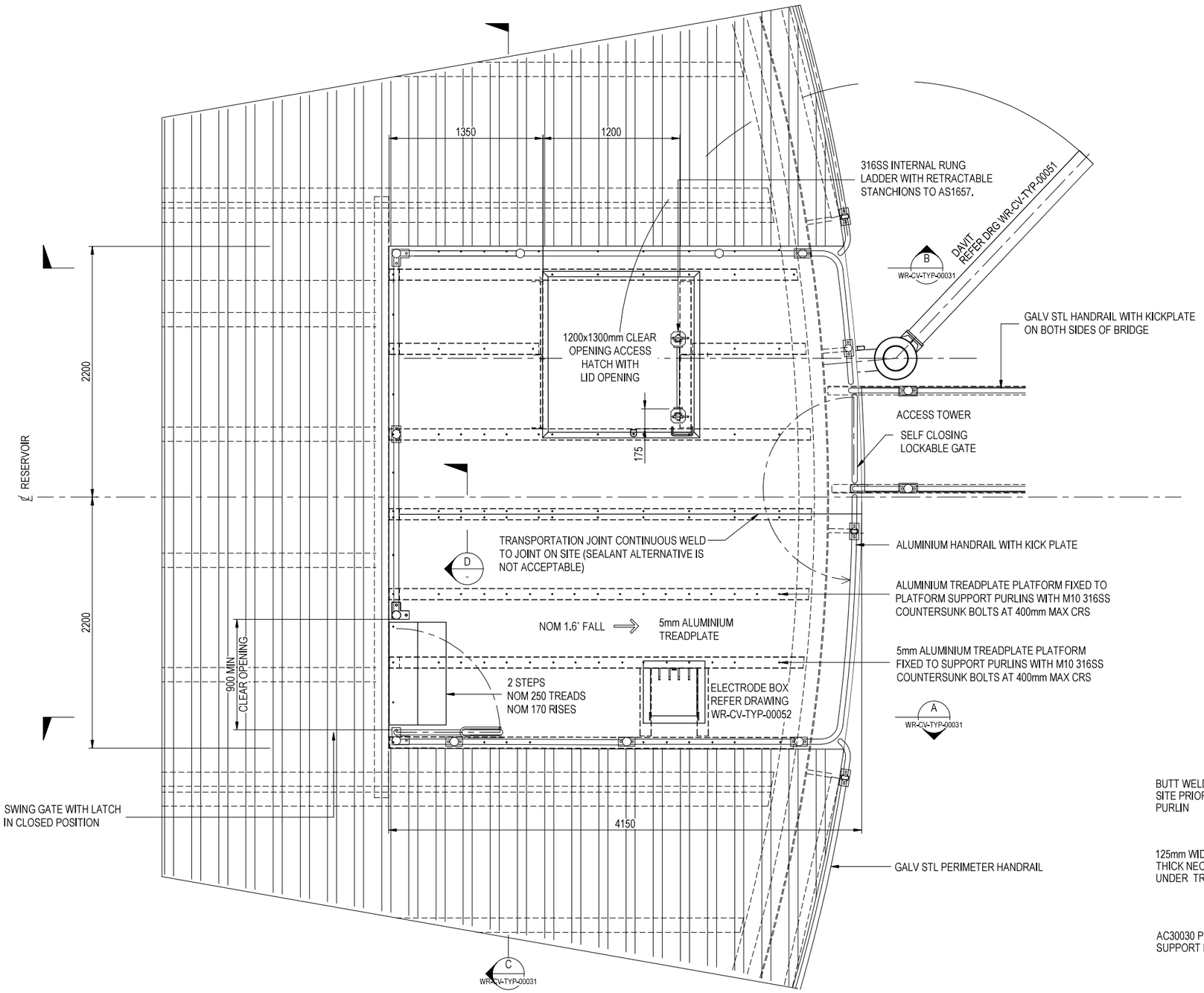
FACILITY/NETWORK TYPE: TYPICAL DRAWING DRINKING WATER RESERVOIRS AND TANKS

DRAWING TITLE: TYPICAL VALVE PIT DETAILS

DRAWING STATUS: *FOR INFORMATION*

URBAN UTILITIES DRAWING No.: WR-CV-TYP-00016

REVISION: A



RESERVOIR #2 PLATFORM OPPOSITE HAND

PLAN OF RESERVOIR #1 PLATFORM

SCALE 1:20

SECTION

SCALE 1:5

D
-

100 0 100 200 300 400
SCALE 1: 5 SCALE IN mm

400 0 400 800 1200 1600
SCALE 1: 20 SCALE IN mm

REV.	DATE	AMENDMENT	
B	21/10/24	Drawing references corrected	M Chandra

UU DELEGATE

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

UrbanUtilities

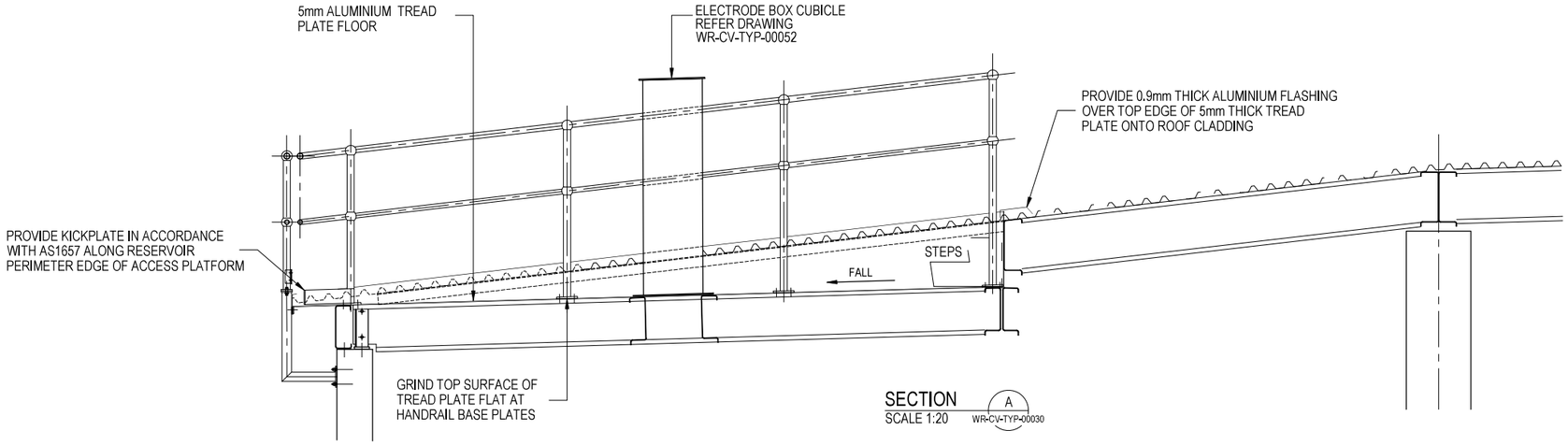
FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

DRAWING TITLE
ROOF PLATFORM
OPTION 1 (PREFERRED)

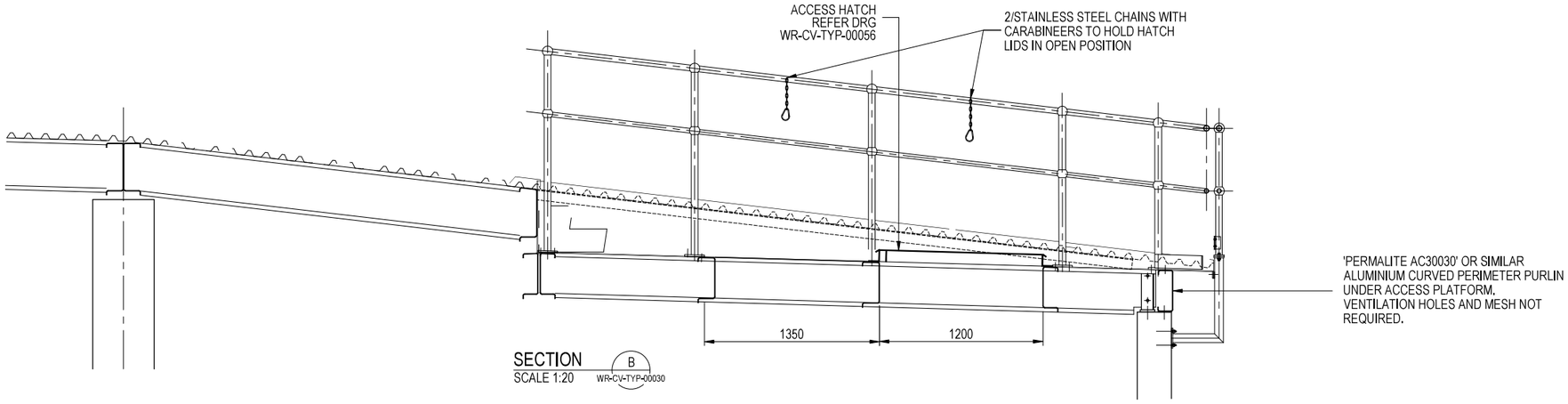
DRAWING STATUS
FOR INFORMATION

URBAN UTILITIES DRAWING No. WR-CV-TYP-00030

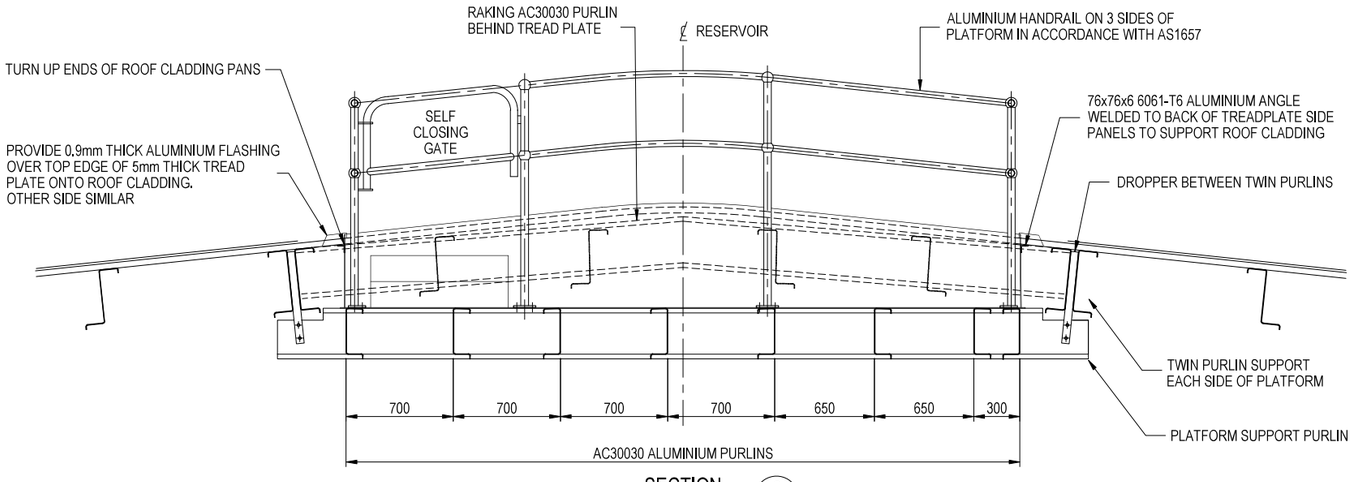
REVISION B



SECTION A
SCALE 1:20 WR-CV-TYP-00030



SECTION B
SCALE 1:20 WR-CV-TYP-00030



SECTION C
SCALE 1:20 WR-CV-TYP-00030

400 0 400 800 1200 1600
SCALE 1: 20 SCALE IN mm

REV.	DATE	AMENDMENT	
B	21/10/24	Drawing Title and Drawing references corrected	M Chandra

DRAFTED BY DATE
CHECKED BY DATE
ENDORSED BY DATE

UrbanUtilities

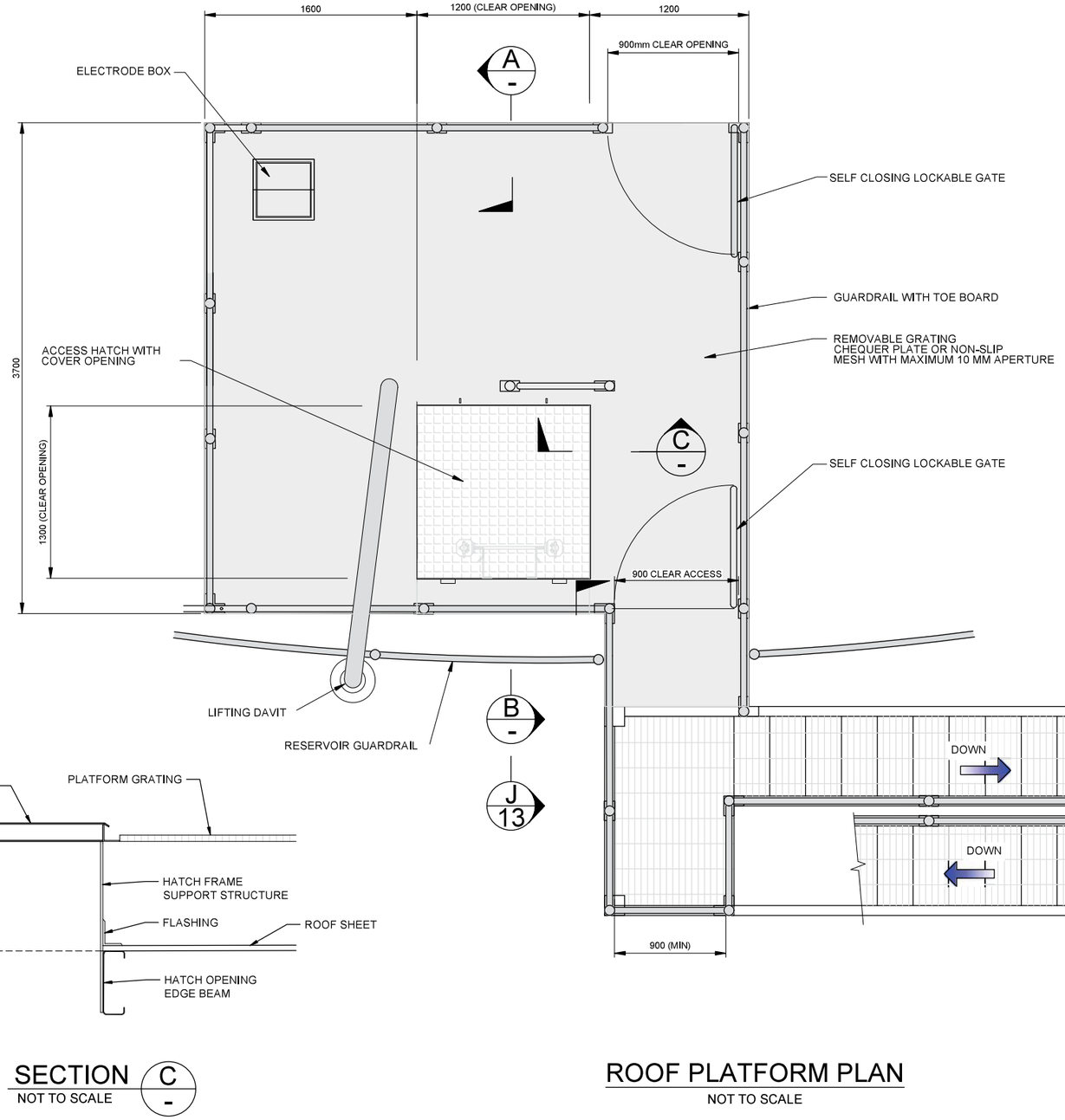
FACILITY/NETWORK TYPE
TYPICAL DRAWING DRINKING WATER RESERVOIRS AND TANKS

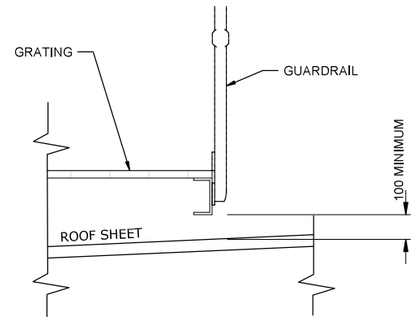
DRAWING TITLE
ROOF PLATFORM SECTIONS OPTION 1

DRAWING STATUS
FOR INFORMATION

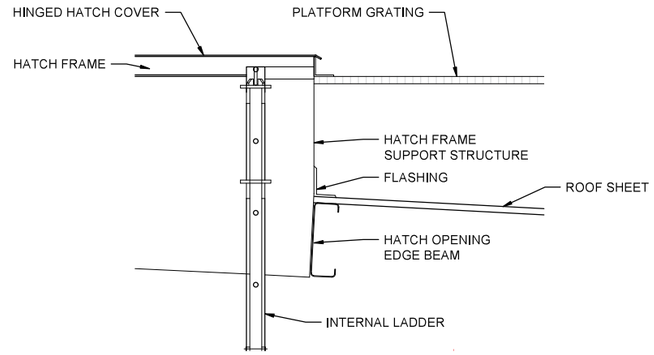
URBAN UTILITIES DRAWING No. WR-CV-TYP-00031
REVISION B

C:\Users\203179\OneDrive - urbanutilities.com.au\Desktop\Projects\UU Standards\Typical Drawings Drinking Water Reservoirs and Tanks\CAD Files\WR-CV-TYP-00031\OUTGOING\Gaurav\Mahesh\final\ WR-CV-TYP-00031.dwg - Plotted by 201179 on 2024-10-21 at 11:40

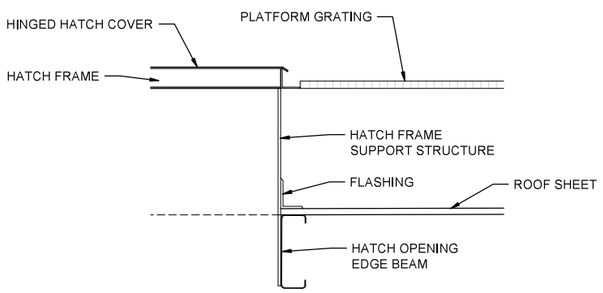




SECTION A - NOT TO SCALE



SECTION B - NOT TO SCALE



SECTION C - NOT TO SCALE

ROOF PLATFORM PLAN

NOT TO SCALE

REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY — DATE

CHECKED BY — DATE

ENDORSED BY — DATE

UrbanUtilities

FACILITY/NETWORK TYPE: TYPICAL DRAWING DRINKING WATER RESERVOIRS AND TANKS

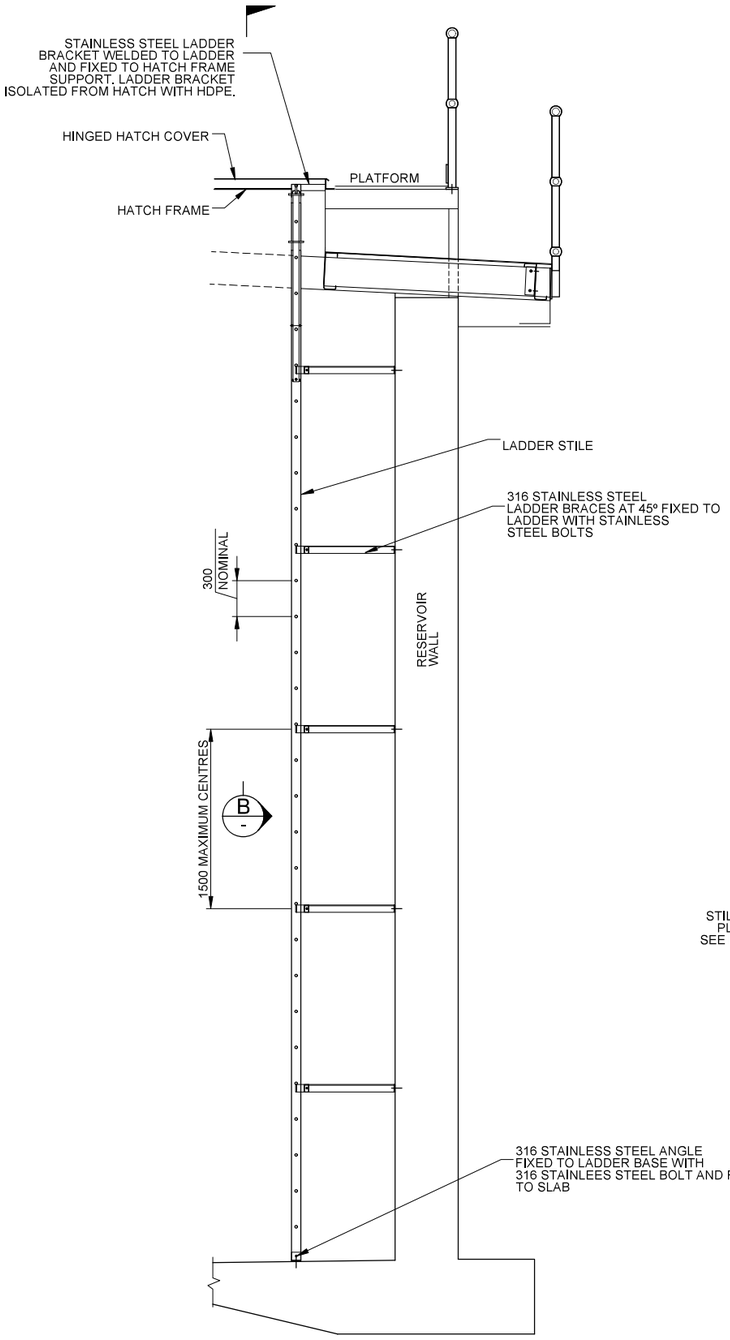
DRAWING TITLE: ROOF PLATFORM OPTION 2 (NON-PREFERRED)

DRAWING STATUS: *FOR INFORMATION*

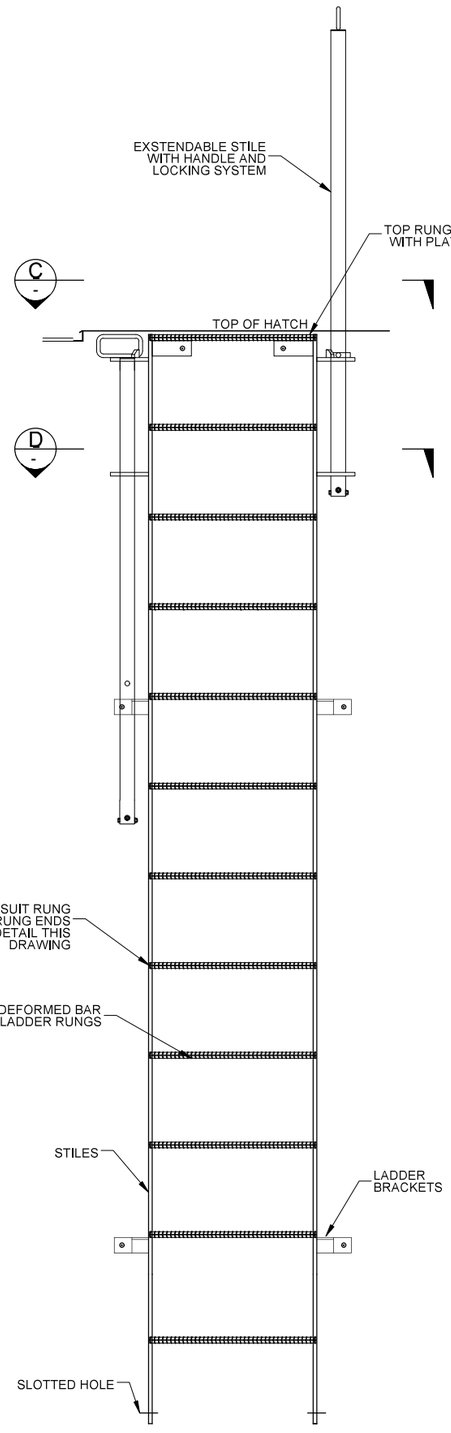
URBAN UTILITIES DRAWING No.: WR-CV-TYP-00032

REVISION: A

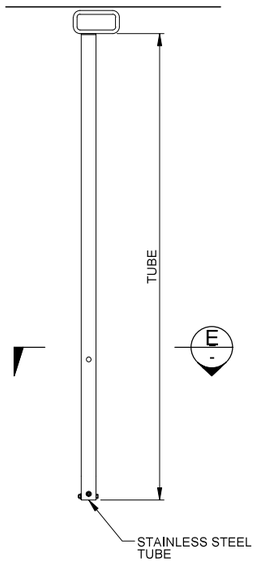
PROPRIETARY FIBRE REINFORCED COMPOSITE LADDERS CONFIRMING TO AS1657 MAY BE ACCEPTED SUBJECT TO UU REVIEW.



SECTION J
NOT TO SCALE 9,10



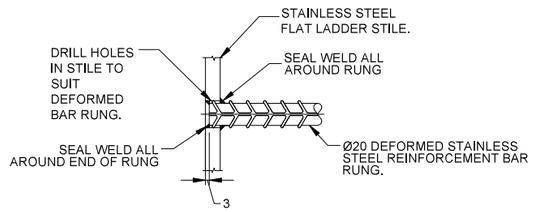
ELEVATION B
NOT TO SCALE



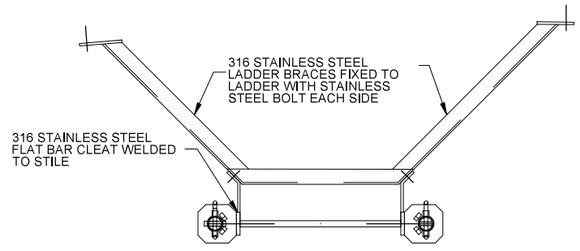
LADDER STILE EXTENSION
NOT TO SCALE

SECTION C
NOT TO SCALE

SECTION E
NOT TO SCALE



RUNG FIXING DETAIL



SECTION D
NOT TO SCALE

REV.	DATE	AMENDMENT	UU DELEGATE
B	18/10/24	Toeboard added. Third rail added to handrail.	M Chandra

DRAFTED BY DATE
CHECKED BY DATE
ENDORSED BY DATE

UrbanUtilities

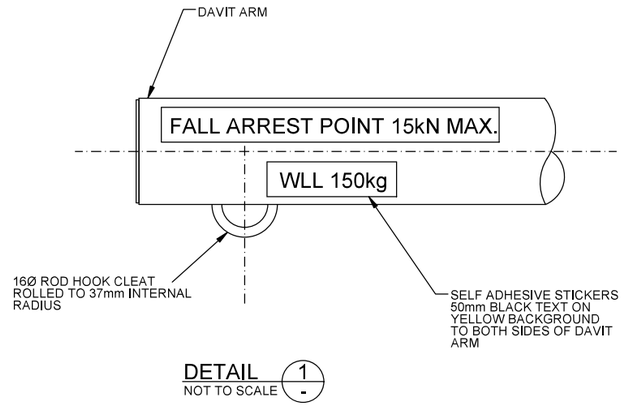
FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

DRAWING TITLE
TYPICAL INTERNAL LADDER DETAILS

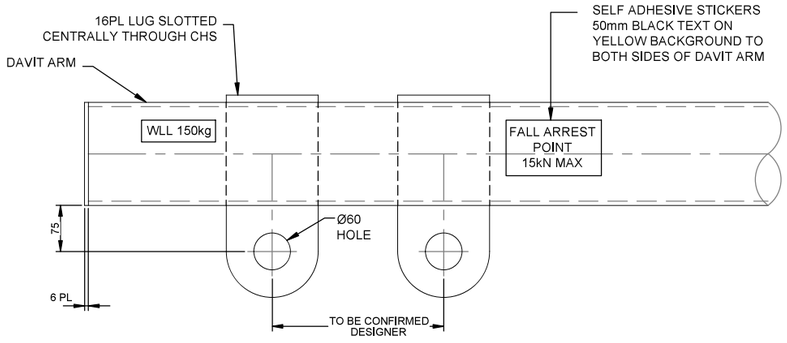
DRAWING STATUS
FOR INFORMATION

URBAN UTILITIES DRAWING No. WR-CV-TYP-00050

REVISION B



DETAIL 1/- NOT TO SCALE

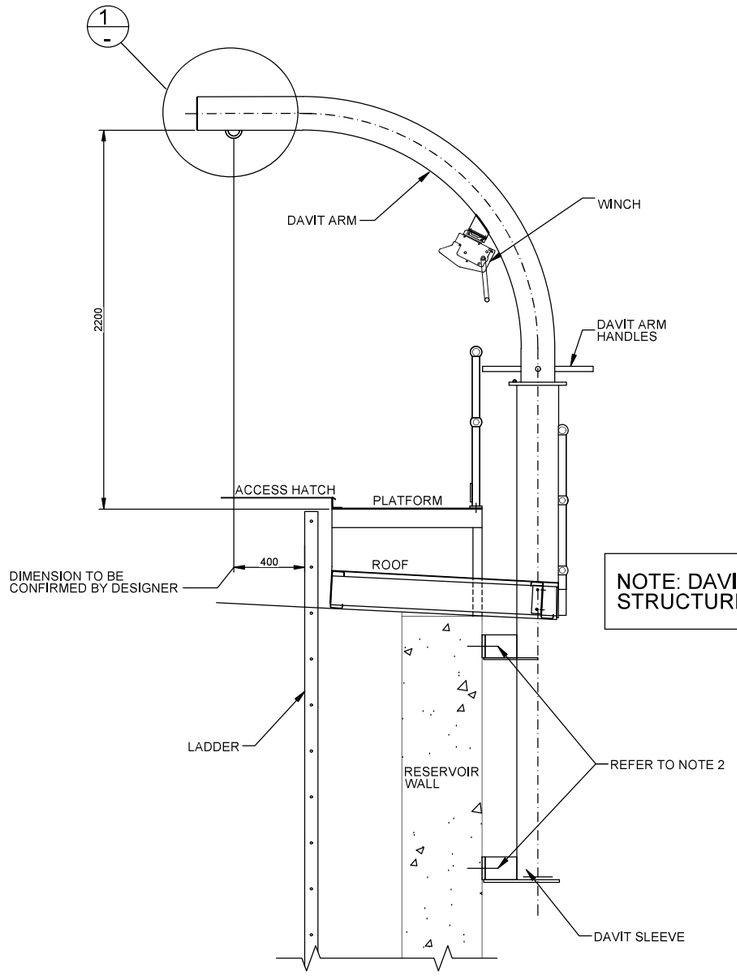


ALTERNATIVE DETAIL 1/- NOT TO SCALE

1. THE DAVIT IS TO HAVE A STAINLESS STEEL NAME PLATE WITH THE FOLLOWING INFORMATION PERMANENTLY MARKED (TO BE CONFIRMED BY THE DESIGNER)

- NAME OF FABRICATOR OR MANUFACTURER
- YEAR OF MANUFACTURER
- IDENTIFICATION NUMBER
- THIS DEVICE HAS BEEN DESIGNED IN ACCORDANCE WITH AS1418, AS1891, AS1891.3, AS4488.
- THIS DEVICE IS RATED AS A FALL ARREST DEVICE FOR SINGLE PERSON USE ONLY, ULTIMATE LOAD CAPACITY 15kN,
- THIS DEVICE HAS A WORKING LOAD LIMIT OF 150kg FOR THE LIFTING OF STATIC LOADS INCLUDING THE SELF-WEIGHT OF LIFTING EQUIPMENT MAXIMUM IN-PLANE DEVIATION OF SLING ANGLE FROM VERTICAL IS 30°.

2. BASE PLATE HOLES TO BE DRILLED ON SITE ONCE RESERVOIR WALL HAS BEEN SCANNED AND REINFORCEMENT/TENSIONING DUCTS LOCATED.



NOTE: DAVITS MOUNTED OFF STAIR STRUCTURE FOR PANEL TANKS

DAVIT ELEVATION NOT TO SCALE

REV.	DATE	AMENDMENT	
C	18/10/24	Fall Restraint changed to Fall Arrest in Notes. Toeboard added. Third rail added to handrail.	MC
B	30/11/23	Dimension - Ladder to Davit Hook Cleat	MC

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

UrbanUtilities

FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

DRAWING TITLE
TYPICAL DAVIT DETAILS

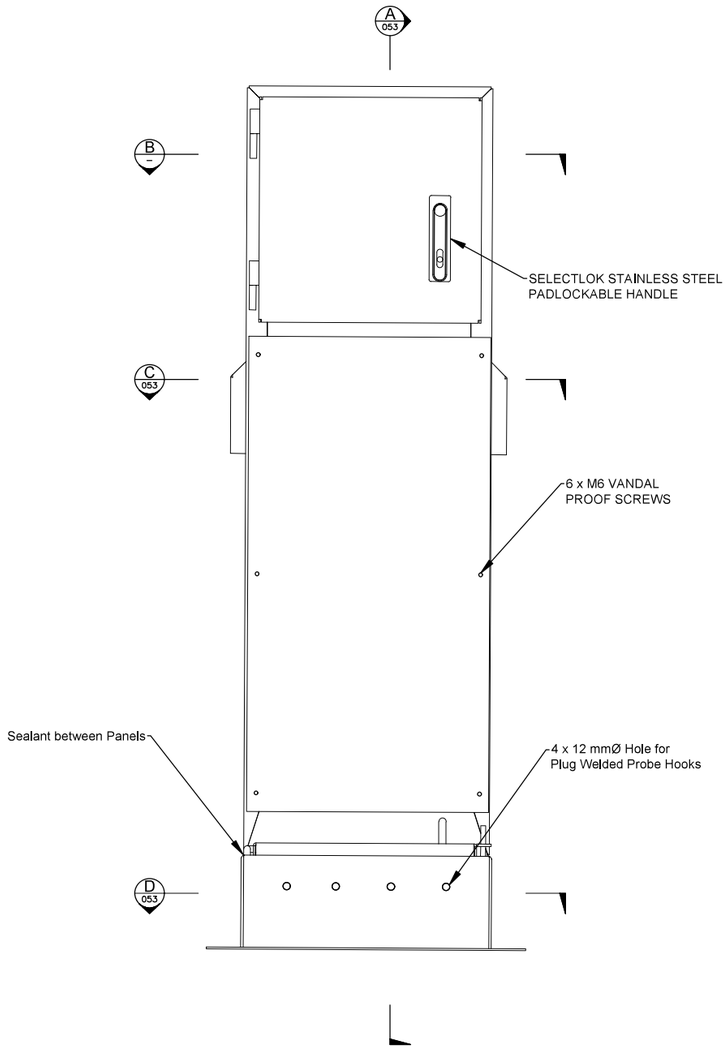
DRAWING STATUS
FOR INFORMATION

URBAN UTILITIES DRAWING No. WR-CV-TYP-00051

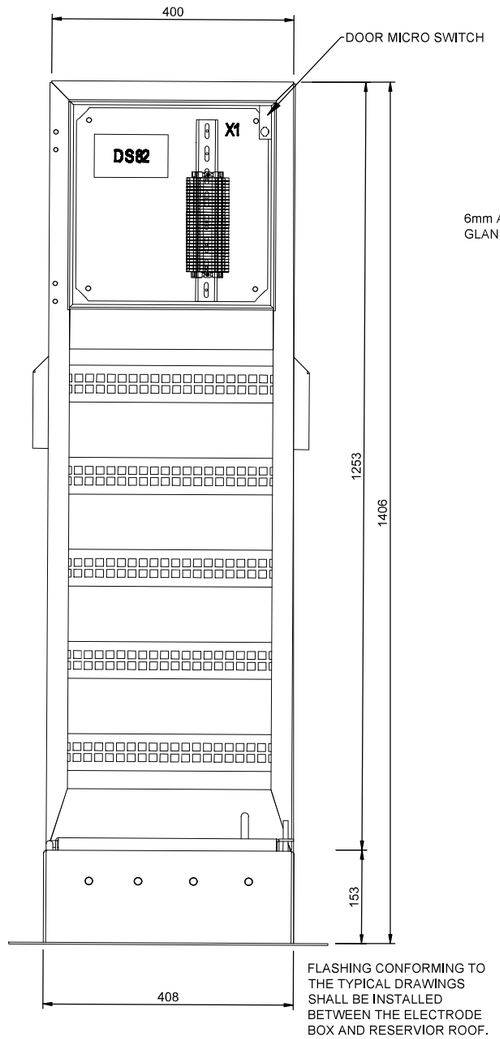
REVISION C

CONSTRUCTION DETAILS

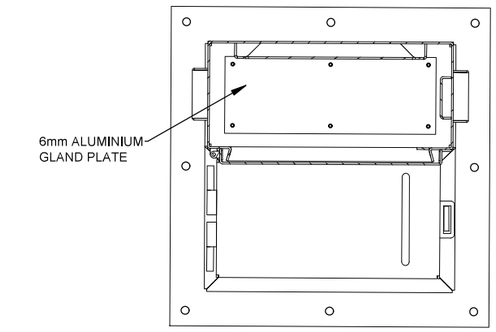
EXTERNAL DIMENSIONS	520mm WIDE, 1406mm HIGH, 520mm DEEP
DESIGNED	DESIGNED IN ACCORDANCE WITH AS/NZS 61439
CONSTRUCTION	MACHINE FORMED AND WELDED. FRONT CONNECTED, FLOOR MOUNTED.
MATERIAL	3.0mm ALUMINUM CUBICLES AND DOORS. 3.0mm ALUMINUM GEAR TRAYS.
FASTENERS	STAINLESS STEEL NUTS & BOLTS.
CABLE ENTRIES	BOTTOM AS SHOWN.
GLAND PLATES	6mm ALUMINIUM WITH DUSTSEALS
DOOR	FITTED WITH 2 (MINIMUM) STAINLESS STEEL PINTLE HINGES. STAINLESS STEEL SWING HANDLE PAD LOCKABLE MIRROR FINISH.
WEATHER SEALS	DURAFOAM TAPE AROUND EACH DOOR.
FINISH	ELECTROSTATIC POWDER COATED.
PREPARATION	CLEAN, DEGREASE AND GRIND SMOOTH
EXTERNAL COLOUR	G54 MIST GREEN TO AS2700
INTERNAL COLOUR	G54 MIST GREEN TO AS2700
EQUIPMENT PANELS	GLOSS WHITE TO AS2700



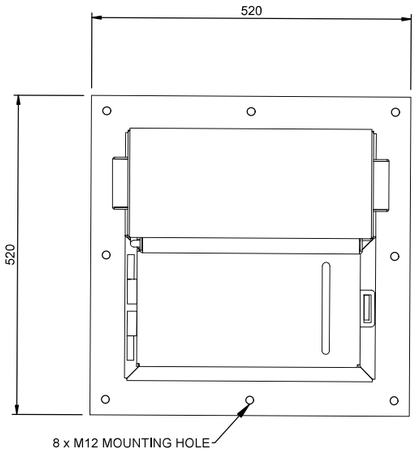
FRONT VIEW



FRONT VIEW
(DOORS AND COVERS REMOVED)



SECTION B - B



TOP VIEW

REV.	DATE	AMENDMENT	
C	18/10/24	Front View Base Dimension Corrected	M Chandra
B	08/02/24	AS3439.1 replaced with AS/NZS 61439	M Chandra

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

UrbanUtilities

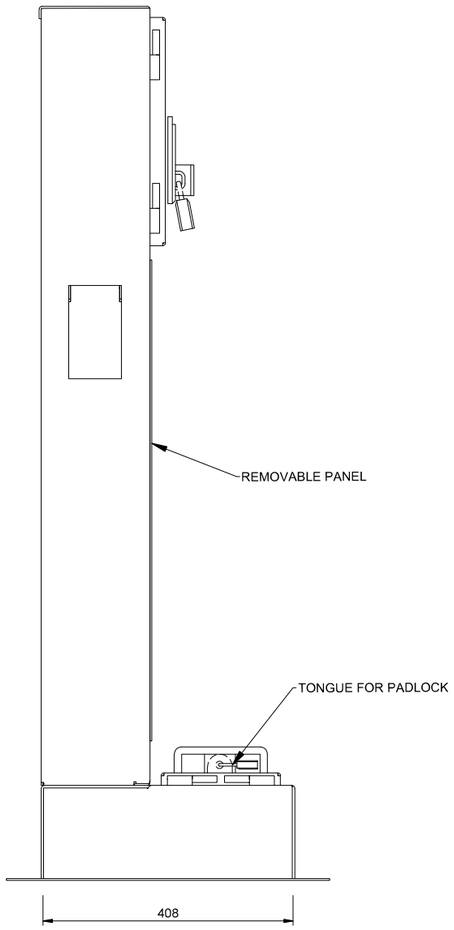
FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

DRAWING TITLE
ELECTRODE BOX
GENERAL ARRANGEMENT

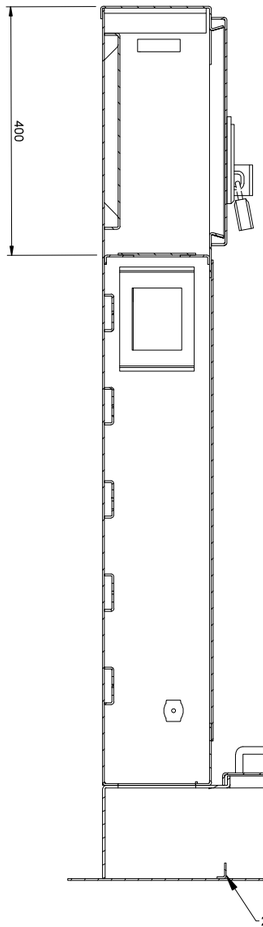
DRAWING STATUS
FOR INFORMATION

URBAN UTILITIES DRAWING No.
WR-CV-TYP-00052

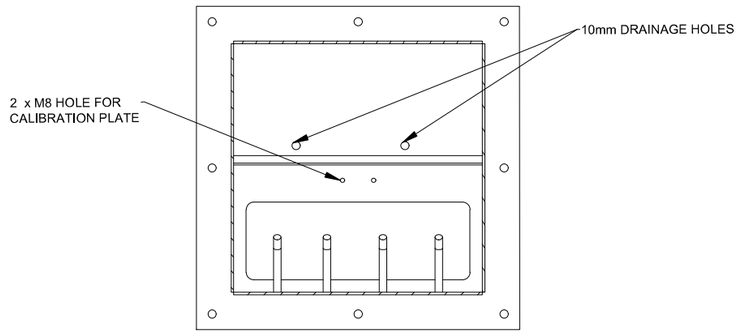
REVISION
C



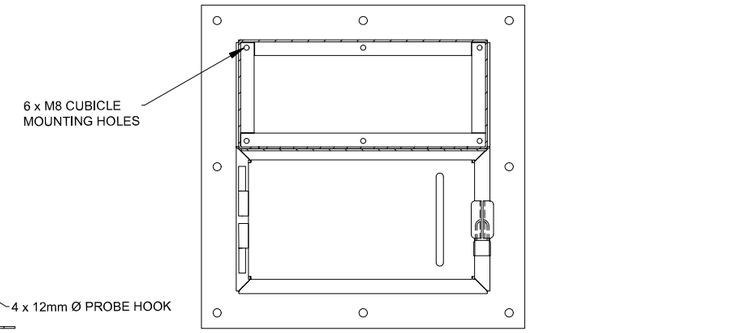
LEFT SIDE VIEW



SECTION A
SCALE NTS 052



SECTION D
SCALE NTS 052



SECTION C
SCALE NTS 052

REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

UrbanUtilities

FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

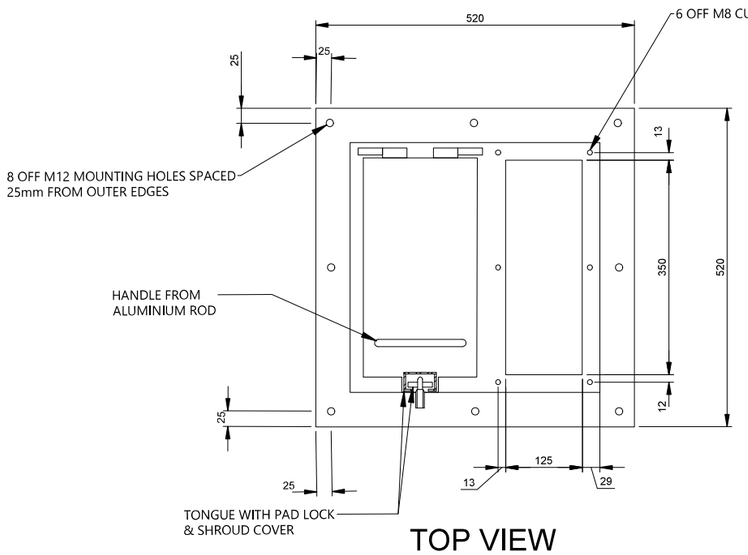
DRAWING TITLE
ELECTRODE BOX
AND CUBICLE ASSEMBLY
GENERAL ARRANGEMENT

DRAWING STATUS
FOR INFORMATION

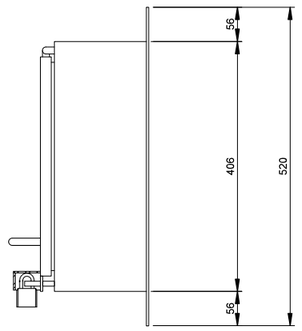
URBAN UTILITIES DRAWING No. WR-CV-TYP-00053

REVISION A

ELEVATIONS: EXTERNAL DETAIL

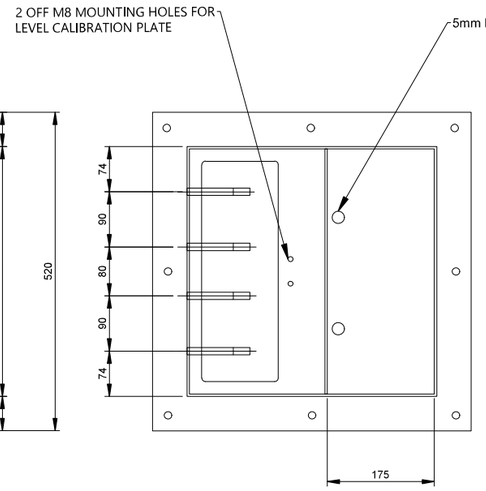


TOP VIEW

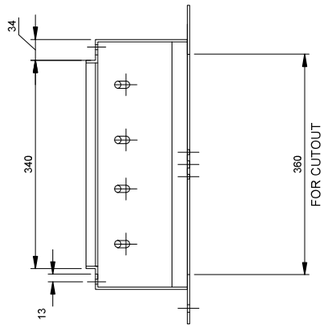


SIDE VIEW

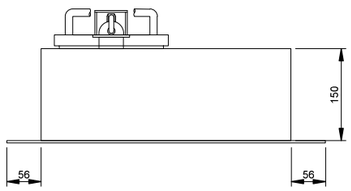
ELEVATIONS: INTERNAL DETAIL



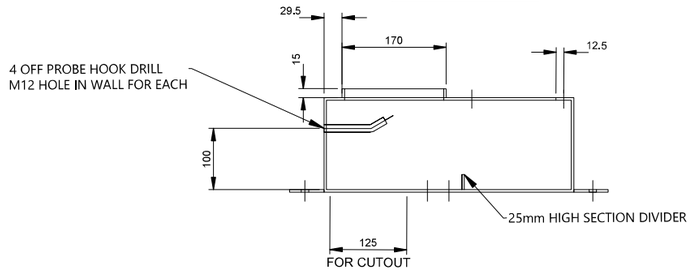
TOP VIEW



SIDE VIEW



SIDE VIEW



SIDE VIEW

REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

UrbanUtilities

FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

DRAWING TITLE
ELECTRODE BOX
LEVEL HATCH BOX
GENERAL ARRANGEMENT

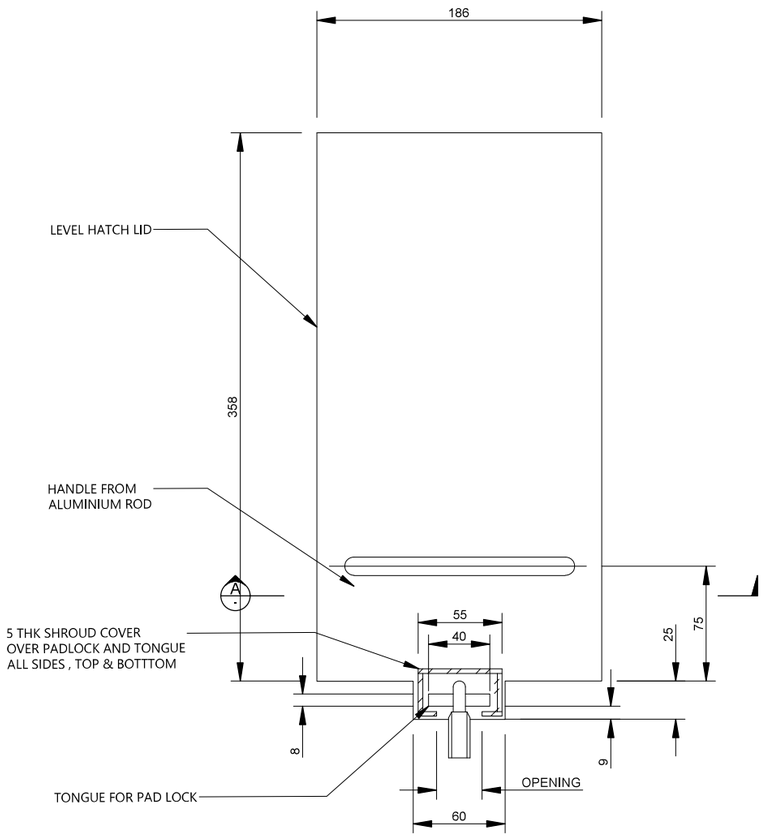
DRAWING STATUS
FOR INFORMATION

URBAN UTILITIES DRAWING No. WR-CV-TYP-00054

REVISION A

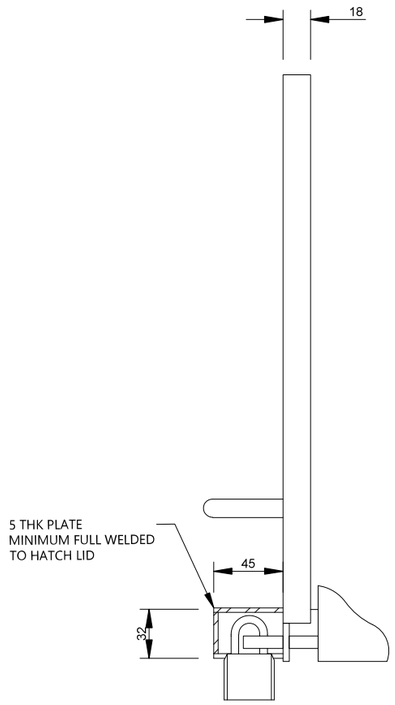
CONSTRUCTION NOTES:

- Exact location of Padlock Tongue and drill hole determined relative to Level Hatch Lid construction.
- Exact size of shroud cover is determined relative to Padlock tongue and Level Hatch Lid construction
- Power coated with Level Hatch. 8mm Marine Grade Aluminium.



TOP VIEW

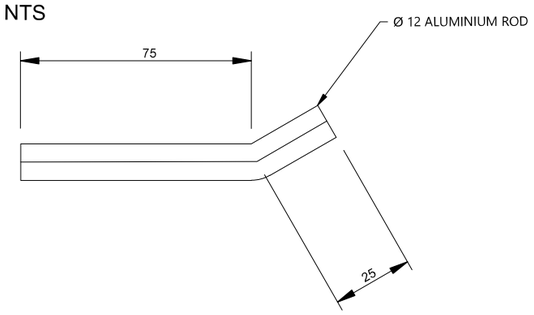
SCALE 1:2



SIDE VIEW

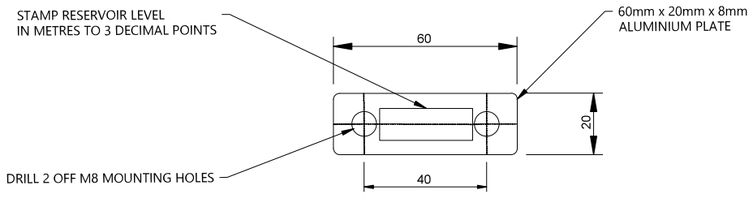
PROBE HOOK 4 OFF:

NTS



LEVEL CALIBRATION PLATE:

NTS

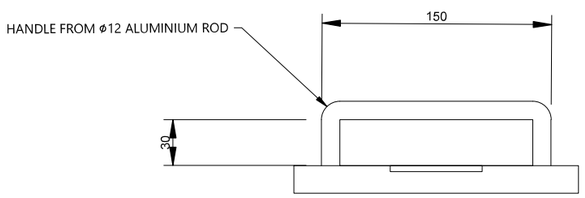


LEVEL HATCH LID DETAIL:

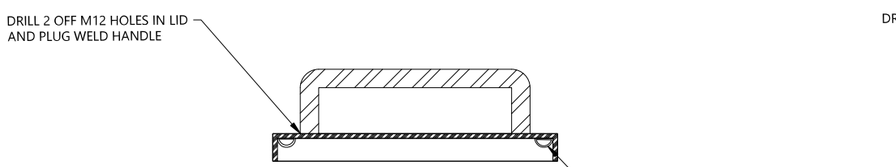
SCALE: 1:2

CONSTRUCTION NOTES:

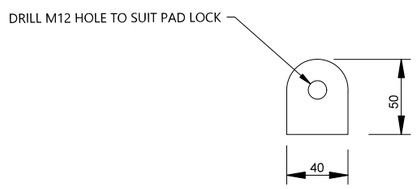
- Level Hatch Lid constructed from 3mm Marine Grade Aluminium.
- Powder coated G5 Mist Green
- Neoprene gasket around internal perimeter to seal Hatch Lid.



FRONT VIEW



SECTION A-A



REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

UrbanUtilities

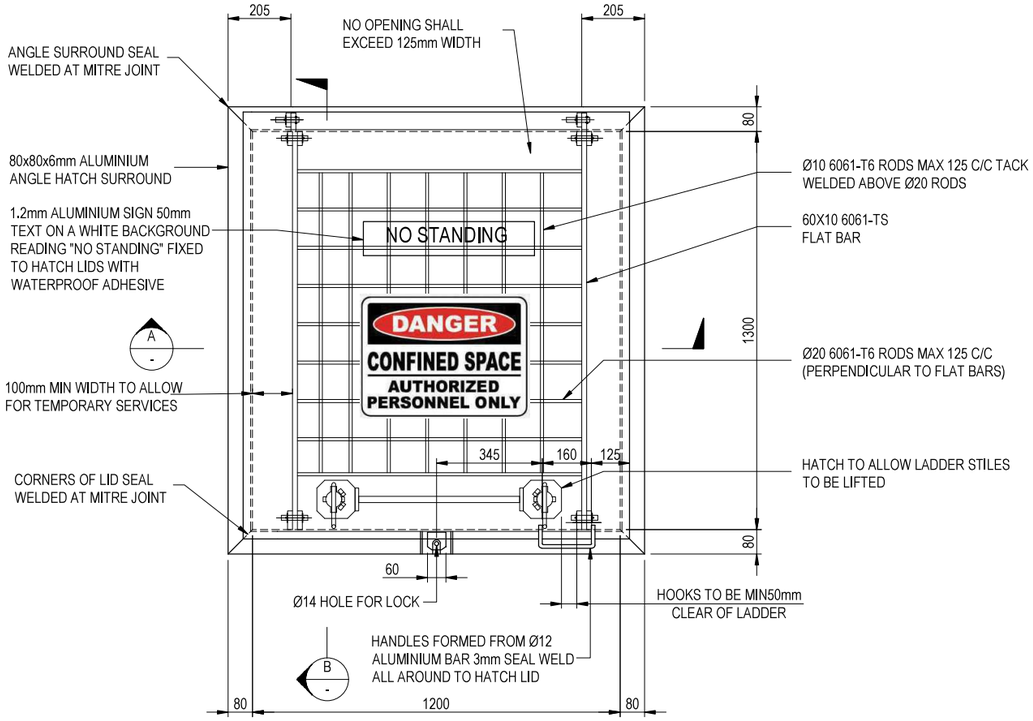
FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

DRAWING TITLE
LEVEL HATCH
PARTS DETAIL
GENERAL ARRANGEMENT

DRAWING STATUS
FOR INFORMATION

URBAN UTILITIES DRAWING No. WR-CV-TYP-00055

REVISION A



PLAN OF EQUIPMENT AND ACCESS HATCH
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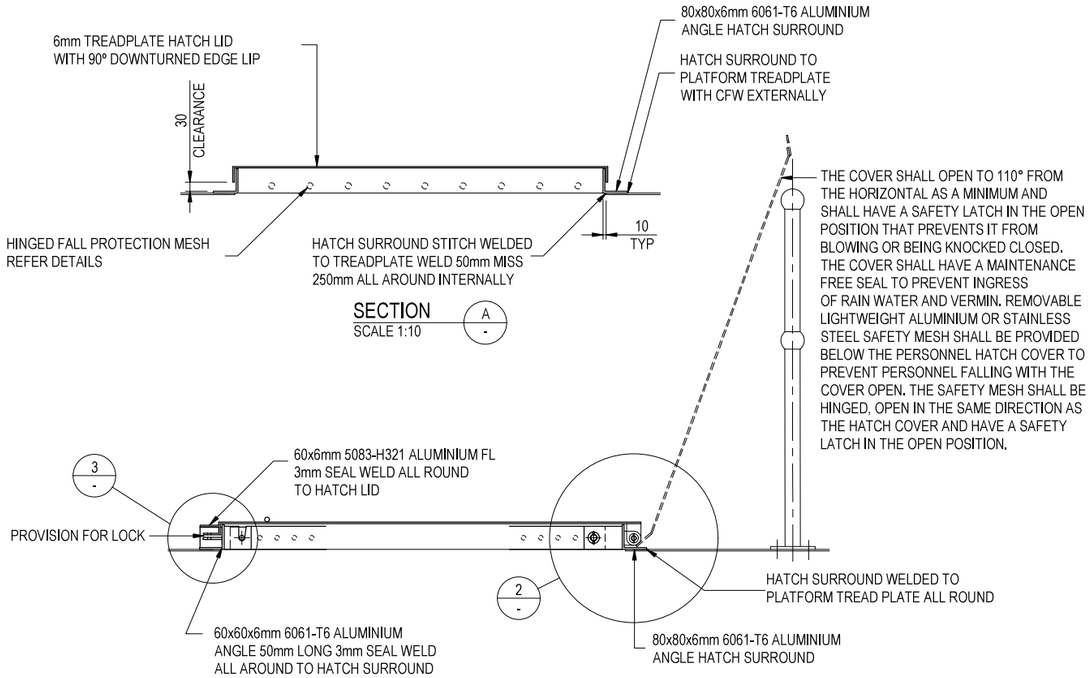
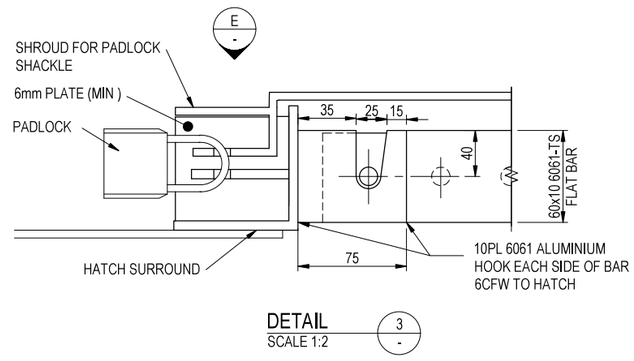
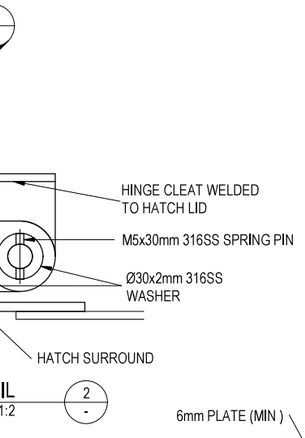


SECTION A
SCALE 1:10

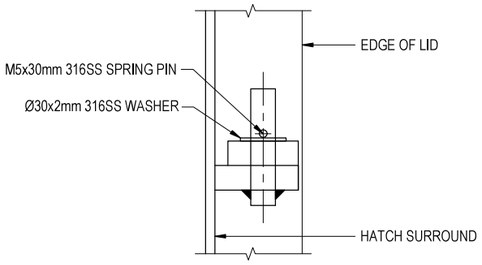
SECTION B
SCALE 1:10



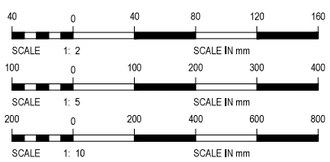
DETAIL 3
SCALE 1:2

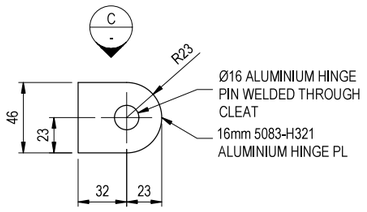


DETAIL 2
SCALE 1:2

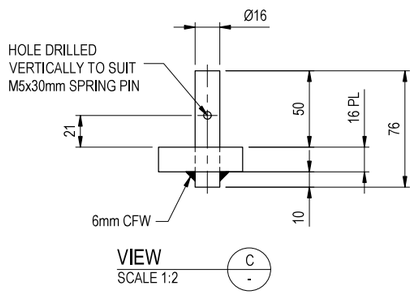


VIEW D
SCALE 1:2

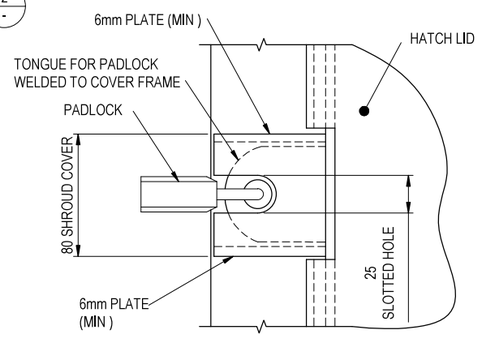




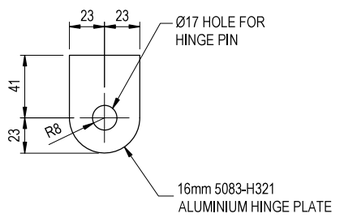
HATCH FRAME HINGE CLEAT
SCALE 1:2



VIEW C
SCALE 1:2



VIEW E
SCALE 1:2



HATCH HINGE LID CLEAT
SCALE 1:2 (A1)

REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

UrbanUtilities

FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

DRAWING TITLE
TYPICAL ROOF DETAILS
ACCESS HATCH DETAILS

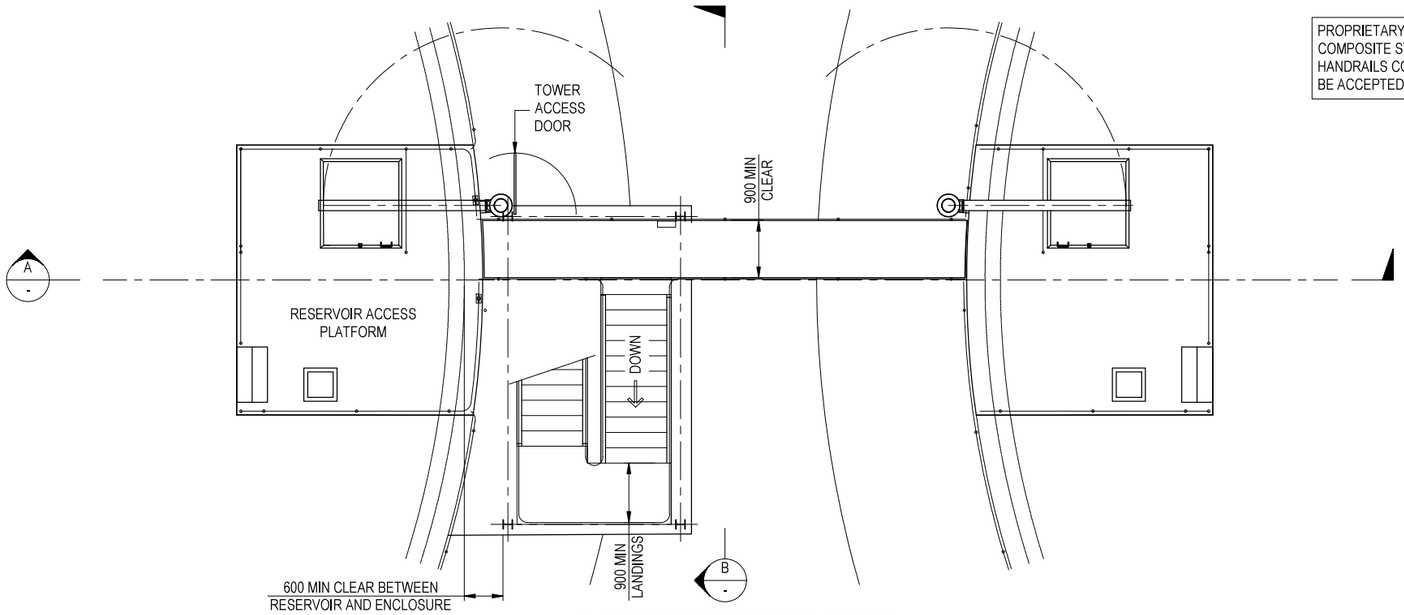
DRAWING STATUS
FOR INFORMATION

URBAN UTILITIES DRAWING No. WR-CV-TYP-00056

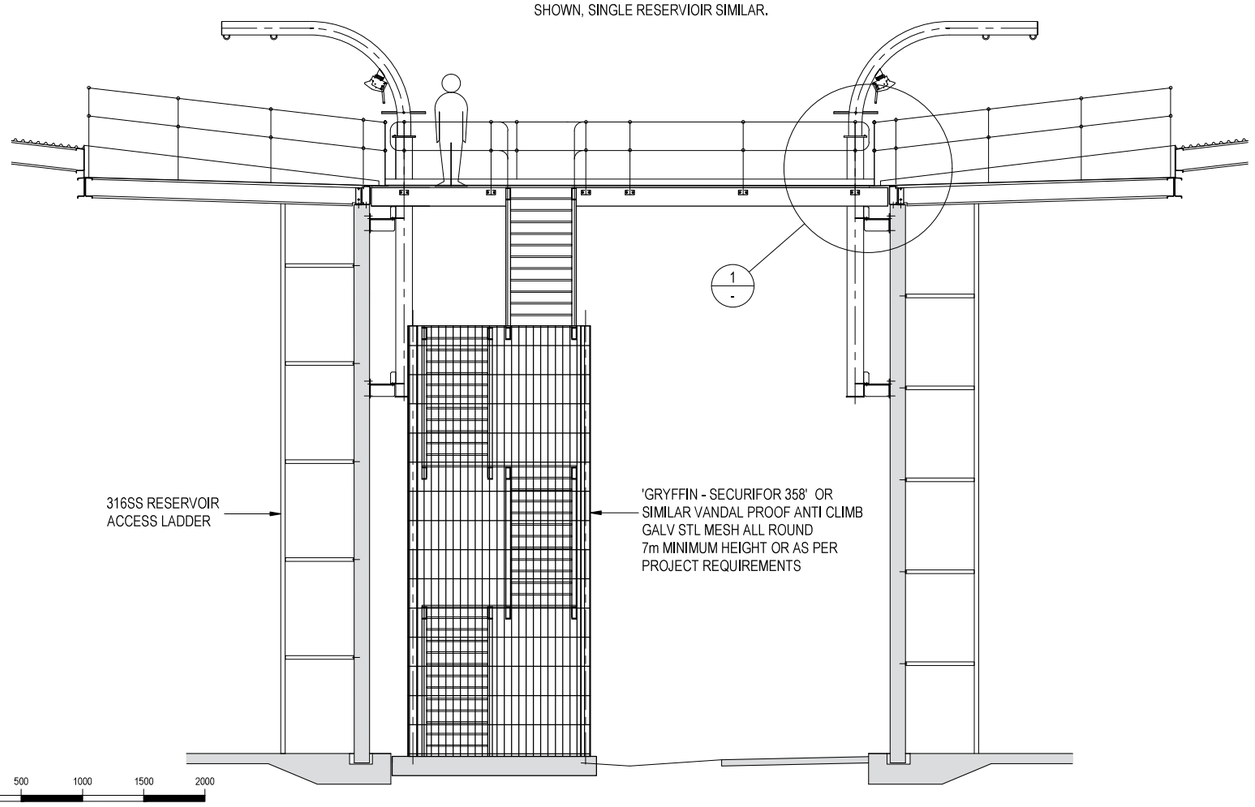
REVISION A

PROPRIETARY FIBRE REINFORCED COMPOSITE STAIR FLIGHTS AND HANDRAILS CONFIRMING TO AS1657 MAY BE ACCEPTED SUBJECT TO UU REVIEW.

NOTES
1. ALL STEELWORK TO BE HOT DIPPED GALVANISED.
2. STAIR STRUCTURE, INCLUDING FOOTING IS TO BE INDEPENDENT OF RESERVOIR STRUCTURE.
3. STAIR STRUCTURE IS NOT TO RELY ON RESERVOIR FOR STRUCTURAL STABILITY OR RESTRAINT
4. SUITABLE PROVISION FOR MOVEMENT BETWEEN LANDINGS AND PLATFORM TO BE PROVIDED.



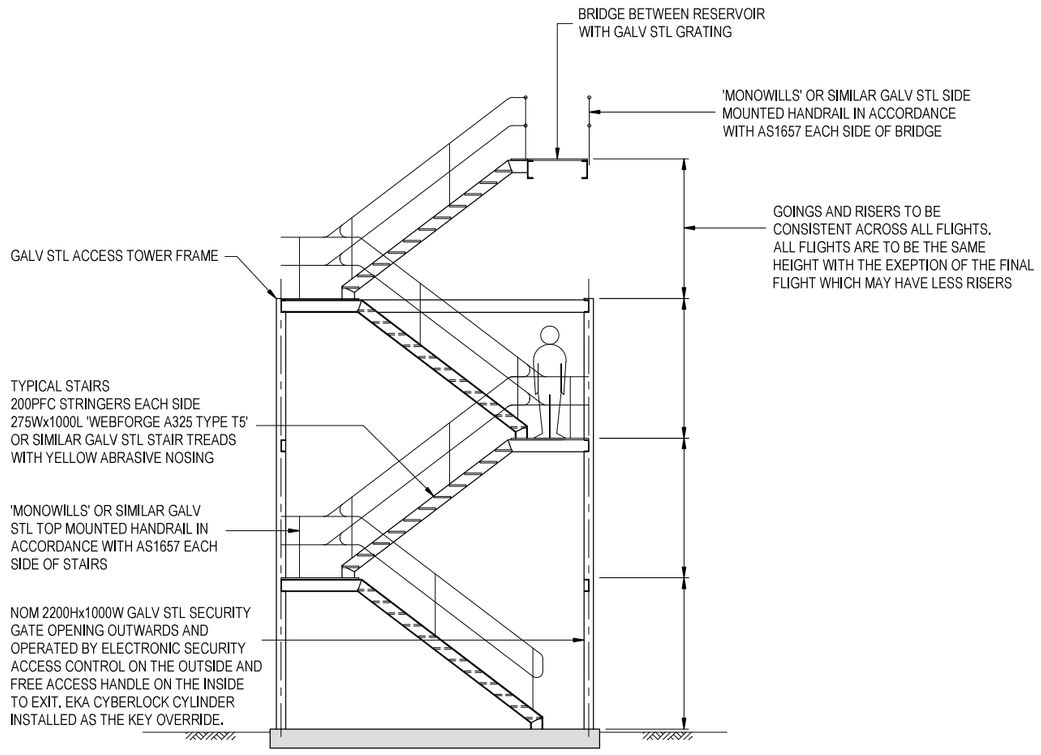
PLAN OF RESERVOIR ROOF ACCESS
SCALE 1:50
TYPICAL DETAIL FOR TWIN RESERVIOR SHOWN, SINGLE RESERVIOIR SIMILAR.



500 0 500 1000 1500 2000
SCALE 1: 25 SCALE IN mm

1000 0 1000 2000 3000 4000
SCALE 1: 50 SCALE IN mm

SECTION A - SCALE 1:50



SECTION B - SCALE 1:50

REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY DATE
CHECKED BY DATE
ENDORSED BY DATE

UrbanUtilities

FACILITY/NETWORK TYPE
TYPICAL DRAWING
DRINKING WATER
RESERVOIRS AND TANKS

DRAWING TITLE
TYPICAL ROOF DETAILS
EXTERNAL ACCESS

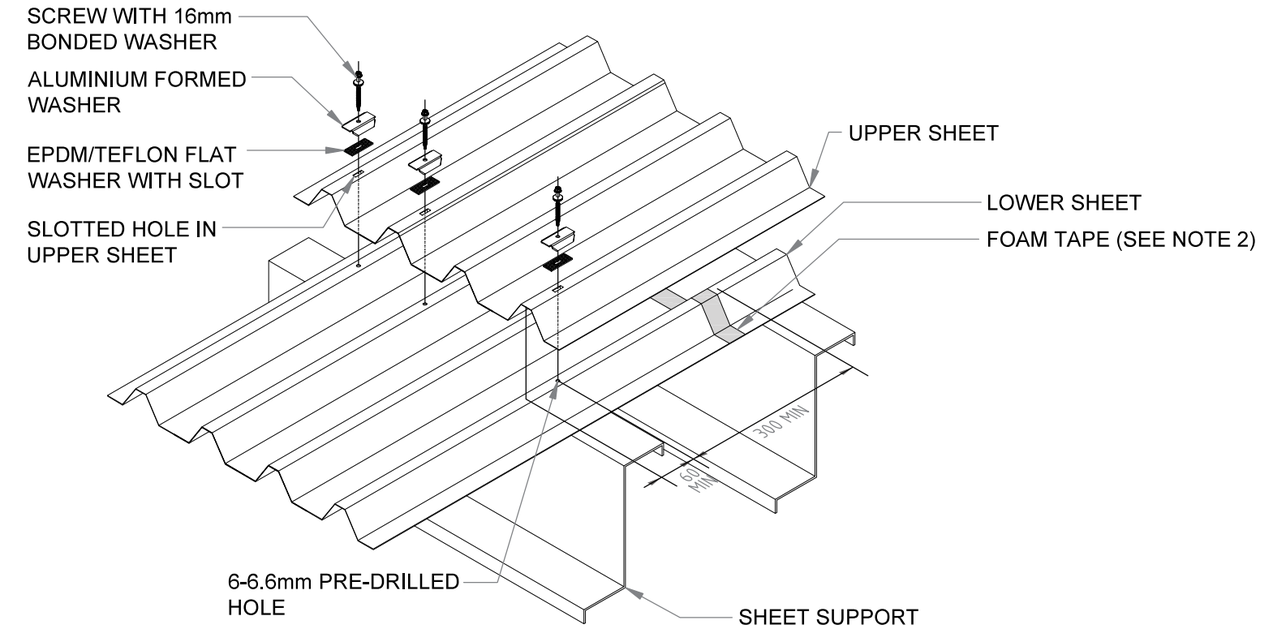
DRAWING STATUS
FOR INFORMATION

URBAN UTILITIES DRAWING No. WR-CV-TYP-00058

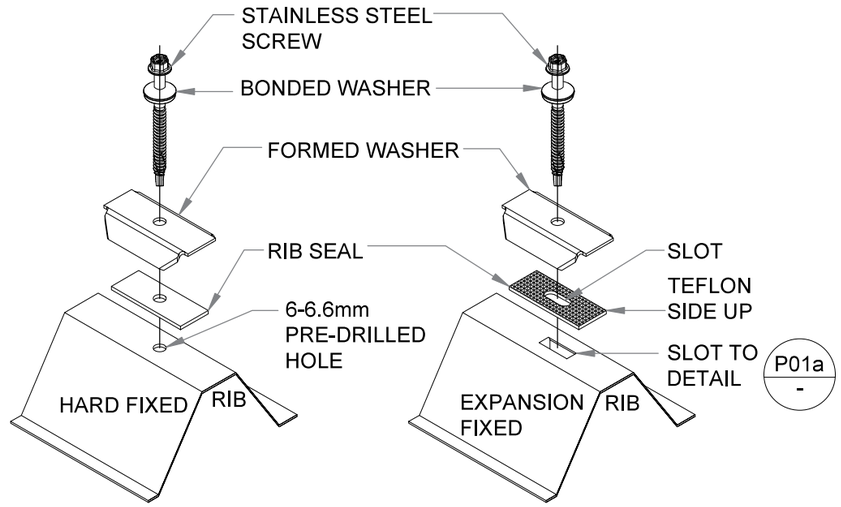
REVISION A

NOTES

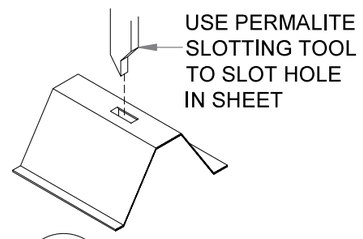
1. SEALANT TO BE PROPRIETARY NEUTRAL-CURING GUN APPLIED SILICONE SEALANT DESIGNED FOR ROOF AND GUTTER APPLICATIONS (SIKASEAL ROOF AND GUTTER OR EQUIVALENT)
2. FOAM TAPE TO BE EPDM FOAM TAPE, 3.2mm THICK, MIN 24mm WIDE. ACRYLIC ADHESIVE ONE SIDE.
3. WHERE MANUFCTURERS RECOMMENDATIONS DIFFER FROM THE TYPICAL DRAWINGS APPROVAL FOR THEIR USE IS TO BE OBTAINED FROM UU. THE INTENT OF THE TYPICAL DRAWINGS SHALL STILL APPLY.



R02 / - TYP. EXPANSION ENDLAP DETAIL ISOMETRIC VIEW



P01 / - POSITIVE FIX FASTING SYSTEM ISOMETRIC VIEW



P01a / - SLOT DETAIL ISOMETRIC VIEW

REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

UrbanUtilities

FACILITY/NETWORK TYPE: TYPICAL DRAWING DRINKING WATER RESERVOIRS AND TANKS

DRAWING TITLE: TYPICAL ALUMINIUM ROOF SHEETING EXPANSION JOINT DETAILS

DRAWING STATUS: *FOR INFORMATION*

URBAN UTILITIES DRAWING No.: WR-CV-TYP-00060

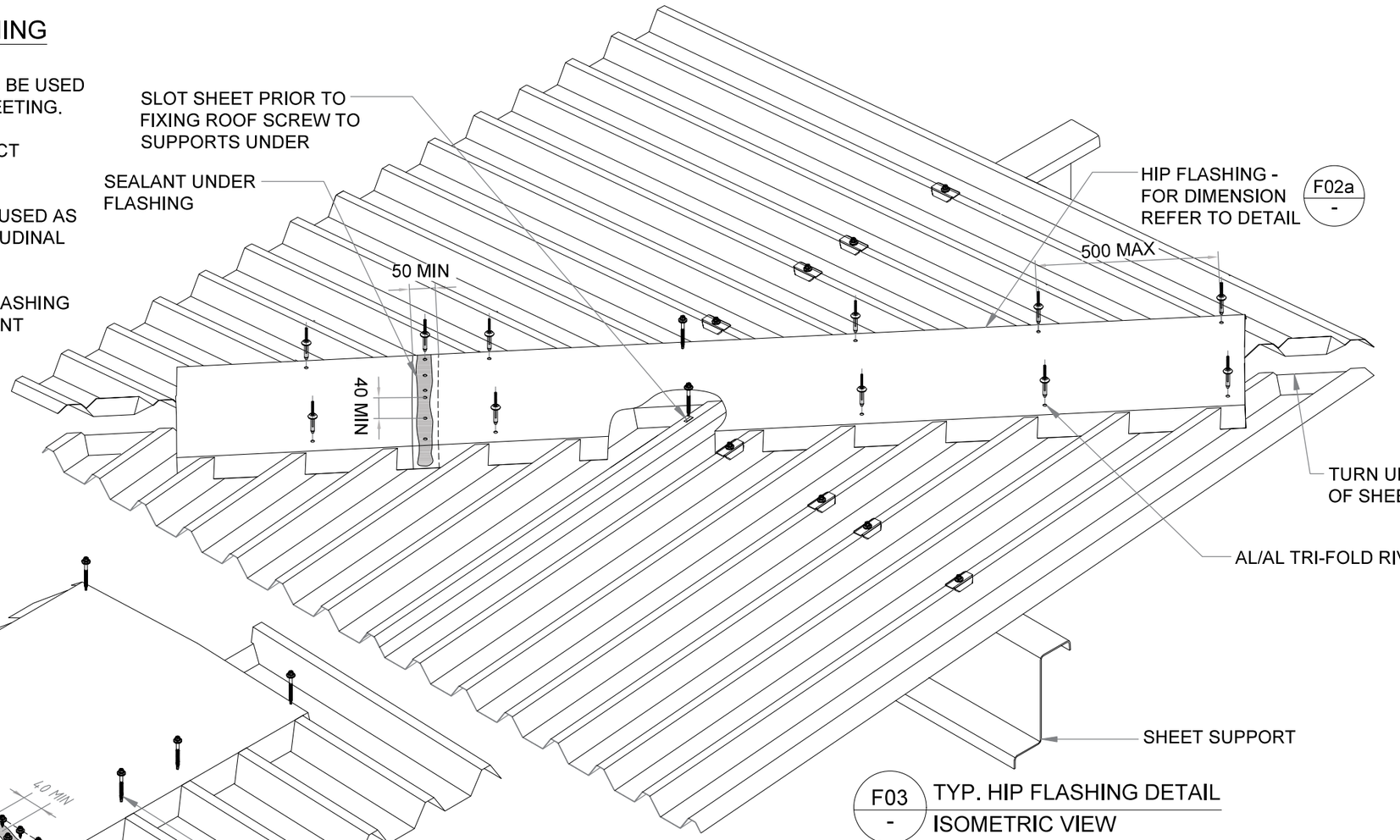
REVISION: A

GENERAL ROOF PENETRATION FLASHING REQUIREMENTS

LONGITUDINAL FLASHINGS FROM THE RIDGE ARE TO BE USED FOR ANY PENETRATION PROVIDED IN THE ROOF SHEETING. TRAY FLASHINGS ARE NOT PERMITTED DUE TO THE DIFFICULTIES IN SEALING AND TENDENCY TO COLLECT DEBRIS.

DEKTITE STYLE SEALS ARE ONLY PERMITTED TO BE USED AS AN OVERFLASHING IN CONJUNCTION WITH A LONGITUDINAL FLASHING.

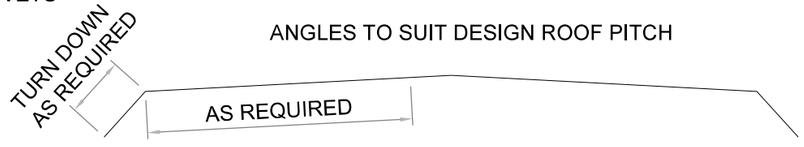
THE DESIGNER IS TO ENSURE THE LONGITUDINAL FLASHING WILL NOT RESULT IN OVERFLOWING OF THE ADJACENT SHEETING PANS.



F03 - TYP. HIP FLASHING DETAIL
ISOMETRIC VIEW

GAPS BETWEEN FLASHING AND ROOF PROFILE TO BE 2mm MAXIMUM.
APPLIES TO ALL FLASHINGS INCLUDING VENTILATION UNITS AND ROOF PENETRATIONS.

F02 - TYP. RIDGE CAP OVERLAP DETAIL
ISOMETRIC VIEW



F02a - TYP. RIDGE FLASHING DIMENSION DETAIL
SECTIONAL VIEW

REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY — DATE
CHECKED BY — DATE
ENDORSED BY — DATE

UrbanUtilities

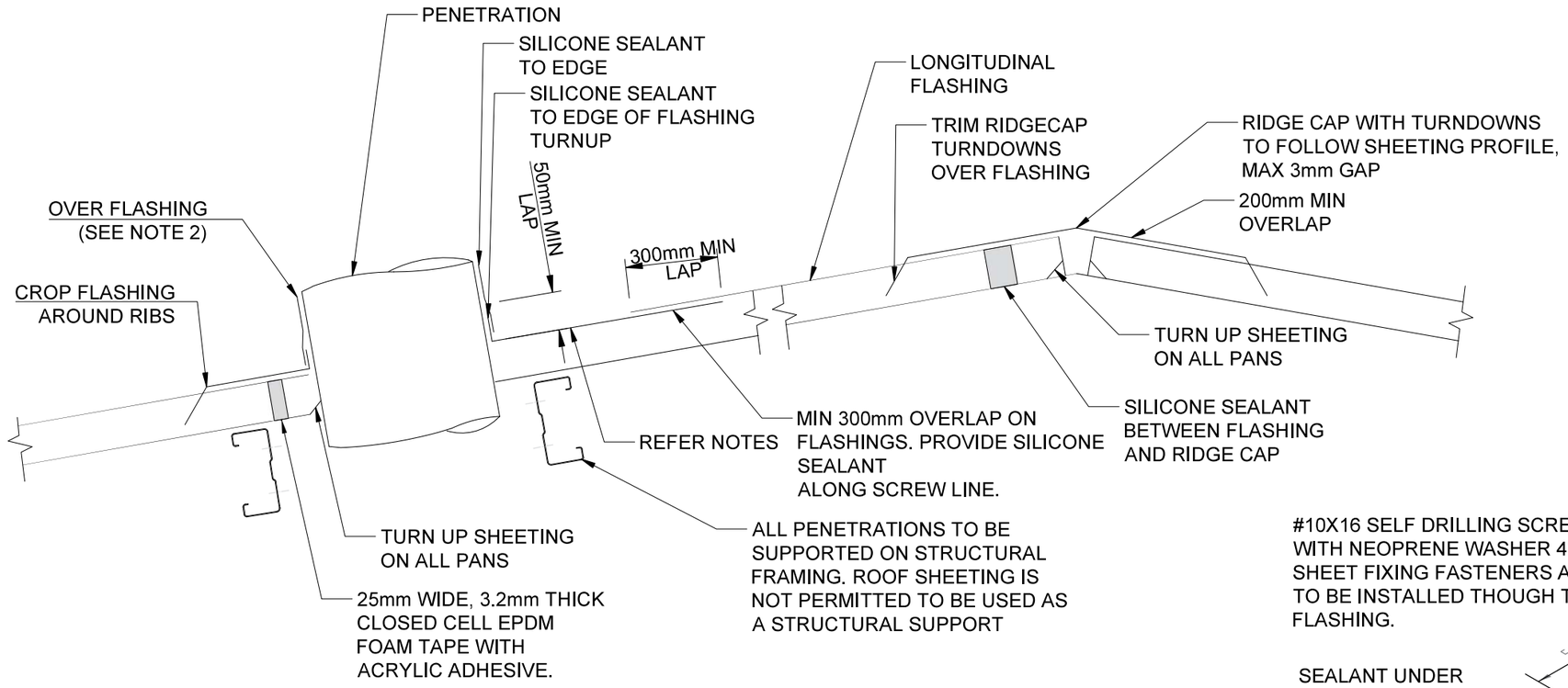
FACILITY/NETWORK TYPE: TYPICAL DRAWING DRINKING WATER RESERVOIRS AND TANKS

DRAWING TITLE: TYPICAL ALUMINIUM ROOF SHEETING DETAILS

DRAWING STATUS: *FOR INFORMATION*

URBAN UTILITIES DRAWING No.: WR-CV-TYP-00061

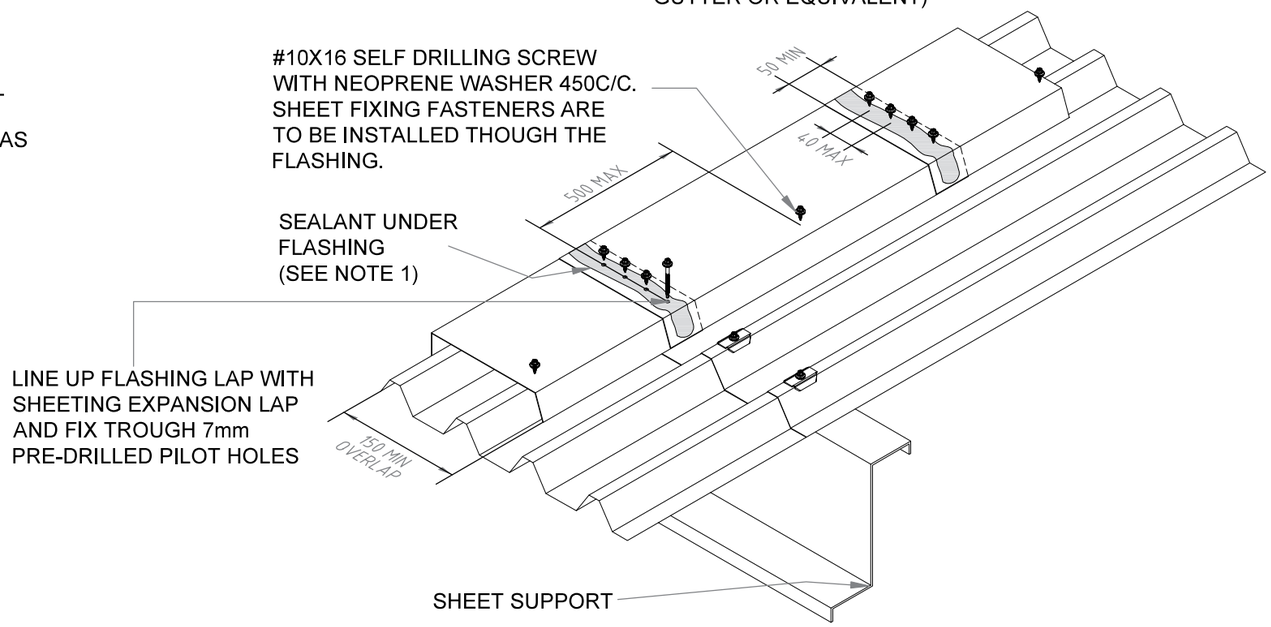
REVISION: A



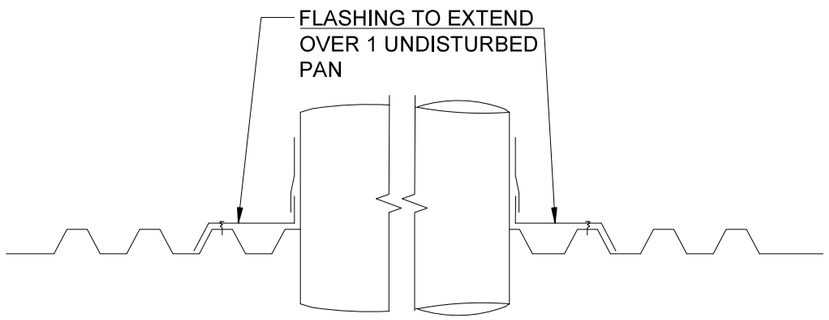
LONGITUDINAL FLASHING TYPICAL DETAILS AT PENETRATION

NOTES

1. FLASHINGS TO BE OF THE SAME MATERIAL AND FINISH AS THE ROOF SHEETING
2. OVERFLASHING TO BE OF THE SAME MATERIAL AS THE ROOF SHEETING OR A PROPRIETARY UV STABILISED PRODUCT DESIGNED FOR THIS PURPOSE. MECHANICAL FIXING TO THE PENETRATION IS PREFERRED. WHERE THIS IS NOT PRACTICAL, A SUITABLE STAINLESS STEEL STRAP OR VERY HIGH BOND DURABLE TAPE SUITABLE FOR THE MATERIAL TO BE BONDED. (EG 3M VHB TAPE 5952 FOR POWERED COATED METAL). THE TAPE AND STRAP SHOULD NOT BE RELIED ON FOR WATER PROOFING AND SEALANT IS IS STILL REQUIRED.
3. ALL FASTENERS SHALL BE GRADE 316 STAINLESS STEEL WITH NEOPRENE WASHERS.
4. ALL SEALANTS TO BE PROPRIETARY GUN APPLIED NATURAL SILICONE DESIGNED FOR ROOF AND GUTTERING APPLICATIONS. (SIKASEAL ROOF AND GUTTER OR EQUIVALENT)



TYP. LONGITUDINAL FLASHING ENDLAP DETAIL ISOMETRIC VIEW



EXTENT OF OVERFLASHING

REV.	DATE	AMENDMENT	UU DELEGATE

DRAFTED BY DATE

CHECKED BY DATE

ENDORSED BY DATE

UrbanUtilities

FACILITY/NETWORK TYPE: TYPICAL DRAWING DRINKING WATER RESERVOIRS AND TANKS

DRAWING TITLE: TYPICAL ALUMINIUM ROOF SHEETING LOGITUDINAL FLASHING DETAILS

DRAWING STATUS: *FOR INFORMATION*

URBAN UTILITIES DRAWING No.: WR-CV-TYP-00062

REVISION: A

12. APPENDIX B- DESIGN DOCUMENTS AND DELIVERABLES

The Contractor shall complete the Post Construction Report after commissioning the reservoir and submit it to Urban Utilities as part of the Handover Process. This report shall include, as a minimum: -

- Records of any additional geotechnical work carried out during construction.
- Records of all concrete mix designs and concrete control testing.
- Records of all post-tensioning operations.
- The results of the water tightness test.
- Operation and maintenance literature for all equipment and valves.
- Description of all telemetry monitoring and control functions including a listing of all I.O.s.
- A full set of As-Constructed drawings signed by the Certifying Engineer.
- The Safety in Design Report showing completion of actions.
- Design Report.
- Reservoir inspection and testing documented and included in the commissioning document including leak test reports and test certificates.
- All documents associated with the asset and future maintenance and operation implementation.
- Warranties and expected life of products including maintenance requirements to maintain warranties and expected life of product.
- Requirements specified in Urban Utilities Reference documents.
- Water Quality Assurance records including the results of water quality testing and other associated water security aspects such as flood test and vermin proof evidence.

13. APPENDIX C – CONCRETE REPAIR

C1 REPAIRS

C1.1 Concrete Repair Materials

The concrete repair materials used shall be suitable for hand application. The Concrete repair mortar shall have, as a minimum, an equivalent strength to the parent concrete. Unless otherwise approved by the Certifying Engineer the concrete patch repair mortar shall be a single component polymer-modified cementitious repair mortar exhibiting the following characteristics:

- A minimum characteristic compressive strength of 40 MPa at 28 days.
- Drying shrinkage at 28 days age of less than 600 microstrain when tested in accordance with AS 2350: Part 13.
- The repair material shall not crack excessively due to thermal and/or shrinkage effects. Excessive cracking shall be defined as cracks with width in excess of 0.10 mm in the repair, crazing/cracking covering significant areas of the repair, or any cracking whatever at interfaces between old concrete and the repair material.
- The total chloride ion content of the repair material shall not exceed 0.1% by weight of cement.
- The total alkali content of the repair material (as Na2O equivalent) shall be limited to 3.0 kg/m3 of repair material.
- Seven-day bond strength to substrate (by direct pull-off), no single result less than 1 MPa, mean result exceeding 1.2 MPa.
- The preferred repair mortar is Renderoc HB40 or an equivalent approved by the Certifying Engineer (ensuring the material is compliant to AS/NZS 4020). Note that the Water Quality Procedures and Testing requirements of section 10.2.6 will apply for recommissioning of the reservoir.

C1.2 Breakout and Removal of Deteriorated Concrete

Breakout of existing failed concrete repairs is to be undertaken as follows:

- Saw cut the perimeter of each repair as a series of straight lines at right angles to the surface to a nominal depth of 20 mm to prevent feathering of edges. Reinforcement is not to be damaged during this process.
- Remove defective concrete within marked out areas through the use of a portable jack hammer or equivalent, to expose the sound concrete substrate.
- After initial removal of defective concrete, the Certifying Engineer shall be informed to inspect the breakout. Where the Certifying Engineer identifies that the surrounding concrete is not sound, inform the Urban Utilities representative. If necessary, the repair area shall be enlarged until such time the Certifying Engineer agrees all defective concrete has been removed.
- Where reinforcement is exposed, the breakout shall extend 25 mm beyond the depth of the reinforcement.
- The repair perimeter shall extend until a minimum 130 mm length of sound reinforcement (i.e. no section loss) is achieved.
- Featheredges will not be accepted and where necessary, fresh saw cuts are to be made to eliminate featheredges at the completion of the breakout.

- Record the exact locations and size of the breakout on relevant drawings and submit to the Certifying Engineer for review and inclusion in the as-constructed work package. The drawings shall be used for the purposes of recording and measuring the work.

C1.3 Treatment of Exposed Reinforcement

To inhibit further corrosion any exposed reinforcement is to be cleaned prior to the reinstatement of concrete. Except where otherwise required by the manufacturer of the repair products, an acceptable methodology is

- Reinforcement shall be cleaned to remove any loose scale and/or corrosion products to achieve a surface finish equivalent to Sa 2.5 AS 1627.4.
- Abrasive blasting or the use of power tools are acceptable methods to achieve this class of finish.
- Where a loss of section greater than 30 % is identified, an equivalent bar diameter in accordance with AS/NZS 4671 shall be welded to the existing sound bar. The weld shall be a double-lap splice (bars vertical) in accordance with Appendix F, Table F4 of AS/NZS 1554.3, Joint Type L-c. The minimum length of weld is 80 mm and weld consumable is W50X in accordance with AS/NZS 2717.1 (ISO 14341). Welding within 50 mm of bends in any bar is not permitted.
- The additional reinforcement shall be lapped in a manner such that the depth of cover is not reduced from the existing value.
- Welding of additional reinforcement shall be performed by experienced personnel with qualifications in accordance to AS 1554.3.
- Precautions shall be taken to prevent excessive heating and resultant damage to surrounding concrete during welding. The reinforcement welded joint configuration shall be double-lap splice as shown in Appendix F, Table F4 of AS 1554.3, Joint Type L-c.
- All reinforcement shall be primed with the preferred primer Nitoprime Zincrich (or a suitably approved equivalent). Application of the priming agent is to be in accordance with manufacturer's recommendations

C1.4 Concrete Substrate Preparation

The concrete substrate is to be prepared prior to reinstatement of the concrete patch repair mortar as follows.

- The substrate shall be lightly scabbled with a handheld power tool such as a pneumatic hammer drill or jack hammer to ensure good adhesion (and mechanical key) with the repair mortar.
- Subsequent to scabbling, thoroughly wash the substrate surface to ensure that the substrate is free from dust, loose particles and other contaminants.
- Prepare the substrate prior to reinstatement of repair concrete by soaking with drinking water for a minimum period of 2 hours.
- The substrate shall be primed with a compatible polymer emulsion-bonding agent (Nitobond HAR bonding agent for Renderoc HB40). Application of the priming agent is to be in accordance with the manufacturer's recommendations. Note that the Water Quality Procedures and Testing requirements of section 10.2.6 will apply for recommissioning of the reservoir.

- The Accountable Party shall witness the concrete substrate preparation prior to concrete reinstatement.

C1.5 Mixing

Mixing of the repair mortar shall be undertaken as follows.

- Mixing of the repair mortar shall be undertaken in accordance with the manufacturer's recommendations. Mixing shall be undertaken on site using power mixing tools. Hand mixing shall not be used.
- Whole bags of dry component material shall be used. Split bags shall not be used. Materials that have passed the manufacturer's "best before" or "use by" dates or have otherwise deteriorated in any way shall not be used.
- Drinking water only is to be used during mixing.
- The volume of mix ingredients shall be measured and added in accordance with the mix proportions and procedures recommended by the manufacturer.

C1.6 Reinstatement

Unless otherwise required by the manufacturer of the repair product, reinstatement of the repair mortar shall be undertaken as follows.

- The repair mortar shall be applied prior to the drying of the priming agent.
- Placement of material on the prepared substrate shall be either by gloved hand or trowel application.
- The repair mortar shall be thoroughly compacted onto the primed substrate and carefully packed around reinforcement to confirm there are no voids.
- Reinstate prepared area with proprietary high performance and low shrinkage repair mortar, compatible with existing concrete. Renderoc HB40 or an equivalent approved by the Certifying Engineer in accordance with the manufacturers requirements. Note that the Water Quality Procedures and Testing requirements of section 10.2.6 will apply for recommissioning of the reservoir.
- If applying in layers, the manufacturers recommended minimum and maximum thickness of application shall be adhered to and each previous layer must be scratched to provide a mechanical key to subsequent layers.
- Confirm that fresh material does not contaminate the reservoir by providing adequate containment to the work area. Dispose of trapped materials off-site in accordance with statutory authority regulations.

C1.7 Surface Finishing

Finishing of the repair surface shall be flush with the surrounding areas within a tolerance of 2 mm.

C1.8 Curing

- Curing shall be undertaken immediately after reinstatement.
- The curing compound shall have a minimum curing efficiency of 90 %.
- A proprietary curing agent that is compatible with the repair mortar shall be used (Concure A99 or similar approved).

- Application of the curing compound shall be in accordance with the manufacturer's requirements.

C1.9 Repair of Surface Defects

Subsequent to the reinstatement and curing of the repair mortar, a visual inspection of the repairs shall be undertaken. Any surface defects identified shall be repaired as follows:

- Remove and dispose of all applied materials that lack uniformity, exhibit segregation, honeycombing, delamination, cracking, or which contain dry patches, voids or sand pockets.
- Repair such areas immediately after cleaning and surface preparation of the substrate and the interface with the existing repairs.

C1.10 Inspection and Testing

Inspection and testing of the repair areas is to include compressive strength testing of repair mortar, visual inspection of all repairs and soundness survey of concrete repairs.

Where the manufacturers specify that additional testing is to be undertaken in order to adhere to their warranty schemes, then this additional testing must be undertaken. If destructive testing is involved, then these test areas are to be repaired as indicated in this document.

C1.11 Visual Inspection

Visual inspection is to be undertaken on the surface of all repair areas. Any defects identified in this visual inspection, such as voids, honeycombing, cracking, crazing, or any cracking at interfaces between old concrete and the repair, shall be deemed unacceptable and are to be satisfactorily repaired.

C1.12 Soundness of Repair (Hammer sounding)

Soundness surveys of all coated areas are to be undertaken after 7 and 28 days of curing. Any hollow sounding repair areas shall be deemed unacceptable and are to be removed and satisfactorily repaired, following the procedures outlined in this document.

C1.13 Compressive Strength Testing

Compressive strength testing of the repair mortar is to be undertaken on the same batch of repair mortar to be used in the repair works as per AS 1012.9. The results of the compressive strength testing are to be submitted to the Certifying Engineer for their approval.

C1.14 Bond Testing

The bond strength of the applied materials shall be tested at a minimum of 3 locations after 7 days curing. The testing shall be undertaken by an adhesion testing of a 50 mm diameter core extending to 20 mm into the parent concrete. Aluminium dollies a minimum of 20 mm thick shall be bonded to ends of the cores. Tensile testing (in a calibrated test machine) shall be undertaken at a strain rate of 1 mm/minute. The load at calculated tensile stress failure and mode of failure shall be recorded. Areas of repair with bond strength below the performance criteria shall be deemed unacceptable and are to be removed and satisfactorily repaired, following the procedures outlined in this document.

C2 EPOXY MORTAR LINING

The concrete surfaces that require a chemically resistant epoxy mortar lining shall comply with this section.

C2.1 Materials

The concrete surfaces will be lined with a high build chemically resistant three component epoxy-based mortar. Nitomortar EL-HB is preferred or a suitably approved equivalent.

Concrete surfaces will be primed using an epoxy resin primer compatible with the repair material. Nitobond EP for Nitomortar EL-HB or a suitably approved equivalent.

Note that all materials require to be approved to AS/NZS 4020 and the Water Quality Procedures and Testing requirements of section 10.2.6 will apply for recommissioning of the reservoir.

C2.2 Contractor Experience

The applicators shall be manufacturer approved applicators of the lining material and shall have appropriate experience in the use of the material and application equipment. Experience in undertaking similar repairs shall be supplied to the Urban Utilities representative for their acceptance before the applicator is allowed to commence work.

C2.3 Trial Application

A trial application to confirm the material and application methodology is adequate shall be undertaken. The trial application shall occur at two sites for each structure to be repaired.

The full scale of epoxy mortar lining work shall not be undertaken prior to successful completion of the trial.

C2.4 Concrete Substrate Preparation

The concrete substrate is to be prepared prior to application of the epoxy lining as follows:

- The area to be lined shall be demarcated using saw cuts 5 mm deep to prevent feathered edges at the extremities of the repair area.
- The substrate shall be lightly scabbled via grit or water blasting to confirm good adhesion (and mechanical key) with the epoxy mortar coating.
- Subsequent to scabbling, thoroughly wash the substrate surface to confirm that the substrate is free from dust, loose particles and other contaminants.
- The Accountable Party shall witness the concrete substrate preparation and verify it is acceptable prior to epoxy lining.

C2.5 Mixing

Mixing of the epoxy mortar shall be undertaken as follows:

- Mixing of the epoxy mortar shall be undertaken in accordance with the manufacturer's recommendations. Mixing shall be undertaken on site using a slow speed electric drill with a suitable paddle. Hand mixing shall not be used.
- Whole bags of component material shall be used. Split bags shall not be used. Materials that have deteriorated in any way shall not be used.
- The use of thinners is not permitted.

- The volume of mix ingredients shall be measured and added in accordance with the mix proportions and procedures recommended by the manufacturer.

C2.6 Application

Application of the epoxy lining shall be undertaken as follows:

- The surface shall be primed using an epoxy resin primer Nitobond EP or similar approved. Application of the primer shall be by brush or spray.
- The epoxy mortar lining material shall be applied within 90 minutes of priming, while the primer is still tacky. If the primer is allowed to dry, a second application is required.
- Application of the epoxy mortar shall be by gloved hand to allow the material to be thoroughly worked into the prepared surface. The epoxy mortar lining shall not be applied over joints.
- The lining shall be built up as required to thickness such that the outmost aggregate is covered by a minimum of 5 mm of epoxy mortar in accordance with the manufacturers recommended application rates.
- The repair surface shall be finished with a steel trowel.
- Confirm that fresh material does not contaminate the reservoir by providing adequate containment to the work area. Dispose of trapped materials off-site in accordance with statutory authority regulations.
- Should the contractor wish to use Nitomortar ELS (spray applied) or similar approved, work methods statement and evidence of experience in the application method must be submitted and accepted by the Certifying Engineer prior to application.

C2.7 Curing

The epoxy mortar shall be allowed to cure for a minimum of 7 days or as specified by the manufacturer. The finished surfaces shall be adequately protected whilst curing.

C2.8 Limitations

Limitations for the works are as follows:

- The repair material shall not be applied when the substrate or ambient temperatures are below 5° C
- Do not mix part bags.
- Do not use thinners.

C2.9 Inspection and Testing

Inspection and testing of the coated areas is to include visual inspection of all surfaces, soundness survey and bond testing.

Where the manufacturers specify that additional testing is required in order to adhere to their warranty schemes, then this additional testing must be undertaken. If destructive testing is involved, then the test areas are to be repaired as indicated in this document.

C2.10 Visual Inspection

Visual inspection is to be undertaken on the surface of all coated areas. Any defects identified in the visual inspection, such as voids, honeycombing, cracking, crazing, or any cracking at

interfaces between old concrete and the coated area, shall be deemed unacceptable and are to be satisfactorily repaired.

C2.11 Soundness of Repair (Hammer Sounding)

Soundness surveys of all coated areas are to be undertaken after 7 and 28 days of curing. Any hollow sounding repair areas shall be deemed unacceptable and are to be removed and satisfactorily repaired, following the procedures outlined in this document.

C2.12 Bond Testing

The bond strength of the applied materials shall be tested at a minimum of 3 locations after 7 days curing. The testing shall be undertaken by adhesion testing of a 50 mm diameter core extending to 20 mm into the parent concrete. Aluminium dollies a, minimum of 20 mm thick, shall be bonded to ends of the cores. Tensile testing (in calibrated test machine) shall be undertaken at a strain rate of 1 mm/minute. The load at calculated tensile stress failure and mode of failure shall be recorded. Areas of repair with bond strength below the performance criteria shall be deemed unacceptable and are to be removed and satisfactorily repaired, following the procedures outlined in this document.

C3 JOINT SEALANT

All expansion and contraction floor slab joints and internal wall joints shall receive joint sealant application.

Joint sealant works shall not commence until the concrete repair mortar and epoxy mortar lining have had adequate time to cure in accordance with the manufacturer's recommendations (minimum 28 days).

C3.1 Materials

Joints will be sealed with an approved chemically resistant polyurethane sealant. Sikaflex Tank N is preferred or a suitably approved equivalent.

Primer shall be suitable for use with polyurethane sealants and concrete (Sika Primer -3N is preferred or a suitably approved equivalent).

Backing rods shall be extruded closed cell polyethylene foam, with a diameter 25 % larger than the joint (Sika Closed Cell Backing Rod is preferred or a suitably approved equivalent).

Joint filler shall be non-absorbent, semi-rigid, polyethylene joint filler.

C3.2 Contractor Experience

The applicators shall be manufacturer approved applicators of the sealant material and shall have appropriate experience in the use of the material and application equipment. Experience in undertaking similar repairs shall be supplied to the Urban Utilities representative for their review.

C3.3 Trial Application

A trial application to confirm the material and application methodology is adequate in sealing the joints shall be undertaken and checked by the Accountable Party to verify acceptable sealing in accordance with the specified standards is achieved. The trial application shall occur at four sites.

TRIAL SITE 1: Floor slab contraction joint, 5 m total trial length (include concrete repair, intersection and saw cut length).

TRIAL SITE 2: Floor slab expansion joint, 5 m total joint length (include concrete repair, intersection and saw cut length).

TRIAL SITE 3: Internal wall contraction joint - 5 m total joint length.

TRIAL SITE 4: Internal wall expansion joint - 5 m total joint length.

The full scale of joint sealing work shall not be undertaken prior to successful completion of the trial.

C3.4 Joint Saw Cutting

The following joint saw cutting will be undertaken prior to joint preparation:

- The joint edges shall be saw cut and broken out to the nominal depth and width in order to achieve the specified dimensions (maintaining a width to depth ratio of 2:1).
- Concrete within the saw cut area shall be mechanically broken out to form the prescribed joint detail as detailed in the Project Drawings.

- Joints which do not require saw cutting shall have their surfaces ground to the depth of sealant application.
- A 3 to 5 mm chamfer shall be ground on all joint edges.

C3.5 Joint Preparation

The following joint preparation will be undertaken prior to the application of the joint sealant:

- Joint surfaces to receive replacement sealant shall be cleaned using mechanical grinding followed by water blasting to remove all traces of foreign material, moisture, or other contaminants.
- All traces of the existing sealant and other contaminants shall also be removed on the concrete surfaces adjacent to joint areas.
- The joint shall be cleaned of all loose material by vacuuming to its full depth.
- A sound, clean and dry (moisture content below the maximum allowed by the sealant manufacturer at time of sealant application) surface shall be achieved ready for the replacement joint sealant.
- Prior to application of sealant, a backing rod shall be installed. The backing rod shall be fitted at the depth of the joint as shown on the Project Drawings to maintain a width to depth ratio of 2:1. The diameter of the backing rod shall be approximately 25% larger than the joint width.
- Prior to application of the replacement sealant, the prepared concrete joint surfaces shall be primed using Sika Primer -3N in accordance with the manufacturer's recommendations unless otherwise approved by the engineer in writing.
- The surface either side of the joint shall be temporarily masked to prevent contamination with excess sealant and facilitate compaction of the sealant thus confirming full contact with the joint sides. The tape shall be removed after sealant application and prior to the manufacturer's specified skinning time.

C3.6 Application

Joint sealant application shall be undertaken as follows:

- Sikaflex Tank N or similar approved shall be applied to the primed surfaces in accordance with the approved Contractors Method Statement and sealant manufacturer's recommendations.
- The sealant shall have a minimum depth of 15 mm and a maximum depth no greater than 20 mm and also meet the required width to depth ratio of 2:1.
- Immediately after the sealant application, the sealant must be tooled and compacted into a regular cross section to the specified profile, using a small spatula or other suitable tool.
- The Contractor must ensure that the completed sealant is adequately protected during curing to prevent damage being caused to it.
- The sealant shall be allowed a minimum of 6 days curing time for 15 mm depth, with an additional 24 hours per additional 2.5 mm depth. The sealant manufacturer shall confirm the curing period and any other curing requirements deemed relevant for this project.

C3.7 Inspection and Testing

The following inspection and testing shall be undertaken:

The sealant manufacturer shall recommend quality control testing on site and acceptance criteria appropriate to confirm the acceptable application of the product, which shall be included in the Contractor's Method Statement and subject to Urban Utilities acceptance.

As a minimum at one location per 100 m of sealant installed a "tongue" of sealant shall be cut using a sharp knife along either side of the joint so that the "tongue" can be lifted to project by approximately 150 mm. The tongue shall then be pulled at an approximate angle of 45 to 90 degrees to the joint surface to tear the sealant out of the joint. The sealant shall fail in cohesion, i.e. tear within itself, rather than pull away from the concrete substrate. In the event that this is not achieved, the Accountable Party shall instruct additional testing in the 100 m of sealant represented by the test and any areas failing to meet the requirement shall be replaced by the Contractor.

Areas where the replaced sealant does not comply with the quality control testing and/or is not properly bonded as demonstrated by hand probing, sagging, has voids, etc. or where the sealant is in the Accountable Party's opinion defective in other ways, it shall be replaced by the Contractor to the Accountable Party's satisfaction by the Contractors. Additional quality control testing may be carried out to non-compliant designated areas.

All destructive tests required to the applied replaced sealant for quality control testing shall be made good and reinstated to the profile of the surrounding surfaces using the approved sealant materials and workmanship.

Upon acceptance that all sealant has been applied in accordance with this Specification the Contractor shall submit original "As Repaired" documents in digital copy to Urban Utilities for the purpose of recording the repair works inclusive of:

a) Tabulated listing of all applied replacement sealant.

b) Position marked on drawing plan of all applied sealant.

c) All quality control tests completed, and results obtained.

d) Position marked on drawing plan of quality control tests.

C3.8 Flexible Bandage Seal

Proprietary bandage systems are subject to Urban Utilities' written approval. A flexible joint sealing system with the capability of bridging the existing joint and perform to the design requirements of the original joint sealing design shall be considered.

Any flexible bandage membrane under consideration shall have a minimum tensile strength of 5.5 MPa and an elongation capacity greater than 600%. The designer shall confirm the requirements for the particular joint being repaired. Flexible bandage systems are not to be considered where concrete substrate strength has not been tested, or where it is found to be below 25 MPa.

The applicators shall be manufacturer approved applicators of the flexible joint sealing system and shall have appropriate experience in the use of the material and application equipment.

14. APPENDIX D – RESERVOIR INFORMATION

Drinking Water Reservoirs and Tanks

Information to be stated in Scope of Works

Item No.	Description	Details
1.	Size of reservoir	
2.	Capacity of reservoir	
3.	Type of reservoir: • Elevated • On ground • Below ground	
4.	Number of reservoirs	
5.	Location and orientation of reservoir	
6.	Location and size of inlet pipe: • Under slab bottom inlet • Top inlet reservoir wall above TWL • Single inlet/outlet or separate	
7.	Operating levels	
8.	Type of reservoir: • Reinforced concrete • Bolted steel panel • Welded mild steel • Polyethylene	
9.	Details of access to the reservoir roof: • Free standing steel stairway location • Height of anti-climb security mesh enclosure • Details of the Davit connections if supported off the stairway columns	
10.	Network model	
11.	Location of reservoir access road from main road	
12.	Stage construction requirements	
13.	Requirements for inlet and outlet from nearest pump station in the network	
14.	Location/area for third party infrastructure	
15.	Location for switchboard	
16.	Requirements for active water mixing and contact time	
17.	Number of access points into the reservoir from the roof	
18.	Location of scour discharge and specific discharge requirements	
19.	De-chlorination requirements for scour/emptying reservoir	
20.	STEP requirements	
21.	Chlorine dosing system requirements	
22.	Connecting pipework for multiple reservoirs	
23.	Reservoir shut plan requirements	
24.	Reservoir by-pass requirements for long term and short term isolation	
25.	Anchor points on roof platform for specific site.	
26.	Davit requirements for specific site:	

Item No.	Description	Details
	• Lifting capacity • Confined space rescue	
27.	Security requirements for specific site	
28.	Documents and deliverables for specific site	
29.	Water quality issues for specific site	
30.	Access and working at heights requirements for specific site	
31.	Ventilation and vermin proof requirements for specific site	
32.	Security lighting requirements for specific site	
33.	Contaminants to be considered for specific site	
34.	Critical spare parts requirements for specific site	
35.	Water tanker connection requirements for specific site	
36.	SCADA control and level probe requirements for specific site	
37.	Actuated inlet and outlet valve requirements for specific site	

15. APPENDIX E – CHAIN WIRE SECURITY FENCING

SECURITY FENCING AND SIGNAGE
STANDARD DRAWINGS

CHAIN WIRE SECURITY FENCING NOTES

NOTES: COASTAL AREA STRUCTURE WITHIN 5 km FROM THE COAST

1. FENCE CONSTRUCTION SHALL COMPLY WITH REQUIREMENTS OF AS 1725.1 AND AS 2423. THIS FENCE IS NOT DESIGNED AS A STRUCTURE AS DEFINED IN AS 4100. THEREFORE, THE DESIGN ASSUMES THAT IT WILL NOT BE SUBJECT TO HIGH WIND LOADS AND IS NOT REQUIRED FOR CROWD CONTROL OR AS A SAFETY BARRIER.
2. THE FOLLOWING PROCESS SHALL BE FOLLOWED FOR PROTECTION TREATMENT:
   - A. ALL STEELWORK SHALL BE HOT DIP GALVANISED. HOT DIP GALVANISING: FERROUS OPEN SECTIONS TO AS 4791, FERROUS HOLLOW SECTIONS TO AS4792.
   - B. ALL FERROUS HOLLOW SECTIONS SHALL BE HOT DIP GALVANISED AFTER FABRICATION TO 60 MICRONS MINIMUM.
   - C. ALL SHARP EDGES OF THE STEELWORK MUST BE GROUND OFF TO A MINIMUM OF 2 mm RADIUS.
   - D. WHIP BLAST ALL EXPOSED SURFACES.
   - E. WIRE MESH SHALL BE PVC COATED.
   - F. NO WELDING OR PAINTING SHALL BE CARRIED OUT AT SITE.
   - G. NO DENTED OR PAINT DAMAGED FENCING MATERIAL SHALL BE ACCEPTED FOR CONSTRUCTION.
   - H. ALL GALVANISED STEELWORK SHALL BE FIRST COATED WITH EPOXY PRIMER 75 MICRONS MINIMUM EG. DULUX® DURABUILD® STE AND SECOND COAT - TWO- PACK POLYURETHANE GLOSS 75 MICRONS MINIMUM.
3. PAINT SYSTEMS SHALL BE IN ACCORDANCE WITH AS 2312 REQUIREMENTS AND DESIGNATED HDG600P6.
4. FENCE COLOURS SHALL CONFORM TO QUEENSLAND URBAN UTILITIES COLOUR PALETTE HERITAGE GREEN.
5. GATE POSTS SHALL BE DN80 (88.9 OD, 4.0 THICK) GALVANISED STEEL TUBE TO AS 1163.
6. CORNER, END AND EVERY EIGHTH POST SHALL BE DN50 (60.3 OD, 3.6 THICK) GALVANISED STEEL TUBE TO AS 1163.
7. INTERMEDIATE POSTS SHALL BE DN40 (48.3 OD, 3.2 THICK) GALVANISED STEEL TUBE TO AS 1163.
8. BRACING STAYS SHALL BE DN32 (42.4 OD, 3.2 THICK) GALVANISED STEEL TUBE TO AS 1163.
9. WIRE TIES SHALL BE 316 GRADE STAINLESS STEEL.
10. ALL CONCRETE SHALL BE GRADE N25.
11. ALL WELDS SHALL BE 5 mm THICK CONTINUOUS FILLET WELD TO AS1554.1 WITH COLD GALVANISING TREATMENT TO COMPLETED WELDS. ELECTRODE TO AS 1554 CLASSIFICATION E48XX.
12. GALVANISED STEEL END CAPS SHALL BE PROVIDED TO ALL POSTS.
13. CORNER POSTS SHALL BE ADOPTED WHERE THE CHANGE IN ANGLE IN HORIZONTAL ALIGNMENT EXCEEDS 20 DEGREES.
14. 1800 HEIGHT CHAIN WIRE SHALL BE 3.15 mm CORE GALVANISED WIRE WITH EXTRUDED PVC 3.95 COATED DIAMETER X 50 mm NOMINAL PITCH KNUCKLED BARBED FABRIC TO AS 2423. BARBED WIRE TO AS 2423.
15. STAYS SHALL BE PROVIDED AT END POSTS, GATE POSTS, CORNER POSTS AND EVERY EIGHTH POST.
16. ALL POSTS SHALL BE VERTICAL. ALL POSTS OTHER THAN GATE POSTS SHALL HAVE TOP EXTENSION CRANKED OUTWARDS FROM SECURED AREA AT 45°.
17. CABLES SHALL BE FORMED FROM TWO 3.15 mm DIAMETER GALVANISED AND PVC COATED WIRES TWISTED TOGETHER.
18. CHAIN WIRE SHALL BE FIXED USING 1.6 WIRE TIES AS FOLLOWS:
    - INTERMEDIATE POSTS AT 3 LOCATIONS;
    - END POSTS AT 3 LOCATIONS;
    - HORIZONTAL CABLE AT 375 CENTRES TO TOP CABLE;
    - HORIZONTAL CABLE AT 600 CENTRES TO MIDDLE CABLE;
    - HORIZONTAL CABLE AT 450 CENTRES TO BOTTOM CABLE.
19. DIMENSIONS IN MILLIMETRES (UNO).
20. VERIFY ALL DIMENSIONS ON SITE BEFORE COMMENCING WORKS.

ENVIRONMENTAL NOTES:

1. NO TREES SHALL BE REMOVED WITHOUT PRIOR APPROVAL FROM QUEENSLAND URBAN UTILITIES.
2. ALL TREES WITHIN THE BOUNDARY OF WORKS SHALL BE PROTECTED WITH TREE GUARDS COMPLYING WITH AS 4970 "TREE PROTECTION GUIDELINES".
3. WHERE APPLICABLE, IN ORDER TO COMPLY WITH THE SELF-ASSESSABLE CODE FOR REMOVAL OF EXISTING MARINE PLANTS, THE CONTRACTOR SHALL NOTIFY FISHERIES QUEENSLAND AT LEAST 5 DAYS PRIOR TO COMMENCEMENT AND 15 DAYS AFTER COMPLETION OF WORKS.

NETWORK ACCESS PERMIT

N1. THE CONTRACTOR SHALL OBTAIN THE NETWORK ACCESS PERMIT FROM networkaccess@urbanutilities.com.au QUEENSLAND URBAN UTILITIES HAS A CENTRALISED NETWORK ACCESS PERMIT.

SIGN TYPE 'A '
NOT TO SCALE

NOTE:

SIGN TYPE 'A' SHALL BE 600 mm x 450 mm COLORBOND™ METAL SHEET WITH 4 COLOURS ON WHITE BACKGROUND, CORNER HOLES (5 mm) & ROUNDED CORNERS (15 mm RADIUS).
SIGN SHALL BE PLACED MID-HEIGHT ON SECURITY FENCE AT 50 m INTERVALS ALONG ENTIRE PERIMETER OF EXISTING AND NEW FENCE TIED TO FENCE WIRE MESH AT ALL 4 CORNERS.

No.	DATE	AMENDMENT	DRAFTED	APPROVED
A	04/16	DRAWING TITLE AND NOTES AMENDED	S.G.	R.K

FUNDING
DESIGN W.O. No.
CONSTRUCTION W.O. No.
FUNDED BY Q.U.U. (✓) EXTERNAL ( )

DRAFTED	M.MOORE/J. STERGOU		
DRAFTING CHECK	*R.ADAMSON / M.L.*		
CAD FILE	125004001.dwg		
Q.U.U. FILE No.			

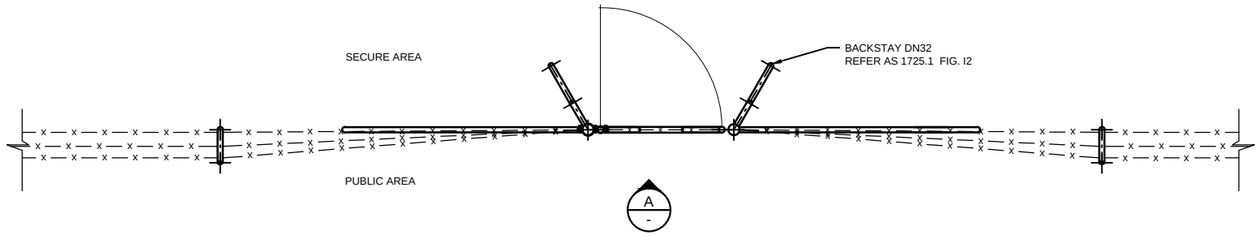
ORIGINAL SIGNED L.HETTIARACHCHI	*08939*	*05.09.13*	
DESIGN	R.P.E.Q. No.	DATE	
ORIGINAL SIGNED F.SCHEELE	*2900*	*05.09.13*	
DESIGN CHECK	R.P.E.Q. No.	DATE	

ORIGINAL SIGNED K.VAHEESAN	*06.09.13*
MANAGER ENGINEERING SERVICES	DATE
FIELD SERVICES DELEGATE	DATE

ASSET/PROJECT
SECURITY FENCING AND SIGNAGE STANDARD DRAWINGS

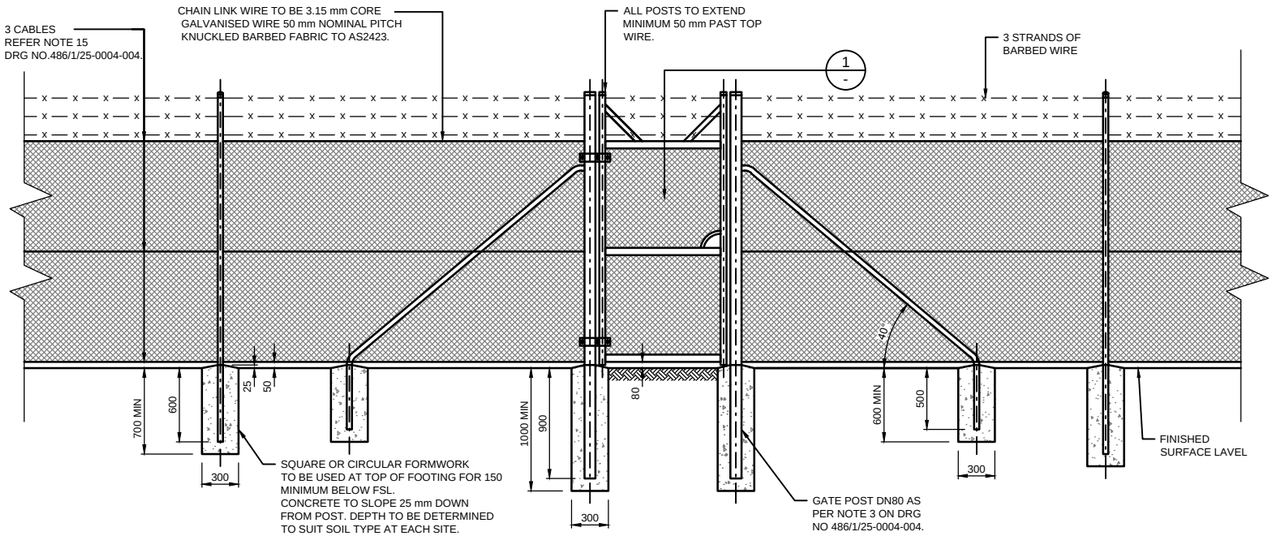
DRAWING TITLE
CHAIN WIRE SECURITY FENCING AND SIGNAGE NOTES FOR COASTAL AREA

SHEET No. 1 OF 6
QUEENSLAND URBAN UTILITIES DRAWING No. 486/1/25-0004-001
AMEND. A



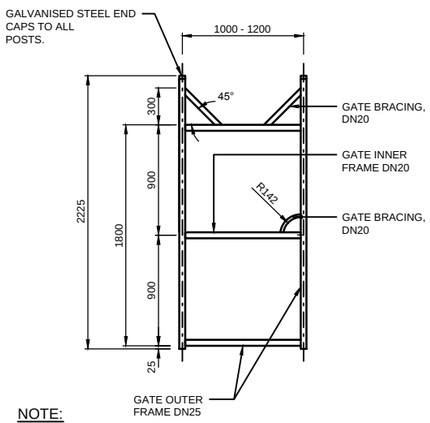
SINGLE PERSON ACCESS GATE PLAN

SCALE 1:25 (A1)



SINGLE PERSON ACCESS GATE ELEVATION (A -)

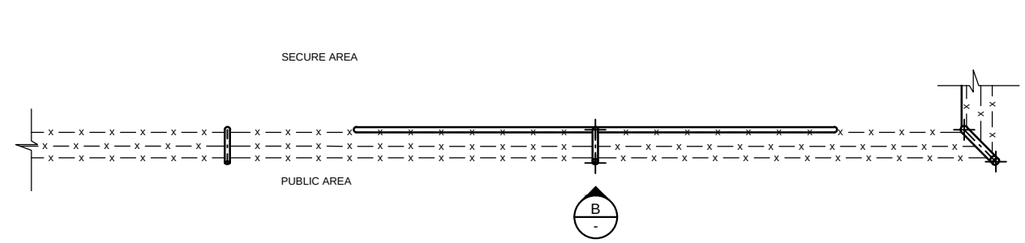
SCALE 1:25 (A1)



NOTE:
REFER TO AS 1725.1 FIGURE I2 TYPE 1
1000 MM OPENING SINGLE GATE FOR DETAILS.
ALL GATES AND BRACING STAYS SHALL BE FACTORY FABRICATED AND GALVANISED.

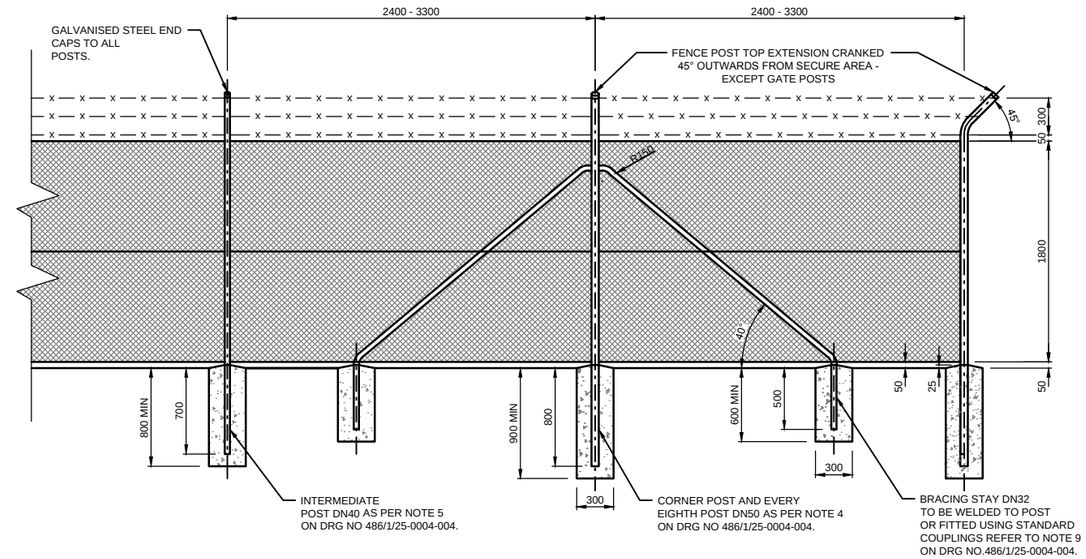
SINGLE PERSON ACCESS GATE DETAIL (1 -)

SCALE 1:25 (A1)



INTERMEDIATE STRAINER ASSEMBLY PLAN

SCALE 1:25 (A1)



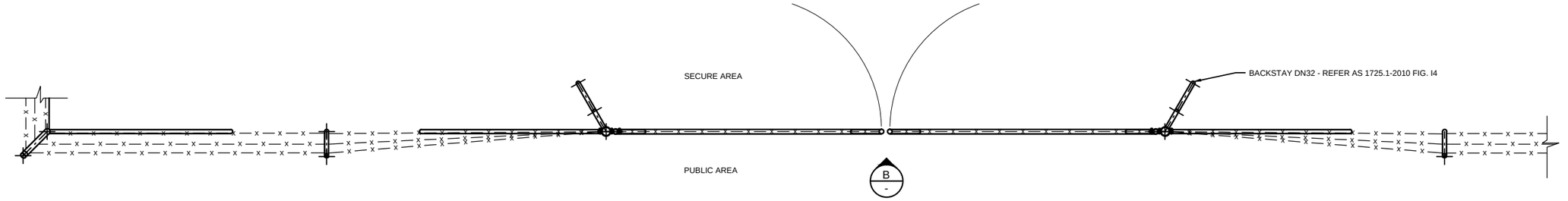
INTERMEDIATE STRAINER ASSEMBLY ELEVATION (B -)

SCALE 1:25 (A1)

NOTE:
STRAINER ASSEMBLY TO HAVE DIAGONAL STAYS SET IN CONCRETE FOOTINGS AT 100 m INTERVALS ON STRAIGHT LENGTHS. REFER FIG G1 IN AS 1725.1.

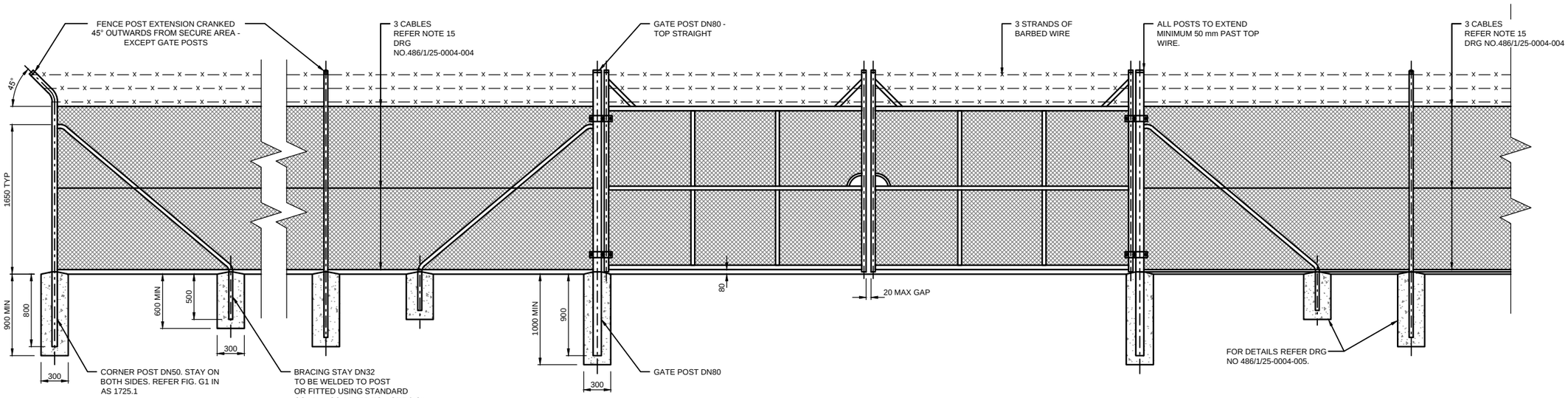
200 0 200 400 600 800 1000
SCALE OF MILLIMETRES
1 : 25 FULL SIZE A1 SHEET

					FUNDING		DRAFTED	M.MOORE/J. STERGOU	*ORIGINAL SIGNED L.HETTIARACHCHI 08939 05.09.13*	*ORIGINAL SIGNED K.VAHEESAN 06.09.13*	ASSET/PROJECT SECURITY FENCING AND SIGNAGE STANDARD DRAWINGS	DRAWING TITLE TYPICAL FENCE AND SINGLE PERSON ACCESS GATE DETAILS FOR COASTAL AREAS	SHEET No. 2 OF 6
					DESIGN W.O. No.		DRAFTING CHECK	*R.ADAMSON / M.L.*	DESIGN R.P.E.Q. No. DATE	MANAGER ENGINEERING SERVICES DATE			QUEENSLAND URBAN UTILITIES DRAWING No. / AMEND.
A	04/16	DRAWING TITLE AND NOTES AMENDED	S.G.	R.K	CONSTRUCTION W.O. No.		CAD FILE	1250004002.dwg	*ORIGINAL SIGNED F.SCHEELE 2900 05.09.13*				486/1/25-0004-002 / A
No.	DATE	AMENDMENT	DRAFTED	APPROVED	FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	Q.U.U. FILE No.	194/255/860/591/11	DESIGN CHECK R.P.E.Q. No. DATE	FIELD SERVICES DELEGATE DATE			



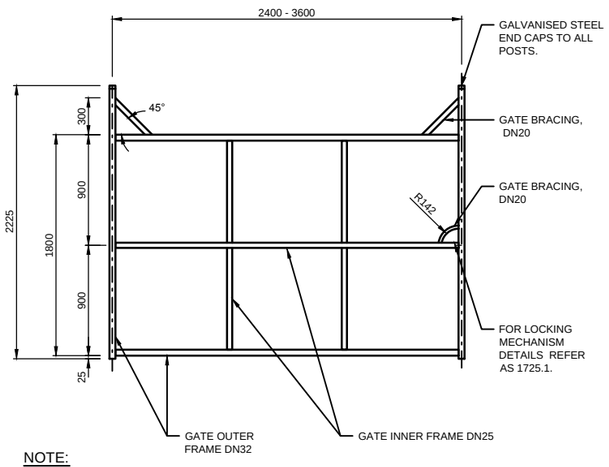
VEHICLE ACCESS GATE PLAN

SCALE 1:25 (A1)



VEHICLE ACCESS GATE ELEVATION B -

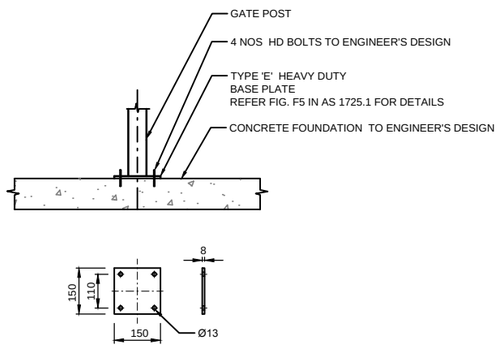
SCALE 1:25 (A1)



NOTE:
REFER TO AS1725.1 FIGURE I4 TYPE 1
6000 mm OPENING DOUBLE GATES FOR DETAILS.
ALL GATES AND BRACING STAYS SHALL BE FACTORY FABRICATED AND GALVANISED.

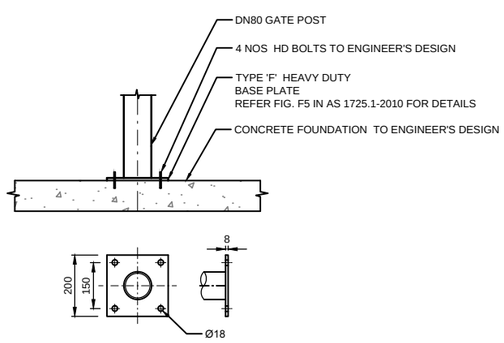
VEHICLE ACCESS GATE DETAIL 2 -

SCALE 1:25 (A1)



BASE PLATE FOR DN50 GATE POST

SCALE 1:10 (A1)



BASE PLATE FOR DN80 GATE POST

SCALE 1:10 (A1)

200 0 200 400 600 800 1000

SCALE OF MILLIMETRES
1 : 25 FULL SIZE A1 SHEET

QUEENSLAND Urban Utilities

					FUNDING		DRAFTED	M.MOORE/J. STERGOU	*ORIGINAL SIGNED L.HETTIARACHCHI 08939*	*05.09.13*	*ORIGINAL SIGNED K.VAHEESAN*	*06.09.13*	ASSET/PROJECT: SECURITY FENCING AND SIGNAGE STANDARD DRAWINGS
					DESIGN W.O. No.		DRAFTING CHECK	*R.ADAMSON /M.L.*	DESIGN R.P.E.Q. No.	DATE	MANAGER ENGINEERING SERVICES	DATE	DRAWING TITLE: VEHICLE ACCESS GATE AND CORNER POST DETAIL FOR COASTAL AREAS
A	04/16	DRAWING TITLE AND NOTES AMENDED	S.G.	R.K	CONSTRUCTION W.O. No.		CAD FILE	1250004003.dwg	*ORIGINAL SIGNED F.SCHEELE 2900*	*05.09.13*			SHEET No. 3 OF 6
No.	DATE	AMENDMENT	DRAFTED	APPROVED	FUNDED BY Q.U.U. (✓)	EXTERNAL ( )	Q.U.U. FILE No.	194/255/860/591/11	DESIGN CHECK R.P.E.Q. No.	DATE	FIELD SERVICES DELEGATE	DATE	QUEENSLAND URBAN UTILITIES DRAWING No. 486/1/25-0004-003 AMEND. A