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Pr11053 - Specification for Chlorine Dosing Systems Design and Construction

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Document Sponsor	Infrastructure Standards and Products Approval Committee
Document Owner	Head of Asset Management
Subject Matter Expert	Infrastructure Standards Engineer
References	Refer to Appendix B of this document

Version Review

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A	Y.Skinner	IS&PA Committee		First draft; distributed for review
1	Y.Skinner	I.Bierne, Head of Asset Management	11/01/2023	New Technical Specification for release
2	Y.Skinner	I.Bierne, Head of Asset Management	24/7/2023	Updated requirements for Regulator notifications and Major Hazardous Facilities
3	J.Munro Document Control Officer	N/A	N/A	Minor amend to replace obsolete reference Pr8871/Pr8874 with Pr11211
4	J.Munro Document Control Officer	N/A	N/A	28/09/2023 Minor admin amendment to align with template format
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6	J. Munro Document Control Officer	N/A	N/A	27/11/2023 Minor amend to update F10996 hyperlink.

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1. Purpose

The purpose of this specification is to define Unitywater's minimum technical requirements for the design, construction, commissioning, and handover of Chlorine Dosing system within Unitywater's drinking water network inclusive for the purposes of maintaining chlorine residual throughout the network. Chlorination Dosing Systems covered by this standard include:

- Liquid - Sodium Hypochlorite or Calcium Hypochlorite.
- Gas - Chlorine Gas.

This Specification shall be read in conjunction with relevant project drawings (where applicable), project specification and supplementary specifications.

NOTES:

The intent of this specification is to apply to new and/or upgraded sites. This specification may not apply to existing infrastructure.

This specification is for chlorine dosing systems that are generally co-located with other assets on the water supply network. Installations at other locations, such as sewage treatment plants, are not covered by this document but the document may be used as guidance.

2. Scope

This Specification shall apply to works to be constructed by contract, sub-contract or direct labour.

This Specification shall apply to works being constructed directly for Unitywater or other authority or for an owner who will hand over the ownership of the constructed works to Unitywater or who will retain ownership.

The Scope of Work shall include the design, supply, installation, testing and commissioning/handover of all chlorination Dosing Systems and associated equipment as shown in the Contract documents.

3. General Introduction to Chlorine Dosing

Unitywater is a Distributor/Retailer organisation that provides water supply and sewerage services to Moreton Bay and Sunshine Coast residential and business customers.

It was formed in July 2010 inheriting six individual former councils water supply infrastructure. The water network has four (4) supply regions, which are then broken down into 14 schemes and associated disinfection operational philosophies. These regions include:

- NPI North (Northern Grid) – Noosa; Maroochy North (South Maroochy River); Maroochy South, Caloundra Coastal; Caloundra Railway Towns, Maleny;
- NPI South (Southern Grid) – Caboolture; Bribie Island, Woodford, Redcliffe, Pine Rivers South, Pine Rivers North (Petrie);
- Dayboro – Dayboro; and
- Kenilworth – Kenilworth.

Over time different solutions have been implemented to dose chlorine to maintain chlorine residual across the water distribution network, thus ensuring a safe drinking water supply to customers.

This standard specification aims to standardise the range of Chlorine Dosing Units (CDU) and provide clear guidance for designers, manufacturers, constructors and installers on Unitywater's requirements. It is anticipated that the dosing units would be co-sited with other assets on the supply network.

This standard specification also applies to temporary and mobile installations. Temporary dosing units may only be used where approved by Unitywater. In general, the units must comply with the following:

- **Temporary/transportable/skid dosing unit** – Total effective storage is 400L and below per installation.

  This specification does not explicitly consider temporary skid units but may form the basis for the supply and performance requirements for these units.

  Chlorine gas temporary/transportable units will NOT be considered.

- **Permanent dosing unit** – Installations whereby total effective storage at the plant is greater than 400L per building.

4. Project Planning

4.1 Confirmation of Need for Chlorine Dosing

As part of the planning phase, the requirement for chlorine dosing should be determined in accordance with the Drinking Water Quality Management Plan (DWQMP). The DWQMP sets out Unitywater's drinking water quality objectives to provide customers with safe and reliable quality drinking water that consistently meets the requirements of:

- the *Public Health Regulation 2018*;
- the Australian Drinking Water Guidelines 2011;
- ISO 22000:2018 - Food safety management systems; and
- any other mutually agreed consumer requirements as detailed in Unitywater's Customer Service Standards.

Using the DWQMP, the Water Quality team will conduct any risk assessments and provide guidance on when and why chlorine dosing should be considered to maintain residual chlorine in the water network.

4.2 Chemical Selection Process

Once it has been determined that chlorine dosing is the most appropriate remedial measure to achieve the required residual chlorine for secondary disinfection at the proposed site, the following details shall be identified for a concept design or business case.

There are several issues to be considered in determining the location, type and storage requirement:

- Location considerations:
  - Current and future maximum month water demand;
  - Chlorine demand maximum and min based on different sources (e.g. Landers Shoot, Ewen Maddock, North Pine, Wivenhoe);
  - Proximity to neighbours;
  - Distance from sensitive areas, residential housing or commercial/public buildings.
- The chlorine dosing system type and configuration considerations:
  - Dosing points, mixing system, etc;
  - Is pH correction needed?
  - Standby requirements;
  - Type of chemical to be used: chlorine gas, sodium hypochlorite or calcium hypochlorite.
- Size and capacity considerations
  - Supplier's requirements (e.g., 7-day delivery or 14 days)
  - Peak day max hour (e.g. gas cylinders give a maximum output. Otherwise evaporators will be required)
  - What will be the average dose rate? Is breakpoint chlorination required, trim or top up of residual?
  - Does the dosage rate vary or is it consistent?
  - The size of chemical storage required.

The flowchat below shall be used as a guide to determine the appropriate chlorine dosing strategy:

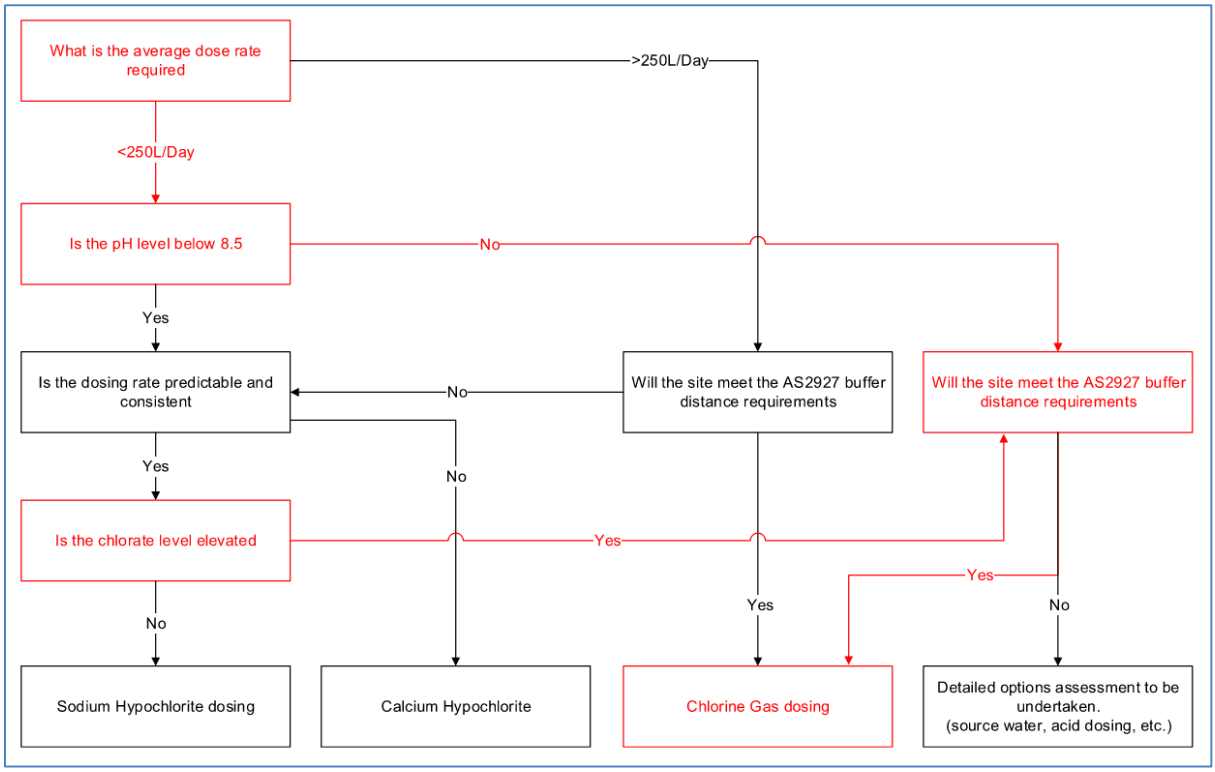


Figure 1 – Flowchart Guide to Determine Chlorine Dosing Strategy

4.3 Additional Gaseous Chemical Design Requirements

In addition to the above, when a facitlity is being considered:

- Includes gaseous chemical stored as a gas;
- Generates hazardous gas intentionally; or
- Can inadvertently generate hazardous gases.

Then the chemical system must have:

- the health and safety impacts assessed by an occupational hygienist;
- an emergency response plan; and
- emergency response equipment identified by the occupational hygienist.

4.3.1 Plume Modelling

A plume modelling study is required when designing (or modifying to) a gaseous chlorine dosing system, when the chlorine system:

- Has 200L or greater of gaseous chemical stored onsite;
- Is within 50m of a place of human occupancy;
- Intentionally generates 100L/hour or more of gas; and
- Can inadvertently generate 50L/hour or more of gas.

4.4 Proposed Location for Chemical Dosing Facility

The preferred dosing site is at an existing Unitywater reservoir site. If a dosing station is away from a reservoir, the following factors need to be considered in selecting the site:

- Flood levels, bushfire hazards, potential for vandalism;
- Power supply;
- Access requirements for delivery, maintenance, construction and emergency vehicles;
- Gas cylinders are not allowed unless approved by UW;
- Vicinity to sensitive areas, residential dwellings, commercial and public places.

4.5 Water Quality Sampling Points

The Water Quality Team will advise if there are any requirements for either:

- Pre-dosing sampling - Sampling to be undertaken to identify that the water network needs a chlorine dosing system to solve an inherent chlorine level issue in the network
- Post-dosing sampling - Sampling undertaken post the design and installation of the chlorine dosing system confirming that the water network chlorine level issue has been resolved.

4.6 Deliverables from the Planning Phase

During the planning phase of the project, the contractor shall liaise with Unitywater to be issued with the Design Parameters. The Design Parameter deliverables will form the design inputs for the project.

Table 1 – Design Parameters

Planning Parameter	Value (Supplied by Unitywater)	Value (Supplied by Designer/Contractor)
Asset ID	<< Site ID >>	
Asset Name	<< Site Name >>	
Asset Location: Address	<< Street Address >>	
Asset Location: GPS Co-ordinates / GIS?	<< GPS Co-ordinates >>	
Type of Dosing	<< Name of Chemical >>	
Concentration of Dosing Chemical	<< Concertation of Chemical >>	
Minimum Dosing Rate (ml / L of water)		ml / L
Maximum Dosing Rate (ml / L of water)		ml / L
Minimum Required Dosing Rates (L/hr)		<< ##.# L / hr >>
Maximum Required Dosing Rates (L/hr)		<< ##.# L / hr >>
Maximum Daily Chemical Usage		<< ## L / day >>
Minimum Storage Volume to achieve 14 days Storage		<< ### L >>
Location for Chlorine Monitoring	<< GPS Co-ordinates >>	
Minimum Performance Parameter	<< #.# >>	
Pressure of Available Water Supply for Process Water	<< mAHD >>	
Pressure of Available Water Supply for Eyewash	<< mAHD >>	

4.7 Spares

Prior to commissioning (see *Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets*), the Contractor shall supply to Unitywater a complete set of all foreseeable spare parts and consumables that would be expected to be required in the first 12 months of the asset's operation. The list shall include item, model, supplier and lead time. Unitywater will decide which spare shall be purchased. Unitywater may purchase critical spares from the Contractor or elsewhere.

Spare male camlock fittings shall be supplied for hypochlorite.

5. Chlorine Dosing Unit (CDU) General Requirements

5.1 Sizing and Solutions Overview

The application of chlorine dosing to maintain chlorine residual is intended for installations at water storage reservoir sites or water pump/booster station sites and is a function of reticulation network water quality.

As such, the requirements can vary significantly across network assets for small water storage reservoirs with low network demand to large water pumping stations or water storage reservoirs located within densely populated environments.

The provision for the CDU facility is highly dependent on the required dose rate and chemical storage requirements. As general guidance:

Small sites with less than 400L of Liquid Storage

Small sites with less than 400L of liquid storage requirement would utilise a prefabricated enclosure style CDU with a reduced footprint for civil requirements. These facilities may also be temporary or mobile. Chlorine gas temporary or mobile units will NOT be considered. Temporary or mobile liquid CDUs will receive supply of liquid sodium or calcium hypochlorite in plastic packages (20-25L), or drums (200L) delivered in trucks or utility vehicles. Usually the temporary or mobile units will consist of a two-tank system, a storage tank (neat sodium hypochlorite) and a dosing tank (diluted sodium hypochlorite). The prefabricated CDU should be designed to:

i. To shield the stored sodium hypochlorite from heat and UV light, thus minimising its degradation rate;

ii. To protect the equipment inside from UV degradation and excessive temperature; and

iii. To exclude rainfall from the bund, therefore eliminating the need to size the bund with additional capacity for rainwater.

Whilst it may not be feasible to apply all requirements to such installations, any deviations should be identified, risk assessed and recorded. Such deviations can be lodged via F10996 *- Deviation to Unitywater Technical Specification or Standard.*

Sites with storage greater than 400 L of total liquid storage

Sites where storage volume exceeds > 400 L of total liquid storage, the CDU is to be housed within a permanent facility (building). The permanent building shall incorporate a chemical delivery bay, see Section 5.4 Chemical Delivery Bay. Permanent buildings shall consist of at least two accessible rooms/areas;

i. a bunded dosing area, for chemical storage and dosing equipment, that can contain any chemical leaks or spills. The bund must be able to contain 110% of the maximum stored volume of chemical, as detailed in Section 5.6 Chemical Storage Tanks.

ii. a second area is for electrical controls, telemetry and document storage.

The CDU should be designed to:

i. To shield the stored sodium hypochlorite from heat and UV light, thus minimising its degradation rate;

ii. To protect the equipment inside from UV degradation and excessive temperature.

Sites with Chlorine gas

Sites where chlorine gas is applicable, the cylinders/tanks are required to be stored in a permanent facility (ventilated building). Permanent chlorine gas dosing systems, buildings shall consist of three rooms:

i. A chlorine storage room;

ii. A chlorine dosing room; and

iii. A switchroom.

Separate external access shall be provided into each room, with no internal access provided internally between rooms.

5.2 Safety Equipment

The following safety equipment must be provided:

- Eyewash and safety shower shall be provided and installed in accordance with AS 4775 Emergency Eyewash and Shower Equipment., At a minimum a safety shower and eyewash shall be located within 2 to 7m of the chemical unloading connection point and an additional eyewash station must be located within the CDU dosing room near the exit. Safety shower and eyewash facilities must be tested and tagged in accordance with AS 4775.
- Long water lines to the safety shower and eye wash station (above ground and external to CDU building) that are exposed to sunlight must be lagged, as water may be heated up by the sun and therefore unsuitable for use. Lagging is to consist of mineral wool insulation with aluminium sheet covering to protect from water ingress and damage.
- If adequate supply pressure for the safety shower and eyewash is not available, a booster pump must be installed. The contractor must determine the capacity of the booster pump including pipeline, RPZ and valve losses.
- A UV resistant hose reel permanently attached to a water tap and capable of reaching all parts of the CDU, including the unloading area. The hose reel is to be fitted with a 20mm female camlock fitting making it suitable for use as a flushing mechanism.
- Sufficient lighting to enable safe work beyond daylight conditions, particularly for the chemical delivery activities.

5.2.1 Fire Protection

A fire protection system shall be provided where required by any building regulations, statutory requirement, or AS 2927.

Any smoke detectors or other equipment installed shall be suitable for exposure to chlorine gas and shall be installed hard-wired in all rooms of the building. The detectors shall be fitted with rechargeable batteries. The alarm output shall be hard wired to the telemetry.

5.2.2 Regulator Notifications

The Work Health and Safety (WHS) Regulation 2011, imposes requirements on a person conducting a business or undertaking (PCBU) at a workplace, which uses, handles, stores or generates hazardous chemicals to placard the workplace, prepare a manifest and notify the regulator where specified quantities of certain hazardous chemicals exceed threshold amounts. The threshold amounts and types of hazardous chemicals are prescribed in Schedule 11 of the WHS Regulations.

Designers should liaise with Unitywater to ensure that the requirements are met.

Manifest Quantity Workplaces

Workplaces that use, handle, store or generate hazardous chemicals above the manifest quantities specified in schedule 11 of the WHS *Regulation 2011* are required to notify the regulator in writing.

Notification is required:

- immediately after it is known that schedule 11 hazardous chemicals are to be used, handled or stored at the workplace or at least 14 days beforehand;
- immediately after it is known that there will be a change in the risk of using, handling or storing schedule 11 hazardous chemicals or at least 14 days beforehand;
- as soon as practicable after schedule 11 hazardous chemicals are no longer used, handled or stored at the workplace.

Workplaces that are required to notify as a Manifest Quantity Workplace under the *WHS Regulation 2011* must provide information under section 348 including:

- a description of the hazardous chemical related activities;
- a copy of the manifest, which must be compliant with schedule 12.

This additional information can be provided using *Form 73 – Notifications of a manifest quantity workplace* to assist workplaces in making this notification to WHSQ.

Additionally, all Manifest Quantity Workplaces must submit a copy of their emergency plan which addresses incidents involving hazardous chemicals, (e.g. leaks, spills, fires and explosions) to the Queensland Fire and Emergency Services via a central email address of QFESEMPlanning@qfes.qld.gov.au.

In general, the manifest quantity for Sodium Hypochlorite (Liquid chlorine) is 2500L (Skin Corrosion Category 1B).

For liquified chlorine gas, the quantity is to be calculated by the total water capacity in litres of the tank. Typically, the manifest quantity for gaseous chlorine is 500L.

Hazmat Box

The manifest must be kept in a place that is in agreement with the Queensland Fire and Emergency Service (QFES). QFES recommend that the manifest be kept in a red waterproof container kept as close as possible to the main entrance.

A suitable sized Hazmat Box is 400mm x 300mm x 90mm deep. The box should be signal red in colour preferably with 100mm white letters stating 'HAZMAT'. It should be mounted securely, for example, on a steel post and concreted in position. For security, a 003 series lock should be installed on the box to enable the emergency services to open the lock as desired.

Placard Quantity Workplaces

Workplaces that use, handle, store or generate hazardous chemicals above the placard quantities specified in schedule 11 of the *WHS Regulation 2011* must ensure that a placard is prominently displayed compliance with schedule 13.An outer warning placard complying with schedule 13 is also required at each entrance to the workplace where emergency services may enter.

In general, the placard quantity for Sodium Hypochlorite is 250L. For gaseous chlorine, the placard quantity is typically 50L.

5.2.3 Major Hazard Facility

The operator of a proposed facility at which chemicals in Schedule 15 of *WHS Regulation 2011* are likely to be present in a quantity that exceeds 10 per cent of their threshold quantity must notify the regulator of this circumstance. A notification of a proposed facility must include the information required by *WHS Regulation 2011 s538* with any necessary changes.

A facility that anticipates having chemicals in excess of the threshold quantity should notify in sufficient time to comply with the Regulations. For example, if the facility is at the early design stage, plans for the facility may not be accurately known. The initial notification information may simply comprise design options under consideration, indications of the number of workers and estimates of the quantities of Schedule 15 chemicals likely to be present. Dates that should be included are the:

- earliest date for introduction of Schedule 15 chemicals;
- earliest date for beneficial production;
- earliest date that the facility may exceed the MHF threshold quantities.

Early notification facilitates the safety case and licensing processes.

Note that all Major Hazard Facility (MHS) threshold quantities are in tonnes (t) and classifications are as per the *Australian Dangerous Goods* (ADG) Code, not the *Globally Harmonised System of Classification and Labelling of Chemicals* (GHS).

Chorine (UN no. 1017) is a Schedule 15 chemical. The threshold quantity is 25tonnes, therefore, 10 per cent is 2.5 tonnes.

5.2.4 Wind Direction Indicator

For gaseous chlorine systems, a wind direction indicator(s), in the form of a yellow windsock/weathervane, shall be provided in a clearly visible location. A stainless-steel weathervane can be used in high wind areas. The position of the indicator shall be selected to provide an indication of wind direction and wind strength from all normal directions of approach.

5.3 Civil Requirements

5.3.1 Site Layout

The following considerations shall be made when determining an appropriate location for the CDU facility within the site:

- Site access, chemical delivery, safety.
- Proximity to dosing points, power and communications.
- Visual amenity.
- Spatial constraints based on CDU facility.
- Delivery bunding and site drainage.
- Security.
- Impact on existing services.
- Not in direct sunlight.
- Truck turning.

Truck dimensions and standard delivery volume shall be according to chemical supplier. Contractor is to source chemical supplier's standard delivery volumes to design for footprint.

5.3.2 Location

In general, the CDU facility shall be positioned to accommodate appropriate access for chemical deliveries and maintenance of the CDU and associated pumping station facilities. The unloading point shall be located adjacent to the CDU facility where practicable. The unloading connection point (camlock) will be located within the CDU facility, as such the delivery vehicles (tankers) shall be within 6m of the CDU connection point in accordance with *NOHSC:2017(2001) - National Code of Practice for the Storage and Handing of Workplace Dangerous Goods.*

Designers must consider separation distances between the CDU facility and the property boundary.

5.3.3 Facility and Equipment Identification and Numbering

The facility and equipment for the CDU shall be in accordance with the following Unitywater technical standard *Pr8843 - Specification For Drawing, Document and Equipment Tag Numbering*.

5.3.4 Flooding

Where applicable, sites shall be designed to have a minimum flood immunity to Q100 events particularly for electrical assets. However, some existing sites may exist where flood immunity is achieved by position infrastructure above ground level on raised level platforms. It may not be practical for dosing facilities and civil works to fully conform to this criterion. Chemical storage tanks must be suitably restrained to avoid floating or movement and shall have their openings, vents and overflow pipework above Q100 levels. Electrical assets must have immunity of Q100 +300mm.

5.3.5 Access

Site access and layout shall accommodate the needs of chemical deliveries vehicles, notionally ten (10) tonne rigid tankers as well as emergency vehicles. The access provisions shall permit the delivery vehicle to either drive through or reverse manoeuvre to the chemical unloading point. The design shall fully consider turning movements in accordance with the relevant standards. Preference is for the delivery vehicle to manoeuvre forward in, forward out of the site.

5.3.6 Carrier Water System

Carrier water is used to transport chemical to the point of injection. The carrier water system must minimise the use of potable water.

Where the chemical dosing system includes carrier water, the carrier water system must include:

- non-return valve;
- RPZD valve when supply is taken from potable water;
- isolation valves;
- flow switch;
- rotameter;
- pressure regulating valve;
- pressure transmitters;
- low flow switch;
- actuated stop valve: solenoid valve for pipe less than 50mm diameter; motorized valve for pipe greater or equal to 50mm. Actuated valves must be fail-safe (Fail-Open);
- pressure regulating valve: to control downstream carrier water pressure.

5.3.7 Flushing Water System

Flushing water valves and connections shall be provided to flush sodium hypochlorite from the storage and dosing system pipework prior to equipment removal or maintenance. The flushing connections shall be located strategically so that all of the sodium hypochlorite lines, right back to the tank, can be flushed.

Drainage points should be provided at various locations on the dosing pipeline for draining of the flushing water when required. However, when flushing the sodium hypochlorite system, the flush water should preferably be directed to the sump point as this is the safest and easiest disposal route. During the initial flushing period the dosing operation of the standby system should be suspended to ensure over-dosing does not occur.

5.4 Chemical Delivery Bay

5.4.1 Containment Methodology

The CDU will include a complete containment methodology for the chemical from the delivery bay to and including the storage tank(s) to the dosing location(s), inclusive of the dosing point(s). The containment must direct any leakage or spillage to a safe location where it may be managed appropriately. The methodology is to include appropriate locations for visual identification of leaks and leak detection at any low points.

Bunding must be provided for the delivery bay and storage tanks to contain any chemical spillages or leakages.

5.4.2 General requirements

Sodium Hypochlorite (Liquid):

Sodium Hypochlorite is supplied and delivered to site in tankers and is unloaded using a pump, or gravity fed from the vehicle to the onsite storage tank/s via camlock hoses. Sodium Hypochlorite is considered a dangerous and corrosive substance which can cause significant damage to the environment if it is not contained.

For liquid systems, a chemical delivery bay located adjacent to the CDU area shall provide containment for any spill or leak and provide safe arrival, parking, offloading, and departure of bulk chemical tankers. Relevant aspects of AS 3780 must be complied with where corrosive materials are used.

Where possible, modifications to the site access should be considered to provide nominal means of containment of the applicable chemical that could result during receipt of deliveries. The designer shall comprehensively consider the site conditions, including access drainage/ grading, valving, receiving environments when making recommendations. At a minimum consideration of a rollover bund and provisions of kerbing around the perimeter of the access pavements, to provide containment of any spills or leaks. The bund shall be designed as a water retaining structure in accordance with AS 3735 and AS 3780. The bunded delivery area shall be designed so it is graded towards a sump pit 600x600x600mm to facilitate the ability to direct spills into an additional storage bund to be appropriately disposed of.

Normally the spill is contained until it is tested for suitable discharge to the stormwater system. If it is not suitable then it needs to be tankered to a suitable discharge point or treatment facility. The bund volume needs to be equal to 110% of the tanker or storage tank volume so the entire spill can be contained in the bund. It is then discharged to stormwater once it is proven to be suitable for discharge

To facilitate appropriate spill containment, both the sump control valve and drainage valve shall be accessible and visible, with visible position indication to the chemical delivery operator.

Any roadway humps at either end of the tanker delivery bay shall be compatible with delivery trucks. The bunded delivery bay and CDU must ensure any stormwater from the surrounding roadway and ground must be channelled away and not flow into the delivery area bund. Any expansion joints in the concrete between the building and bunded delivery area must be mastic filled to prevent chemical seepage in between joints.

Sump pit shall be provided with a class D grated cover constructed from FRP or Aluminium and rated suitably to trafficable loads. Valves located in pit shall not be in a trafficable location but fully accessible off driveway.

Gating mass should be less the 15kgs for manual handling purpose or have alternative means to lifting and removal.

Camlock Filling Point

Where applicable, the connection point for large liquid chemical deliveries to the facility shall be via a DN50 standpipe with a male DN50 camlock connection located within the dosing facility bund area, hydraulically connects with a hydraulic connection to the common manifold pipework between the tanks and the dosing pump. A standpipe shall be provided with inline isolation. Refer to camlock requirements on the IPAM list, which states material shall be stainless steel 316 and maximum DN100.

Chlorine Gas:

Chlorine Gas is supplied and delivered to site in gas drums/cylinders and are unloaded via a mechanical lifting device (gantry crane/jacks/trollies). The new chlorine gas drums/cylinders replace the empty chlorine gas drums/cylinders. The new chlorine gas drums/cylinders must be connected to the "Chlorshield Leak Detection" system (or approved equivalent).

The onsite containments provisions are mandatory unless specifically assessed as not being required on a site-specific basis through the Safety in Design, and HAZOP process in Pr8187 – Safety in Design.

5.5 CDU Building

When a CDU building is applicable; the CDU building facility is to be housed in a masonry block structure designed in accordance with AS3700 Masonry Structures and Building Code of Australia requirements and the following Unitywater Standard *Pr9903* - *Specification for Building and Structural Works*. Other structures styles may be used when approved by Unitywater at the design stage.

Size and arrangement of the building could vary depending on the dosing requirements of the site and the required minimum storage volumes of 14 days. It is envisaged that the requirements of the facility can be adapted to suit, with common dimensions.

Access shall be in accordance with AS/NZS 2927. This shall allow for pedestrian movements with self-contained breathing apparatus equipment.

The roof structure shall be a mono-slope construction, with a minimum 3-degree pitch from draining from front to rear of the building. The roof drain shall be pipes. No gutter to be provided. A 300mm wide (minimum) concrete apron under the rear overhang to prevent erosion. A concrete mowing strip, minimum 300mm wide shall be provided to the rest of the perimeter of the building. The apron shall drain to nearest stormwater system or a minimum of 3m from the building. Minimum 600mm overhanging eaves shall be provided over sides with access openings, standard eaves on all other sides.

The structural shall have metal roofing with a fully watertight and birdproof roofing system of the type shown and specified, complete with all necessary accessories, and trim including capping, and flashings. The roof framing, purlins, battens, etc shall be concealed from view internally with a false plasterboard finish ceiling, with provisions for ventilation, ceiling insulation and light fittings.

The building structure shall have sufficient space provisions for the required CDU equipment and provisions, including the removal of the chemical storage units, delivery connection; associated pipework, dosing pumps and fittings to be contained within a self-draining bund structure, set below the access level. The walls of the bunding structure wall consist of watertight solid concrete construction conforming and is considered liquid retaining and shall be confirming to AS3735 – Concrete Structures and Retaining Liquids.

The layout of the of Chlorine Dosing storage tanking, pumps, pipework, valve facilities should consider access and ergonomics in kind.

The facility shall have provisions for a potable water supply (via RPZ), washbasin and eye washing facilities. Washdown facilities shall be provided for cleaning and flushing of the delivery pipework.

If applicable to the site, grey water plumbing and sump drainage shall be directed into common plumbing to the sewerage network.

All other generic design considerations of the building and facilities shall follow the requirements of *Pr9903* - *Specification for Building and Structural Works* and shall may include but are not limited to the following:

- Materials of construction;
- Waterproofing;
- Lighting and Power;
- Security;
- Concrete works;
- Structural Steelwork.

5.5.1 Ventilation and Air Conditioning Requirements

For liquid chlorine systems

Adequate ventilation must be provided to prevent condensation build-up inside the building. This can be achieved using vents or extraction fans.

Natural ventilation of the structure is to be achieved via drawing cool air in through side entry vents (insect/vermin proof) and egress through the roof structure via ventilator/s. A single large ventilation portal shall be provided in the end wall of the structure, fitted with fixed louvers, and vermin proof meshing accessible from the inside for cleaning.

All ventilation, door framing, and louvres systems shall be constructed from 6063 T5 heavy duty extruded framing conforming to AS 1866.

Designers shall determine in consultation with Unitywater whether an air conditioning system is required to prevent degradation of sodium hypochlorite. An air conditioning system may also be required for the electrical control room as determined in *Pr9380* - *Specification for Electrical Installations at Network Sites*.

For gaseous chlorine systems

For gasous chlorine systems the selection of the type of ventilation system to be installed shall take into account the level of risk to indivudals (both within and external to the building and site) in the event of a chlorine gas leak. The venitlation systems for the chlorine dosing room and the chlorine storage room shall comply with AS/NZS 2927 - The storage and handling of liquefied chlorine gas. Adequate ventilation can be provided using natural or mechanical ventilation.

Due to the ventilation requirements of AS2927, air conditioners are not required in the chlorine storage room. An air conditioning system may be required for the electrical control room as determined in *Pr9380* - *Specification for Electrical Installations at Network Sites*.

Mechanical ventilation shall be activated and operated under normal conditions whenever the dosing room and/or the storage room are occupied

5.6 Chemical Storage Tanks

5.6.1 Sodium Hypochlorite:

Chemical storage tanks must be provided for safe storage of sodium hypochlorite. The preferred arrangement of the tanks is furthest away from the electrical room and the entry door(s). The tanks must be provided within the bunded area inside the CDU building.

The chemical storage tank design must consider:

- Chemical delivery volumes;
- Shelf life;
- Frequency of tank maintenance and cleaning;
- Prevention/mitigation of chlorate formation.

Storage of sodium hypochlorite is important in the management of chlorate formation. Chlorate is a disinfection by product (DBP), and although there is no health limit under the ADWG, QLD health have recently advised a limit of >0.8mg/L sustained consistently over a period of 12 weeks in drinking water is now required to be reported to the drinking water regulator.

Sodium hypochlorite degrades over time and forms chlorate, which is also a corrosive solution. This is caused by storage temperature, sunlight and contaminants in the tank such as heavy metals and suspended solids.

To mitigate chlorate formation two storage tanks may be required depending on tank size and siting requirements, to allow for regular complete tank cleaning whilst maintaining chlorine dosing. Thus, the storage tanks must be designed and constructed to provide maximum drainage of the tank and its connections while still maintaining the structural integrity of the tank walls and base. Designers may also consider other mitigation methods such as ensuring tank sizing thus giving adequate turnover and temperature control.

Equipment such as access hatches and level sensors must be easily reached for ease of operation and maintenance.

Tank overflows connections shall be designed to prevent siphoning of the tank contents and shall discharge into the bund without excess splashing. Tank vents shall be located so that any discharges do not present a hazard to other equipment or operators.

There are 3 references to tank capacity as follows:

1. Nominal Capacity – This is the tanks capacity as stated by the manufacturer. It is the tanks nominal capacity without fittings.
2. Effective capacity – This is the capacity of the tank to contain product. It is the tanks volume as determined from the floor of the tank to the invert of the tank overflow.
3. Working capacity – This is the tank capacity to deliver product. It is determined from the obvert of the discharge to the invert of the overflow.

The storage volume shall be calculated from the working capacity. The 100% tank capacity is defined as the volume from empty up to the invert of the tank overflow nozzle.

Regular monitoring of chlorate is conducted at dosing locations and downstream is undertaken under the DWQMP Verification Monitoring Program.

Sodium hypochlorite tank material

Storage tanks shall be manufactured from high-density PE spirally wound FRP or other suitable material suitable for Sodium Hypochlorite. The tanks shall be resistant to chemical attack and designed and constructed in accordance with the relevant requirement of AS 3780. They also shall be designed and constructed in accordance with:

- AS4766 when made from PE;
- EN 13121 when made from FRP.

A minimum of 1.5 times the specific gravity of the fluid to be stored in the tank shall be assumed for calculation of the wall thickness requirement.

To avoid external corrosion, all welded brackets such as hold-down lugs, pipe supports and lifting lugs shall be designed to allow water/chemical to drain away without pooling.

The tank/s supplied shall be fitted out with the required branches, fittings, labelling and identification number. The labelling requirements shall include, but is not limited to the material of construction, the name of the manufacturer and the date of manufacture.

The tank must be suitably reinforced and supported to withstand all forces, including filling forces, without deforming when it is full. If required, the tank must be fabricated such that the top of the tank is capable of supporting the weight of maintenance personnel.

For an FRP tank, it must be anchored and mounted on a suitable concrete plinth.

Suitable lifting lugs must be fitted to access hatches.

For a covered tank with a sidewall height of not greater than 2 m, a minimum of one 600mm diameter access hatch shall be provided in the top of the tank. Where the tank is small <5kL and a 600mm diameter access hatch is not feasible, a 450mm diameter access hatch shall be provided.

The hatch shall be made from lightweight materials, weighing no more than 15 kg, in accordance with AS 3996, Class A. Weight limits shall be labelled where appropriate.

Tank must have a minimum of the pipework features as shown in Table 7 below.

Table 2 – Sodium Hypochlorite Pipework

Pipework	Details
Fill Point	One 50mm diameter flanged tank fill point inlet on the top side inlet from tanker unloading point, complete with a fill valve. A 50 mm suitable male camlock style fitting, with cover, must be supplied and installed at the tanker filling point. This pipe must rise vertically and then slope downwards towards the tank (1 in 100 fall). It must enter the top of the chemical storage tank and be located above the level of the overflow pipe.
Drain Branch or Process Outlet	One flanged drain branch/process outlet with minimum diameter of 50 mm on the side of the tank located in a low position, as close to the tank floor level as practicable.
Overflow	One 80 mm diameter flanged overflow branch. The overflow line diameter should be at least 1.5 times the diameter of the filling line. The overflow line must be located such that it prevents immersion of instruments and equipment located in the tank roof and directs chemical safely away from operators and to the bund sump. The overflow must terminate in a water trap.
Vent / Breather	One 50 mm diameter flanged vent (breather) on the apex of the tank roof must be supplied. The vent must run from the top of the tank grading up to an external vent with a conical top sealed with vermin proof mesh.

Pipework	Details
Scour	One flanged scour outlet on the bottom of the tank. It must be located 100 mm above the tank floor. It must be fitted with a manual isolation valve and a motorised isolation valve which must have a battery backup sufficient to drive the valve close in a power failure.
Valves	Isolation (stop) valves on each of the inlet and outlet connections.

All branches on the tank must finish with 150 mm or more from the tank wall or roof with ANSI flanges with stainless steel backing rings. All stub flanges to be gusseted.

Adequate fixings at the base of each tank shall be provided for stability.

5.6.2 Level Indicators

An ultrasonic level indicator to show the level/quantity of the contents inside the tank shall be provided above the overflow line. The transmitter shall be connected to the control and telemetry system to allow remote monitoring. 0% level shall be at the obvert of the tank outlet and 100% must be at invert of the tank overflow.

In addition to the ultrasonic transducer, a hydrostatic level sensor shall also be provided for High, High-High and Low conditions.

A level indicator shall be adjacent to the tank wall, in order to indicate actual liquid level inside the tank during filling and shall be visible from the filling/transfer point.

A weatherproof digital display shall also be installed at the filling transfer point, to indicate the actual level during filling. An alarm system, consisting of a klaxon and beacon shall also be installed at the filling transfer point, to alarm if tank has overflowed during filling.

In addition, the overflow pipe shall be piped to the sump in such a way, that the tanker driver can view the discharge point from outside of the bund, to indicate if the tank is overflowing.

5.6.3 Chemical Storage Bund

Containment of the chemical storage will vary depending on the size of the building and required storage volume or the respective chemical. The size and number of chemical storage tanks is to be determined with the projects needs specification.

However, generally the standard arrangement shall utilise a common footprint within a concrete bund, with a minimum separation between tanks of 1m to permit access for maintenance to pipework, valves, and pumps.

The bund shall be designed to AS3735 Concrete Structures for Retaining Liquids and shall also comply with AS1657 Fixed Platforms, walkways, stairways and Ladders – Design, Construction and Installation.

The bunding concrete surfaces shall be protected with a NOV coating system, which shall assist cleaning and wash-down.

The bunded area shall have a 1 in 100 grade towards the sump such that there is no pooling of liquid on the bund floor.

The storage bund shall have 600x600x600mm sump with a minimum DN100 valved drainage line to the nearby external bund sump pit. The position of the valve must be visible and obvious to the operators when left open. It must be able to be operated from external to the bunded area. The discharge line maybe combined with chemical delivery bay discharge line. A class B FRP grating is to be provided for the sump.

Bunded area to have high level alarm to alert the control room that the bund level is above and beyond normal levels (i.e. large spill, flooding, or sump pump not operational).

All pipework in the bund shall be installed to minimise trip hazards. All pipework, except the drainage/sump pipework shall enter over the wall of the bund.

Electrical equipment

All electrical equipment should be installed above the full chemical bund level and capable of working when the bund is full.

5.7 Gaseous Chemical Design Requirements

5.7.1 Storage of Containers

Adequate space shall be provided in the gas storage room for storage and handling of spare containers.

The minimum storage space provided shall be that required for the number of containers that are on duty plus the number on standby, or 2 containers (whichever is greater).

The number of spare containers to be stored on site will depend on delivery quantity and frequency and will be determined by Unitywater in liaison with the chlorine supplier. Storage space will need to be allocated accordingly.

Some facilities may be limited by the quantity of containers that can be stored on site to prevent classifying as a Major Hazardous Facility. Under Queensland WHS Regulation (Section 356) any facility with chemicals above the 10% threshold limit must be assessed as to whether they should be licensed as a major hazard facility. The 10% threshold limit for Chlorine is 2.5 tonne (SOURCE: www.worksafe.qld.gov.au).

5.7.2 Handling of Containers

Minimising the manual handling requirement of cylinders shall be considered when designing a building and the site layout.

For drum installations, either appropriately rated monorail hoists or cranes or an appropriately designed trolley system shall be provided, with appropriate lifting beams.

Adequate clearance shall be provided around equipment and in the storage room for the safe and efficient handling of containers.

Each cylinder that is connected to the chlorine manifold shall have an emergency shutoff device (Chlorshield or approved equivalent) mounted on it so that supply from the container can be terminated in the event of a leak being detected

An electronic scale comprising a load cell and a digital readout in kilograms shall be provided for each container or drum that is on duty or standby. Scales shall be constructed of durable material designed to withstand the environment. Digital readouts shall be wall mounted adjacent to each container and a sign shall nominate which container it is associated with. Weigh scale indications shall be mapped through to SCADA. Note that weight measurement is only used for monitoring purposes and is not used as part of the cylinder changeover system.

6. Mechanical Requirements

The design and construction of the mechanical works shall be in accordance with the requirements in *Pr9693 - Specification for Mechanical Installations* unless otherwise specified in this document.

The required dosing system shall be designed to provide a reliable, continuous dosing of metered volumes of chemical. All valves, fittings and pipework necessary for the proper operation of the dosing system shall be provided. The piping shall be suitable for the chemical conveyed.

6.1 Gaseous Chemical Design Requirements

6.1.1 Chlorinators

Chlorinators shall be constructed of materials suitable for continuous contact with chlorine.

The chlorine feed shall be designed to shut off automatically if a line fracture (downstream of the chlorinator) or a breakage of the rotameter glass occurs.

If an excessive vacuum develops, the system shall be designed to allow air only to be drawn in.

6.1.2 Chlorine Gas Containers

All equipment and materials shall be compatible with the concentrations of chlorine being dosed and shall comply with the requirements of AS2927.

Individual restraints shall be provided within the building for all containers.

6.1.3 Manifolding of containers

The system shall be provided with automatic changeover of containers. Changeover shall take place when the duty container(s) reach the minimum residual chlorine gas pressure, as detected by the vacuum regulator.

The number of containers online at any time shall be minimised and take into account anticipated system demand (and varying water quality and chlorine demand), site conditions and manufacturers maximum draw rate recommendations.

Manifolding (or parallel operation) of containers shall:

- Be avoided, if possible;
- Be in accordance with AS/NZS 2927.

Manifolding shall be achieved using one of the methods shown in Table 8.

Table 3 – Types of Chlorine Gas Manifolding

Vacuum manifolding	Pressure manifolding
Default method of providing manifolding of chlorine containers	Only to be implemented (under the following conditions: • This system is considered to be safe; • In stations where operational characteristics of vacuum manifolding (e.g. possible uneven draw rates between cylinders, etc.) will cause unacceptable operational limitations; • 70 kg cylinders are used for chlorine storage in the installation.
One vacuum regulator for each cylinder installed directly onto each container	One vacuum regulator shall be installed and connected to the manifold connected to cylinders i.e. there will one vacuum regulator for each manifold.

Any pressure manifold installation shall be designed and installed in accordance with the following:

- Connection pipes between the cylinders shall be as short as possible to minimise the likelihood of damage and gas leaks;
- The chlorine emergency shutdown system shutdown valve shall be provided on each cylinder and shall be connected immediately at the outlet of the chlorine cylinder;
- Be manufactured from materials suitable for chlorine.

6.1.4 Vacuum Regulators

Vacuum regulators shall incorporate suitably sized drip legs and filter/heater assemblies as required (not all cylinder systems require a drip leg but should be incorporated in drum systems).

Pipework elevations shall be such to avoid pooling and be sloped such that liquid gravitates to the drip leg.

Adjustable draw-off control shall be provided.

Vacuum regulators shall be installed directly onto each container i.e. there will be a vacuum regulator for each container.

6.2 Chemical Injection Point

The chemical injection point must be designed to achieve even dispersion and mixing of the injected chemical. Chemical injection points that can syphon must be installed with a pressure sustaining valve as close as possible, but no more than 2m, from the injection point.

Chemical injection into a pipe must be:

- accessible for operation and maintenance;
- a retractable chemical injection quill;
- located within a pit or enclosure, when above ground.

Chemical injection into a tanks or channel must be:

- nominally 300mm from the wall. To avoid direct contact with the wall.

Chemical injection to atmosphere above a water body must be:

- nominally 300mm from the wall. To avoid direct contact with the wall;
- visible for witnessing;
- guarded for both physical contact and environmental conditions (e.g. wind);
- accessible for maintenance and removal.

The use of shields to prevent splashing to nearby walls (where a corrosive chemical is used).

Retractable Chemical Injection Quill

Retractable chemical injection quills must pass through the injection point isolation valve. The injection quill must include:

- a restraint that:
  - keeps the quill in place, holding back against the process pressure;
  - allows insertion and retraction of the quill to a point where it is clear of the isolation valve and sealed off by a compression gland;
- flexible hose that is:
  - pressure rated;

  - chemically compatible;
  - long enough to allow removal of the injection quill through the isolation valve;
- have valves on the injection point and the injection pipe to facilitate disconnection;
- release of the chemical 25-50% of the receiving pipe diameter from the pipe wall.

6.3 Valve Selection

Valve selection shall be in accordance with AS/NZS 2927. Valves for liquid chlorine use shall be of Class 18 PVC or equivalent suitable material of similar mechanical, thermal and corrosion resistant properties. Valves used in the gaseous chlorine systems shall be in accordance with AS2927.

Isolation valves (manual) for dosing applications shall be full bore, ball valves preferably uPVC construction (George Fisher or equivalent) with socket or union ends. Valves shall show the direction of flow. Other preferred valves are listed on SEQ Code IPAM lists.

All valve material shall be suitable for the application. The check valve spring shall be made of hastelloy C alloy. The actuated valves if any shall be electrically actuated.

Water lines coming from Unitywater supply mains must be provided with Reduced Pressure Zone (RPZ) valves for backflow (contamination) prevention, refer to approved variants for SEQCode IPAM list.

The pressure rating of the valves shall be PN16 or higher as required for the application. Valves shall be supplied with union or socket connectors for connection of pipe.

6.4 Pump Selection

Pumps shall be selected by the designer for specific requirements. Preferred pumps are listed on AKAPIS-E-RG-002 F10678 Accepted Electrical Equipment List and SEQ Code IPAM lists.

A n+1arrangment configuration with identical duty and standby dosing pumps (brand, type and capacity range) shall be provided for dosing. The switchover to the standby pump shall be automatic via SCADA. Automatic changeover between pump duties shall be configured on time as well as pump fault.

Pumps shall be fitted with a cooling fan to enable operation at low speed. The fan is to be integrated into the pumps and not separately monitored or controlled.

Suction and discharge fitting and diameters shall be nominally suit 20mm thick-walled hose. Fittings shall be designed for easy access and removal for cleaning and maintenance. The designer shall include pulsation dampeners if required.

Adequate provision must be made for draining of lines for maintenance. This typically involves at least one drain valve on each of the suction and discharge sides of the pump. These valves must be fitted with a camlock style fitting. The valving must be provided to allow for flushing of the chlorine dosing lines without dismantling the lines.

6.4.1 Potable water booster pump

At locations where the water pressure is insufficient to meet the service water requirements for the CDU (wash-down hose, safety shower and eyewash), a potable water booster pump must be installed.

One duty pump of suitable type and capacity range must provide the required flow and pressure requirements.

6.4.2 Pump Flushing Requirements

Adequate provision shall be made for draining of lines for maintenance. This typically involves at least one drain valve on each of the suction and discharge sides of the pump. These valves shall be piped to the sump. The valving shall be provided to allow for flushing of the chlorine dosing lines without dismantling the lines.

6.5 Pipework and Fittings

Pipework jointing and installation to be carried out in accordance with manufacturers requirements.

Pipe selection and fittings shall consider the potential risk for blockages. Pipes and fittings shall be assembled to allow an easy cleaning process to the pipework internals and simple disassemble if requited. Internal/ external dosing lines from pump to wet-well should be flexible 20mm NBR thick-walled rubber hose. Connection and termination of flexible lines shall use polyethylene DN20 camlock fittings (type C&E) with heavy duty SS316 clamps OR SS316 equivalents.

Rigid pipework for use of manifolds between tanks, pumps, and filling points shall be minimum DN50-80 uPVC ANSI Schedule 80 or Polyethylene PE as stated in AS4130. Pipework arrangements shall be designed to be compact as possible, utilise flange sections (breakpoints), rodding points, long radius bends, and Y-branches for converging and diverging flow paths. Short radius bends shall not be used. Drain/ flushing points shall be integrated into manifold arrangements, for manual flushing.

Rigid pipework within the CDU shall be where possible routed above ground, and supported on appropriately spaced SS316 brackets, utilising threaded SS316 rods chemically set into the underlying slab. All pipework supports must be suitable for contact with the chemical being dosed. Water lines for safety shower/ eyewash basin and washdown facilities shall be PE100, SDR11 (PN16) fittings to be PN16 metric compression fittings approved variants for UW SEQ Code IPAM list. Camlock fittings shall be Stainless Steel 316 or polyethylene construction.

All pipework shall be labelled and coloured in accordance with *Pr9693 - Specification for Mechanical Installations.*

Chlorine Gas Pipework

Chlorine gas pipeline used to transfer chlorine gas under vacuum shall be constructed from nylon tubing or Class 18 PVC or suitable equivalent material with similar mechanical, thermal and corrosion resistant properties, in accordance with AS/NZS 2927.

Chlorine container flexible connections

Piping or hoses used to connect chlorine containers to the installation, shall be kept as short as possible, however sufficient length shall be provided to ensure the safe and practical connection and disconnection of the container.

6.5.1 Pressure transducer indicator

Where dosing is going into a pressure main, a pressure transmitter must be installed and interlocked to stop the dosing at high pressure.

7. Water Quality Sampling

If required in the project scope of work, the type of analyser used shall take into account any fluctuations in pH and temperature including other relevant water quality parameters (i.e., hardness, salinity) that apply at the site. Free and total chlorine shall be measured continuously by devices that do not require the use of chemical buffer solutions. Devices that do require the use of chemical buffer solutions are not preferred and shall not be installed unless requested by Unitywater. This will allow the analyser water to be collected and potentially re-injected into the water supply system, upstream of the dosing point. Where water is re-injected to supply, components of the analyser in contact with the water shall be approved for use in potable water systems and comply with AS/NZS 4020.

Where water sources and/or water quality require the use of chemical buffer solution analysers, these shall be provided. Where a chemical solution that is not approved for use in potable water systems is used in an analyser, the waste stream shall be disposed of to the sewer or otherwise disposed of or collected in an appropriate manner. Non-return valves shall be incorporated in the design to prevent these reagents entering the potable water supply system.

Dedicated analyser sample water lines shall be located and sized to minimise the time required for water flow to reach the analysers and shall be fitted with strainers.

For each analyser installation a manual sample point shall be installed along the same sample water line (or as close as practical) next to the analyser to allow for manual residual comparison against the analyser reading.

7.1 Sampling points

Sample points shall be located to ensure the chlorine has stabilised in solution and is well mixed before reaching the sample point.

Where possible, a sample point should be located outside the building (within a tamper proof enclosure), to enable easy access for analyser verification.

For in-pipe dosing applications, the sample point shall be located downstream from the injection point at a location that is representative of the water. For in-tank dosing applications, the sample point shall be located to ensure that the sample is a true representative of all water in the tank. Tank mixing should be considered to avoid variability in chlorine residual readings. Consideration should be given to providing a chlorine analyser on the discharge of the tank for the purpose of trim control and/or validation.

8. Electrical Requirements

All electrical works shall be installed in accordance with Australian Standards and the following Unitywater standard Pr9380 - Unitywater Specification for Electrical Installation at Network Sites.

Chlorine building light and power distribution boards shall be supplied from site switchboards and may be located in the chemical room. The preference is for distribution boards to be in rooms separated from chemical storage and cylinder/drums. All electrical equipment in the chemical building, including wiring, shall be installed above the full chemical bund level.

All electrical equipment shall be capable of working when the bund is full of liquid. As both water and the dosing chemicals are electrical conductors, safety of personnel within the bund must be considered when designing the layout of electrical equipment within the building.

The electrical equipment should be reliable. The equipment shall be makes preferred by Unitywater, unless unavailable. Equivalent, better quality or better performing alternatives may be utilised.

All instrumentation required for the reliable and safe operation of the system shall be included. This shall include but not be limited to level switches, load cells, pressure transmitters, flow transmitter and flow switches.

The site conditions and functions of the equipment shall be taken into consideration when designing the electrical systems to ensure that the equipment can be operated safely and efficiently. Particular attention shall be given to equipment installed in an adverse environment and/or exposed to weather.

Temperature rise within electrical enclosures and cubicles must not exceed the maximum temperature specified for the components located within enclosures.

In the case of extended power outages, the electrical load demand requirements for each point of power supply and the demand details shall be provided as part of the documentation. The controls shall be designed for automatic restart in the case of return from power failures.

Equipment is to be arranged to prevent inadvertent contact with live terminals during normal operation of switchgear, resetting circuit breakers or the like. All door mounted equipment shall have finger-proof terminals or be fitted with insulating boots/covers. Alternatively, the equipment can be completely screened by a clear, removable cover. Pipelines installed near electrical controls shall be shielded with PE covers to prevent leakage/spray from effecting electrical components and to direct leakage onto the floor and to the sump.

8.1 Integration to Existing Reservoir / Water Pump Station Switchboard

The CDU electrical and instrumentation system can be directly and individually integrated into the onsite switchboard, or if space is limited in the existing board, then a remote dosing panel is also acceptable. The dosing system will integrate the following circuits into the reservoir / water pump station switchboard:

- Dosing Pump:
  - Power Circuit, including:
    - Circuit breaker;
    - Run contactor;
    - Thermal Overload;
    - Field Isolator.
  - Control Circuit including:
    - Manual / Off / Auto Switch;
    - Run Relay.
- Building Power and Lighting:
  - Lighting Circuit including safety switch and light switch.
  - Power outlet including safety switch and power outlet.
  - Lighting circuit for the safety shower.
- Instrumentation:
  - Chemical Storage Tank Level Sensor Analog Input and level display.
- Safety shower supply and controls, including:
  - Valve, pressure and flow switches;
  - Visual flashing beacon and audible alarming.
- Interlinking to the site Fire Indicator Panel;
- Chlorshield control panel.

8.2 Dosing Pump

If the dosing pump is selected to run in Auto Mode on the selector switch, it will run when the digital output from the RTU is active.

If selected to Manual Mode on the selector switch, the pump will run continuously until switched to the OFF mode on the Selector Switch.

8.3 Level Instrumentation

Levels measurements within the tank(s) is via load cells, which is displayed on a visible digital display.

The transmitters shall be connected to the control and telemetry system to allow remote monitoring with the full range of the device measure in % and (L)

- 0.0% = 0.0 L
- 100.0% = Maximum capacity of the tank.

8.4 Cable Tray

There shall be an electrically continuous stainless steel or non-metallic cable tray around the complete inside perimeter wall of the dosing room and into the electrical controls room. The cable tray shall have plastic divider segregated sections for power and controls cables. The power cable section will be 2/3 of the space and the controls cable section will be about 1/3 of the space. The cable try shall be spaced off the wall using spacer so that control cables will fit between the wall and cable tray where relevant. Power cables shall come out of the bottom of the cable tray and controls cables shall come out of the top or back of the cable tray. The cable tray shall be sealed with a removable compound where it penetrates through the wall between the dosing room and electrical controls room.

8.5 Power outlets

One 15 Amp IP66 switched socked outlet (3-pin, 240 V) power outlet must be provided in the chlorine dosing area as well as a 10 Amp 240V power outlet for an automated door (if applicable).

8.6 Lighting

The Contractor shall design and supply lighting system to comply with the relevant Australian Standards. Lighting shall be designed to allow safe access and operation of the asset at night-time. Energy efficiency, easy maintenance and reliability of the lighting system shall be taken into consideration in the design. External lighting shall be vandal proof.

8.7 Gas Leak Detection System and Emergency Shutdown

A Chlorshield or equivalent shall be installed as an automatic gas leak detection and emergency isolation device for chlorine gas cylinders and drums.

9. Control System Requirements

9.1 Integration into existing Control System

The CDU system can be directly and individually integrated into the onsite control system, with the onsite RTU expanded to cater for the additional Physical IO and hard-wired control circuits required.

9.2 Required Modes of Operation (RTU Code)

The control system shall be designed to provide a fully automatic dosing system that can achieve the required chlorine levels required to meet the Drinking Water Quality Management Plan including:

- Flow Paced Dosing with Trim functionality for pH, temperature, ORP as required.
- Remote Manual Mode - Fixed Dose Rate controlled by SCADA Operator.
- Local Manual Mode – Fixed Dose Rate controlled by Local Operator.

The base code for chemical dosing systems shall be issued by Unitywater to the Integrator to inform the type of alarms to be implemented.

The Functionality of the system shall be detailed in a functional description (authored by the process engineer) and subsequent Functional Specification (authored by the control system engineer).

The use of the safety shower shall trigger an alarm via the RTU, and/or the dosing system controller, to the overall remote control/SCADA.

Table 4 – Physical IO

IO Type	Sodium Hypo System	Chlorine Gas System
DI	• Recirculation Pump - Running • Recirculation Pump - Healthy • Recirculation Pump - Line Flow Switch • Ejector Pump - Running • Ejector Pump - Healthy • Ejector Pump - Line Flow Switch • Sample Pump - Running • Sample Pump - Healthy • Sample Pump - Line Flow Switch • Pre Dosing - Water Quality Analyser – Healthy • Post Dosing - Water Quality Analyser - Healthy • Sample Water Return Tank - High Level Alarm • Safety Shower - Flow Switch Active • Dosing Pump - Running • Dosing Pump - Healthy	• Recirculation Pump Running • Recirculation Pump Healthy • Recirculation Line Flow Switch • Ejector Pump Running • Ejector Pump Healthy • Ejector Line Flow Switch • Sample Pump Running • Sample Pump Healthy • Sample Line Flow Switch • Pre Dosing - Water Quality Analyser – Healthy • Post Dosing - Water Quality Analyser - Healthy • Sample Water Return Tank High Level Alarm • Safety Shower Flow Switch Active • Chlorshield Gas Detection System Alarm • Chlorshield Gas Detection System Healthy • Chlorine Gas Pressure Switch 1 – Tank 1 Empty • Chlorine Gas Pressure Switch 2 – Tank 2 Empty • Chlorine Gas Pressure Switch 3 – Tank 3 Empty * • Chlorine Gas Pressure Switch 4 – Tank 4 Empty *
DO	• Recirculation Pump - Run Command • Ejector Pump - Run Command • Sample Pump - Run Command • Dosing Pump - Run Command	• Recirculation Pump Run Command • Ejector Pump Run Command • Sample Pump Run Command • Chlorshield Gas Detection System Siren & Light

IO Type	Sodium Hypo System	Chlorine Gas System
AI (4-20mA)	• Pre-Dosing - WQ Analyser – Flow Rate • Pre-Dosing - WQ Analyser – Free Chlorine • Pre-Dosing - WQ Analyser – Total Chlorine • Pre-Dosing - WQ Analyser – pH • Pre-Dosing - WQ Analyser – ORP • Post Dosing - WQ Analyser – Flow Rate • Post Dosing - WQ Analyser – Free Chlorine • Post Dosing - WQ Analyser – Total Chlorine • Post Dosing - WQ Analyser – pH • Post Dosing - WQ Analyser – ORP * • Dosing Tank - Level (4-20mA)	• Pre-Dosing - WQ Analyser – Flow Rate • Pre-Dosing - WQ Analyser – Free Chlorine • Pre-Dosing - WQ Analyser – Total Chlorine • Pre-Dosing - WQ Analyser – pH • Pre-Dosing - WQ Analyser – ORP • Post Dosing - WQ Analyser – Flow Rate • Post Dosing - WQ Analyser – Free Chlorine • Post Dosing - WQ Analyser – Total Chlorine • Post Dosing - WQ Analyser – pH • Post Dosing - WQ Analyser – ORP * • Chlorine Gas Cylinder 1 – Weight • Chlorine Gas Cylinder 2 – Weight • Chlorine Gas Cylinder 3 – Weight • Chlorine Gas Cylinder 4 – Weight • Chlorshield – Leak Detector Cell 1 • Chlorshield – Leak Detector Cell 2 • Chlorshield – Leak Detector Cell 3 • Chlorshield – Leak Detector Cell 4 • Chlorinator Position Feedback
AO (4-20mA)	• Dosing Pump Dose Rate	• Chlorinator Position Command

9.3 SCADA Requirements

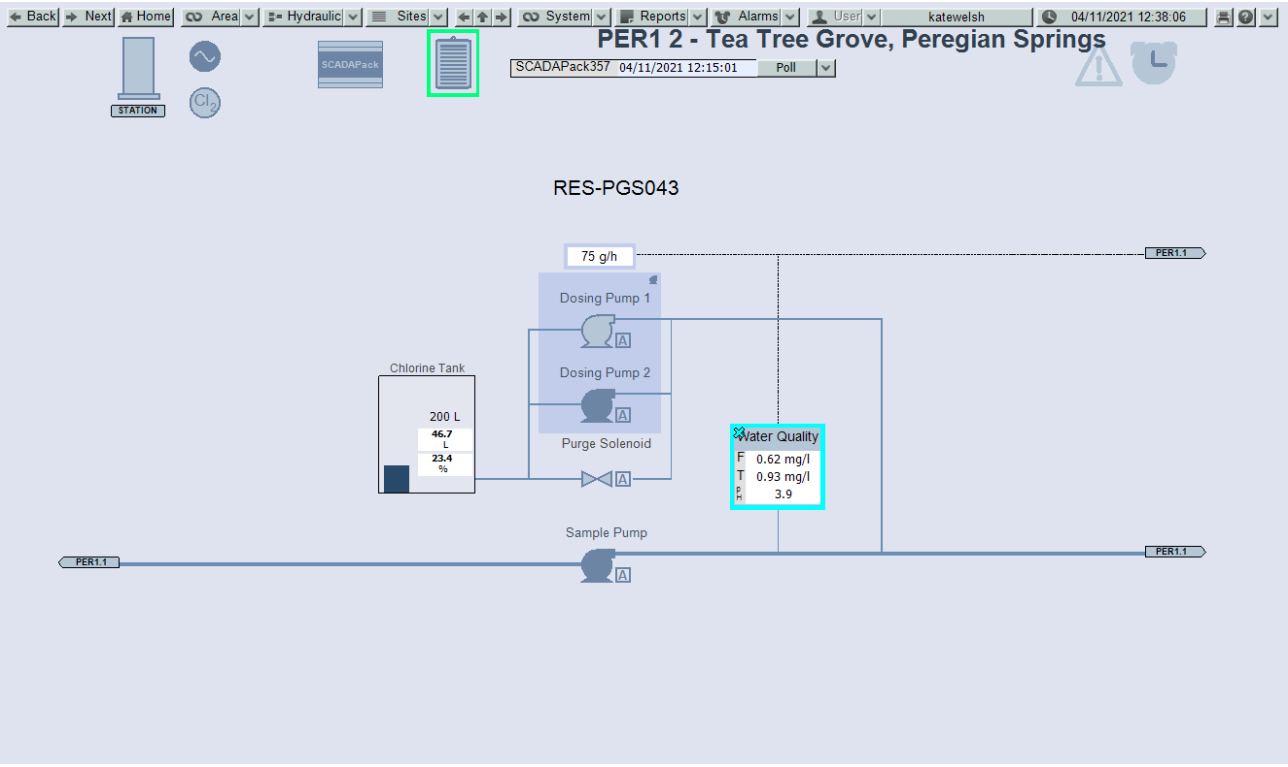
All SCADA configurations shall be implemented in accordance with the following Unitywater standard *Pr9834 - Specification for SCADA Standard*.

The site's SCADA configurations shall be updated to include all the equipment being monitored and controlled. Appropriate SCADA pages shall be developed to provide the operator interface including:

- SCADA main display page showing tank, pumps, instruments;
- Status tab showing all status signals;
- Control tab showing all operator adjustable setpoints;
- Trend tab showing all appropriate trend data.

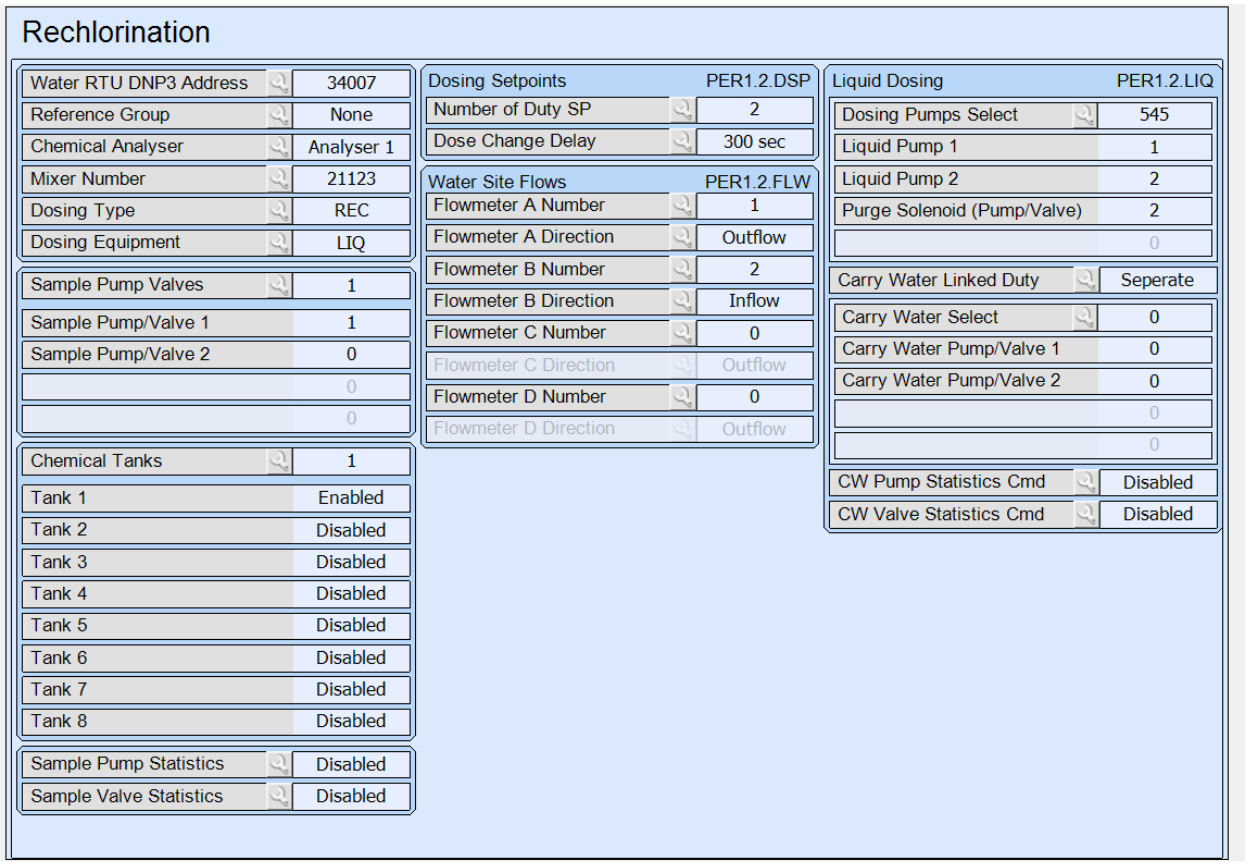
9.3.1 Sodium Hypo Example SCADA Pages / Tabs

The following figures show example SCADA pages and tabs created for chemical dosing systems.



Water.WIF.PGS.PER1.2.Display.Overview

Figure 2 – Example SCADA Page for Sodium Hypochlorite (Liquid)



Water.WIF.PGS.PER1.2.Groups.Chemical 1.Display.Pop Up - EN

Figure 3 – Example Setpoint Tab of SCADA Page for Sodium Hypochlorite (Liquid)

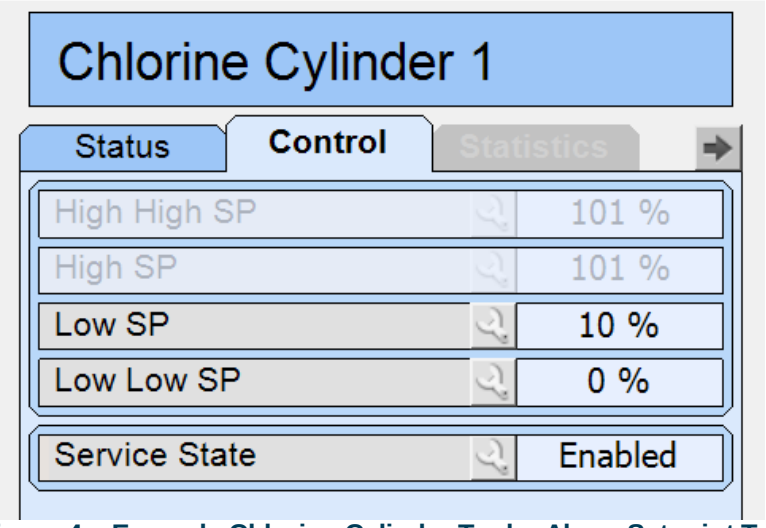


Figure 4 – Example Chlorine Cylinder Tank - Alarm Setpoint Tab

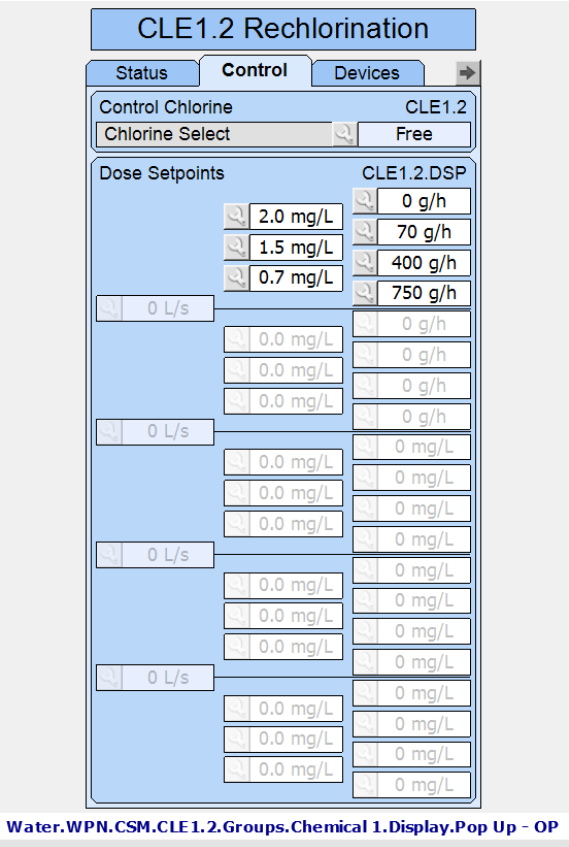


Figure 5 – Example Chemical Dosing System Setpoints Tab

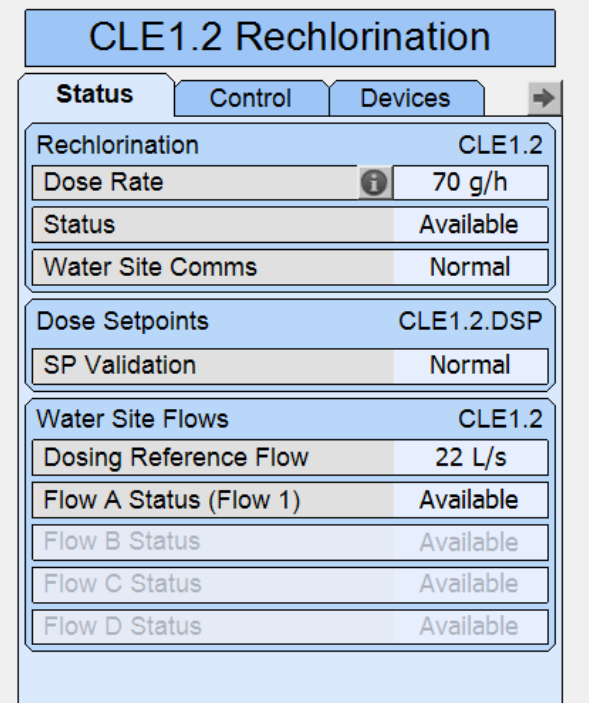


Figure 6 – Example Chlorination Status Tab

9.3.2 Chlorine Gas Example SCADA Page

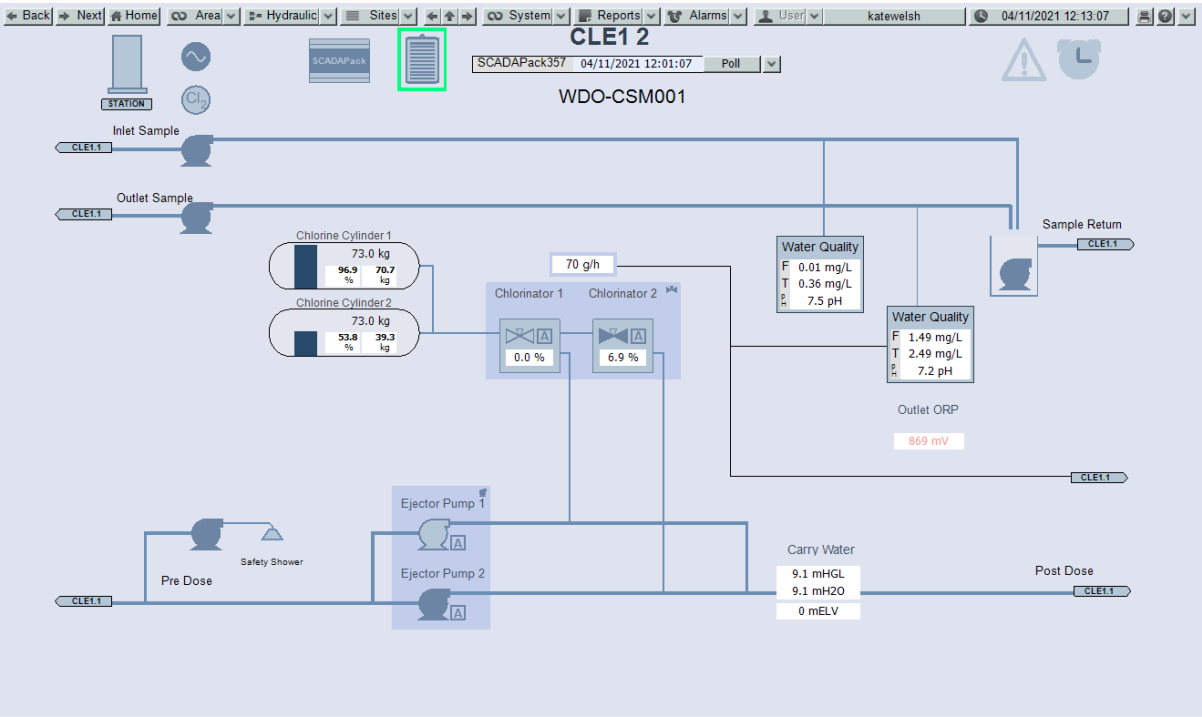


Figure 7 – Example SCADA Page for Chlorine Gas

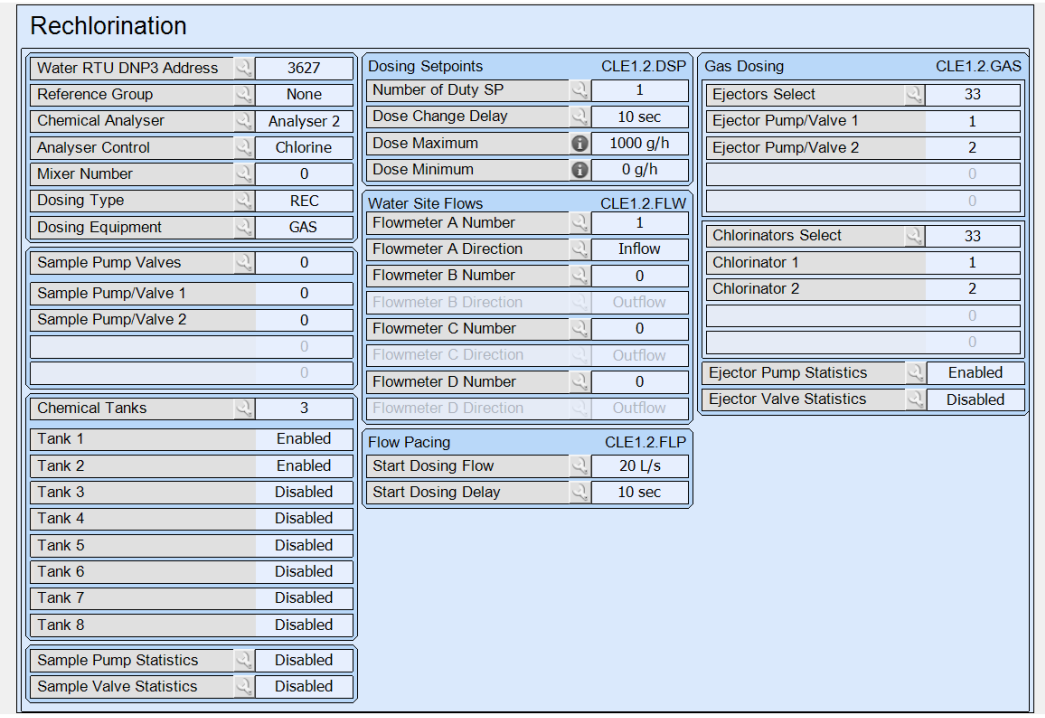


Figure 8 – Example Setpoint Tab of SCADA Page for Sodium Hypochlorite (Liquid)

10. Design Requirements

10.1 Safety in Design Methodology

The designers shall undertake Safety in Design, HAZID, HAZOP, and CHAIR workshops as detailed in *Pr8187* - *Safety in Design Procedure*.

10.2 Process, Civil & Mechanical Design

The design and construction of the civil works shall be in accordance with the requirements contained in Unitywater specifications:

- *Pr9902* - *Unitywater Specification for Civil and Earthworks.*
- *Pr9903* - *Unitywater Specification for Building and Structural Works.*
- *Pr9693* - *Unitywater Specification for Mechanical Installations.*

In addition to the above the design shall fully consider the relevant Australian, internationals and industry standards where relevant.

10.2.1 Deliverables

Detail Design is to utilise the standard design templates and create a site-specific design drawing and design basis deliverables, for this site detailing the civil design including:

- Basis of Design Report – Civil & Structural sections;
- Basis of Design Report – Mechanical & Hydraulic sections;
- Equipment Schedules (Drives, Valves and Instruments);
- Safety in Design Register and Report;
- Civil & Mechanical Drawings as per the following table:

Table 5 – Civil & Mechanical Drawings List

Sheet	Drawing Title
01	Cover Sheet, with Locality Plan and Drawing List
02	Site Specific Process and Instrumentation Diagram (P&ID)
02	Notes pages
03	General Arrangement of Site Layout and Access
04	Delivery Bunding, Access sections and Concrete details, Sump valve pit details
05	Delivery Bunding, Access, Structural details
06	CDU Cabinet layouts, sections, and details
07	Structural Steel Details
08	Dosing tank, pipework, pumps GAs, sections, and details (internal to CDU)
09	Dosing Lines Plan and section, penetration details (potentially external to CDU)
10	CDU Building GA layouts, sections, and details
11	CDU Building Structural Details
12	CDU Building facilities

10.3 Electrical Design & Control System Design

The design and construction of the electrical works shall be in accordance with the requirements contained in Unitywater specifications *Pr9380 - Unitywater Specification for Electrical Installations at Network Sites.*

In addition to the above the design shall fully consider the relevant Australian, internationals and industry standards where relevant.

10.3.1 Deliverables

Detail Design is to utilise the standard design templates and create a site-specific design drawing and design basis deliverables, for this site detailing the electrical and control system design including:

- Basis of Design Report – Electrical and Control System Sections;
- Electrical Drawings (as per table below);
- Site Specific Functional Specification.

Table 6 – Electrical and Control System Drawing List

Sheet	Drawing Title
01	Cover Sheet, with Locality Plan, Electrical conduit layout and Drawing List
02	Single Line Diagram
03	Schematic for Recirculation Pump & Sample Pumps
04	Schematic for Dosing Pumps
05	Schematic for 24VDC Distribution
06	RTU Termination Diagram
07	RTU Termination Diagram
08	RTU Termination Diagram
09	Equipment & Cable Schedule
10	General Arrangement Drawing of Panel

11. Inspection, Testing and Commissioning Requirements

11.1 Commissioning

The Contractor shall prepare a Commissioning Plan in accordance with *Pr11211* - *Specification for Commissioning and Handover of Active and Passive Assets* and must be submitted to the Superintendent for acceptance prior to commencing any commissioning activities and no commissioning activities may commence until the Plan has been accepted.

The Contractor shall ensure adequate contingency planning during network interventions is implemented and shall be included as part of the Contract price.

11.2 Civil & Mechanical Inspection and Testing

11.2.1 Building Certification

The Contractor shall provide all building certification documents for design and certification of the CDU to the Principal's Representative.

11.2.2 Hydrostatic Test and Leak Detection (Bund, Tanks and Pipework)

The chemical room bund area should be watertight prior to the application of the internal coating. The bund area of chemical storage area shall be filled with water for at least 24 hours and prior to the internal coating being applied. It will be satisfactory if there is no water leakage through the wall, slab, penetrations, joints, etc. The storage and dosing tank(s) should be filled to prevent any movement due to flotation.

- New storage and dosing tanks and pipework shall be filled with water and inspected for leakage for at least 24 hours.
- Tanks shall be tested to the SG of the tank.
- Pipework shall be pressure tested to 1.5 times the operating pressure.

11.2.3 Pump Inspection and Testing

Pump Testing shall be in accordance with *Pr9693* - *Specification for Mechanical Installations.*

- Section 10.9.1 - Hydrostatic testing
- Section 10.9.2 - Pump performance testing

11.2.4 Coating Testing

Refer to WSA201 – Manual for selection and application of protective coatings, Section 10 - QUALITY CONTROL INSPECTION AND TESTING.

11.3 Electrical and Control System Inspection and Testing

The Contractor undertake all inspection and testing for electrical and control system works in accordance with the requirements contained in Unitywater specification Pr9380 - Unitywater Specification for Electrical Installations at Network Sites.

The testing will include as a minimum the following Electrical ITPs, FAT and SAT requirements

- Switchboard Electrical Testing and test certificate;
- Switchboard Visual check;

- Equipment Isolation Checks;
- All protection and Control equipment settings;
- Control System Functionality Checks;
- SCADA control and alarm Tests.

11.4 Process Commissioning

Once the electrical and control system testing has been completed successfully, the process can now be commissioned including:

- Manual Operation - Using Water
- Automatic Operation - Using Water
- Manual Operation - Using Chosen Chemical
- Automatic Operation - Using Chosen Chemical

11.5 Proof of Performance - Downstream Sampling

Commissioning shall be deemed complete when the dosing system can run continuously without any fault for a period of two weeks.

The plant shall start and stop during this two-week period as required by the Principal's Representative. The Proof of Performance shall include at least one chemical delivery.

During this period, the Contractor shall maintain the unit in a proper working manner. The unit shall be used to demonstrate system performance. The Contractor shall carry out any work necessary to ensure the unit is working correctly.

12. Handover Requirements

The Contractor shall provide commissioning documentation and information in accordance with:

- *F10844 - Operational Readiness Checklist;*
- *Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets*
- Electrical test certificate.

12.1 Project Closure

Provide final project cost and confirmation that all identified works have been completed.

A completed Unitywater Asset Template of all active and decommissioned assets on site shall be returned to Unitywater.

All relevant QA documentation to be provided through Objective Connect.

12.2 As Constructed Information

The As Constructed drawings shall be prepared and supplied in accordance with the asset information data shall be recorded on the 'As-Constructed Asset Record for Water Supply Assets' spreadsheet will be provided by Unitywater. This asset data shall include full asset details including installed value of all items.

12.3 Asset Manuals

Asset manuals shall be prepared and provided in accordance with the SEQ WS & SD & C Code Asset Information Specification.

12.4 Operating and Maintenance Manual

A draft Operating and Maintenance (O&M) Manual for the CDU must be prepared and submitted prior to process commissioning. It must be finalised and re-submitted after successful commissioning of the unit and incorporate any learnings or changes required during commissioning and proof of performance.

13. Appendices

Refer to following pages.

Appendix A – Definitions/Acronyms

The following definitions, abbreviations and acronyms are used throughout this specification.

Term	Meaning
ANSI	American National Standards Institute
AS	Australian Standard
AS/NZS	Australian and New Zealand Standard
CHAIR	Construction Hazard Assessment Implication Review
CDU	Chlorination Dosing Unit
DBP	Disinfection By Product
DN	Pipe Diameter
DWQMP	Drinking Water Quality Management Plan
EPDM	Ethylene Propylene Diene Monomer Rubber
FAT	Factory Acceptance Testing
FMECA	Failure Mode, Effects and Critical Analysis
FRP	Fibre Reinforced Plastic
HAZCHEM	Hazardous Chemical
HAZMAT	Hazardous Material
HAZID	Hazard Identification
HAZOP	Hazard and Operability Study
HDPE	High Density Polyethylene Pipe
I/O	Input / Output
Integrator	Person/Entity responsible for the supply, installation and commissioning of the control system
ITP	Inspection and Test Plan
NBR	Acrylonitrile Butadiene Rubber, Nitrile, Buna-N
NC	Normally Closed
NPI	Northern Pipeline Interconnector – part of Seqwater Water Grid which allows water to be transferred between different parts of the water grid
NO	Normally Open
NOV	Novolac Epoxy
OHS	Occupational Health and Safety
P&ID	Piping & Instrumentation Diagram
PE	Polyethylene
PE100	Polyethylene pipe with MRS (minimum required strength) of 10.0MPA Pipe
PLC	Programmable Logic Controller
PN	Pressure Nominal, Pressure Rating
PPE	Personal Protective Equipment
Ppm	Parts per million
PVC	Polyvinyl Chloride
Q100	Flood level at which there is 1% annual exceedance probability, or a 100-year average recurrence interval
QA	Quality Assurance

Term	Meaning
RPZ	Reduced Pressure Zone
RPEQ	Registered Professional Engineer Queensland
RTU	Remote Telemetry Unit
SAT	Site Acceptance Test
SCADA	Supervisory Control and Data Acquisitioning
SDS	Safety Data Sheet
SS	Stainless Steel
UNO	Unless Noted Otherwise
U-PVC	Un Plasticised Polyvinyl Chloride
WSAA	Water Services Association of Australia

Appendix B – References

General

All works shall be completed in accordance with this Specification, the Project Specification and stated supplementary specifications.

Reference to specific clauses of the various codes is intended to highlight those points and shall not be taken to imply a lesser importance for all other applicable clauses.

All the works shall conform to the Rules and Regulations of the Statutory Authorities having jurisdiction over the Site.

If the requirements of this Specification do not comply with the minimum requirements of the statutory regulations and standards, the Statutory regulations and standards shall apply. If the requirements of this Specification are more exacting than the minimum requirements of the statutory regulations and standards, this Specification shall apply.

All Materials, fittings, accessories, and equipment supplied by the Contractor shall be new and the best obtainable of their kind and shall comply in all respects with the requirements of the relevant Unitywater and Standards Australia specifications.

All Contractors have an obligation to comply with all relevant legislation and regulations. As a minimum (and not limited to) the following legislation and related regulation and codes shall apply:

- *Building Act 1975* (Qld);
- *Building Fire Safety Regulation 2008* (Qld);
- *Building Regulation 2021* (Qld);
- *Electrical Safety Act 2002* (Qld);
- *Electrical Safety Regulation 2013* (Qld);
- *Electricity Act 1994* (Qld);
- *Electricity Regulation 2006* (Qld);
- *Environmental Protection Act 1994* (Qld);
- *Environmental Protection (Air) Policy 2019* (Qld);
- *Environmental Protection (Noise) Policy 2019* (Qld);
- *Environmental Protection (Water and Wetland Biodiversity) Policy 2019* (Qld);
- *Professional Engineers Act 2002* (Qld);
- *Public Health Act 2005* (Qld);
- *Public Health Regulation 2018* (Qld);
- *Queensland Building and Construction Commission Act 1991* (Qld);
- *Water Supply (Safety and Reliability) Act 2008* (Qld);
- *Work Health and Safety Act 2011* (Qld);
- *Work Health and Safety Regulation 2011* (Qld);
- South East Queensland Water and Sewerage Design and Construction Code (SEQ WS & S D & C Code) includes SEQ Asset Information Specification;

- SEQ Infrastructure Products and Materials lists (Civil and Mechanical);
- National Construction Code (NCC);
- Queensland Development Code;
- Model Planning Scheme Development Code for Hazardous Industries and Chemicals, Worksafe QLD 2016;
- Planning Guideline State Code 21: Hazardous Chemical facilities Version 2, Worksafe QLD;
- NOHSC:2017(2001) Storage and Handing of Workplace Dangerous Goods.

Relevant Unitywater documents that relate to this specification

Title
F10678 - Unitywater Accepted Electrical Equipment List
F10996 - Deviation to Unitywater Technical Specification
Pr8187 - Safety in Design Procedure
Pr8843 - Unitywater Drawing and Equipment Tag Numbering
Pr11211 - Specification for Commissioning and Handover of Active and Passive Assets
Pr9032 - Procedure for Managing Water Quality During Mains Commissioning
Pr9080 - Unitywater Specification for CAD BIM Drafting and Modelling Standards
Pr9380 - Unitywater Specification for Electrical Installation at Network Sites
Pr9693 - Unitywater Specification for Mechanical Installations
Pr9769 - Unitywater Specification for Concrete Surface Protection
Pr9834 - Unitywater SCADA Specification
Pr9902 - Unitywater Specification for Civil and Earth Works
Pr9903 - Unitywater Specification for Building and Structural Works
Pr10618 - Power System analysis and Arc Flash study
Pr11034 - Specification for Trunk Water Main Design and Construction
Pr10883 - Safety in Design Guidelines

International and Australian Standards referenced within this specification

Standard	Title
Quality Systems	
AS 2990	Quality Systems for Engineering and Construction Projects
AS 3901	Quality Systems for Design/Development, Production, Installation and Servicing
AS 3902	Quality Systems for Production and Installation
AS 3903	Quality Systems for Final Inspection and Test
Drawings	
AS 1100	Technical Drawings
AS 1101	Graphical Symbols for General Engineering
AS 1102	Graphical Symbols for Electrotechnology

Standard	Title
Workplace, Health & Safety	
AS 1319	Safety signs for the occupational environment
AS1657	Fixed platforms, walkways, stairways and ladders
AS2927	The Storage and Handling of Liquified Chlorine Gas
AS 3780	Storage and handling of corrosive substances
AS4020	Products in Contact with Drinking Water
AS 4775	Emergency Eyewash and Shower Equipment
AS 60417(IEC 60417)	Graphical symbols for use on equipment
[NOHSC:2017(2001)]	National Code of Practice for the Storage and Handing of Workplace Dangerous Goods
Structures	
AS 1170.1	Structural design actions - Permanent, imposed and other actions
AS 1170.2	Structural design actions - Wind actions
AS 1170.4	Structural Actions – Earthquake Actions
AS 1866	Aluminium and Aluminium Alloys – Extruded Rod Bar, Solid and Hollow Shapes.
AS 3600	Concrete Structures
AS 3610	Formwork for concrete
AS 3735	Concrete Structures for Retaining Liquids
AS 4100	Steel Structures
Pipework, Vessels and Associated Standards	
ANSI C901-17	Polyethylene (PE) pressure pipe and tubing for water service
AS 1159	Polyethylene pipes for pressure applications
AS1210	Pressure Vessels
AS 1260	PVC-U pipes and fittings for drain, waste and vent application
AS 1275	Metric Screw Threads for Fasteners
AS 1345	Identification of the contents of Pipes, conduits and ducts
AS 1460	Mechanical jointing fittings for use with polyethylene pressure pipes
AS 1462	Methods of test for plastics pipes and fittings
AS 1477	PVC pipes and fittings for pressure applications
AS1657	Fixed platforms, walkways, stairways and ladders—Design, construction and installation
AS 2032	Installation of PVC pipe systems
AS 2033	Installation of PE pipe systems
AS 2129	Flanges for pipes, valves and fittings
AS 2492	Cross-linked polyethylene (PE-X) pipes for pressure applications

Standard	Title
AS 2537	Mechanical jointing fittings for use with crosslinked polyethylene (PE-X) for pressure applications
AS 2566	Buried flexible pipelines
AS/NZS 2927:2019	The storage and handling of liquefied chlorine gas
AS 3500	National plumbing and drainage code
AS 3500.1	Plumbing and drainage – water services
AS 3879	Solvent cements and priming fluids for PVC (PVC-U and PVC-M) and ABS and ASA pipes and fittings
AS 3996	Access covers and grates
AS 4041	Pressure Piping
AS 4087	Metallic flanges for waterworks purposes
AS 4129	Fittings for Polyethylene pipes for pressure applications
AS 4130	Polyethylene pipes for pressure applications
AS 4131	Polyethylene compounds for pressure pipes and fittings
AS 4343	Pressure equipment – Hazard levels
AS/NZS 4766	Polyethylene storage tanks for water and chemicals
AS ISO 9624	Polyethylene (PE) pipes for fluids under pressure - Mating dimensions of flange adapters and loose backing flanges
ASTM A213/A213M	Standard Specification for Seamless Ferritic and Austenitic Alloy Steel Boiler, Superheater, and Heat-Exchanger Tubes
ASTM D1290	Standard specification and practice for electrofusion joining of polyolefin pipe and fittings
ASTM D1785	PVC plastic pipe – schedule 80
ASTM D2467	PVC socket fittings – schedule 80
ASTM D2683	Standard specification for socket type polyethylene fittings
ASTM D3261	Standard specification for butt heat fusion
Electrical	
AS 1680	Interior Workplace Lighting
AS 2293	Emergency Escape Lighting and Exit Signs for Buildings
AS 3000	Electrical Installations – Building, Structures and Premises (SAA Wiring Rules)
AS 3008	Electrical Installations – Selection of Cables Part 1 Cables for Alternating Voltages Up To and including 0.6/1 kV
AS 3021	Electrical Installations – Construction and Demolition Sites
Other	
ISO 22000	Food Safety Management Systems