ACP0002
CHEMICAL DOSING UNIT
STANDARD SPECIFICATION

NOTES:
1. This Specification is to be used by Designers for all Chemical Dosing Unit projects.
2. The content of this Specification must not be changed or altered.
3. This Specification is not intended to be a stand-alone document. Project specific documents and additional technical clauses must be included with contract documentation.
Table of Contents

1.1 Scope .................................................................................................................................................. 4
1.2 Style of this Specification .................................................................................................................. 4
1.3 New Designs and Innovations ......................................................................................................... 4
1.4 Responsibilities .................................................................................................................................... 5
1.5 Contents of this Document .............................................................................................................. 8
1.6 Acronyms and Abbreviations ......................................................................................................... 8
1.7 Reference Documents ....................................................................................................................... 9

2 General Requirements .......................................................................................................................... 11
2.1 Containment Methodology ............................................................................................................. 11
2.2 Minimum Criteria ............................................................................................................................ 11
2.3 Site Conditions .................................................................................................................................. 12
2.4 Materials ........................................................................................................................................... 12
2.5 Pipework and Fittings ...................................................................................................................... 13
2.6 Civil Works ....................................................................................................................................... 15
2.7 Mechanical Works ........................................................................................................................... 16
2.8 Electrical Works ............................................................................................................................... 16
2.9 Instrumentation .................................................................................................................................. 17
2.10 Telemetry & Control ....................................................................................................................... 18
2.11 Internal Cable Tray ......................................................................................................................... 19
2.12 Services .......................................................................................................................................... 19
2.13 Security and Access Control .......................................................................................................... 19
2.14 Facility and Equipment Identification and Labelling ..................................................................... 19
2.15 Entering Asset Details into Maximo, IICATS & HYDRA ............................................................. 20
2.16 Signage ........................................................................................................................................... 20
2.17 Fencing (if required) ....................................................................................................................... 21
2.18 Elements of CDU ............................................................................................................................ 21
2.19 Maintenance Access ....................................................................................................................... 21

3 Chemical Delivery Bay ......................................................................................................................... 22
3.1 Location .......................................................................................................................................... 22
3.2 Access ............................................................................................................................................. 22
3.3 Delivery Bay Bund ............................................................................................................................. 22
3.4 Sump and Discharge Line ................................................................................................................. 23
3.5 Safety Equipment ............................................................................................................................. 23
3.6 Tanker Power Connection Outlets ................................................................. 24
3.7 Fill point ............................................................................................................. 24
4  CDU Building ........................................................................................................... 26
4.1 Building Layout and Dimension ........................................................................ 26
4.2 Mobility .................................................................................................................. 26
4.3 Bund Floor and Wall .............................................................................................. 28
4.4 CDU Internal Sump and Discharge Line ............................................................ 28
4.5 Electrical Controls Room .................................................................................... 29
4.6 Electrical ............................................................................................................... 29
4.7 Ventilation .............................................................................................................. 30
4.8 Lighting .................................................................................................................. 30
4.9 Platform Ladder .................................................................................................... 31
4.10 Safety Equipment ................................................................................................. 31
4.11 Chemical Manifest ............................................................................................... 31
5  Chemical Storage Tank ........................................................................................ 32
5.1 Material .................................................................................................................. 32
5.2 Structural ............................................................................................................... 33
5.3 Access Hatch ......................................................................................................... 33
5.4 Tank Inlet and Outlet ............................................................................................ 33
5.5 Level Instruments .................................................................................................. 34
5.6 Digital Display ....................................................................................................... 34
5.7 Additional Requirements for Magnesium Hydroxide Tank(s) ............................... 35
6  Dosing System ......................................................................................................... 38
6.1 CDU Dosing Pumps and Pipework ................................................................. 38
6.2 Not Applicable to Chemical Dosing Unit ............................................................ 40
6.3 Dosing Cabinets .................................................................................................... 40
6.4 Pulsation Dampeners at Pumps .......................................................................... 40
6.5 Depressurising, Flushing and Draining ............................................................... 40
6.6 Automatic Isolation Valves ................................................................................. 40
6.7 Pressure Transducer Indicator ............................................................................. 40
6.8 Dosing Chemical Flowmeter ............................................................................... 41
6.9 Carrier Water System ........................................................................................... 41
6.10 Potable Water Booster Pump ............................................................................. 41
6.11 Double Containment of Filling and Dosing Lines ............................................. 42
6.12 Dosing Point ................................................................. 42
6.13 Leak Detection Pits ....................................................... 43
6.14 Gas Sampling ............................................................... 43
6.15 Sewer Flow Meters ....................................................... 43
6.16 Not applicable to Chemical Dosing Unit ......................... 43
6.17 Labelling and Identification .......................................... 43
7 Submission ........................................................................ 44
7.1 Design Drawings .......................................................... 44
7.2 Operating and Maintenance Manual ................................ 44
7.3 Critical Spare Parts ...................................................... 45
8 Testing and Commissioning ............................................. 46
8.1 Hydrostatic Test and Leak Detection ............................... 46
8.2 Commissioning Test Run .............................................. 46
8.3 Building Certification ................................................... 47
8.4 Submission of Work As Constructed (WAC) Documents .... 47
8.5 Handover ....................................................................... 47
9 Document Control .......................................................... 48
Appendices ......................................................................... 49
Appendix A: DTC Drawing List ........................................... 50
Appendix B: Sydney Water Asset Data Management and Commissioning ........................................... 52
Appendix C: Construction Hazard Assessment Implication Review (CHAIR) ................................. 53
Appendix D: Operations & Maintenance Manual Template ................................................................. 54
Appendix E: SWC Guide to Proven Products ................................................................. 55
Appendix F: CDU Commissioning Checklist ........................... 56
General

1.1 Scope
This document specifies the detailed design and construction requirements for a standard Chemical Dosing Unit (CDU) located in the sewer network. The primary function of the CDU is to accurately dose the specified chemical for suppression of hydrogen sulphide generation in sewage, as a part of corrosion and odour control management.

This Specification does not apply to temporary dosing units but may form the basis for the supply and performance requirements for temporary units. Temporary CDUs may only be used where approved by the Principal.

The document is to be used for the design, construction, installation and commissioning of both, transportable and permanently installed CDUs. The selection of type (transportable or permanent) shall be agreed with the Principal. In general, the units shall comply with the following;
- **Transportable CDU** – Total effective storage below 27 kL consisting of a two tank system.
- **Permanent CDU** – System whereby storage of chemicals at the plant is greater than that of a transportable unit. Where the technical requirements for the design and construction of the plant varies for a particular section these variations shall be clearly stated in this specification. Otherwise the Contractor is to comply with all sections for both transportable and permanent plant types.

1.2 Style of this Specification
This document is written in the directive style. Where an obligation is given and it is not stated who is to undertake these obligations, they are to be undertaken by the Contractor. Therefore guidance on the allocation of tasks or separation of a contract into sub packages or work orders is not included in this specification. The specification shall outline the final requirements of the units however not dictate who shall undertake these works.

Where a submission, request, or proposal is required, and it is not stated who the recipient should be, it is to be provided to the Principal for approval.

Any discrepancies between this specification and other standards and/or regulatory requirements shall be clarified with the Principal.

1.3 New Designs and Innovations
This document provides an indicative solution for the Works. The Contractor may wish to develop the indicative solution shown, or produce their own design that will fully comply with the requirements of this Specification.

Any alternative materials, designs, methods of assembly, and processes that do not comply with the requirements of this Specification, or are not mentioned in it, but give equivalent performance outcomes to those specified, are not necessarily prohibited and will be considered by the Principal. Written approval from the Principal shall be sought with the design submission, prior to the commencement of construction.
1.4 Responsibilities

Responsibilities relating to the contractual terms and conditions, including financial matters and site issues are covered in the relevant contract documents. Specific responsibilities are noted in this document, but they do not necessarily describe all the activities required for the Works.

For the purpose of developer funded works, the words “Principal” and “Contractor” in this Document shall be replaced with the words “Sydney Water” and “Developer” respectively.

1.4.1 Contractor

The Contractor shall be fully responsible for the detailed design and construction being fully compliant with the requirements of this Specification, and provide a complete, functional CDU that meets all the relevant Australian Standards, Codes of Practice, industry standards, and all statutory requirements. The complete system shall include but is not limited to, all structures, pipework, fittings, valves, pumps, instruments and controls, from the point of bulk delivery to the point of chemical dosing into the process streams.

The Contractor should be aware that this specification is for a standard CDU. As sites vary each site must be assessed on an individual basis for site specific risks.

In addition, the Contractor shall provide the following:

- Design drawings and review of the CDU standard design.
- The Contractor shall submit CDU design drawings for Principal’s review at concept, 50% detailed design and 90% detailed design stages.
- A lifting plan for the installation and removal of the CDU.
- Review Principal supplied HAZOP report. Refer BMIS
- Carry out a total of two Construction Hazard Assessment Implication Review (CHAIR 1 & 2) workshop. CHAIR 1 shall be undertaken at the concept design stage, and CHAIR 2 at the detailed design stage. The CHAIR workshops shall be in accordance with Sydney Water Health and Safety Procedure, HSP-058: Risk Assessment in Design and the guidelines prepared by WorkCover NSW.
- Review Principal supplied CHAIR 3 report. Refer Appendix C
- Review the Principal supplied Failure Mode, Effects and Critical Analysis (FMECA) workshop report. Refer SWC Business Management Information System (BMIS).
- Commissioning plans including: Inspection & Test Plans and Defects Rectification Plan in accordance with Sydney Water’s Asset Commissioning Standard Administration Procedure (IMS0035).
- FAT testing (wet FAT/Pre SAT) in the factory prior to delivery to site.
- Update of Sydney Water information systems including:
  - Sydney Water’s Maintenance Management System (MAXIMO) asset listing to be completed and sent to Asset Knowledge (Data Creation), who will allocate asset numbers and notify the HYDRA Register & the Operational Technology Service (OTS). Refer to Section 2.15.
  - O&M Manuals, WAC drawings and other documentation necessary for the optimal operation and maintenance of the CDU, as detailed in Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects and the Principal supplied O&M manual shell document (refer Appendix D).
• All documentation submitted to the Principal shall be formatted such that it complies with Sydney Water’s quality documentation requirements. Typically, electronic versions in PDF, Word and DWG formats need to be provided as well as two hard copies.
• Additional specific equipment as may be necessary for the operation, maintenance and cleaning of the particular chemical system being provided, or as specified by the Principal or recommended by the chemical supplier and regulatory bodies.
• Storage tanks, process pipes, drain and overflow pipes, fittings, valves, equipment and instruments constructed of materials compatible with the chemicals stored and conveyed. All materials of construction shall be non-corroding for their chemical usage.
• Stairs, ladders and walkways, where appropriate, to allow ease of access to all storage tanks and equipment for maintenance purposes. All such stairs, ladders and walkways shall be constructed of appropriate corrosion resistant materials.
• Provide adequate access for maintenance purposes.
• Necessary facilities to ensure all spills and leakages are contained.
• Safety facilities, such as safety showers, eyewash stations, fire extinguishers and so on.
• Tags, labels, signs, and other markings, for all these systems which clearly indicate the individual system, chemical contents, hazards, warnings and any other pertinent information in accordance with the requirements of the relevant standards, Codes of Practice and statutory authorities.
• Safety Data Sheets (SDS) for the dosing chemicals supplied.
• SPS Contingency Plans (GA drawing emailed to spsplans@sydneywater.com.au)
• Any additional items/equipment requested by the Principal.

1.4.2 Principal
The Principal (Sydney Water), through its appointed representative / consultant, will provide input for the development of the detailed design required in this Specification. The input includes, but is not limited to:
• This Specification;
• Items in this Specification that will be done by others.
• Deemed To Comply (DTC) drawings including Layouts and Process and Instrument Diagrams (PIDs);
• HAZOP documentation - refer to BMIS
• CHAIR 3 report. refer Appendix C
• Failure Mode, Effects and Critical Analysis (FMECA) workshop report. refer BMIS
• Standard general arrangements of the chemical dosing unit; refer DTC drawings.
• Safety Data Sheets (SDS) for the dosing chemicals supplied.
• Sample template for Operation and maintenance manuals – refer Appendix D.
• Contact details of SWC security systems contractor.
• General scope of civil works required at site for access and egress of service and delivery vehicles.
• Provide the information in the following table:
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Quantity/Requirements</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of dosing system;</td>
<td>Flow paced/Diurnal rate</td>
<td></td>
</tr>
<tr>
<td>Type and properties of dosing chemical;</td>
<td>(Insert name of chemical, concentration, acid content etc.)</td>
<td></td>
</tr>
<tr>
<td>Chemical supplier name and contact details</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location of the CDU</td>
<td>(Insert street address, asset number etc.)</td>
<td></td>
</tr>
<tr>
<td>Mobility requirement of the CDU Building;</td>
<td>TRANSPORTABLE / PERMANENT</td>
<td></td>
</tr>
<tr>
<td>Rate of chemical dosing minimum</td>
<td></td>
<td>Litres/hour</td>
</tr>
<tr>
<td>Rate of chemical dosing maximum</td>
<td></td>
<td>Litres/hour</td>
</tr>
<tr>
<td>Dilution/carrier water flow rate</td>
<td>10:1 with maximum chemical dosage rate</td>
<td></td>
</tr>
<tr>
<td>Delivery Bund Sump Pump (if required)</td>
<td></td>
<td>Metres head</td>
</tr>
<tr>
<td>Pressure of available water supply for process water</td>
<td></td>
<td>Metres head</td>
</tr>
<tr>
<td>Pressure of available water supply for safety shower and eyewash;</td>
<td></td>
<td>Metres head</td>
</tr>
<tr>
<td>Advise whether H₂S monitoring is to be fed back to the CDU;</td>
<td>YES / NO</td>
<td></td>
</tr>
<tr>
<td>Diurnal minimum pressure of the pressure sewer main being dosed into;</td>
<td></td>
<td>Metres head</td>
</tr>
<tr>
<td>Diurnal maximum pressure of the pressure sewer main being dosed into;</td>
<td></td>
<td>Metres head</td>
</tr>
<tr>
<td>Delivery tanker size;</td>
<td></td>
<td>Kilolitres</td>
</tr>
<tr>
<td>Maximum temperature of the delivered chemical;</td>
<td></td>
<td>°C</td>
</tr>
<tr>
<td>Minimum chemical tank storage size;</td>
<td></td>
<td>kilolitres</td>
</tr>
<tr>
<td>Minimum performance parameters, (for example, pH and dissolved sulphide levels expected before and after chemical dosing).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protective coating system to be applied (external)</td>
<td>PUR-B or PSL for Anti Graffiti ACL for Aesthetic</td>
<td>-</td>
</tr>
</tbody>
</table>
1.5 Contents of this Document

Section 2 contains requirements for the standard design of the CDU.

Sections 3 to 6 contain requirements for the design of specific components of the standard chemical dosing system, namely the Chemical Unloading Bay, the CDU Building, the Chemical Storage tank, and the Chemical Dosing system.

Sections 7 and 8 contain requirements for the submission of the design, and for the testing and commissioning of the CDU respectively.

1.6 Acronyms and Abbreviations

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS</td>
<td>Australian Standard</td>
</tr>
<tr>
<td>AS/NZS</td>
<td>Australian and New Zealand Standard</td>
</tr>
<tr>
<td>BMIS</td>
<td>SWC Business Management Information System</td>
</tr>
<tr>
<td>ATWL</td>
<td>Above Top Water Level</td>
</tr>
<tr>
<td>CHAIR</td>
<td>Construction Hazard Assessment Implication Review</td>
</tr>
<tr>
<td>CDU</td>
<td>Chemical Dosing Unit</td>
</tr>
<tr>
<td>DTC</td>
<td>Deemed To Comply (drawing list)</td>
</tr>
<tr>
<td>FAT</td>
<td>Factory Acceptance Testing</td>
</tr>
<tr>
<td>FMECA</td>
<td>Failure Mode, Effects and Critical Analysis</td>
</tr>
<tr>
<td>FRP</td>
<td>Fibre Reinforced Plastic</td>
</tr>
<tr>
<td>HAZCHEM</td>
<td>Hazardous Chemical</td>
</tr>
<tr>
<td>HAZMAT</td>
<td>Hazardous Material</td>
</tr>
<tr>
<td>HAZOP</td>
<td>Hazard and Operability Study</td>
</tr>
<tr>
<td>HSP</td>
<td>Health and Safety Procedure</td>
</tr>
<tr>
<td>IICATS</td>
<td>Integrated Instrumentation, Control, Automation, and Telemetry Systems</td>
</tr>
<tr>
<td>I/O</td>
<td>Input/Output</td>
</tr>
<tr>
<td>MAXIMO</td>
<td>Sydney Water's Maintenance Management System</td>
</tr>
<tr>
<td>NPER</td>
<td>National Professional Engineers Registration</td>
</tr>
<tr>
<td>NTC</td>
<td>National Transport Commission</td>
</tr>
</tbody>
</table>
**1.7 Reference Documents**

The following documents are to be referenced with this Specification:

<table>
<thead>
<tr>
<th>AS</th>
<th>Australian Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS 1319</td>
<td>Safety signs for the occupational environment</td>
</tr>
<tr>
<td>AS 1345</td>
<td>Identifications of the contents of pipes, conduits and ducts</td>
</tr>
<tr>
<td>AS 2129</td>
<td>Flanges for pipes, valves and fittings</td>
</tr>
<tr>
<td>AS 3500</td>
<td>National plumbing and drainage code</td>
</tr>
<tr>
<td>AS 3735</td>
<td>Concrete structures retaining liquids</td>
</tr>
<tr>
<td>AS 3780</td>
<td>Storage and handling of corrosive substances</td>
</tr>
<tr>
<td>AS 3996</td>
<td>Access covers and grates</td>
</tr>
<tr>
<td>AS 4775</td>
<td>Emergency Eyewash and Shower Equipment</td>
</tr>
<tr>
<td>AS 4130</td>
<td>Polyethylene (PE) pipes for pressure applications</td>
</tr>
<tr>
<td>AS/NZS</td>
<td>Australian Standard/New Zealand Standard</td>
</tr>
<tr>
<td>AS/NZS 3000</td>
<td>Electrical Installations (Australian/New Zealand Wiring Rules)</td>
</tr>
</tbody>
</table>
AS/NZS 4766 Polyethylene storage tanks for water and chemicals

ANSI American National Standards Institute

ANSI Z358.1 Compliance requirements- Emergency shower and eye wash stations

EN European Standard

EN 13121 GRP Tanks and Vessels for Use Above Ground


Australian Design Requirements ADR 43/04 2006.

National Transportation Commission (NTC) – Australian Dangerous Goods Code (latest edition)

SafeWork NSW – Storage and Handling of Dangerous Goods: Code of Practice, 2005

Work Health and Safety Act 2011

Work Health and Safety Regulation 2017


Orica (Ixom) Bulk Delivery Requirements

Orica (Ixom) Bulk Installation Guidelines

Orica (Ixom) On-Site Inspection Guidelines

Sydney Water’s Asset Commissioning Standard Administration Procedure IMS0035

Sydney Water’s Health and Safety Procedure HSP-058: Risk Assessment in Design

Sydney Water’s Instrumentation and Control Standards TOG_TS01

Sydney Water Sewer Odour & Corrosion Control Standards TOG_TS08

Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects, MEFA0001

Water Services Association (WSA) Manual for Selection and Application of Protective Coatings, WSA 201

Sydney Water’s Supplement to WSA 201 (ACP0166)

Sydney Water’s Procedure for Disinfecting New Mains, WPIMS5027

Sydney Water’s Technical Specification Part 1 – Civil Works, CPDMS0023

Sydney Water’s Technical Specification Part 2 – Mechanical Works, BMIS0209

Sydney Water’s Technical Specification Part 3 – Electrical Works, CPDMS0022

Sydney Water Electric Intruder Detection Specification EIDS

Sydney Water’s Asset Data Management & Commissioning SAP

Sydney Water Health and Safety Procedure, HSP-058:

Sydney Water Business Management Information System (BMIS)

Risk Assessment in Design and the guidelines prepared by WorkCover NSW (CHAIR)
2 General Requirements

2.1 Containment Methodology
The CDU will include the development of 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 shall direct any leakage or spillage to a safe location where it may be managed appropriately. This methodology is to include appropriate locations for visual identification of leaks and leak detection at any low points.

The containment methodology is to be discussed and accepted by the Principal prior to implementation. The method may include proprietary product pipe in pipe, single run PE dosing lines inside PE/U-PVC pipe, leak detection pits or a combination of the above. Any other containment systems which are viable for the chemical and Site Acceptance Testing requirements will also be considered. The containment methodology is the responsibility of the contractor responsible for the construction of the plant as well as the civil contractor running dosing lines, unloading points, pump out locations and any other chemical pipework or pits.

Bunding shall be provided for the delivery bay and storage tanks to contain any chemical spillages as described in the following clauses.

2.2 Minimum Criteria
This specification represents the minimum requirements for the chemical dosing unit.

The CDU shall be designed to:

- Provide a minimum service life of:
  - 50 years for structural elements
  - 20 years for tanks and pipework
  - 10 years for mechanical, pumping, electronic and control equipment

- Achieve a level of treatment according to the minimum requirements outlined in Section 1.4.2 of this Specification, over the designed service life, taking into account the increase in sewer system loading;

- Comply with all relevant regulatory requirements, Standards, and Codes of Practice, including, but not limited to:
  - Work Health and Safety Act 2011
  - Work Health and Safety Regulation 2017
  - SafeWork NSW – Storage and Handling of Dangerous Goods Code of Practice 2005
  - AS 3780 – The Storage and Handling of Corrosive Substances
  - All other referenced documents in this specification

- Not cause interruption to the normal operation of the Sydney Water sewerage system;
• Have complete chemical receiving, storage, transfer, and dosing systems, and the necessary safety facilities;
• Be capable of automatic operation via Sydney Water’s Telemetry System (IICATS);
• Be capable of local manual operation;
• Be capable of adjustment of the treatment level during operation;
• Be safe to operate, maintain and decommission;
• Contain all spills of the chemical being used and have a bund capacity of 9,000 litres or a minimum 110% of the chemical storage volume, whichever is greater;
• Give effective process control under both routine and non-routine operations;
• Be self-contained, to allow transport and relocation; and
• Have online hydrogen sulphide monitoring installed downstream of the chemical dosing point, at a location nominated by the Principal, which is linked to the Sydney Water IICATS network.

2.3 Site Conditions

The site is normally subjected to temperate climate conditions, with an ambient temperature range of (minus) -6°C to 50°C, and humidity of up to 100%.

Additional consideration shall be given for sites that are subjected to strong wind and saltwater spray/mist, for example, marine conditions. Thus, all equipment shall be designed to accommodate and operate satisfactorily within these weather conditions.

Consideration must be given to Sydney Water’s requirements for building over or close to Sydney Water sewer, water or stormwater assets.

2.4 Materials

2.4.1 General

All materials selected or adopted in the design shall be suitable for installation in the proposed environment, including contact with the chemical being used and high humidity conditions. They shall be corrosion resistant and selected to match the relevant specified design life. Where required, materials shall be coated in accordance with the latest edition of Water Services Association Manual for Selection and Application of Protective Coatings, WSA201 and Sydney Water’s Supplement to WSA 201, ACP0166.

2.4.2 Corrosion Resistance

All internal parts in contact with the chemical substances are required to be corrosion resistant against the chemical involved.

All bolts, nuts, and washers shall be made from stainless steel grade 316, or equivalent, which is deemed to be suitable for the application.

2.4.3 Adhesive, Sealants, and Gaskets

All adhesives and sealants shall be resistant to oil and water, non-supportive of microbial growth, and dimensionally stable. They shall also be resistant to chemical attack by the dosing chemical. All gaskets shall be made from Viton rubber materials. Refer Appendix E: ‘SWC Guide to Proven Products’.
2.5 Pipework and Fittings

Materials for CDU pipe work and fittings shall be uPVC or cPVC ANSI Schedule 80 or Polyethylene PE to AS4130 (except magnesium hydroxide dosing lines, see 2.5.2 below). Refer Appendix E.

Pipework for the dosing line (except magnesium hydroxide dosing lines) to the dosing point shall be either:

- UPVC/cPVC George Fischer double containment system (Double-See™), or equivalent approved by the Principal
- PE100 polyethylene PN16 dosing pipe with PE100 polyethylene PN16 containment pipe, or
- PE100 polyethylene PN16 dosing pipe with DWV containment pipe

All pipes, including those in pipe trays and trenches, shall be painted in accordance with WSA201-Application of Protective Coatings and Sydney Water supplement ACP0166.

A solvent welding course is to be completed by the piping installation team to satisfy Principal’s and pipework supplier’s requirements.

The minimum pressure rating class of all pipes and fittings shall be PN 16. All pipework selected shall be designed specifically for use in the chemical industry and resistant to chemical attack.

All pipework, fittings and equipment installed and fabricated will be in accordance with the following:

- Method of jointing polyethylene pipe work shall be electrofusion jointing. The manufacturer’s recommendations must be followed with the correct specialised tools when installing pipes and fittings (no compression fittings to be used).
- All personnel undertaking pipework installation to be competent and have undertaken PVC installation training (SWC and supplier’s), polyethylene electro-fusion jointing training and Sydney Water chemical dosing training.
- Pipe work jointing and installation shall be carried out in accordance with the manufacturer’s specification and requirements, inclusive of pipe cutters, chamfering and de-burring tools.
- All pipework is to be painted (ACL system) or coloured and labelled as per Sydney Water Technical Specification: Part 2 – Mechanical Works and points a) to c) below:
  a. Below ground double contained pipework - only carrier pipework is required to be coloured and labelled.
  b. Above ground double contained pipework - double containment pipework must be coloured and labelled as per specification, carrier pipework is not required to be coloured and labelled.
  c. All other non-pipe in pipe chemical pipework (i.e. single containment) is required to be coloured and labelled as per the Specification.
- Pipes less than 50 mm in diameter, located outside of the CDU structure shall be suitably lagged to prevent freezing at low weather temperature (< 6°C). Pipe trays located outside shall be supplied and installed with suitable covers.
• Buried non-metallic pipes shall have continuous metal tape placed in the trench above the pipe to allow detection.

• All chemical dosing lines external to the CDU (above ground or buried) shall be double contained arrangement. In addition to this, all chemical dosing and/or water lines passing through the CDU electrical controls room shall also be double contained arrangement. Where lines are installed in the CDU electrical controls room they shall be shielded with PE covers to prevent leakage spray reaching electrical cubicles and to direct any leakage onto the floor. A drain shall be installed to the outside.

• The arrangement of all pipes shall allow a leak to be readily identified and contained, and facilitate repair or replacement of the inner pipe. The arrangement of the pipework shall allow a leak to drain into the CDU bund or the dosing point. All drainage should be vermin proof. Underground dosing lines shall be designed so that the pipework can be replaced without the need for excavation.

• All ball valves shall be full-bore type. For throttling purposes, a diaphragm valve suitable to the specific application must be used. These, along with other non-standard pipework fittings shall be double union type to minimise damage during repair and maintenance. Appropriate space is to be left around unions to enable dismantling. Utilise spacers under pipe clips where attaching directly to flat surfaces.

• Valves, piping and fittings should be from the same supplier for a specific dosing system and where possible, for any existing chemical dosing system on site. All valves of the same size, duty and type supplied under the contract shall be identical.

• Joints shall be either solvent welded (glued), electro fused, or flanged. Screwed connections may be permitted as an exception where there is no other alternative. For example, magnesium hydroxide dosing systems require a stainless steel actuated ball valve, due to the abrasiveness of the product. These valves normally exhibit screwed connections.

• Only approved pipe glues (Weldon 724) and solvents (coloured primer) that are designed for use with the specific chemicals and piping systems are to be used. Minimum curing times for primers and glues, as specified by the manufacturer, are to be strictly adhered to.

• Potable water must be provided for the eyewash and safety shower at all sites. All potable water lines coming from Sydney Water mains shall be provided with Reduced Pressure Zone (RPZ) valves to prevent carrier water flowing back into the mains. RPZ device should be installed downstream of the supply feeding the potable water supply on site to prevent pressure loss to safety showers and eye washes.

• A separate RPZ shall be provided to ensure backflow from the Chemical Dosing Unit cannot enter the emergency shower and eye wash facilities. All RPZ devices are to be installed by a licensed plumber and appropriately tested in accordance with the requirements of AS3500. Where required, booster pumps or pressure reducing valves shall be installed based on the incoming water pressure and the pressure at the dosing point.

A generic CDU Site Layout General Arrangement for the Potable Water Supply is provided in the DTC drawings of this Specification.

A list of proven products is included for reference in Appendix E. Products may be added to this list with the approval of Sydney Water.
2.5.1 Pipework supports
All pipework supports shall be suitable for contact with the chemical being dosed. Metal support systems such as ‘Unistrut’ or metal brackets and clips shall not be used. Proprietary systems such as Georg Fischer shall be used where available.

2.5.2 Magnesium Hydroxide Pipework
The following are additional requirements for Magnesium Hydroxide dosing systems to those stated above:

- Flexible lines internal and dosing lines to be 20mm NBR thick walled flexible rubber hose instead of PE. Spares for all flexible hoses to be provided.
- Rigid dosing manifold from tank to pumps shall be as compact as possible to reduce potential for blockages. Furthermore, the hoses feeding to and from the dosing pumps shall be provided to allow easy disassembly for cleaning.
- Spare dosing line to be run.
- The dosing and batch pump suction and discharge connections shall be constructed for easy access and removal. Pipework shall consist of Y-pieces for all divergent and convergent sections to promote flow in direction of dosing and reduce clogging.
- Long radius bends to be used in pipe runs.
- All take-offs are to be from the bottom of the line.
- Provide a roddable run which is steep (1:10 fall) and of large bore diameter for CDU drain line to sump.
- Union bends are to be provided to facilitate rodding.
- Non return valves to be tideflex type (except in the case of a non-pressure system).
- Strainer mesh to be 5mm SS Grade 316.
- SS Grade 316 two-part ball valves to be used on storage tank automatic outlet valve and drain valve to sump for wear purposes.
- All valves on the dosing line shall be full bore valves, except where specified on the P&ID.
- Fill lines for Magnesium Hydroxide to be aluminium camlock fittings.

2.6 Civil Works
The design and construction of the civil works shall be in accordance with the requirements contained in Sydney Water’s Technical Specification Part 1 – Civil Works, unless specified otherwise in this document. Where necessary, relevant Dangerous Goods Regulations shall be complied with.

As a minimum for the transportable CDU, the foundation pad shall have a sub-base of 200 mm thick cement stabilised DGB20 road base (3% minimum cement content), any soft spots in the founding material shall be compacted to 98% of maximum dry density prior to laying sub-base. The top of the foundation pad shall be 50mm above the surrounding ground level and shall extend 150mm past the building perimeter. The CDU base shall be placed on 50mm of packing sand and a 0.25mm waterproof membrane double lapped and taped at joints. The waterproof membrane shall be increased to 2 layers for saline conditions. A 50mm layer of sand is required under the CDU to ensure the load is evenly distributed on the foundation pad. A geotechnical engineer or engineering geologist
is to confirm the allowable bearing capacity of the foundation soil is sufficient for the requirements specified by the CDU supplier. If the foundation is not sufficient then the geotechnical engineer is to provide direction on ground improvement works required at site. The geotechnical engineer is to be engaged by the contractor undertaking the Civil works.

Where insufficient or unsuitable access to site is provided then a detailed design is to be undertaken in accordance with SWC Technical Specifications.

### 2.7 Mechanical Works

The design and construction of the mechanical works shall be in accordance with the requirements contained in Sydney Water’s Technical Specification Part 2 – Mechanical Works, unless otherwise specified in this document.

### 2.8 Electrical Works

#### 2.8.1 Scope of Work

The electrical scope of work of this contract is for the design, manufacture, supply, delivery, installation, testing and commissioning of all electrical equipment. This includes the incoming power supply system, communication, control, instrumentation, and all necessary accessories and associated equipment, for the proper functioning of the dosing system to be installed at the site.

This includes, but shall not be limited to the following:

- Where the CDU is a standalone plant install the power supply cables from the point of common coupling, and 3-phase power supply from the Electricity Authority supply, to the CDU connection point of the dosing system, including metering, termination, lightning and surge protections. Where the CDU is installed within a sewage pumping station site the power supply shall be provided from the pumping station electrical switchboard via a separate circuit breaker. The electrical loading shall incorporate an extra allowance of 30% for future loads.
- Installation of a non-metallic cable tray around the complete inside perimeter wall of the dosing room. The cable tray shall have segregated sections for power and controls cable.
- Provision of IICATS interfacing signals;
- Provision of all cabling and wiring between the CDU and the SWC supplied IICATS RTU (Remote Telemetry Unit) including surge protection units;
- Provision of internal and external lighting;
- Provision and installation of all equipment, materials, accessories, cabling, conduits, power poles/posts, connections and housings to enable the system to be fully operational;
- All necessary electrics are earthed to comply relevant aspects of AS/NZS 3000;
- Where non-standard CDU designs are used (in terms of DTC drawings and P&IDs) then the application specific settings in the standard Plain English Functional Description (PEFD) proforma shall be changed by the process designer and the Functional Design Specifications (FDS) shall be customised by OTS.
- Site testing and commissioning; and
- Provision of Work As Constructed (WAC) drawings.
2.8.2 Standards
The design and construction of the electrical works shall be in accordance with the requirements contained in Sydney Water’s Technical Specification Part 3 – Electrical Works, unless specified otherwise in this document. The RTU panel is to comply with I & C Standard.

2.8.3 Electrical Equipment
All equipment shall be new and suitable for its purpose, comply with Australian Standards and be rated for continuous in service condition within a switchboard. All electrical equipment supplied should be available from suppliers within Australia.

All items of equipment shall be designed, manufactured and installed to perform their required functions reliably and efficiently. The Contractor shall take into consideration the conditions and functions of the equipment when designing the systems, and selecting equipment, to ensure the system could 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 components inside those enclosures, including the thermostat and heater. Adequate ventilation shall be provided in the enclosures and cubicles. Switchboard ventilation fans should be considered for installations using dosing pumps with Variable Speed Drives.

A thermostat and heater shall be supplied to prevent condensation inside the electrical and controls enclosures and cubicles.

Live equipment and terminals shall be located behind removable covers or doors, and shrouded to prevent accidental contact when the control panel’s front doors are open, including equipment mounted on doors.

The switchboard shall have touch protection included in the design. Where more than one item of equipment is supplied and installed to perform a particular function, all such items of equipment shall be identical and completely interchangeable.

The site is subject to power failure. The equipment shall be designed for automatic restart when the power returns.

The Contractor shall develop electrical circuits, and submit the electrical circuit diagrams to the Principal’s Representative for review prior to manufacture Circuit design shall be in accordance with DTC electrical drawings provided at time of tender. This will be a hold point.

2.8.4 Battery Backup
The controls and RTU shall be provided with 2 off 24V battery backup units, one for the RTU modem and instruments and the other for the motorized and solenoid valves. The battery supplied for the RTU should be sized according the requirements in TOG_TS01. The battery for the valve power supply shall be sized to provide 2 complete operations for the maximum number of open motorized valves. The batteries shall be suitable for a life of at least 3 years continuous use with checks at 12 monthly intervals.

2.9 Instrumentation
All instrumentation including level transmitters, flow transmitter, flow switches and level switches shall comply with the TOG_TS01. If there is any discrepancy between this document and the TOG_TS01, it shall be raised to the Principal at the Design phase, to allow him / her to make an appropriate ruling.
on the matter. The Contractor shall resolve any issues of concern with the Principal and obtain written approval prior to proceeding with ordering and manufacture.

The contractor shall install permanent online hydrogen sulphide monitoring at a strategic location downstream of the chemical dosing point, that will communicate daily with Sydney Water IICATS. The online hydrogen sulphide monitoring shall be a separate standalone site (i.e. will not provide a feedback loop to the dosing control system of the CDU) and be installed at a location and be of a type specified by Principal.

2.10 Telemetry & Control

The CDU is to be supplied as a package by equipment supplier with all necessary control and instrumentation. The CDU shall be designed for connection into Sydney Water’s Telemetry System. Telecommunications shall be provided as per TOG_TS01.

Specific requirements of telemetry and control for a CDU are detailed in Sydney Water’s IICATS Sewer Odour and Corrosion Standards TOG_TS08. Unless directed otherwise, the digital and analogue inputs and outputs shall be provided as specified in TOG_TS08. If there is any discrepancy between this document and the TOG_TS08, it shall be raised to the Principal's Representative prior to design commission to allow him/her to make an appropriate ruling on the matter.

Telecommunications shall be provided by a 3G link to the mobile network. The Contractor shall supply a suitable 3G aerial mounted on the CDU building and cabled to the RTU panel. A surge protector should also be installed.

Where available, recycled water shall be used for dilution water and hosing purposes. Potable water of suitable pressure and flow must be provided for the eyewash and safety shower at all sites.

The selection and installation of field mounted electrical equipment within the chemical storage and dosing area of the CDU building must have a minimum IP54 rating and comply with the requirements of AS/NZS 3000 Section 6: Damp Situations.

Additionally, where the CDU is co-located with a sewer pumping station, the level sensors on the sewer pumping station wet well shall be hard wired into the CDU RTU to cut dosing at the wet well ATWL and stop over flow of chemicals into the environment.

2.10.1 CDU Controller

The primary control of the CDU shall be provided by a local RTU. The controlling RTU shall be to TOG_TS01.

The CDU shall be installed with monitoring and control equipment to Sydney Water Standards, which shall enable it to integrate into Sydney Water's IICATS.

2.10.2 RTU

Control and monitoring of the CDU shall be provided through the RTU which will be connected to the IICATS network. The RTU and IICATS network will provide the means for supervisory control and monitoring from remote workstation. Supervisory control shall permit overriding control from the SOC.

A stand-alone RTU shall be provided in the CDU control panel to control and monitor the plant. In this case;

• The RTU shall be installed in a segmented section of the control panel or in a separate fully accessible adjacent panel.
• The RTU power supply shall be provided by Dyne Industries with 8 hours battery back-up and sized as per TOG_TS01.
• Digital and analogue I/O shall be connected to the RTU in accordance with TOG_TS01. Hardwired signals shall be terminated through the knife switch terminals in the RTU panel. External inputs to the RTU shall be connected through surge diverters.
• The supplier shall interconnect all telemetry components, including connection of the RTU equipment. (Refer TS01 for details).
• The RTUs and Modem, as well as configuration of this equipment, will be free-issued by Sydney Water. The contractor will be responsible to provide the external aerial for the site (COL7195/7199 with SMA Male Connector) mounted on j bracket external to the building, as per the I&C Standard.

2.11 Internal Cable Tray
There shall be a 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.

2.12 Services
Services to the CDU shall include potable water supply, electrical power, telephone connection (if required), and drainage. These services are to be identified as to their location relative to the dosing unit.

2.13 Security and Access Control
All doors shall be keyed for Sydney Water security “CBY” (yellow key). The Illawarra system however uses a PS1 key.

2.14 Facility and Equipment Identification and Labelling
All equipment shall have a unique identification number beginning with SX in accordance with ACP0055 Asset Numbering Standard Operating Procedure. Sydney Water designates unique identification numbers for all its asset and associated equipment and Sydney Water will assign these.

The facility and equipment identification and labelling shall be in accordance with Sydney Water’s Specification SDIMS0026 Facilities Site Signage Specification and Maintenance Related Clauses for Capital and Operational Projects.

A standard Sydney Water facility asset sign shall be mounted on the outside of the CDU building.
2.15 Entering Asset Details into Maximo, IICATS & HYDRA

The Contractor shall provide information for the update of Sydney Water information systems including:

- Sydney Water’s Maintenance Management System (MAXIMO) asset listing to be completed & sent to Asset Knowledge (Data Creation), who allocate asset numbers & notify the HYDRA Register & OTS.
- SPS Contingency Plans (GA drawing emailed to sps-plans@sydneywater.com.au)

Use the “Location Number Request Form for New/Existing Assets” form MEPR0063 (refer Appendix B) to add new assets and have asset numbers assigned to them by Asset Knowledge Data Creation group. MEPR0063 form is available from the Asset Knowledge page on iConnect.

Request new asset numbers from Asset Knowledge (Data Creation), then forward with P&IDs to OTS for IICATS updates.

The principal’s representative shall ensure that HYDRA GIS is updated to include the location of the CDU and chemical dosing line, from the CDU to the dosing location. The dosing line shall be shown in HYDRA as a pressure main with pipe size, pipe type, etc. noted. The chemical dosing line must have the term CHEMICAL DOSING LINE entered into the 'General Information' field in HYDRA.

2.16 Signage

Signage shall be erected as required in accordance with Facilities Site Signage Specification. These include, but are not limited to the following:

- Sydney Water Facilities’ site signage Specification - Document Number: SDIMS0026
- For sites with capacity greater than 10 kL, a Hazardous Chemical (HAZCHEM) warning placard with UN number and chemical class to be placed on the main site entrances or on the CDU building as well as the storage tanks, when a hazardous chemical is stored on site.
- Information panels as per current edition of the Australian Dangerous Goods Regulation shall be placed in prominent and visible locations. As a minimum, there shall be one each on the chemical storage tank, and another on the inside of the door to the bunded area.
- Confined Space Entry Permit placard to be placed on the storage tank.
- Capacity of the storage tank stated on the tank.
- A sign that identifies the chemical, specifies tank asset number, full tank capacity and safe tank fill volume must be placed adjacent to the fill point.
- Safety signage as per DTC Drawings must be placed at the front of the CDU building or inside the door.
- If required by National Construction Code (>100 square metres) luminous emergency EXIT sign placed inside above the exit door.

Other relevant OHS signs shall be installed in accordance with AS 1319. The signs may include, but are not limited to, safety shower, eye wash station, and non-potable water tap.
2.17 Fencing (if required)
To prevent access from the general public and protect against vandalism, a man proof, fence shall be supplied and installed with a gate at the perimeter of the CDU area. It shall be located so as not to interfere or restrict operational and maintenance activities, including chemical tanker delivery. Any fencing must allow the largest chemical delivery tanker servicing the site to park completely off the road to allow access gates to be opened and closed safely. The Principal will specify when fencing is required.

Fencing shall be designed in accordance with Sydney Water’s Deemed to Comply (DTC) drawings – Facility Fencing. Where this fencing is not suitable due to gate span or other parameters the Contractor shall be responsible for providing a separate fence design to the Principal for approval during the design phase of the contract.

2.18 Elements of CDU
A CDU shall consist of the following elements:

- Chemical tanker delivery bay;
- CDU building, which contains two rooms; one for the electrical control panel and IICATS RTU, and the other a self bunded room for the chemical storage tank, dosing pumps and pipe work;
- Electrical control panel with RTU;
- Chemical storage tank(s);
- Dosing system;
  - Pumps;
  - Pipes;
  - Valves;
  - Instrumentation;
- Safety and wash down equipment

Specific requirements for each chemical dosing system and components of the CDU are detailed in the following sections of this Specification.

A set of CDU Process and Instrumentation Diagrams (P&ID), and general arrangement drawings and sketches are available as appendices at the end of this document. The proposed design shall be conceptually similar to them, unless instructed otherwise by the Principal.

2.19 Maintenance Access
The layout of the equipment inside the CDU building shall be submitted to the Principal for approval prior to construction. This is to ensure that access hatches, level indicators, pumps and so on, can be easily reached by personnel for maintenance and operation. For standard general arrangements of the chemical dosing unit; Refer DTC drawings.
3 Chemical Delivery Bay

A chemical delivery bay and associated roadworks or re-grading shall be designed and constructed to provide safe arrival, parking, off-loading, turning around (if necessary), and departure of bulk chemical tanker trucks.

3.1 Location

The delivery bay shall be located adjacent to the CDU building. Unless otherwise specified, the CDU building shall be located on the left side of the tanker.

The unloading point shall allow the chemical delivery tanker to be fully inside the delivery bay when unloading. The unloading hose connection point is typically located inside the CDU building, and shall be no more than 6m from the tanker connection point, as per the Dangerous Goods Code of Practice.

3.2 Access

The chemical delivery tanker shall be able to access the site safely without traffic controllers. It must be safe for the truck to turn off the roadway into the property and for the driver to stop the truck and open the gate. Depending on traffic conditions in the area, slip lane(s) may be required.

The delivery bay and its access shall be large enough to accommodate a tanker to be reversed into the bund and exit the site in a forward direction. Alternatively, the access shall allow the tanker to drive through and exit the site in a forward direction. The design is to avoid the possibility of the delivery truck having to pass back through a bund in which a spill has occurred.

3.3 Delivery Bay Bund

The delivery bay shall be a concrete slab with a bund wall, to provide containment for any spill or leaks. Relevant aspects of AS 3780 shall be complied with where corrosive chemicals are used.

The bund shall be designed as a water retaining structure in accordance with AS 3735. It shall have a capacity of 9,000 litres or 110% capacity of the largest tanker vehicle compartment, whichever is greater.

The bunded area shall be designed with a 1 in 75 grade towards the sump drain, such that no pools of chemical will accumulate on either side of the bund. The bund walls must also be painted yellow to increase visibility and reduce the risk of tripping onsite. The step between the delivery bay bund low level and CDU footpath is to be a maximum of 225mm as per AS1657 step size criteria unless approved by the Principal.

Any roll-over kerbs in the roadway at either end of the tanker delivery bay bund shall be designed to allow normal passenger vehicles (Class B99) to enter and exit without scraping the bottom of the vehicle as per the clearance requirements of ADR43/03 unless other vehicle agreed or specified by the Principal. Bund should be red oxide colour for ferrous chloride sites only.

The area between the tanker bay bund and the CDU building shall be concreted, and any spills in this area must be contained and drain into the delivery bay bund.

The delivery bay and CDU arrangement must ensure any stormwater from the surrounding roadway and ground shall be channelled away, and not flow into the delivery bay bund. Any expansion joints in the concrete path between building and delivery bay shall be mastic filled to prevent chemical seepage in between joints.
3.4  **Sump and Discharge Line**
A sump pit to collect liquid from the bunded area shall be provided. It shall have minimum dimensions of 600 x 600 x 600 mm to ensure sufficient capture of rainwater or hosedown water without filling the bund sump, whilst the drain valve is closed during deliveries. The drain valve shall be installed in the sump pit including union joint and extension spindle.

The sump shall drain by gravity (typically a 100 mm UPVC pipe) where feasible, to an appropriate location. This may be either to a Sewage Pumping Station (SPS) inlet maintenance hole, or a wet well of the SPS. The connecting pipe from the sump to the drain point shall be pressure rated and sealed with a suitable chemically resistant coating to avoid chemical ingress into the concrete wall. The pipe outlet shall be above the sewage overflow level (to create an air gap). A P-trap and a flap valve shall be installed at the other end of this drain line to help prevent sewer odours escaping via this line. A manual isolation valve shall be provided on this line in a separate dry pit adjacent to the sump. This pit shall have a lightweight lockable lid. If a gravity arrangement is not feasible, then a manually started, self-priming pump shall be provided to empty the sump.

In addition, where the site has a submersible pump installed, the bund sump needs to be substantially larger to ensure efficient operation of the submersible pump and prevent pump short cycling. High-level alarms shall be provided in the event of heavy downpours or pump failure.

In the event that the sump pump is required to pump into a pressure main it shall be the same size and type used in the household pots for the pressure system.

The submersible pump shall be corrosion proof and shall be fitted with a titanium impeller (e.g. Tsurumi or equivalent). The submersible pump shall be elevated from the floor of the sump to prevent clogging by dirt and debris. It shall be furnished with an accessible discharge union coupling, to enable removal for cleaning and servicing without the need for confined space entry.

The pump shall have a suction leg and automatic low-level trip, and be installed in the sump. The pump will be used for pumping any spills back to a discharge point fitted with a 50 mm Camlock style coupling. It shall only be activated by a local stop/start station, which can be operated without entering the bund, and include an automatic low-level cut-out.

The sump pit shall be located where it is not subjected to vehicle loading at one of the sides (outside) of the delivery bay bund. It shall be fitted with a grate/cover made from lightweight materials, in accordance with AS 3996 (Class A), weighing no more than 16 kg. The weight limit shall be labelled where appropriate. Where the unit's location is subject to falling debris from trees in the area, perforated sump covers with 12mm diameter holes must be used as opposed to grated covers to prevent blocking of drainage system.

3.4.1  **Camlock Pump Out Point**
A camlock pump out point shall be installed to allow pump out from the sump pit and bund area. The location of the camlock pump out point shall be adjacent to the sump. The pump out point shall be installed on an up-stand off the pumped discharge line from the sump pump, or on its own upstand if no sump pump is required on the site. Isolation valves shall be installed to allow pump out from the sump pit pump or camlock connection.

3.5  **Safety Equipment**
The following safety equipment shall be provided:
• A safety shower and eyewash station, which complies with AS 4775, located within 2 to 7m of the chemical unloading connection point. This is typically mounted to the inside of the right hand door of the transportable CDU building. An additional eyewash station shall be located within the CDU dosing room near the exit, on the furthest wall away from the dosing system and tank. Safety shower and eyewash facilities shall be tested and tagged in accordance with AS 4775. Refer to Appendix E.

• Long water lines to the safety shower and eye wash station (above ground and external to CDU building) that are exposed to sunlight shall 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 shall 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.

• An ABE fire extinguisher for use in electrical fires shall be provided for dosing sites excluding magnesium hydroxide and calcium nitrate.

When the delivery bay is not adjacent to the CDU building (that is, in a remote location), an additional safety shower is required within 2 to 7 meters of the tanker connection point.

All equipment provided shall be located such that the potential for vandalism is minimised.

3.6 Tanker Power Connection Outlets

Two permanently mounted electrical power outlets are required for unloading of the dosing chemical. These power outlets are 415 V (20 amps) and 240 V (15 amps), and are interlocked with the storage tank level transmitter (90%) and high-level switch (95%), to prevent operation of the tanker unloading pump on high-level. That is, automatic cut out of the outlets during filling when the tank level reaches high-level (90%).

They shall be located within 7.5 m of the unloading hose connection point, and inside the CDU building and guarded from splashback at the fill point. For further detail on the switch arrangement, refer to Sydney Water’s IICATS Sewer Odour and Corrosion Standards TOG_TS08.

3.7 Fill point

At the tanker filling point, a 50mm tanker fill pipe with a 50mm suitable male camlock fitting angled downwards at 45°, with removable cover, shall be supplied and installed. From this fill line a branch, with valve and extension piece pointing vertically down shall be supplied and installed for hose draining purposes. Refer to typical chemical dosing unit DTC drawing set.

The camlock coupling point must be positioned at least 600mm and no more than 900mm above the ground and firmly supported above and below the wye fitting. Transfer pipes should rise vertically from the tee and slope downward (1 in 100) at the top of the tank(s) to minimise drainage losses. The tank inlet branch should be above the level of the overflow pipe. The fill point must be fully contained inside a bund to prevent release of chemicals in the event of leaks at the connection point. The fill
A point is to be fitted with a digital display and associated equipment in accordance with this specification.

A second tanker fill point shall be provided with valves and drain line but with a screwed plug fitted instead of a camlock. This line will connect to the dosing tank but be used only in an emergency to feed direct to the dosing tank. An individual fill point is required for each tank if there are multiple tanks in series.

A placard containing information on chemical, tank capacity and safe fill volume must be placed clearly on each line at the loading point as shown in DTC drawings and as per SDIMS0026 Customer Delivery Safety Signage Specification.

Refer to Section 2.5.2 for special requirement for Magnesium Hydroxide.
4 CDU Building

A reinforced concrete, two-room building shall be designed to accommodate the chemical storage tanks and its bund, dosing equipment and control panel, along with the necessary control functions, alarms and telemetry links.

The building shall be designed to be weather proof and prohibit unauthorised entry. Its construction shall be vandal-proof and painted in accordance with the WSA Manual for Selection and Application of Protective Coatings, WSA 201 and Sydney Water’s Supplement to WSA 201. Principal shall advise whether the protective coating shall be Aesthetic (ACL coating System), Anti Graffiti (PUR-B or PSL coating System) or coastal environment (PUR-A coating system) The colour of the plant shall be as advised by the Principal.

4.1 Building Layout and Dimension

The building shall consist of two separately accessible rooms; a bunded dosing room for chemical storage and dosing equipment, that is capable of containing any chemical leaks or spills. The second room is an electrical controls room for electrical controls, telemetry, and document storage. The rooms shall be divided by a wall with a fixed transparent window (polycarbonate) of a reasonable size (typically 1m wide by 0.6 m high) to allow viewing of all key elements in the dosing room when operating from the control panel inside the electrical controls room. The window sill shall be positioned a minimum of 100mm above the chemical bund level. Separate doors shall provide external access into the two rooms. The doors shall be steel fabrication and adequately corrosion protected in accordance with WSA 201 and Sydney Water’s supplement to WSA 201.

The dimension of the building shall be designed to allow adequate space to work in, and regular operation and maintenance of the tank(s) and equipment to be carried out, without removal of the roof. As a minimum, the ceiling height shall be greater than 2.2 m from the ground or 0.5 m from the highest tank whichever is the greatest.

Normal working areas shall have immediate access to the point of safe egress. The width for emergency access and egress shall be no less than 1 m, unless specified otherwise.

The door of the chemical dosing room shall be a double door that can accommodate removal and replacement of the storage tank(s). The doors shall have a mechanism to lock them in the open position whilst the site is attended, and lockable shut when not attended. Door shall be replaceable without damaging the concrete substrate of the unit. Refer DTC drawing for more information.

Alternatively, a removable modular roof with stainless steel grade 316 lifting lugs shall be provided with a single door for access. Where a removable roof is provided, all electrical wiring connected to equipment on the roof, such as ventilation fans shall have dismantling joints or sockets to unplug and disconnect prior to removal of the roof.

A single hinged door shall be provided to the control room that opens to the outside. The door has to be provided with a lock and latch mechanism.

4.2 Mobility

Unless specified otherwise, the building shall be designed to be transportable, without having to dismantle and reinstall the chemical storage tank(s), pipework, pumps, control system and all other equipment. Suitable lifting lugs made from corrosion resistant steel shall be provided and located at the base of the building. Lifting lugs shall be grouted over after installation and locator markings made at the lifting point locations.
The design life of the lifting lugs shall exceed the design life of the building. Structural certification from a structural engineer with National Professional Engineers Registration (NPER) with the Institution of Engineers Australia shall be provided to certify the lifting of the building. The lifting procedure shall be stated in the O&M manual and the detailed drawings.

A stainless steel plate shall be mechanically fastened to the building, stating lifting certification date, construction materials, dry weight, maximum loaded lifting weight, and maximum load for each individual lifting lug shall be provided.

Structural drawings shall be submitted to the Principal for written approval prior to construction. This shall include, but is not limited to:

- Concrete drawings with all dimensions specified (clearly showing the location of the lifting lugs)
- Concrete reinforcement drawings (plan view and sections)
- Notes pages, which captures:
  - Concrete grade
  - Finishes
  - Reinforcement grade and cover reinforcement
  - Sub-grade preparation with notes (detailing allowable baring capacity and so on)
  - Design life of building and lifting lugs
  - Design capacity of lifting lugs and lifting procedure, clearly identifying which lifting lugs to be used for transport, and loads imposed by lifting lugs
- Building certification of design and fabrication referenced for each individual drawing.

4.2.1 Permanent Plant Specific Requirements

Where storage requirements do not facilitate the use of indoor tanks and an external tank is required for dosing then a separate bunded area shall be provided. The bunded external tank area shall be designed for chemical storage capable of containing any chemical leaks or spills and shall be designed as a water retaining structure in accordance with Section 3 of this document.

The tank bunded area shall be covered with a carport type steel structure to provide sufficient weather protection for intermittent works within the bund and to ensure rainwater does not collect in the bunded area. The roof is to have sufficient storm water drainage and downpipes. The roof connections are to be bolted to minimise the works involved in removing the roof if a tank replacement is required. The roof shall be designed to withstand all forces associated with dead, imposed and wind loading as specified in AS1170.0, AS1170.1 and AS1170.2. The design shall be site specific to evaluate wind direction, topographic and shielding factors. The walls shall be clad to a height 1m below the roof line on all four sides.

Around the perimeter of the bund fence in compliance with the DTC 5000 series is to be provided to increase site security of the outdoor asset as specified by The Principal. The gate shall be fitted with a lock compatible with a Yellow CBY key (or PS1 key for Illawarra system).

4.2.2 Lifting Plan

As part of the design the Contractor shall provide a lifting plan for the CDU unit for installation and removal. The plan shall show the location of the crane and its outriggers and include the mass of the...
crane and the maximum force at each outrigger point. The lifting plan shall be site specific and include
the make and model of the crane used in the design. The lifting plan shall include details of the lifting
points and their maximum loads.

The lifting plan shall be reviewed by a geotechnical engineer engaged by the contractor who will
undertake any testing and calculations necessary to confirm suitable bearing capacity of the earth at
the outrigger location. Geotechnical engineer shall confirm the temporary works required to achieve
required bearing capacity at outrigger location and any works for locating the crane at the lifting point.

4.3 Bund Floor and Wall

Any chemical storage area in the CDU building shall be bunded in accordance with the requirements
detailed below. The bund shall be designed as a water retaining structure in accordance with AS
3735. It shall have the capacity of at least 110% of the total capacity of the tank(s) located within the
bund compartment.

The bund wall height shall be a minimum of 400 mm. The need for high bund walls needs to be
balanced against the more difficult access and emergency egress and the overall size of the building.
For wall height greater than 400 mm, access stairs are required in and out of the building. Where
access steps/stairs are required, they shall be provided on the inside and outside of the bund wall to
provide safe access and egress, in accordance with AS1657 and DTC drawings.

A high level alarm (connected to IICATS) shall be installed in the bund, to alert the operator that a spill
may have occurred. The alarm set point shall be agreed with the Principal, and cause an automatic
shutdown of the CDU.

The bunded area shall be designed with a 1 in 75 grade towards the sump pit such that no pools of
water/chemical will accumulate on the bund floor.

The bund wall and floor shall be coated with NOV coating systems in accordance with the Manual for
Selection and Application of Protective Coatings, WSA 201 and Sydney Water’s Supplement to WSA
201 ACP0166. This includes Magnesium Hydroxide bunds and sumps, although this is not required
for chemical protection but is a major aid to cleaning.

All pipework shall be run around the perimeter of the dosing room to minimise trip hazards, and as
far away from electrical wiring as practicable. With exception to the bund drainage pipe, all pipes shall
pass through the building wall above the top of bund wall.

4.4 CDU Internal Sump and Discharge Line

To allow for the management of any chemical spills occurring in the internal bunded area, it shall
drain to a low point recessed into the floor of the building. A DN50 PVC pipe shall be installed through
a penetration at the low point of the building. The penetration for this pipe through the CDU floor shall
consist of a PVC socket cast into the floor with a puddle flange glued to it (as shown in the drawing
DTC-7009) such that chemicals will not come in contact with the concrete. The PVC pipe shall
connect to either the delivery bund sump or a new sump (minimum dimensions 600mm x 600mm x
600mm) if the delivery bund sump is not at an appropriate location. The sump shall be fitted with a
lightweight lockable lid. A manual isolation valve shall be provided on this line.
Where it is feasible to drain any sump under gravity (typically a 100 mm pipe) to either a SPS inlet maintenance hole or a SPS wet well a drain line shall be run from the sump to the drain location. Refer section 3.4 of this Specification for sump and discharge details.

If a gravity arrangement is not feasible, then a manually started self-priming pump shall be permanently installed to empty the sump (refer Section 3.4).

The discharge line may be combined with the chemical delivery bay discharge line (refer Section 3.4). A recessed low point inside the chemical room of the building is to be located adjacent to the door to facilitate maintenance.

External sumps shall have a lockable, easily operated lid that will permit the addition of a sump pump. The lid shall prevent the ingress of rainwater and debris.

Where there is water supply within the CDU bunded area, a 50 mm overflow pipe shall be provided above the 110% bund directing the flow away from electrocals, operator accesses and where possible, to the delivery bay/intermediate sump. This can be provided through the wall of the CDU. The design shall include ready isolation of the water supply without the need to enter the bund.

### 4.5 Electrical Controls Room

The electrical controls room shall have an external entrance door opening outwards. The chemical delivery lines and water supply lines shall pass through a hole in the floor of the electrical controls room. The pipework shall rise above bund height and then enter the bunded dosing room. The pipework in the controls room shall be shielded with PE panels, designed to prevent impact damage to the pipes and prevent any leakage or spray from the pipes reaching the electrical and controls cubicles. Any leakage shall be diverted onto the floor of the room. The floor shall be sloped so that any leakage flows towards and out of the door and into the delivery bund.

The Contractor shall provide a table and chair in the control room.

### 4.6 Electrical

All electrical equipment in the chemical room, 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.

One 3-pin, 240 V power outlets must be provided in the electrical control room for power supply. An additional twin GPO should be provided in the RTU section of the control panel.

A high impact weatherproof IP 55 socket outlet shall be provided for the sump pump. This outlet should match that of the sump pump provided. Most often this is a single phase sump pump. The outlet shall be mounted inside the building, on the wall, a minimum of 300 mm above the bund level. Power lead to the pump shall be captive when the switch is in the on position. The outlet shall be provided with a chemically resistant, engraved plastic label (10 mm high minimum lettering) screwed to the wall above the outlet, indicating, “For sump pump - do not use for filling”.

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Warning - Document current at time of printing or downloading
4.7 Ventilation

Adequate ventilation shall be provided to prevent condensation build-up inside the building using door vents and extraction fans.

Separate electric ventilation fans shall be provided for the chemical dosing room and the electrical controls room. Where ferrous chloride/ferric chloride is the dosing chemical, the ventilation fans must run continuously, be corrosion resistant and be able to be operated via a 24-hour timer if required.

In other dosing systems, the fan is only required to operate when plant personnel are inside the CDU building. An automatic door switch on the CDU building shall be provided to automatically start the fans when the doors open, and stop the fans when the doors close. This switch will also log building access to RTU and turn on/off interior lighting.

The electrical controls room and chemical dosing room fans shall be mounted on the roof of the building. To provide adequate cross flow ventilation, mechanical vents shall be provided low down, preferably on the eastern wall, a minimum of 300 mm above floor level in the electrical room and above the bund level in the chemical room. These vents shall be vermin proof. The fans shall be capable of achieving 6-12 air changes per hour. The ventilation fans are not required to be monitored or controlled by the RTU.

If required, an air conditioning system shall also be provided for the electrical controls room.

4.8 Lighting

Internal and external lighting of the CDU building shall be provided to allow normal work to be carried out 24 hours a day. The external lighting shall be provided to cover the area where filling is to take place and the entry door.

The lighting installation shall meet all the applicable requirements of Sydney Water’s Technical Specification Part 3 – Electrical Works. Specific lighting requirements are described in the following:

1. A minimum illumination level for internal lighting of 400 LUX using LEDs shall be supplied and installed in each room. An automatic door switch shall be provided, to automatically turn on the lights when the CDU doors are open, and shut off the lights when the doors close. One emergency luminary with a 2 hour battery backup, shall be supplied and installed for each room.

2. The external lighting shall be 30W LED floodlight fitting. Glare from the fitting shall be carefully controlled for comfort. Lighting using unshielded lamps shall not be visible to the public at normal viewing angles.

3. The external lighting design shall be vandal proof. It shall utilise the building for mounting, where practicable. The lighting shall be controlled via a light switch located inside the control room in the CDU building. During automatic mode, the operation of the lights shall be controlled via a photocell. During manual mode, light can be switched on and off by operator with an ‘OFF’ 15 minutes delay to allow operators to safely egress the site with lights still on.

4. An overall site lighting study shall be completed after layouts are complete, including but not limited to, delivery bay, roadways, access road, gates and approach road.

5. Additional lighting shall be provided at roadways, gates and approach road.
4.9 Platform Ladder
A lightweight, corrosion resistant 1200mm high safety type platform ladder shall be supplied to provide access to the manholes of all tanks, level sensor, room lighting, and any elevated equipment. Platform ladder to be compliant with AS/NZS 1892 and any applicable SafeWork NSW requirements. Platform to include closable gate to provide fall protection on all four sides and to have braking system for the wheels to prevent movement during use.

4.10 Safety Equipment
Refer Section 3.5.

4.11 Chemical Manifest
If the chemical is above the Dangerous Goods manifest quantity (i.e. >10,000 L), then a Hazardous Material (HAZMAT) box shall be mounted just inside the site main entrance gate. A chemical manifest shall be provided in the box and shall meet the requirements of NSW Storage and Handling of Dangerous Goods Code of Practice 2005. Chemical manifest should comply with WHS Regulation 2017 Schedule 11. This typically contains the following details:

- Date of preparation
- Name and contact details of Occupier / Sydney Water Responsible Person
- Contact details for two people in case of emergency
- Details of dangerous goods storages including type, location, number and volume of tanks
- Safety Data Sheet (SDS) of the chemical
- A site plan of the premises which includes:
  - Location of essential site services, fuel and power isolation points
  - Location of fire extinguisher and safety shower/eye wash facilities
  - Location of the manifest
  - Main entry and exit points
  - Location and classes of dangerous goods storages and how they are identified
  - Dosing area
  - Location of all drains on site
  - Nature of adjoining water storage facility
  - Location of emergency assembly area
5 Chemical Storage Tank

Chemical storage tank(s) shall be provided for safe storage of the dosing chemical. The tank(s) shall be located within the bunded area inside the CDU building dosing room. The preferred arrangement of the tank(s) is furthest away from the control room and the entry door.

The storage tank(s) shall be designed and constructed to provide maximum draining of the tank and its connections while still maintaining the structural integrity of the tank walls and base.

Equipment, such as access hatches and level sensors shall be easily reached from the platform ladder for ease of operation and maintenance.

The storage tank shall be designed for the maximum delivery temperature of the chemical. This temperature will be advised by SWC or its representative.

The tanks provided shall be the tallest and thinnest available with sufficient access to the level transducer on top. Clearance above the tanks shall be a minimum of 500mm.

There are 3 acknowledged 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 oververt of the discharge to the invert of the overflow.

The storage volume shall be calculated from the Working capacity. Level sensors that communicate through IICATS operate between 5% & 90% of the Working capacity.

5.1 Material

The storage tank shall be manufactured from rotomoulded polyethylene or other material suitable for the chemical specified. It shall be designed and constructed in accordance with AS/NZS 4766. Where the dosing chemical is a corrosive substance, the chemical storage tank shall be resistant to chemical attack and designed and constructed in accordance with the relevant requirement of AS 3780. A minimum of 1.5 times the specific gravity of the fluid to be stored in the tank shall be assumed for calculation of 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 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.

All stub flange nozzles shall be complete with stiffened gussets and supplied 316 stainless steel backing rings, ANSI 150. For indicative tank layout drawing including all required appurtenances refer to DTC drawings.
5.2 Structural
The tank shall be suitably reinforced and supported to withstand all forces, including filling forces, without deforming when it is full. The tank shall be fabricated such that the top of the tank is capable of supporting the weight of maintenance personnel.

For a FRP tank, it shall be anchored and mounted on a suitable concrete plinth. Suitable lifting lugs shall be fitted. Bitumen sealed mats must also be installed between the storage tank and concrete plinth.

Where the tank requires a mixer, such as when magnesium hydroxide is used as the dosing chemical, the mixer shall not be supported by the tank.

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

For any other tank, the minimum dimension of the side access hatch is 600 mm diameter. The side access hatch shall be hinged to the tank wall.

The hatch shall be made from lightweight materials, weighing no more than 16 kg, in accordance with AS 3996, Class A. Weight limits shall be labelled where appropriate.

When magnesium hydroxide is used as the dosing chemical, the access hatch shall provide sufficient sealing to prevent humidity loss.

5.4 Tank Inlet and Outlet
Tank shall be as per the DTC drawings and have a minimum of the following pipework features:

- One 50 mm diameter vent (breather) on the apex of the tank roof shall be supplied. The vent shall run from the top of the tank grading up to an external vent with a conical top sealed with vermin proof mesh.

- One 80 mm diameter overflow branch. The overflow line diameter should be at least 1.5 times the diameter of the filling line. The overflow line shall 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 shall terminate in a water trap consisting of a bucket supplied by the Contractor.

- One drain branch with minimum diameter of 50 mm shall be provided as close to the tank floor level as practicable.

- One 50mm diameter fill pipe to the top side inlet from tanker unloading point, complete with a fill valve. A 50 mm suitable male camlock style fitting, with cover, shall be supplied and installed at the tanker filling point. This pipe shall rise vertically and then slope downwards towards the tank (1 in 100 fall). It shall enter the top of the chemical storage tank and be located above the level of the overflow pipe.

- Two suitably sized branches in the tank roof of the tank for Ultrasonic level transmitter fitted with female camlock connection. One shall be used the other is to be a spare, both are to be located in positions which are accessible from a moveable access platform.
• One suitably sized branch in the roof of the tank for the relief line return from the chemical dosing cabinet.
• One suitably sized bottom side outlet. It shall be located 100 mm above the tank floor. It shall be fitted with a manual isolation valve and a motorised isolation valve which shall have a battery backup sufficient to drive the valve close in a power failure.
• Two 25mm Diameter branches located in the same vertical plane at appropriate levels for the installation of a magnetic level indicator. An additional branch may be required if the level switch low is not integral with the magnetic level indicator.
• Automatic cut out during filling when the tank reaches High Level (90%).
• Automatic cut out during dosing when the tank reaches Low Low level (5%).
• Isolation (stop) valves on each of the inlet and outlet connections.
• All branches on the tank shall 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.
• If multiple tanks are used in a balanced or train arrangement, all interconnecting or balancing pipework shall be adequately sized such that filling the primary tank will collectively fill all interconnected tanks without the need to wait for tanks to balance.
• 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.

5.5 Level Instruments
An ultrasonic level indicator to show the level/quantity of the contents inside the tank shall be provided above the overflow line. It should be mounted on a removable camlock style fitting and easily accessible from a platform ladder. The transmitter shall be connected to the control and telemetry system to allow remote monitoring as specified in Sydney Water’s IICATS Sewer Odour and Corrosion Standards TOG_TS08. 0% level shall be at the bottom of the tank and 100% must be at invert tank overflow.

In addition to the ultrasonic level indicator, a visible indicator shall also be provided. A transparent tank with level markings is acceptable. Otherwise the transparent tube 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 separate capacitance type High Level (95%) switch (LHL) and automatic cut out during filling shall also be provided.

A separate capacitance type Low Level Switch (LSL) shall be provided.

An alarm is to be sent to IICATS if the tank is dropping too fast, indicating a major leak. Rate of drop to be confirmed with SWC controls team.

5.6 Digital Display
A weatherproof digital display of the tank level 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. The digital display for tank level shall be suitable for operation with 24V DC power supply. It shall be equipped with
sunlight readable LEDs and a minimum reading range of 10m. It shall be suitable to display percentage values.

The digital display shall have a minimum rating of IP 56, and shall be installed with suitable mounting accessories. The digital display shall be mounted on the fill line above the isolating valve as shown in the DTC drawings.

5.7 Additional Requirements for Magnesium Hydroxide Tank(s)

When magnesium hydroxide is used as the dosing chemical, the following requirements shall also be met:

5.7.1 Storage Tank(s)

- The inside walls of the tanks shall be smooth, so that no accumulation of chemical precipitate occurs on the internal tank walls, ribs or bends;
- The tank, including the vent and overflow shall be completely water sealed;
- The overflow pipeline from the storage tank shall be provided separate to the tank drain line and have a downstream water seal to prevent loss of humidity in the tank;
- Include an outlet pump suction nozzle separate to the drain line, as close to the tank floor as practicable. This outlet shall be a 50 mm diameter pipe. The outlet shall extend into the storage tank and be chamfered such that the opening is pointing in the opposite direction of mixing;
- Include an isolating valve fitted on the outlet to the pump suction nozzle as close as practicable to the tank wall then an IP 57 Stainless Steel Gr. 316 motorised valve. The motorised valve shall close on power failure. Refer PIDs.

Storage Tank Mixer

A slurry type chemical such as magnesium hydroxide requires a tank mixer to keep the slurry chemical in homogeneous state. It shall be supplied with, but not limited to:

- Mixer to be a minimum of 1/3 the diameter of the tank, mixer blade size and spec ification to be confirmed with SWC chemical dosing team staff prior to purchase. Lifting arrangement to be provided for safe retrieval of mixer.
- 200RPM mixer with VSD, bottom blade of mixer must sit at discharge outlet level. Second blade at 1/3rd up.
- Bottom blade angled, top blade paddle shaped.
- Mixer shaft shall rest in locator welded to the base of the tank.
- Mixer to be capable of being split in two sections in order to be able to remove the mixer from the tank without removal of CDU roof. Shaft shall be removable from drive.
- Mounting hole to be square cut in top of the tank to limit the high torque applied to the tank roof. Tank manufacturer to confirm suitability of the square cut for mixer torque forces.
- Impellers and shaft made from 316 grade stainless steel;
- The ability to stir the chemical from its minimum to maximum depth. A galvanised steel-mounting frame, structurally independent of the mixing tank;
• Automatic control and manual capability;
• A control timer to set the mixer running time;
• A neoprene or similar suitable material gasket shall be provided around the mixer shaft to prevent humidity loss.

Mixer blades should extend to a height just above that of the discharge outlet to maintain agitation of the MHL down to Low Lever Cut-out

5.7.2 Batching Tank (if required)
This section to be revised when updated standard designs for magnesium hydroxide dosing are available.

At low pumping rates (below 10L/hr), magnesium hydroxide may solidify and cause blockages. As such, the design of low dose rate systems involves a batch tank, to make a diluted magnesium hydroxide slurry to dose at greater than 10L/hr.

Where a batch tank is required, the following shall be met:
• The inside walls of the batch tank shall be smooth so that no accumulation of chemical precipitate occurs on the internal tank walls, ribs or bends;
• The tank shall include an overflow pipe fitted at the High High (HH) alarm level and installed such that excess liquids drain away from trafficked areas and to the bund sump;
• Separate fill lines for magnesium hydroxide and dilution water into the batching tank shall be provided. They shall enter directly into the top of the batch tank;
• The dilution water pipework shall include an isolation valve, flow switch, rotameter, solenoid valve(s) and non-return valve(s). The rotameters shall have a minimum length of 250 mm. A flow switch shall be installed on the common line to provide a “dilution system failed” alarm (failsafe) as an input to the IICATS RTU, on low flow;
• The dilution water solenoid shall be made of materials compatible with magnesium hydroxide dosing, and set to open on low level alarm from the level sensor. It shall be set to close on level sensor high alarm;
• A transfer pump shall be provided to transfer concentrated magnesium hydroxide from the storage tank to the batching tank. It will be PLC controlled, started on low alarm from the level sensor and stop on a timer. The pump shall be identical to the dosing pumps used in the unit, and set at a constant speed. A Doppler flow meter shall be installed outside of the transfer line in order to confirm transfer of chemical.
• A level sensor shall be provided to control the batching process. A high level alarm (H) shall stop the dilution water by closing the dilution water solenoid. A low level alarm (L) shall be used to begin the batching process. A low low level alarm (LL) shall inhibit dosing pumps, and a no change alarm will inhibit the process and raise an IICATS alarm. The level sensor shall be located such that the mixing and fill line operation do not interfere with the level sensor's accuracy. A “dilution system failed” alarm (failsafe) as an input to the IICATS RTU, shall be raised on the following conditions:
  o Dilution water low flow
  o Level sensor HH
- Level sensor LL
- Level sensor no change
- Transfer pump no flow

- A batching tank mixer shall be provided. The batching tank mixer shall comply with the requirements of the Storage Tank Mixer with the exception that it will operate at a speed between 150 and 1,500 rpm. A variable speed drive shall be attached to the mixer;

- The tank shall have a conical bottom with a manual ball valve at the lowest point to allow the slurry to be fully drained out. An IP 57, stainless steel, three-way motorised valve that closes off chemical supply on power failure shall be provided after the manual valve. This valve inhibits dosing pumps when closed as this line feeds the dosing pumps and enables flushing water to clear the dosing line.
6 Dosing System

The required dosing system shall be designed to provide a reliable, continuous dosing of metered volumes of chemical. Where more than one dosing chemical is used, each type of dosing chemical shall have its own dosing system. 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. The system shall be capable of operating in both automatic and local manual modes.

The system shall be supported by suitable supports for the required pumps, valves, fittings and pipework (uni-strut is not considered suitable), all pipework to be supported by pipe manufacturer proprietary product as they allow for movement without damage.

6.1 CDU Dosing Pumps and Pipework

Refer Appendix A: DTC drawings for a list of generic P&IDs.

6.1.1 Ferrous Chloride / Calcium Nitrate

Pumps

Two identical duty and standby digital dosing pumps of suitable type and capacity range, shall be provided for dosing. The switchover to the standby pump shall be automatic via IICATS. Automatic changeover between pump duties shall be configured on pre-set time as well as pump fault.

The dosing pumps shall be designed to allow minimum dosing during the initial operation of the CDU.

The dosing pumps shall be digital with a turndown ratio of 500:1 or better. Solenoid-driven pumps, double simplex capabilities via multiplexing and ganging of gearboxes are not acceptable.

The pumps are to incorporate digital indication of the set rate. Metering accuracy of the pumps shall be better than 2.5% of the set rate at a variable suction head.

Each pump shall be fitted with an external pressure relief valve, vented back into the calibration vent line returning into the storage tank.

Approval from the Principal shall be sought prior to procurement of pumps to be installed in the CDU.

Pipework and Appurtenances

Adjustable pressure retaining valves shall be incorporated on each discharge line from the dosing pumps to maintain dosing accuracy over the range of operating depths in the storage tank, and to act as anti-syphoning protection.

Duty and standby suction strainers with an opening of 1.5 mm shall be provided.

6.1.2 Dosing Cabinets

The pumps and associated instruments shall be enclosed in a polypropylene dosing cabinet, thickness of plate may vary depending on size and weight of the pumps required and shall be designed specifically to the requirements of each unit. The doors to the cabinet shall be transparent (polycarbonate) for safe viewing of the dosing system.

The dosing cabinets shall be designed for ease of access and pump maintenance. There shall be a divider in the centre of the dosing cabinet to separate the two dosing pumps. There shall be a catch pot on the base of the dosing cabinet to ensure all spillages are contained and directed to the sump. A high level switch to detect fluid in the catch pot will be hardwired interlocked to stop the dosing pumps when activated. The cabinet requires adequate ventilation.
Dosing pipework from the point it exits the dosing cabinet shall be double contained and drain back to the dosing cabinet for pipework within the CDU building.

All valve handles are to be lockable.

6.1.3 Magnesium Hydroxide (Neat or Batched)

Pipework needs to be clearly labelled for direction of flows as well as the fluid contained in it and appropriately colour coded according to WSA 201 and Sydney Water’s supplement to WSA 201.

When a slurry type chemical such as magnesium hydroxide is used as the dosing chemical, there is an option to operate the dosing system in either “Neat Mode” or “Batch Mode”. At low pumping rates, magnesium hydroxide may solidify and cause blockages. As such, the design of low dose rate systems involves a batch tank to make up diluted magnesium hydroxide slurry for dosing.

A generic P&ID of these systems are provided in DTC drawings.

Pumps

Two identical duty and standby dosing pumps Bredel or equivalent of suitable capacity range, shall be provided for dosing. The switchover to the standby pump shall be automatic via IICATS. Automatic changeover between pump duties shall be configured on time as well as pump fault.

The pumps shall be fitted with a cooling fan on the motor to enable to operate at low speed. The fan is not to be separately monitored or controlled but integrated into the pump.

If a batching system is selected, a third identical pump shall be provided for chemical transfer.

All pumps shall be peristaltic type and have adjustable speed. The minimum and maximum operating speeds shall follow the manufacturer’s operating instruction to prevent overheating, excessive wear or damage.

Turndown shall be carried out using a variable speed controller. If turndown cannot be achieved using a single pump, multiple pumps shall be used. The pumps shall be designed to allow minimum dosing during the initial operation of the CDU.

A dose rate turndown ratio of 30:1 shall be provided.

Pump speed shall not exceed 3000rpm at 50Hz.

Approval from the Principal shall be sought prior to procurement of pumps to be installed in the CDU.

- Pipework and Appurtenances

Refer Section 2.5.2 for all piping requirements for Magnesium Hydroxide

Flexible piping shall not be used except where specified on the P&ID.

Spare tubing, fittings and lubricant shall be provided for each pump supplied.

Where a batching tank is installed, the magnesium hydroxide pipeline shall enter the batching tank directly from the top of the tank. This line shall not be mixed with the dilution water line before entering the tank.
6.2 Not Applicable to Chemical Dosing Unit

6.3 Dosing Cabinets
Refer Section 6.1.2.

6.4 Pulsation Dampeners at Pumps
Pulsation dampeners shall be provided in the discharge pipework from the dosing pump and shall be suitably sized for the displacement of the pump so that discharge pressure fluctuation does not exceed 10%. The pulsation dampeners shall have a diaphragm separating the air chamber from the liquid chamber. The air chamber shall be pressurised, and be capable of re-pressurising by air pump via a Schrader valve. A pressure gauge shall be installed. The position of the pressure gauge shall be located before the pressure relief valve and the loading valve.

Where possible, pulsation dampener should be located vertically at the top of the common discharge from the dosing pumps, such that discharge flow is directly into the dampener before a change of direction along the dosing line.

6.5 Depressurising, Flushing and Draining
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 fitted with a camlock style fitting. The valving shall be provided to allow for flushing of the chemical dosing lines without dismantling the lines.

A 20mm Male polypropylene camlock style fitting shall be provided on all flushing points to match that on the hosereel.

A 50mm Male polypropylene camlock style fitting shall be provided at the chemical filling line fitted with a lockable cap.

All camlocks are to be supported.

Where magnesium hydroxide is used as the dosing chemical, an automatic flushing system connected to a dedicated timer, shall be installed for the outlet line to flush excess magnesium hydroxide that may settle and clog the line.

6.6 Automatic Isolation Valves
The automatic isolation valve shall be a motorised PVC-U ball valve (stainless steel where magnesium hydroxide is the dosing chemical). The valve shall consist of two separate modules – the valve body and the actuator. The valve shall include a compact electric actuator capable of open/close feedback and be complete with position indicator and a facility for manual control. The valve position signal shall be sent to the control system. The valve shall close on power failure and the actuator shall be IP 65/67 per EN 60529.

6.7 Pressure Transducer Indicator
Where dosing is going into a pressure main, a pressure transmitter shall be installed and interlocked to stop the dosing at high pressure.
### 6.8 Dosing Chemical Flowmeter

A flowmeter (magnetic and Teflon coated type preferred) shall be installed in each common dosing line (typically prior to the pressure sustaining valve). There shall be sufficient upstream and downstream straight pipe run to prevent flow disturbances affecting the flowmeter. The dosing flowmeter shall be calibrated to units of litres per hour. The flow meter shall measure the flow and transmit the flow signal to the control system. The flow meter shall display the flow rate and any error messages.

Flowmeter shall be flanged to ANSI 150.

This is not required for systems where the dosing chemical is a slurry type, such as magnesium hydroxide.

### 6.9 Carrier Water System

Carrier water shall be piped from the service water system to provide a minimum dilution ratio of 10:1 of carrier water to dosing chemical. If site pressure is not able to accommodate 10:1 ratio then booster pump must be installed in the CDU. The contractor shall determine the capacity of the booster pump including pipeline and RPZ and valve losses.

Flow from the carrier water line shall pass through an isolation valve, flow switch, rotameter, actuated valve(s) and non-return valve(s). The rotameters shall have a minimum length of 250 mm.

Actuated valves shall be solenoid valve for lines <50mm and motorised valve for lines ≥ 50mm.

Actuated valves, isolation valves and all other items of equipment in the carrier water system must be compatible with the chemical being dosed.

A flow switch shall be installed on the common line to provide a “carrier water system failed” alarm (failsafe) as an input to the IICATS RTU, on low flow.

A suitably sized RPZ valve shall be provided in the carrier water line for backflow prevention.

Only proprietary back flow prevention devices shall be used.

Where dosing chemical is a slurry type such as magnesium hydroxide, the carrier water system is used as a flushing system. This is to flush the dosing lines clean of magnesium hydroxide once dosing is complete.

The flushing water shall operate with a dedicated timer, where a solenoid valve shall open and flush the dosing line and the solenoid valve will close at the end of timer duration. The flushing line shall have a pressure indicator installed.

Where recycled water is available, it shall be used for the carrier water (excluding eyewash facilities and safety showers, which are connected upstream of the RPZ). The recycled water supply line shall also be fitted with an RPZ (work by site contractor).

### 6.10 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 shall be installed.
One duty pump of suitable type and capacity range, shall provide the required flow and pressure requirements. The booster pump is not controlled or monitored by the IICATS control system and requires integral or independent controls.

Approval from the Principals representative shall be sought prior to procurement of pumps to be installed in the CDU.

6.11 Double Containment of Filling and Dosing Lines

Chemical dosing lines outside of the bunded area must be a pipe-in-pipe arrangement. The intention is to prevent a leak in the pipe from contaminating the soil and groundwater, and to protect it from accidental damage. Care must be taken with the design and installation of the outer pipe so that leaks from the inner pipe can be readily detected and shall be sealed to stop ingress of ground water.

Concrete encasement of a conduit for the containment lines when laid in ground is acceptable.

Double containment from within the bunded area through to the dosing point shall be constructed in such a way to facilitate replacement of dosing line without excavation of that section of pipe. Continuous PE or pressure rated uPVC pipe are preferred.

Where requested, an additional dosing line shall be installed as a backup.

Leak detection shall be included in accordance with Sydney Water’s Technical Specification Part 2 – Mechanical Works.

6.12 Dosing Point

6.12.1 Pressure Sewer Dosing

When dosing into a pressurised sewer, the following must be included in the dosing point design;

- Pressure dosing must be located in a pit.
- Have a 20mm valved drain/flushing line fitted to the main with hose connection point.
- Have a high level switch (LSH) in the pit to detect flooding or chemical leakage.
- Have an isolating ball valve and a non-return valve.
- Have a flexible PE dosing line fitted with compression fittings for <20mm Dosing line and fusion welded for >20mm dosing line
- Be fitted with double isolation ball valve at the tapping point. For Tapping point configuration refer to DTC Drawings.
- The pit is to drain back to the delivery bay sump where possible. Drain line to be fitted with an isolation valve.

6.12.2 Gravity Sewer Dosing Point

For gravity sewer dosing, a maintenance access hole shall be used for the dosing point. A suitably sized guide tube shall be installed down the wall of the maintenance access hole for the dosing line to be fed down. The outlet of the dosing line shall be positioned so that chemical flows directly into the flow without splashing chemical on the walls of the maintenance access hole. Mechanical compression elbows shall be used inside the maintenance hole for maintenance access.
6.13 Leak Detection Pits
Leakage detection pits shall be installed at low points in the double contained dosing line. The double containment pipe shall end at this pit to allow any leaks in the dosing lines to partially fill the pit. The leakage detection pit shall be fitted with a LSH switch to detect a leak. The LSH signal cable shall run back to the CDU and be connected to the controls cubicle. The signal shall stop the dosing system and send an alarm to the RTU.

If the leakage detection pit is next to a gravity sewer maintenance access hole being dosed it shall have an overflow above the LSH switch level feeding into the maintenance access hole with a flap valve to prevent sewer gas backflow into the leak detection pit.

6.14 Gas Sampling
Sydney Water requires installation of H₂S gas monitoring equipment at a maintenance hole location downstream of the CDU. The location of which is to be nominated by Sydney Water. The online equipment shall be to Sydney Water’s requirements.

6.15 Sewer Flow Meters
An inline flow meter is required to be installed on installations which dose into sewage pressure mains. This enables flow paced chemical dosing to be performed on the pressure main.

A non-intrusive ultrasonic flow meter shall be used. Magnetic flow meters are not acceptable.

The CDU contractor shall provide power and control functions from the CDU cubicles for the flowmeter.

A sample line shall be provided downstream of the flowmeter.

6.16 Not applicable to Chemical Dosing Unit

6.17 Labelling and Identification
Labelling and identification of equipment and structures shall follow the requirements of Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects
7 Submission
The following shall be submitted to the Principal’s representative for approval prior to ordering.

7.1 Design Drawings
Design drawings of the proposed CDU installation shall be provided. They shall cover all design issues including:

- Location of the CDU on site including access and egress points, delivery bunds, drains, services, dosing lines, pits and where required, truck turning bays (general arrangement);
- Process & Instrumentation Diagram (P&ID) drawing(s) with an associated list of equipment, material and size details. Supplied by the Principal with this specification;
- Position and layout of all equipment including pipework and storage tank (dimensional layout – plan and elevation). Supplied by the Principal with this specification;
- Electrical drawings (including circuits, control systems, equipment lists, manufacturer general arrangement, items, list, site general arrangement, conduit sizes and locations).
- Structural drawings, including the building

The drawing format shall be in accordance with Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects.

The Contractor shall submit all “Work-As-Constructed (WAC)” drawings, as follows:

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7.2 Operating and Maintenance Manual
A draft Operating and Maintenance (O&M) Manual for the CDU shall be prepared and submitted to the Principal’s Representative prior to SAT. It shall be finalised and re-submitted after successful commissioning of the unit.

An exploded view of pump and consumables list is required in the O&M manual.

A template for the O&M manual is included with this specification.

The O&M manual shall be in accordance with Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects.
7.3 Critical Spare Parts

The Contractor shall supply critical spare parts lists for the installation. The list of critical spare parts shall be discussed and agree with the Principal's Representative prior to procurement. SWC may purchase critical spares from the Contractor or elsewhere.
8 Testing and Commissioning

Factory Acceptance Testing (FAT) of prefabricated units needs to be conducted in the presence of representative(s) from the Principal's end once all operation and maintenance manuals are complete and an updated set of all drawings are made available. Typical FAT requirements are outlined in Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects. This needs to be conducted prior to installation of the unit at the site.

Following installation, the CDU shall be tested and commissioned in accordance with Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects. The checklist in Appendix 1 and 2 of Sydney Water's Asset Commissioning Standard Administration Procedure (SAP) IMS0035, shall be used by the Commissioning Coordinator to ensure all of the Principal's requirements for asset commissioning are met. The Contractor shall develop a Commissioning Plan based on IMS0035 which shall be submitted to the Principal's representative for review. Written approval from the Principal's representative shall be sought prior to commissioning.

An example Commissioning checklist is shown in Appendix F.

The Contractor shall provide the necessary expertise and resources for successful commissioning of the unit.

In addition, the following tests shall be carried out:

8.1 Hydrostatic Test and Leak Detection

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.

8.2 Commissioning Test Run

For the purpose of the Site Acceptance Test (SAT), a test run shall be undertaken in accordance with the Contractor’s site commissioning methodology, which shall be approved by the Principal’s Representative. The test run shall be a minimum of one month in duration. Typical SAT requirements are outlined in Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects. The test run shall be carried out in the following stages:

- Manual operation using water.
- Automatic operation using water.
- Manual operation using chemical.
- Automatic operation using chemical.

Commissioning shall be deemed complete when the whole of the works are capable of running 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 SAT 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 to Sydney Water. The Contractor shall carry out any work necessary to ensure the unit is working correctly.

The reduction of the dissolved sulphide in the downstream sewage shall be recorded by SWC or its representative and used to adjust the dose rate.

At the end of this period, the Contractor shall issue a certificate stating the outcome of the testing and commissioning to allow Handover, in accordance with Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects.

8.3 Building Certification

The Contractor shall provide all building certification documents for design and certification of the unit to the Principal.

8.4 Submission of Work As Constructed (WAC) Documents

The Handover is not complete until all WAC documents, such as detailed drawings, O&M Manuals, FMECA documentation, MAXIMO entries and so on, have been submitted to the Principal’s Representative. Refer to Sydney Water’s Maintenance Related Clauses for Capital and Operational Projects. This is a Hold Point.

8.5 Handover

The Asset Commissioning SAP as detailed in SWC ‘Maintenance Related Clauses’ shall be followed to ensure all issues are finalised before handover of the CDU to Sydney Water.
9 Document Control

**Title:** Chemical Dosing Unit Standard Specification

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**Document owner:** Ken Wiggins – Urban Design & Engineering Manager

**Prepared by:** Jason Smith – Senior Mech Engineer - UD&E

**Stakeholders Consulted:**
- Leighton Cramp – SCADA Project Engineer
- Gino Iori – Service Delivery Officer Level 6 - CD
- Jeff Scott – Plant Manager Level 1 - CD
- Barry Cook – PO Chemical Dosing Level C - CD
- Darren Azzopardi - PO Chemical Dosing Level C - CD
- Peter Haylock – Design Engineer - DM
- Daniel Blackwell – Design Engineer - DM
- Milan Rubcic – Lead Engineer (Mechanical) – UD&E
- Anthony Sinton – SCADA Engineer

**Approved by:** Ken Wiggins – Urban Design & Engineering Manager

10 Change History

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<td>August 2008</td>
<td>Louisa Vorreiter</td>
<td>Jerry Sunarho</td>
<td>First Issue</td>
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<tr>
<td>2</td>
<td>February 2011</td>
<td>Janssen Chan</td>
<td>Sally Rewell</td>
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<td>3</td>
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<td>Janssen Chan</td>
<td>Derek Cunningham</td>
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<td>4</td>
<td>October 2018</td>
<td>Ken Wiggins</td>
<td>Jason Smith</td>
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Appendices
### Appendix A: DTC Drawing List

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Appendix B: Sydney Water Asset Data Management and Commissioning

Refer Maintenance Related Clauses

Information on Inspection & Test Plans and Defects Rectification Plan can be found Sydney Water's Asset Data Management & Commissioning SAP (IMS0035).

A sample “New Location Listing For Assets” template is shown in the succeeding table. More information can be found from Sydney Water’s Asset Knowledge* group page on iConnect.

MEPR0063.02: Maximo (MXES) - Location Number Request Form for New/Existing Assets

Instructions:
1. Columns marked in RED are mandatory for Service Provider.
2. Sydney Water will allocate Maximo Location Numbers for finalisation of the P & ID for Assets.
3. Reference on P & ID (by Service Provider) is a temporary identifier until Location Number is allocated by Asset Data Management.
4. Examples (below highlighted in blue) are given for guidance only.
5. Do not over write or delete blue example area. Start entering your data after the last blue line (Line 18)
6. Please email completed spreadsheet and P & ID diagrams to AssetDataMgmt@sydneywater.com.au
7. For further assistance, please contact the Asset Data Management representative of Sydney Water.

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NOTE: * Asset Knowledge is the new business unit name for the previous Asset Data Management.
Appendix C: Construction Hazard Assessment Implication Review (CHAIR)

CHAIR Safety in Design Tool, developed by Work Cover NSW needs to be carried out in three phases namely:

- **CHAIR-1**: Conceptual Design Review (To be completed by the Contractor)
- **CHAIR-2**: Detailed Design Construction or Demolition Review (To be completed by the Contractor)
- **CHAIR-3**: Detailed Design Maintenance & Repair Review. See attached CHAIR 3 report prepared by SWC for the standard CDU Unit.

More information as to guidewords and how to conduct CHAIR can be found at [Work Cover NSW](https://www.workcover.nsw.gov.au).

### CHAIR – 3 - Minutes Recording Table

Below is the link to the CHAIR 3 report prepared by SWC for the standard CDU unit (Ferrous Chloride or Calcium Nitrate) as well as the CHAIR 3 report prepared by SWC for the standard Magnesium Hydroxide CDU unit.

[https://elogin.ads.swc/BMIS/SWDocControl.nsf/AllActive/ACP0002.01/$FILE/ACP0002.01.pdf](https://elogin.ads.swc/BMIS/SWDocControl.nsf/AllActive/ACP0002.01/$FILE/ACP0002.01.pdf)
Appendix D: Operations & Maintenance Manual Template

Please find link below to Appendix D

https://elogin.ads.swc/BMIS/SWDocControl.nsf/AllActive/ACP0002.02/$FILE/ACP0002.02.docx
Appendix E: SWC Guide to Proven Products

Please find link below to Appendix E

https://elogin.ads.swc/BMIS/SWDocControl.nsf/AllActive/ACP0002.03/$FILE/ACP0002.03.docx
Appendix F: CDU Commissioning Checklist

CDU Site Commissioning Checklist

Prior to commencing commissioning the following mandatory requirements to be addressed:

a. Latest revision of construction drawings are provided including:
   o Electrical.
   o Process & Instrumentation Diagram.
   o Civil showing pipework layouts, services and operational valve locations.

b. A draft copy of the O&M manual is available.

c. A copy of the function design specification is available.

d. The relevant IICATs RTU I/O listing is available.

e. Dosing Pump performance curve is laminated and attached to control room wall.

f. Completed Inspection & Test Plans as well as Factory Acceptance Test Documentation.
   - Sign off from IXOM (formerly ORICA) for installation conformance to chemical delivery requirements.
   - SWC Bi-Lock barrels to suit the CBY key are installed on the access doors to the Chemical Dosing Unit. SWC Bi-lock padlocks to suit the CBY key are installed on all pit covers and site access gates.

g. Access doors to the Chemical Dosing Unit are able to be secured in the open position.
   - Externally located electrical meter panels where supplied will have a spare key provided to suit the energy suppliers proprietary padlock.

h. Delivery bund complies with capacity requirement as per ACP0002.

i. Power to the Chemical Dosing Unit is connected and phase rotation is correct.
   - A label clearly identifying the origin of the electrical sub-circuit is provided above the main isolator for the Chemical Dosing Unit.

j. Potable & Non-Potable water is connected.
   - Potable water pressure is adequate at all times of the day to operate the safety shower (minimum 75.7 L/min @ 210 kPa).
   - Potable and Non-Potable RPZs are clearly labelled, protected by vandal resistant cages and fitted with SWC Bi-Lock padlocks that suit the CBY key.
   - Externally located taps are fitted with vandal resistant handles and are clearly labelled NON POTABLE, DO NOT DRINK.
   - A roof mounted retractable Hose Reel (UTY) c/w camlock fitting and hose nozzle is provided and has sufficient length to reach the entire truck delivery bund.
• The chemical dosing line is installed according to site design either in a dedicated chemical dosing pit or where installed in a gravity sewer system, into the Inlet Maintenance Hole, to direct chemical delivery into the centre of the incoming sewerage flow. The dosing line is appropriately supported and terminated to allow future removal and re-installation where possible, negating the need for confined space entry.

• The IICATs RTU is operational, program is loaded and communications available (3G or Fibre Optic).

• Internal and external lighting is operational.

• Ventilation fans are operational.

• All electrical instrumentation is programmed and correctly ranged including:-
  o Variable Speed Drives. (VSD)
  o Digital Dosing Pumps. (PMP)
  o Level Transducers. (LTX)
  o Pressure Transducers. (PTX)
  o Flow Transducers. (FTX)
  o Set-point relays within Analogue Level Displays. (FIX)
  o Programmable Level Switches. (LSH, LSL)
  o Programmable Flow Switches. (FSL)

• Motor thermal or electronic overloads are correctly set to the F.L.C. of the motors.

• Time clocks if applicable are programmed.

• Automatic Valves are configured for open / close operation and feedback position indication.

• Chemical Storage tank holds sufficient water to conduct automatic and manual testing (i.e. above low-level cut-out).

• Pressure loading and relief valves are adjusted to the required operational pressures and marked accordingly. (PCV, PRV)

• Pulsation dampeners are charged with nitrogen to 80% of system design operational pressure. (DMP)

• All internally and externally located equipment is labelled with allocated MAXIMO numbered tags as required.

• Appropriate valve isolation keys and or handles are provided for operation of below ground valves and removal of associated pits or covers.

• Relevant site safety signage is securely affixed to access doors and is clearly visible when doors are open.

• Safety Shower and eyewash signs securely affixed to the wall and door as required.
• DG Labelling is correct and affixed to the chemical storage tank. A tank capacity label is affixed to the tank.

• DG labelling is also affixed to the external wall of the building so it is clearly visible when approaching from the access roadway.

• All chemical pipework is correctly labelled for the chemical to be dosed. Direction of flow is clearly indicated.

• Potable and Non-Potable water pipes are correctly labelled.

• HAZCHEM signage is attached to site access gates.
  - Site access gates are able to be secured in the open position.
  - HAZMAT box is installed inside the site perimeter fence and contains site safety folder (applicable for chemical installations over 10KL).
  - All plug-in electrical equipment is tested and tagged.
  - A dry powder fire extinguisher is located on the wall of the control room and is tested and tagged.
  - Fire extinguisher signage is affixed to the wall above the extinguisher.
  - A suitable mobile platform ladder is located within the process room for access to instrumentation located on the roof of the chemical storage tank. Instrumentation as well as the tank manway should be within easy reach whilst standing on the ladder. The level transducer (LTX) should be able to be removed for cleaning without unscrewing from the tank.
  - A table, chair, document storage and spare parts cabinet (if required) are supplied in the control room.
  - Electrical control panel is lockable with either a standard electrical switchboard key (92268, CL001) or SWC padlock.

Chemical Dosing Unit Sequence Testing

k. RTU Digital and Analogue Inputs
  - Manually activate each RTU input and confirm both local and remote operation.
  - RTU Digital and Analogue Outputs
  - Remotely activate each digital and analogue output to check for automatic sequence operation.

• Drop test each Dosing Pump (PMP) to confirm correct calibration to the chemical dosing Flowmeter (FTX)

• Sequentially run each Dosing Pump (PMP) in manual and check for the following operations:-
  - Standby Dosing Pump is interlocked from operation when Duty Dosing Pump is running.
• Place both of the Dosing Pumps (PMP) in auto and check for the following operations:

  o Dilution Water Solenoid (SOV) activates when Dosing Pump runs. Dilution Water Running light illuminates. Dilution water Rotameter (FIX) is set to provide a dilution water flow of 20:1 to that of the Dosing Pump.
    - Isolate the dilution water and check for correct operation of the Dilution Water Low Flow switch (FSL) and associated alarm input on the RTU.

  o Switch off the duty Dosing Pump local isolator, the duty Dosing Pump stops, pump fault light illuminates and the standby Dosing Pump starts running.

  o Dosing Pumps drive throughout the diurnal profile speed range or speed set-points programmed in the RTU.

  o Dosing Pumps stop operation and the auto valve closes in accordance with the FDS when associated interlocks are activated. These interlocks include:-
    - Process Room Bund High Level (LSH)
    - Dosing Cabinet Catch-pot (if applicable) (LSH)
    - Secondary Containment High Level (if applicable) (LSH)
    - Dose Pit High Level (if applicable) (LSA)
    - Storage Tank Low Level (LSL & LSC)
• Where applicable, the storage tank agitator (MIX) is correctly sized and located within the storage tank to adequately agitate the entire tank contents to a minimum level equal to the low level cutout (LSL & LSC) of the storage tank.

• Where applicable check the automatic operation of the batching sequence including Batch Pump run time and Dilution Water Solenoid (SOV) activation with cut-out on high level.
  - Check batching sequence stops operation when associated interlocks are activated.

• Activate the Truck Power Outlets and then fill the storage tank with water to activate both High Level set-points (LSA & LSH). Confirm Truck Power Outlets are de-activated and subsequent activation of the High Level warning Klaxon (KLX) and Beacon (BEA). Press the Siren Mute button on the control panel to silence the Klaxon.

• Drain the storage tank to flood the process room bund in order to check the bund containment capability and bund capacity.

• Drain the bund then re-initiate the chemical dosing system in manual to ensure continued operation of the automatic valve after it has been submerged.

• Fill the delivery bund sump with sufficient water to activate the delivery bund Sump Pump (if applicable). Place the delivery bund Sump Pump in auto and close the doors to the Chemical Dosing Unit. Check automatic operation of the delivery bund Sump Pump. Open the doors to the Chemical Dosing Unit and check that the automatic operation of the Sump Pump is inhibited. Run the delivery bund Sump Pump in manual to check for low level cut-out.

• Check for correct mounting and operation of the Safety Shower / Eyewash and separate Eyewash (SEQ).

• Undertake site inspection to identify all externally located valves and controls associated with the Chemical Dosing Unit. These include:-
  - Process Room Bund Drain Valve
  - Secondary Containment Drain Valve (if applicable)
  - Dose Pit Drain Valve (if applicable)
  - Delivery Bund Drain Valve (if applicable)
  - External Lighting Switch

• Check valving for correct labelling and descriptions are in accordance with design requirements.

• Identify access and egress to the Chemical Dosing Unit for delivery operations, after-hours access, potential trip hazards and obstacles.

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