Guideline

EMERGENCY RELIEF STRUCTURE Headwall & Duckbill Check Valve Arrangement

1. Background

A variety of strategies that can be adopted to remediate or introduce an Emergency Relief Structure (ERS) in a wastewater system have been developed and can be summarised into four categories:

Category A: Installing an inline check valve into an existing or new structure.

Category B: Installing a duckbill check valve in a new chamber along the existing relief pipe.

Category C: Constructing a new ERS or relocating an existing ERS. This option requires a new weir to be constructed as well as a duckbill valve chamber. This option may also require decommissioning an existing ERS.

Category D: Solution at the discharge point of overflow into a natural environment. This option requires a headwall structure and a duckbill check valve solution to protect and avoid siltation of the relief pipe.

The following Deemed to Comply (DTC) drawings provide standard design solutions for the above Categories A, B and C:

DTC/2401	Instructions, General Notes and Drawing List
DTC/2402	Arrangement 1 – New Valve Chamber
DTC/2403	Arrangement 2A – New Weir & Valve Chamber (One Structure)
DTC/2404	Arrangement 2B – New Weir & Valve Chambers (Separate Structures)
DTC/2405	Arrangement 3A/B – Decommission of Buried ERS
DTC/2406	Arrangement 3C/D – Decommission of Standard ERS
DTC/2407	Arrangement 4A/B/C – Inline Check Valve
DTC/2408	Arrangement 5 – Raising Buried Chamber
DTC/2409	Typical Details
DTC/2410	Arrangement 1 – New Valve Chamber, Structural Reinforcement Details
DTC/2411	Arrangement 2A – New Weir & Valve Chamber (One Structure), Structural Reinforcement Details
DTC/2412	Arrangement 2B – New Weir & Valve Chambers (Separate Structures), Structural Reinforcement Details Sheet 1 of 2
DTC/2413	Arrangement 2B – New Weir & Valve Chambers (Separate Structures), Structural Reinforcement Details Sheet 2 of 2

Due to site variability, the design solution for Category D cannot be standardised to become a DTC drawing. Instead, this guidance document has been developed to provide the design philosophy for a solution at the discharge point of overflow into a natural environment.

2. Design Philosophy

The preferred solution at the discharge point of an ERS into a natural environment generally comprises a headwall structure, scour protection and a backflow prevention device located at the end of the discharge pipe.
Refer to Appendix 1 for guidance drawings of the preferred arrangement.
This document is for guidance only, bespoke designs will be required to cater to site-specific conditions (hydraulics, location, ground conditions, site constraints, etc.) on a case by case basis.

The following site-specific assessments must be carried out to inform the design:

- Hydraulic modelling assessment to confirm weir level, relief pipe size and overflow frequency and volume of the ERS. Design must not increase overflow frequency of the ERS. Undertaken by Sydney Water planning and required information provided to the guidance user.
- Specialist Engineering Assessment for existing structures.
- Site specific constraints to be considered, that is, environmental assessment and geotechnical investigations to be carried out.

The Contractor is to liaise with the relevant Waterway Management authorities early to ensure their requirements are met. Some Waterway Management authorities are concerned with the visual aesthetics and geophysical stability impacts of a headwall or any other structure in a waterway, therefore early consultation is required to inform design.

Design to be carried out by competent Civil and Hydraulic engineering personnel, specifically experienced in these type of structures as per Sydney Water Engineering Competency Standard.

This document does not cover environmental requirements. The designer needs to consult an environmental representative and consider environmental impacts prior to construction.

2.1 Headwall Structure

- A hydraulic assessment (modelling to determine ERS weir crest level, discharge pipe size, overflow frequency and volume) is to be undertaken to determine the level and location of the discharge pipe outlet, which subsequently governs the level and location of the headwall structure. Undertaken by Sydney Water planning and required information provided to guidance user.
- The suitable layout for the structure and the area of disturbance is to be confirmed prior to works commencing.
- When finalising the location of the headwall structure, access for maintenance is to be considered and Sydney Water Customer Delivery and all relevant stakeholders are to be consulted.
- The headwall structure can be either cast in-situ or pre-cast concrete units.
- The headwall structure is to be recessed into the watercourse bank to reduce potential flood interference and the need for discharge flow attenuation measures.
- The headwall apron level is to be above the waterway bed level to reduce the risk of silt build-up in the headwall and backflow prevention valve.

- The headwall structure dimensions should be such as to afford protection to the backflow prevention valve from debris impact and direct water flows.
- The proposed dimensions of the headwall structure for different sizes of discharge pipes are provided on the guidance drawings in Appendix 1.
- A geotechnical investigation prior to construction is required to be undertaken to confirm the ground conditions (including soil/rock material properties) in order to inform the design, in particular the foundation requirement of the headwall structure and the embankment stability at the location of the headwall. The results of the ground conditions and required preparation works are to be assessed and verified by a competent geotechnical engineer.
- Global stabilities (including overturning, sliding and bearing) of the headwall structure, temporary and permanent embankment at the location of headwall are to be undertaken based on the actual ground conditions revealed from the geotechnical investigation results. The design shall be assessed and verified by a competent geotechnical engineer.

2.2 Scour Protection

- Suitable scour protection is to be provided while meeting design requirements consistent with flow velocities and blending into the topography.
- A plume from the valve can potentially impact the stability of the bank on the opposite side of the discharge point, particularly if the outflow is perpendicular to the bank. If that is the case, a suitable solution for energy dissipation is to be adopted to minimise the impact.
- Disturbed vegetation is to be rehabilitated using a mix of local vegetation species planted at an appropriate density. While establishing, plants are to be protected with a mix of open-weave jute mesh.
- For watercourse bank protection and restoration around the headwall structure, gabion walls are to be used.
- Gabion walls to meet TfNSW QA specification R55: Rock Filled Gabions and Mattresses.

2.3 Backflow Prevention Device

- The backflow prevention device is to be a Tideflex Duckbill Check Valve - Series 35-1 (flange type) or approved equivalent.
- The contractor is to confirm the size of the discharge pipe and the maximum back pressure that will apply on the valve to ensure the duckbill check valve will be procured with the correct size and pressure rating.
- If the duckbill check valve is to be installed in harsh environment conditions (e.g. high level of hydrogen sulphide, prone to bushfire, etc.), the contractor will need to liaise with the manufacturer to select the suitable material for the valve.
- The installation of the duckbill check valve is to comply with the manufacturer’s requirements.
- The flange of the duckbill check valve is to be secured on the headwall structure by anchor rods. Only chemical anchors are allowed for this application.
- The clearance from the bottom of the flange and the apron to be kept at a minimum of 150-200mm to provide sufficient room for valve installation and maintenance.

2.4 Existing Discharge Facility

- At an existing ERS, the existing discharge facility is to be assessed for satisfactory performance regarding conveyance, bank stability and a backflow prevention device.
- If the existing discharge facility cannot be modified to meet requirements outlined in this guidance document, the facility is to be demolished and replaced with a new structure.
- If blockage is found at the discharge point, discharge point must be raised or relocated (to be confirmed with Sydney Water planning).

2.5 Restoration

- Restoration and revegetation are to cover all disturbed areas and comply with requirements of relevant Waterway Management authorities.

3. Context

3.1 References

This guidance document is to be read in conjunction with the latest version of the following documents:

Document type	Title
Document	Sydney Water Technical Specification – Civil
Document	Sewerage Code of Australia WSA 02-2002-2.2 Sydney Water Edition
Document	Sydney Water Engineering Competency Standard
Document	Safework NSW Safety in Design Procedure
Document	Queensland Urban Development Manual (QUDM)
Document	Sydney Water Wastewater Network Planning Guideline
Document	Sydney Water Wastewater Overflow Abatement Guideline
Document	DTC/2401 – Emergency Relief Structure: Instructions, General Notes and Drawing List

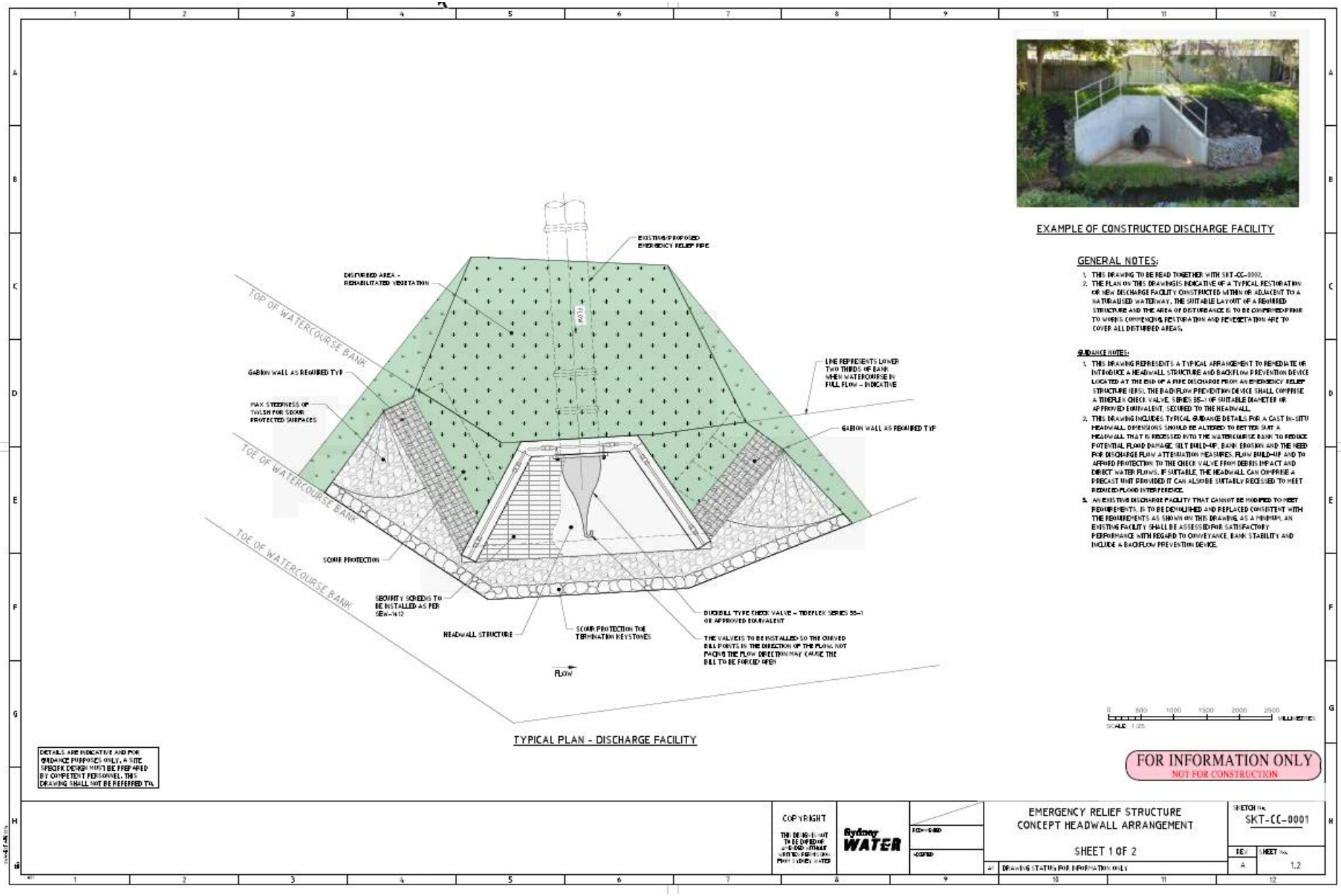
4. Ownership

Role	Title
Group	Asset Lifecycle
Owner	Manager, Engineering
Author	Robert Loncar, Lead Civil Engineer, Specialist Engineering

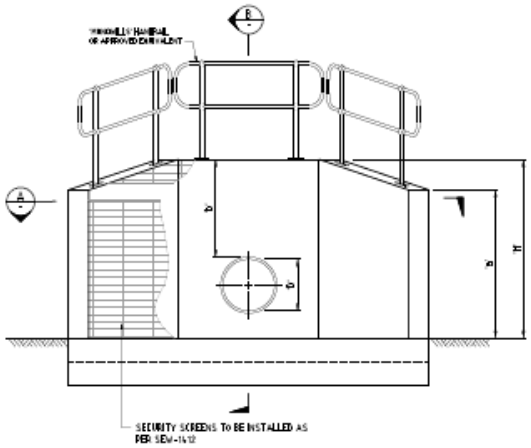
4.1 Change history

Version	Issue Date	Approved by	Brief description of change and consultation
1	1/10/2021	Engineering Manager	New document

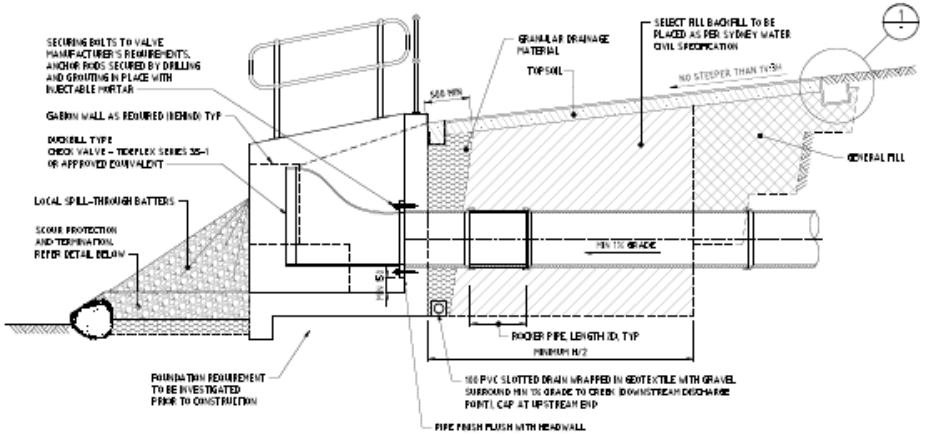
Appendix 1 Guidance Drawings



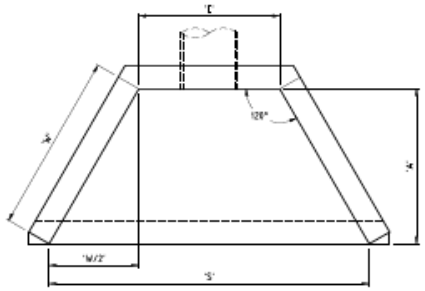
EMERGENCY RELIEF STRUCTURE Headwall & Duckbill Check Valve Arrangement



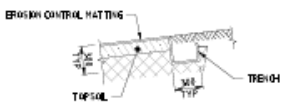
TYPICAL HEADWALL ELEVATION
SCALE 1:25



SECTION B HEADWALL BACKFILL & STABILISATION DETAIL
SCALE 1:25

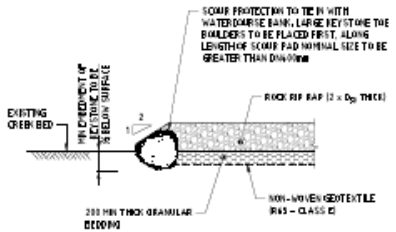


SECTION A CONCRETE
SCALE 1:25



DETAIL 1
SCALE 1:5

EROSION MATTING TERMINATION TRENCH DETAIL



TYPICAL SCOUR PROTECTION TOE TERMINATION DETAIL
SCALE 1:25

SCOUR PROTECTION

1. SCOUR PROTECTION TO COMPRISE SANDSTONE MATERIAL IN A DOUBLE LAYER OF INTERLOCKING ROCK D_{50} ≥ 350mm PLACED ON 200mm THICK LAYER OF GRANULAR BEDDING.
2. NON–WOVEN GEOTEXTILE IS REQUIRED TO SEPARATE COMPACTED FILL / IN–SITU MATERIAL AND GRANULAR BEDDING RUBBLE / FINES (0–100mm) TO BE POURED INTO VOIDS AND BRUSHED IN PLACE.

VALVE SIZE	TIDEFLEX VALVE SERIES 35–1, ANSI FLANGE SIZE (INCHES)	SIZE	(in)	10	12	14	16	20	24	30
DIMENSIONS	D NOMINAL PIPE DIAMETER (I.D.)		(mm)	250	300	375	450	525	600	750
	A APRON DEPTH		(mm)	1000	1000	1000	1000	1450	1450	1450
	C HEADWALL LENGTH		(mm)	950	950	950	950	1500	1500	1500
	S APRON WIDTH		(mm)	2185	2185	2185	2185	3405	3405	3405
	W WING WALL LENGTH		(mm)	1555	1555	1555	1555	1965	1965	1965
	H TOTAL HEIGHT		(mm)	1600	1650	1550	1600	2050	2150	2300
	a WALL END HEIGHT		(mm)	1025	1025	1025	1025	1515	1515	1515
	b WALL HEIGHT ABOVE PIPE		(mm)	900	900	900	900	1215	1215	1215

DETAILS ARE INDICATIVE AND FOR GUIDANCE PURPOSES ONLY. A SITE SPECIFIC DESIGN MUST BE PREPARED BY COMPETENT PERSONNEL. THIS DRAWING SHALL NOT BE REFERRED TO.

0 500 1000 1500 2000 2500 MILLIMETRES
SCALE 1:25

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

Sydney WATER

DESIGNED
ADOPTED

EMERGENCY RELIEF STRUCTURE
CONCEPT HEADWALL ARRANGEMENT
SHEET 2 OF 2

DRAWING STATUS: FOR INFORMATION ONLY

SKETCH No. SKT–CC–0002
REV A
SHEET No. 2.2