A review of the application of OceanSave® in Australia

Date: June 2021

Document Control Sheet

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Authors	Brad Dalrymple, Michael Wicks.
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Synopsis	This report provides an analysis of the application of OceanSave® technology as a stormwater treatment asset within Australia.

Executive Summary

Over recent decades, the implementation of stormwater control measures (SCMs) to achieve a more 'water sensitive' urban environment and reduce the hydrologic and water quality impacts of urban development has increased across Australia (and overseas). The OceanSave® is a vortex type engineered stormwater management device designed to remove litter, gross pollutants, sediment and associated pollutants from stormwater runoff.

This report provides a review of the performance of OceanSave®, and of its suitability for application within Australia. This review has shown that OceanSave® is an appropriate stormwater treatment asset type for application in Australian urban environments. This finding considers a range of factors, including the following:

- **Equivalence to other CDS® technologies:** The OceanSave® technology has design elements and removal performance that are the same as other 'Continuous Deflection Separation' (CDS®) technologies. A letter describing the equivalence of the OceanSave® to the CDS® unit is provided in Appendix A.
- **Government approvals:** OceanSave® (and other CDS® technologies) has been accepted by many of the most stringent stormwater quality regulators within Australia and overseas.
- **Case studies:** Over approximately 7,000 CDS® technologies have been installed within Australia. Over approximately 35,000 CDS® technologies have been installed in USA.
- **Performance monitoring:** CDS® technologies have been subject to significant independent research including that undertaken by the Co-operative Research Centre for Catchment Hydrology (Australia), Monash University (Australia), University of California Los Angeles, and Portland State University, operating in 'real world' conditions, all showing significant reductions in pollutant concentrations and loads.
- **Applicability to local conditions:** For applications across Australia, the OceanSave® is expected to achieve similar pollutant load removal rates to those observed by the aforementioned performance monitoring studies. This is for a combination of reasons, including:
  - As described above, the OceanSave® has design elements and removal performance that are the same as other CDS® technologies
  - OceanSave® (and other CDS® technologies) uses physical (filtration) treatment processes – and these are highly unlikely to be significantly impacted by differences in climate conditions (e.g. temperatures, rainfall frequencies/ amounts) between sites within different parts of Australia and the monitoring sites.
  - OceanSave® (and other CDS® technologies) operates with a unique circular screen. Thus, variations in performance will predominantly be subject to sediment particle size, influent concentrations and speciation (nutrient solubility) rather than locality.

It is recommended that the treatment performance of OceanSave® within Australia be modelled using a gross pollutant trap or generic treatment node within eWater's MUSIC software, with stormwater treatment performance consistent with the values summarised in Table 3-1 up to the design treatment flow rate of the given OceanSave®.

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1 Introduction

1.1 Background

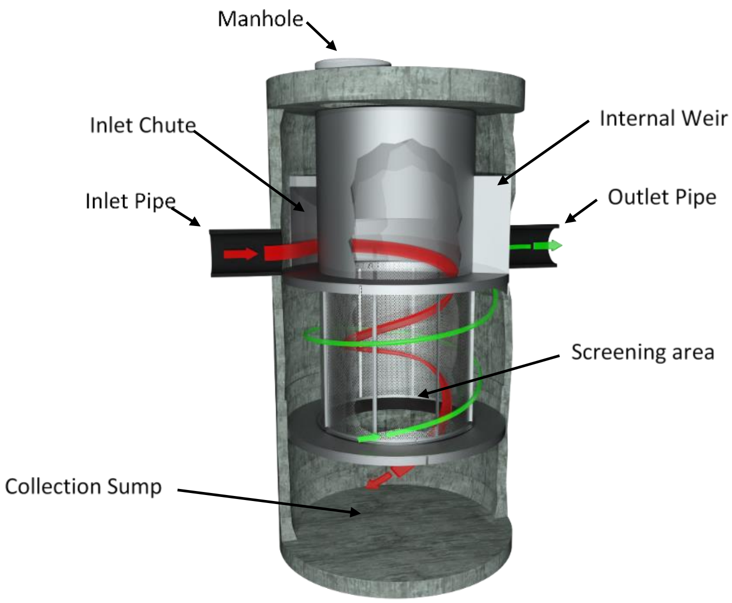
It is commonly understood that unmitigated urban stormwater is a key contributor to reduced water quality and waterway health in Australia and internationally. Traditional urban development and associated stormwater drainage practices of conveying stormwater runoff to waterways as efficiently as possible (providing minimal opportunities for treatment and reuse) have been recognised as being unsustainable and inappropriate due to changed catchment hydrology (e.g. increased frequency and volume of stormwater flows) and increased stormwater pollutant loads to waterways and associated ecological impacts.

Water Sensitive Urban Design (WSUD) is an internationally recognised concept that offers an alternative to traditional development practices, providing a holistic approach to the design of urban development that aims to minimise the negative impacts on the natural water cycle and protect the health of waterways (South East Queensland Healthy Waterways Partnership, 2006). Over recent decades, the implementation of stormwater control measures (SCMs) to achieve a more ‘water sensitive’ urban environment and reduce the hydrologic and water quality impacts of urban development has increased across Australia (and overseas).

1.2 OceanSave® overview

The OceanSave® is a vortex type engineered SCM designed to remove litter, gross pollutants, sediment and associated pollutants from stormwater runoff as either a stand-alone technology or as part of a ‘treatment train’ (with stormwater treatment assets located downstream to provide further treatment).

Figure 1-1 illustrates the components of an OceanSave®. Example photos of an OceanSave® installation are provided in Figure 1-2. Further information in relation to the design and management of OceanSave® technologies is provided in Appendices B to D.



Source: Ocean Protect (2021)

Figure 1-1 Conceptual diagram of OceanSave® components

Figure 1-2 Example photos of an OceanSave® installation

OceanSave® employs a unique screen design that maximizes hydraulic capacity and pollutant removal whilst simultaneously cleaning the screen surface. During operation, a tangential inlet causes stormwater to swirl in the circular treatment chamber. Buoyant materials migrate to the centre of the treatment chamber and rise above the screen while non-floating pollutants are trapped in the storage sump below.

During a storm, pipe flow enters the inlet structure where it is directed tangentially to the circular screen. The system builds driving head and forces water down into the screening area. This creates a vortex action with high tangential velocities across the face of the screen relative to the normal velocities through the screen. This indirect screening feature simultaneously cleans the screen surface whilst removing debris from stormwater. Floatable material is captured in the screening zone. There is also a baffle wall outside the screening zone that allows for the storage of hydrocarbons. Sediment and settable material fall into the sump below the screening area with treated stormwater exiting through the screen to the outlet pipe.

At higher flow rates, a portion of the runoff spills over the weirs located on either side of the inlet structure without affecting the treatable flow rate of the OceanSave®. At the end of the storm water drains down to the pipe inverts further promoting the settling of fine suspended debris into the storage sump.

As illustrated in Figure 1-1, an OceanSave® has the following key components:

- Inlet chamber featuring separation cylinder, inlet flume and bypass weirs
- Treatment chamber featuring stainless screen and baffle wall
- Storage sump.

1.3 Report objectives

The objectives of this report are to provide the following:

- A review of the application of the OceanSave® technology within Australia
- A review of the methods for modelling the treatment performance of OceanSave® technologies (and, if appropriate, identify a recommended method).

2 Review of Suitability of OceanSave® in Australia

2.1 Preamble

This section provides a review of the suitability of OsceanSave® for urban conditions in Australia, based on the following aspects:

- Research and development
- Case studies
- Government approvals
- Treatment performance monitoring
- Applicability to local conditions.

2.2 Research and development

The design and implementation of the OceanSave® technology is based on over thirty years of research and development, testing and field monitoring.

The OceanSave® technology has design elements and removal performance that are the same as other 'Continuous Deflection Separation' (CDS®) technologies. A letter describing the equivalence of the OceanSave® to the CDS® unit is provided in Appendix A.

2.3 Case studies

Since around 1993, CDS® technologies have been installed in a variety of applications to meet regulatory requirements set by authorities throughout Australia and overseas.

Over approximately 7,000 CDS® technologies have been installed within Australia. Over approximately 35,000 CDS® technologies have been installed in USA.

2.4 Government approvals

CDS® technologies has also been accepted by many of the most stringent stormwater quality regulators within other parts of Australia and overseas, including:

- Blacktown City Council
- Washington State Department of Ecology (TAPE) GULD – Pre-treatment
- New Jersey Department of Environmental Protection (NJ DEP)
- North Carolina Department of Environmental Quality (NC DEQ)

2.5 Treatment performance monitoring

CDS technologies have been the subject of significant independent research including that undertaken by the Co-operative Research Centre for Catchment Hydrology (Australia), Monash University (Australia), University of California Los Angeles and Portland State (Contech Stormwater Solutions, 2007).

Table 2-1 and Table 2-2 provides a summary of seven (7) examples of CDS® technologies operating in 'real world' conditions in Australia and USA respectively where treatment performance monitoring has been undertaken.

Table 2-1 Summary of predicted treatment performance case studies for CDS® technologies in Australia

Reference	Location	Site details	Methodology summary	Performance summary
Allison et al (1998)	Coburg, Victoria, Australia	• CDS unit • 50-ha catchment (35% commercial, 65% residential land use) • Mean rainfall 660mm per year	• Monitored by Allison et al • 12-month monitoring period (May 1996 to May 1997) • 7 sampling events • gross pollutants analysed • Flow-rates and volumes measured	• "Practically all gross pollutants trapped by the stormwater were trapped by the CDS device (i.e. 100% removal rate)" (Allison et al, 1998)
Walker et al (1999)			• Monitored by Walker et al (1999) • 15-month monitoring period (November 1996 to February 1998) • 15 storm events sampled • Influent & effluent analysed for solids, nutrients • Flow-rates and volumes measured	• During storm events, for TSS, "the CDS unit effectively reduced concentration levels above 75 mg/L, with a mean removal efficiency of approximately 70%. For concentration levels below 75 mg/L, TSS removal was highly variable" (Walker et al, 1999). • During storm events, "removal rates for TP were found to be approximately 30%, although there were occasions when downstream concentrations were found to be higher than the inflows" (Walker et al, 1999). • During storm events, "removal rates for TN were found to be highly erratic" (Walker et al, 1999). • Mean annual TSS and TP loads removal of 65 and 21% respectively
Birch et al (2009)	Chiswick (Western Sydney), NSW, Australia	• 3m-diameter CDS unit • 60-ha urban catchment • Mean rainfall 911mm per year	• Monitored by Birch et al • 27-month monitoring period (June 2018 to September 2020) • 6 sampling events • Influent & effluent analysed for solids, nutrients, faecal coliforms and metals	• Mean concentration removal efficiencies: TSS 28%; TP 4%; TKN 10%, NOx -4% • Decreases in faecal coliforms for high flow events, but increases in low flow event • Low and highly variable removals for trace metals

Table 2-2 Summary of predicted treatment performance case studies for CDS® technologies in USA

Reference	Location	Site details	Methodology summary	Performance summary
Strynchuck et al (2000)	Brevard County, Florida, ISA	• CDS unit • 24.5-ha catchment (road, industrial, vacant and commercial land usage) • Mean rainfall 1227mm per year	• Monitored by Brevard County • 5 storm events sampled between April 1998 and March 1999 • Influent & effluent analysed for TSS and TP • Flow-rates and volumes measured	• Removal efficiency for TSS and TP of 52% and 31% respectively
Herngren et al (2007)	Baton Rouge, Louisiana, USA	• CDS unit, 500mm screen height, 500mm screen diameter, 200mm oil baffle installed for one event • 1088m^2 catchment (road, 100% impervious) • Mean rainfall 1595mm per year	• Monitored by Louisiana State University • 6-month monitoring period (April to October 2004) • 3 sampling events • Influent & effluent analysed for solids • Flow-rates and volumes measured	• 79-94% of particles above 75µm removed • 21-57% of particles between 25-75µm removed • 4-43% of particles smaller than 25µm.
Contech Engineered Solutions (2010)	Point pleasant, Orange County, New Jersey	• High Efficiency CDS unit model PMSU20_25 (CDS2025) • 0.8-ha catchment (bank building and car parking, 78% impervious) • Mean rainfall 1227mm per year	• Monitored by Sovereign Consulting (with Contech installation, operation and maintenance of sampling equipment) • 19 storm events sampled between January and November 2008 • Influent & effluent analysed for solids • Flow-rates and volumes measured	• Significant reductions for suspended solids loads were observed between influent and effluent sampling locations: SSC (<2000µm) 98%, TSS-SM (<2000µm) 95%, TSS-EPA (<2000µm) 95%, SSC (<500µm) 97%, and SSC (<50µm) 65%.

As summarised in Table 2-1 and Table 2-2, studies assessing the performance of CDS® technologies show significant reductions in pollutant loads.

No published studies are available that have assessed the performance of CDS® technologies in removing oil and grease from stormwater. Removal rates are, however, anticipated to be high given that there is anticipated high correlation of oils and grease removal with observed sediment capture n CDS® technologies. For example, an assessment of stormwater quality by Hoffman et al (1982) from a “typical example of a commercial land use” in Rhode Island (USA) showed that “petroleum hydrocarbons were largely associated with particulate material”, and that the “particulate fraction of the hydrocarbons accounted for 83 to 93% of the total hydrocarbons”. Similarly, Colwill et al (1994, cited in Walker et al 1999) “found 70% of oil and approximately 85% of polycyclic aromatic hydrocarbon (PAH) to be associated with solids in the stormwater”.

2.6 Applicability to local conditions

As described in 1.2, OceanSave® (and other CDS® technologies) uses physical (filtration) treatment processes – and these are highly unlikely to be significantly impacted by differences in climate conditions (e.g. temperatures, rainfall frequencies/ amounts) between local conditions and the monitoring sites described in Section 2.5.

Regardless of rainfall intensity and duration, the OceanSave® (and other CDS® technologies) operates with a unique circular screen. Thus, variations in performance will predominantly be subject to sediment particle size, influent concentrations and speciation (nutrient solubility) rather than locality. For example, as described by Neumann et al (CSIRO 2010), it is easier to achieve higher pollutant load removal rates when runoff has higher pollutant concentrations. It should be noted, however that minimum (to get meaningful outcomes from a % reduction perspective) and maximum (not to overstate % reductions) influent concentrations set out in various field sampling protocols have been adhered to reduce the variability of performance expectations.

Solubility of nutrients is also critically important to the total nutrient pollutant removal performance. The removal of soluble pollutants such as ammonium or ortho-phosphate tend to be more difficult to remove than solids as the removal pathways/mechanisms are not only dictated by media contact time, sediment particle size, sediment density and concentration, but also competing pollutants ie, selective removal of soluble pollutants such as ammonium vs metals (Pb, Cu & Zn etc) typically found in urban runoff. Sites with low Dissolved Inorganic Nitrogen (DIN, sum of Ammonium, Nitrite and Nitrate) tend yield lower Nitrogen removals than sites with higher proportions of Total Kjeldahl Nitrogen (TKN) which is predominantly solid.

2.7 Conclusion

Based on the information presented in the above sections, the OceanSave® is considered to be an appropriate stormwater treatment asset type for application in urban environments within Australia.

3 Modelling OceanSave® treatment performance

3.1 Preamble

This section describes and assesses potential methods for modelling the treatment performance of OceanSave®, and identifies the most appropriate method.

3.2 Modelling software

The Model for Urban Stormwater Improvement Conceptualisation (MUSIC) is a software tool from eWater that simulates the behaviour of stormwater in urban catchments. MUSIC is the preferred tool for demonstrating the performance of stormwater quality treatment systems (Water By Design 2010, BMT WBM 2015).

Within MUSIC, the user is required to specify source nodes, which represent the stormwater flow and pollutant generating areas of the site being modelled. Treatment nodes can also be included to simulate (and assess) the operation of any stormwater treatment devices (e.g. biofiltration) within the site being modelled.

3.3 Treatment node options

As outlined in the previous section, MUSIC models the performance of stormwater treatment devices using 'treatment nodes'. It is recommended that the OceanSave® technology be modelled using the 'Gross Pollutant Trap' (GPT) or 'generic' treatment nodes within MUSIC.

The pollutant removal provided by the OceanSave® is modelled within MUSIC by adjusting the pollutant removal 'transfer functions' within the GPT or generic treatment node for gross pollutants (GPs), total suspended solids (TSS), total phosphorus (TP), and total nitrogen (TN). The high flow bypass rate should equal the maximum treatment flow capacity of the given OceanSave® (refer to Technical Design Guide in Appendix B).

The pollutant removal transfer function values vary across jurisdictions within Australia. Table 3-1 summarises the stormwater treatment performance for OceanSave® typically applied within Australia.

Table 3-1 OceanSave® Treatment Performance Accepted by Majority of Councils within Australia

Pollutant	Predicted removal efficiency (%)[1]	References[2]
Gross pollutants	• 100%	• Based on Allison et al (1998), Walker et al (1999) and high rates of sediment removal observed in other studies.
Total suspended solids	• 70%	• Based on Walker et al (1999), noting MUSIC modelling guidelines (Water by Design 2010, BMT WBM 2015, eWater 2016) recommend applying a storm event mean concentration of 269 to 270mg/L.
Total phosphorus	• 30%	• Based on Walker et al (1999)
Total nitrogen	• 0%	• Based on Walker et al (1999) and Birch et al (2009)

1: Removal up to design flow rate (refer to Technical Design Guide in Appendix B). All flows greater than this flow rate are assumed to be receive zero pollutant removal.
2: References are summarised in Table 2-1 and Table 2-2.

3.4 Recommendation

It is recommended that the treatment performance of OceanSave® within Australia be modelled using a GPT or generic treatment node (as described above), with stormwater treatment performance consistent with the values summarised in Table 3-1), up to the design treatment flow rate for the specific OceanSave® model (see Appendix B).

4 Conclusion

This report has provided a review of the performance of OceanSave®, and of their suitability for application within Australia. This review has included the following:

- Overview of case studies of OceanSave® and associated Government approvals
- Review of treatment performance monitoring for OceanSave® operating in ‘real world’ conditions

This review has shown that OceanSave® is an appropriate stormwater treatment asset type for application in Australian urban environments.

It is recommended that a GPT or generic treatment node (in eWater’s MUSIC software) be applied in modelling the performance of OceanSave® in Australia, with stormwater treatment performance consistent with the values summarised in Table 2-1, up to the design treatment flow rate for the specific OceanSave® model (see Appendix B).

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Appendix A Letter describing equivalence of OceanSave® relative to the CDS® Unit

This appendix provides a letter from Lars Herngren, (19 June 2020) describing the equivalence of OceanSave® technology to the CDS® unit.

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19th June 2020
Our Ref: 16273

Ocean Protect Pty Ltd
PO Box 444
Alexandria NSW, 1435

Attention: Michael Wicks

Dear Michael

RE: OceanSave GPT functionality and equivalency

We refer to your OceanSave models OS-0606, OS-0809, OS-1112, OS-1515, OS-2318 and OS-2324. Based on our review of the developed OceanSave product, it is considered equivalent to a continuous deflective separation gross pollutant trap based on the following:

- Equivalent inlet dimension ratios to maintain velocities for rotation and self-cleaning of the screen at capacity flow;
- Equivalent weir heights specified to maintain operational head at capacity flow;
- Equivalent stainless-steel screens;
- Identical expanded mesh screen and opening;
- Outlet dimensions sufficient for the flow rates expected through each unit;
- Equivalent sump volumes based on capacity flow;
- A shear cone at the base of the screen to cut off the rotation and reduce the risk for resuspension of solids stored in the sump area;
- Sufficient pollutant storage; and
- Sufficient access for maintenance of the GPT including improved access behind the screens for finer material without the need to remove the screen.

Based on the above, it is expected that the OceanSave product will have equivalent functionality to a continuous deflective separation gross pollutant trap. It is noted that the models covered by this letter are in-line units and have internal bypass capacities up to what has been specified. The designer will need to consider weir heights and hydraulic bypass arrangements suitable for the catchment and existing drainage network to avoid unacceptable hydraulic conditions and may require an offline diversion chamber with additional bypass depending on the capacity of the drainage network on which the unit is to be installed. The designer should also consider the buoyancy forces associated with the installation and any other site specific conditions.

It should be noted that the OceanSave range covered in this letter has a 900x900 access manhole for maintenance. This means it has to be cleaned using a suction

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truck as the maintenance access prevents it from being cleaned by a grab truck. Access to behind the screen is generally via a 600mm diameter access manhole and can be cleaned using a suction truck.

The Oceansave product externals and internals have been designed in accordance with:

- AS 3600:2018 (50 years design life +- 20%) for externals
- AS/NZS 1664.1:1997 for internal aluminium structures

Whilst AS/NZS 1664.1:1997 does not specify a design life, standard steel durability of 50 years is expected to be extended by the use of aluminium with up to 75 years durability in typical Australian environmental conditions.

We acknowledge the extent of product development undertaken by Ocean Protect to achieve a device that is technically equivalent in functionality to the CDS Unit, and it can claim “Continuous Deflection Separation Technology” has been achieved.

Kind regards,

Lars Herngren,
For and on behalf of
H&H Consulting Engineers Pty Ltd

Appendix B OceanSave® Technical Design Guide

This appendix provides a technical design guide for OceanSave®, produced by Ocean Protect.

OceanSave

Technical Design Guide

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Rev: *1* ***Last Updated:*** *Jan 2021*

Introduction

The OceanSave is a vortex type engineered stormwater management device designed to remove litter, gross pollutants, sediment and associated pollutants from stormwater runoff. It removes all particles 5 mm and greater from stormwater flows, including neutrally buoyant material. It also removes some suspended solids and free-floating oil and grease via the internal baffle.

The internal treatment components are made of marine grade aluminium and a specially manufactured perforated 316 stainless screen with an integrated stiffening cage to provide longevity under the toughest conditions. These components are housed in a round, concrete manhole. Due to its lightweight, compact design OceanSave is well suited for tight sites and can be used as a standalone treatment system or as a pre-treatment device in conjunction with other stormwater tertiary treatment technologies.

Operation Overview

OceanSave employs a unique screen design that maximizes hydraulic capacity and pollutant removal whilst simultaneously cleaning the screen surface. During operation, a tangential inlet causes stormwater to swirl in the circular treatment chamber. Buoyant materials migrate to the centre of the treatment chamber and rise above the screen while non-floating pollutants are trapped in the storage sump below.

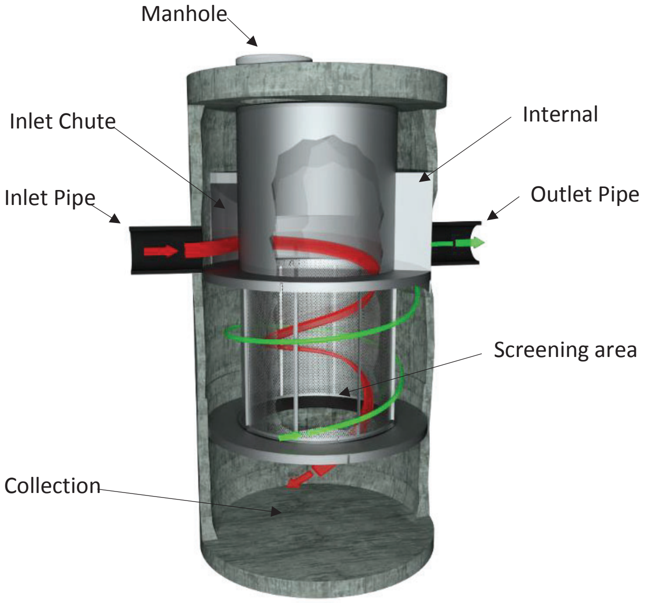

Figure 1: OceanSave components and flow path

During a storm, pipe flow enters the inlet structure where it is directed tangentially to the circular screen. The system builds driving head and forces water down into the screening area. This creates a vortex action with high tangential velocities across the face of the screen relative to the normal velocities through the screen. This indirect screening feature simultaneously cleans the screen surface whilst removing debris from stormwater. Floatable material is captured in the screening zone. There is also a baffle wall outside the screening zone that allows for the storage of hydrocarbons. Sediment and settable material fall into the sump below the screening area with treated stormwater exiting through the screen to the outlet pipe.

At higher flow rates, a portion of the runoff spills over the weirs located on either side of the inlet structure without affecting the treatable flow rate of the OceanSave. At the end of the storm water drains down to the pipe inverts further promoting the settling of fine suspended debris into the storage sump.

Features & Benefits

Each OceanSave system consists of the following features;

- Inlet chamber featuring separation cylinder, inlet flume and bypass weirs
- Treatment chamber featuring stainless screen and baffle wall
- Storage sump

The design of the inlet chamber allows one or more inlet pipes to enter at any location around an 180^0 arc. The outlet orientation can varied to suit your particular site conditions – hence acting as a junction pit.

Figure 2. OceanSave Screen

Due to the inlet chamber design, the vortex rotational flow is always initiated regardless of inlet pipe orientation.

The treatment chamber features a specially manufactured expanded metal 316 stainless screen with an integrated stiffening cage for longevity. Due to the treatment chamber configuration, the system can easily be inspected for any fine silt build up behind the screen and can easily be removed via a suction hose without dismantling any internal components.

The benefits of the OceanSave GPT are;

- Compact manhole design typically utilising a maximum of 3 pre-cast concrete pieces
- Single orientation each model size – no need for offsetting the inlet pipe from the trunk line
- On-line or offline units available for each model
- Minimal on-site assembly of internal components

Pre-cast Manhole OCEANSAVE is pre-configured (pipe size, location, unit height etc) prior to arrival upon site for ease of installation. These systems have a maximum of three pre-cast concrete pieces with minimal internal fit-out required on-site at time of installation. The internal fit-out on-site simply requires affixing the integrated screen cage to the inlet chamber and sump.

Configurations

The standard configuration for the OceanSave is a Pre-cast Manhole. This accommodates a wide variety of sizes and is suited to most applications. Where the site pipe flow is larger than what the inline OceanSave manholes can accommodate, diversion chambers can be utilised to convey these larger flows. A wide range of precast and custom designed diversion structures can be used.

The offline range is denoted with -D (e.g. OceanSave OS-11612-D) indicating an offline diversion box is required. See figures below for further detail.

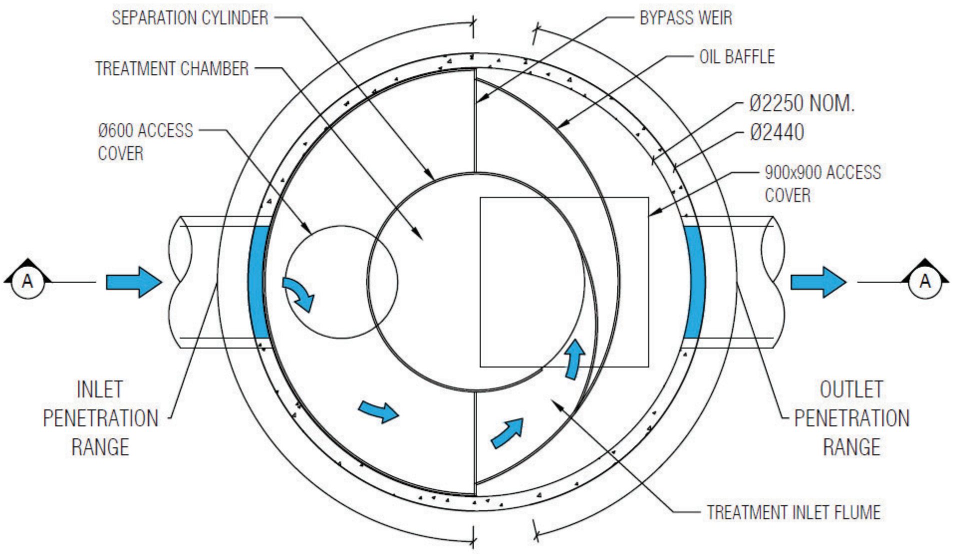

Figure 1. OceanSave Manhole (OS-1112)

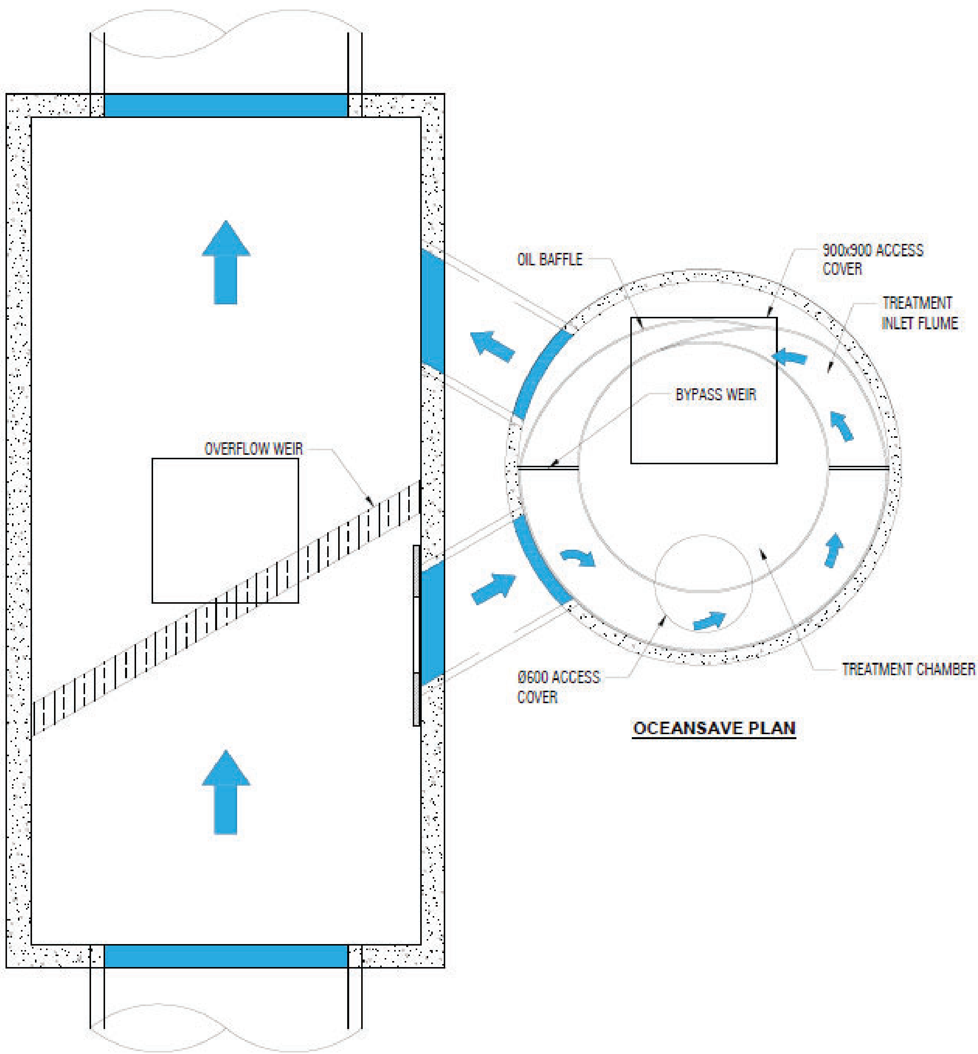

Figure 2. OceanSave-D Offline (typical)

Online

OceanSave	Diameter (ID)	Typical depth below invert	Maximum Flow	Recommended single pipe size *	Water quality flow rate	Sump storage capacity	Oil storage capacity
	m	m	L/s	mm dia	L/s	m^3	L
OS-0606	1.2	1.3	228	375/450	28	0.8	150
OS-0809	1.5	1.6	368	450/525	68	0.8	250
OS-1112	2.25	2.0	765	600/750	155	2.5	600
OS-1612	2.25	2.8	890	600/750	250	4.4	650
OS-1618	3.25	3.4	1200	750/900	350	11.9	2000
OS-2318	3.25	3.4	1580	750/900	580	11.9	2000
OS-2324	3.25	4.0	1680	900/1050	870	9.5	2000

* The pipe size can be physically larger than the recommended pipe size if required.

Offline

OceanSave	Footprint	Typical depth below invert	Maximum Flow	Recommended single pipe size **	Water quality flow rate	Sump storage capacity	Oil storage capacity
	m	m	L/s	mm dia	L/s	m^3	L
OS-0606-D	1.37	1.3	1048	525	28	0.8	150
OS-0809-D	3.3 x 1.7	1.6	1338	750	68	0.8	250
OS-1112-D	5.2 x 4.3	2.0	2355	900	155	2.5	600
OS-1612-D	5.2 x 4.3	2.8	3800	1200	250	4.4	650
OS-1618-D	5.2 x 4.3	3.4	3800	1200	350	4.4	650
OS-2318-D	6.1 x 4.3	3.4	3800	1200	580	11.9	2000
OS-2324-D	6.1 x 4.3	4.0	3800	1200	870	9.5	2000
TWIN - OS-2324-D	9.2 x 3.6	4.0	4600	1200	1680	19.0	4000

** The recommended pipe size is maximum pipe for the precast diversion box
Custom diversion structures can be used for larger pipe sizes

Table 1. OceanSave Models

Performance & Select Approvals

Field testing both locally in Australia and overseas has been undertaken for indirect screening devices like the OceanSave. Further research is being undertaken in Australia. The design and performance certification statement is available upon request from Ocean Protect.

The OceanSave style of gross pollutant traps has been accepted by some of the most stringent stormwater quality regulators in North America and Australia.

Please contact your Ocean Protect representative to obtain the OceanSave approval status in your area.

Maintenance

Every manufactured treatment device will eventually need routine maintenance. The question is how often and how much it will cost. Proper evaluation of long-term maintenance costs should be a consideration when selecting a manufactured treatment device.

OceanSave systems provides unobstructed access to stored pollutants, making it easy to maintain. Maintenance is a simple process using a vacuum truck, with no requirement to enter the unit. Fine silt build behind the screens of these devices can occur periodically. The OceanSave has been configured in such a way to allow removal of this debris without dismantling the screen or internal components.

Maintenance support – Ocean Protect provides flexible program options and contract terms. A detailed maintenance guide as well as Mass Load calculation spreadsheet is available upon request.

Design Basics

The OceanSave style of gross pollutant traps has been successfully installed in a variety of applications to meet regulatory requirements set by authorities and has been available in Australia for almost 20 years.

The design requirements of any OceanSave are detailed in 3 typical steps. These are;

1. Hydraulic Design & Configuration
2. Water Quality Design
3. Mass Load Design

Hydraulic Design & Configuration

All OceanSave GPTs must be designed to ensure that the hydraulic requirements of the system are met without adversely impacting the upstream hydraulics and eliminate any likelihood of localised flooding. Table 1 details the hydraulic loss for model at the maximum flow rate. The designer must ensure the corresponding head loss can be catered for the proposed development site.

For an OceanSave system the inlet and outlet pipes are located at the same invert level at the top of the inlet chamber deck.

Water Quality Design

Ocean Protect recommends and uses the widely endorsed Model for Urban Stormwater Improvement Conceptualisation (MUSIC), which makes it easy for correctly sizing an appropriate OceanSave system for your site.

A complimentary design service which includes MUSIC modelling is provided by the Ocean Protect qualified engineering team. Simply email your project details to design@oceanprotect.com.au or alternatively you can always call one of our engineers for a discussion or to arrange a meeting in your office.

The team will provide you with a cost-effective design containing the quantity and type of components required to meet your water quality objectives together with budget estimates, product drawings and the MUSIC (*.sqz) file.

Conversely, you can download the MUSIC treatment nodes for the Ocean Protect products from our website (www.oceanprotect.com.au).

When designing your own OceanSave GPT for water quality purposes in MUSIC a single Generic Treatment Node is required.

All details such as drawings, specifications and maintenance manuals can also be downloaded for integration into your project’s documentation and the Ocean Protect friendly engineering team is always available to review your model or to provide additional assistance and guidance in how the OceanSave system should be configured for your site.

Mass Load Design

A typical solids and gross pollutant annual load can be obtained by completing a Water Quality Design undertaken most often in MUSIC. The selection of an appropriate OceanSave model should be undertaken such that the sump capacity falls within the maintenance frequency of 4 to 12 months.

Appendix C OceanSave® Standard Drawings

This appendix provides example standard drawings for the OceanSave®, produced by Ocean Protect.

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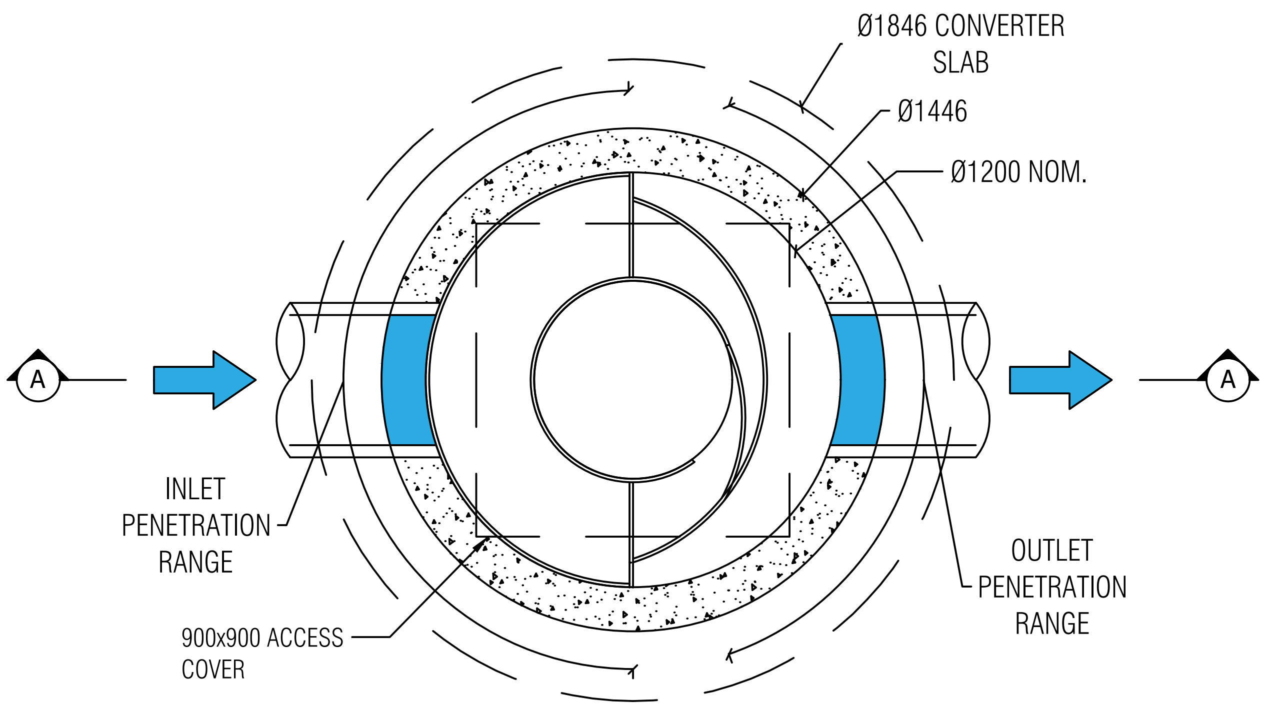
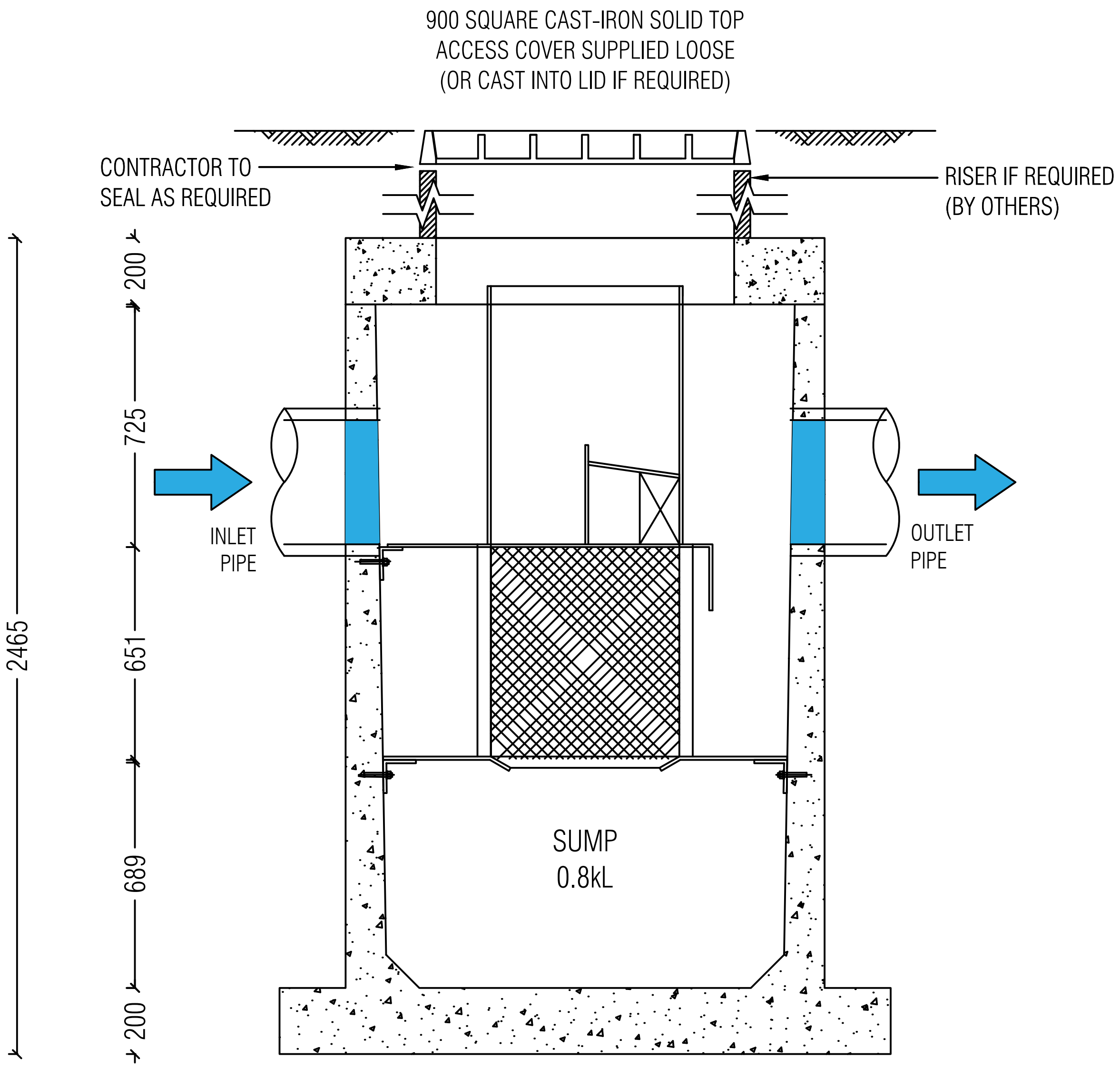


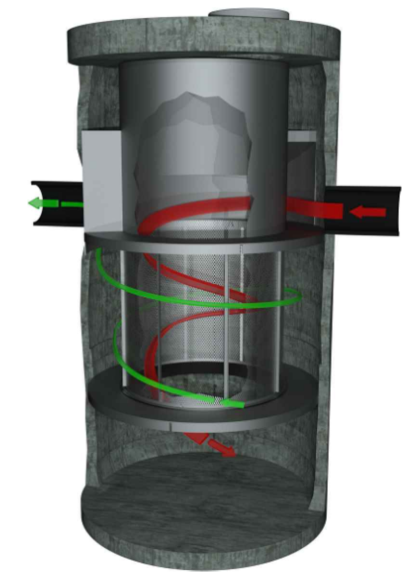
OCEANSAVE PLAN



OCEANSAVE DESIGN TABLE

TO BE INSTALLED ONLINE THE TOTAL INLET PIPE FLOW RATE MUST BE LESS THAN THE SPECIFIED UNITS LISTED MAXIMUM TOTAL FLOW RATE; THE UNIT MUST BE PLACED OFFLINE WHERE THE INLET FLOW RATE EXCEEDS THIS VALUE.

TREATABLE FLOWRATE [L/s]	28
MAXIMUM TOTAL FLOWRATE [L/s]	228
WEIR HEIGHT [mm]	300



SITE SPECIFIC DATA REQUIREMENTS

TOTAL FLOWRATE THROUGH INLET [L/S]	[ ]

PIPE DATA:	I.L.	MATERIAL	DIAMETER
INLET PIPE	[ ]	[ ]	[ ]
OUTLET PIPE	[ ]	[ ]	[ ]

UPPER TANK WEIGHT	TBA
LOWER TANK WEIGHT	TBA

NOTE: TANK SUPPLIED IN TWO PARTS; PARTS A & B TO BE JOINED ON SITE

GENERAL NOTES

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4. ALL WATER QUALITY TREATMENT DEVICES REQUIRE PERIODIC MAINTENANCE. REFER TO OPERATION AND MAINTENANCE MANUAL FOR GUIDELINES AND ACCESS REQUIREMENTS.
5. SITE SPECIFIC PRODUCTION DRAWING WILL BE PROVIDED ON PLACEMENT OF ORDER.
6. DRAWING NOT TO SCALE.

INSTALLATION NOTES

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B. CONTRACTOR TO PROVIDE ALL EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING DETAIL PROVIDED SEPARATELY).

C. CONTRACTOR TO INSTALL AND LEVEL THE STRUCTURE, APPLY SEALANT TO ALL JOINTS AND TO PROVIDE, INSTALL AND GROUT INLET AND OUTLET PIPES.

D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT SCREEN & SEPARATION CYLINDER COMPONENTS DURING INSTALLATION

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OCEANSAVE 0606
SPECIFICATION DRAWING

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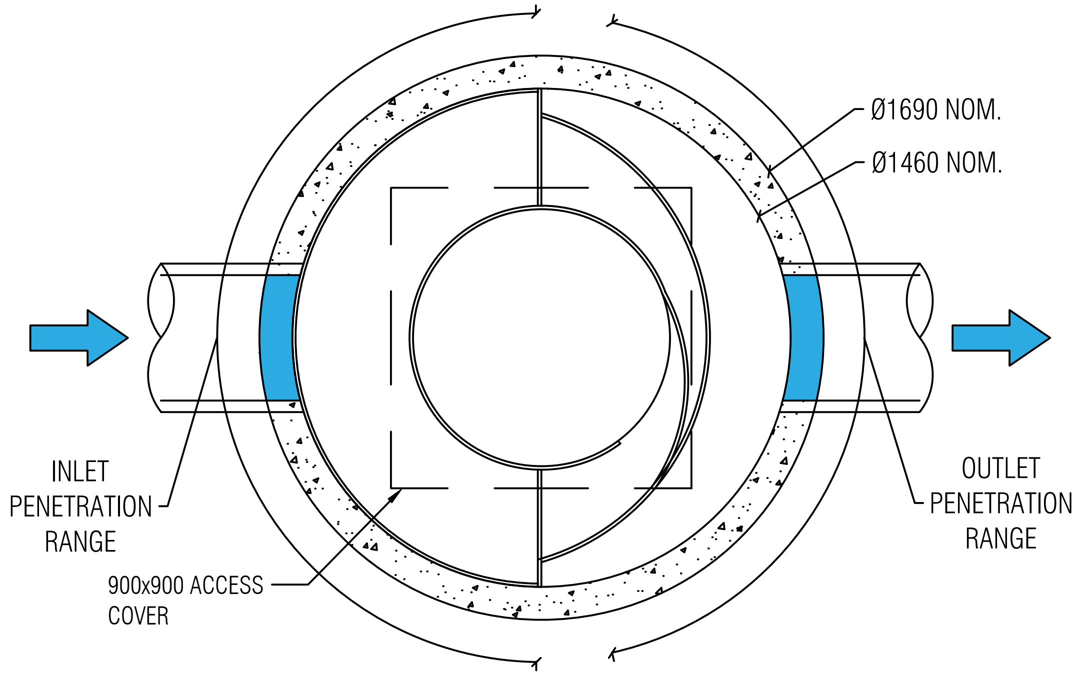
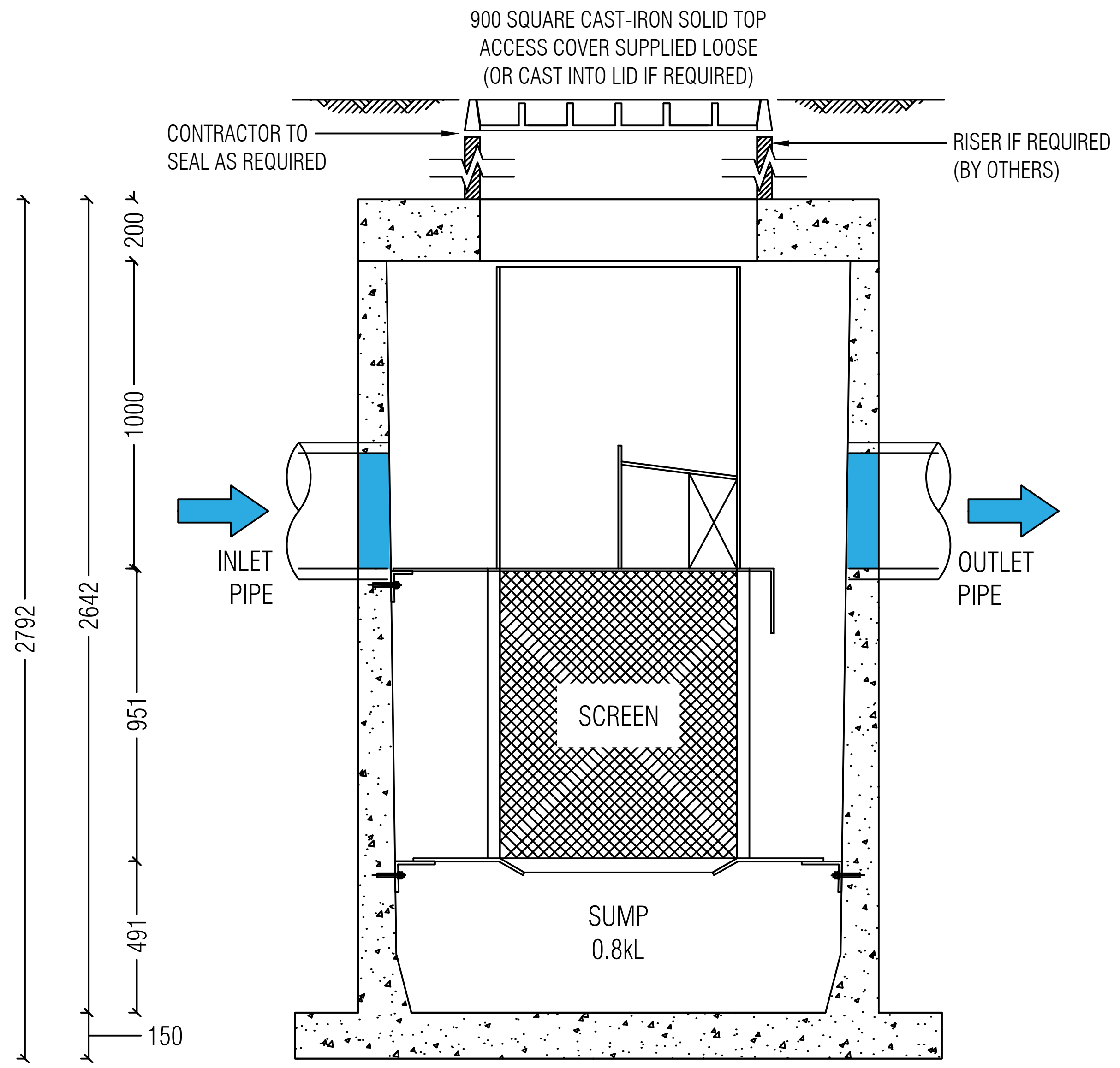


OCEANSAVE PLAN



OCEANSAVE SECTION

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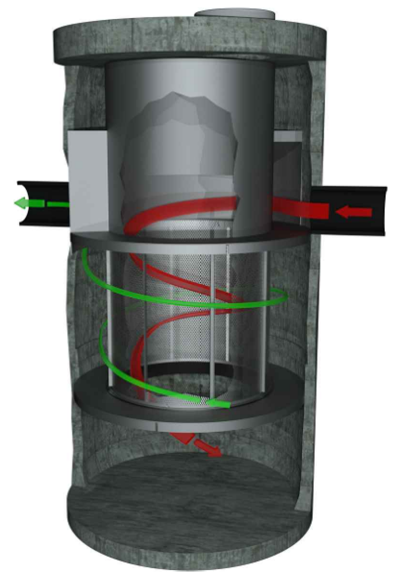
TREATABLE FLOWRATE [L/s]	68
MAXIMUM TOTAL FLOWRATE [L/s]	368
WEIR HEIGHT [mm]	400



SITE SPECIFIC DATA REQUIREMENTS

TOTAL FLOWRATE THROUGH INLET [L/S]	[ ]

PIPE DATA:	I.L.	MATERIAL	DIAMETER
INLET PIPE	[ ]	[ ]	[ ]
OUTLET PIPE	[ ]	[ ]	[ ]

UPPER TANK WEIGHT	TBA
LOWER TANK WEIGHT	TBA

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SPECIFICATION DRAWING

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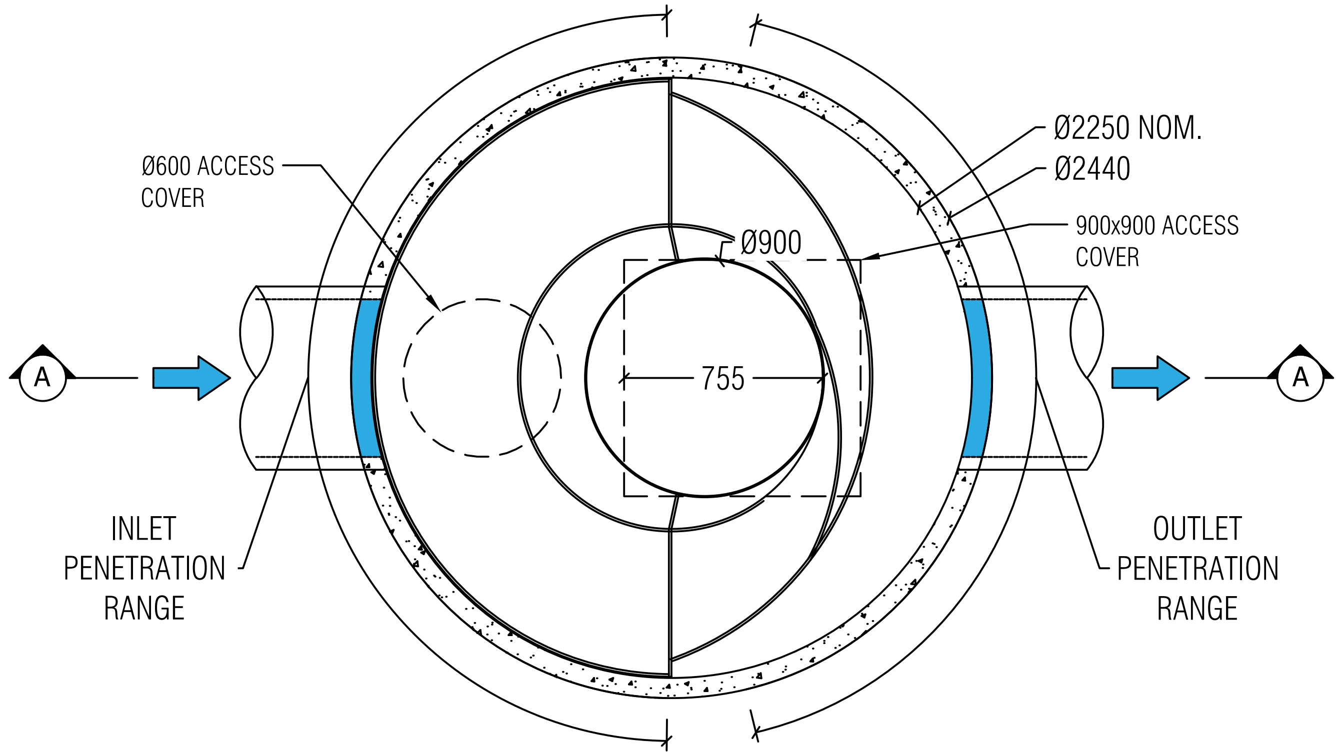
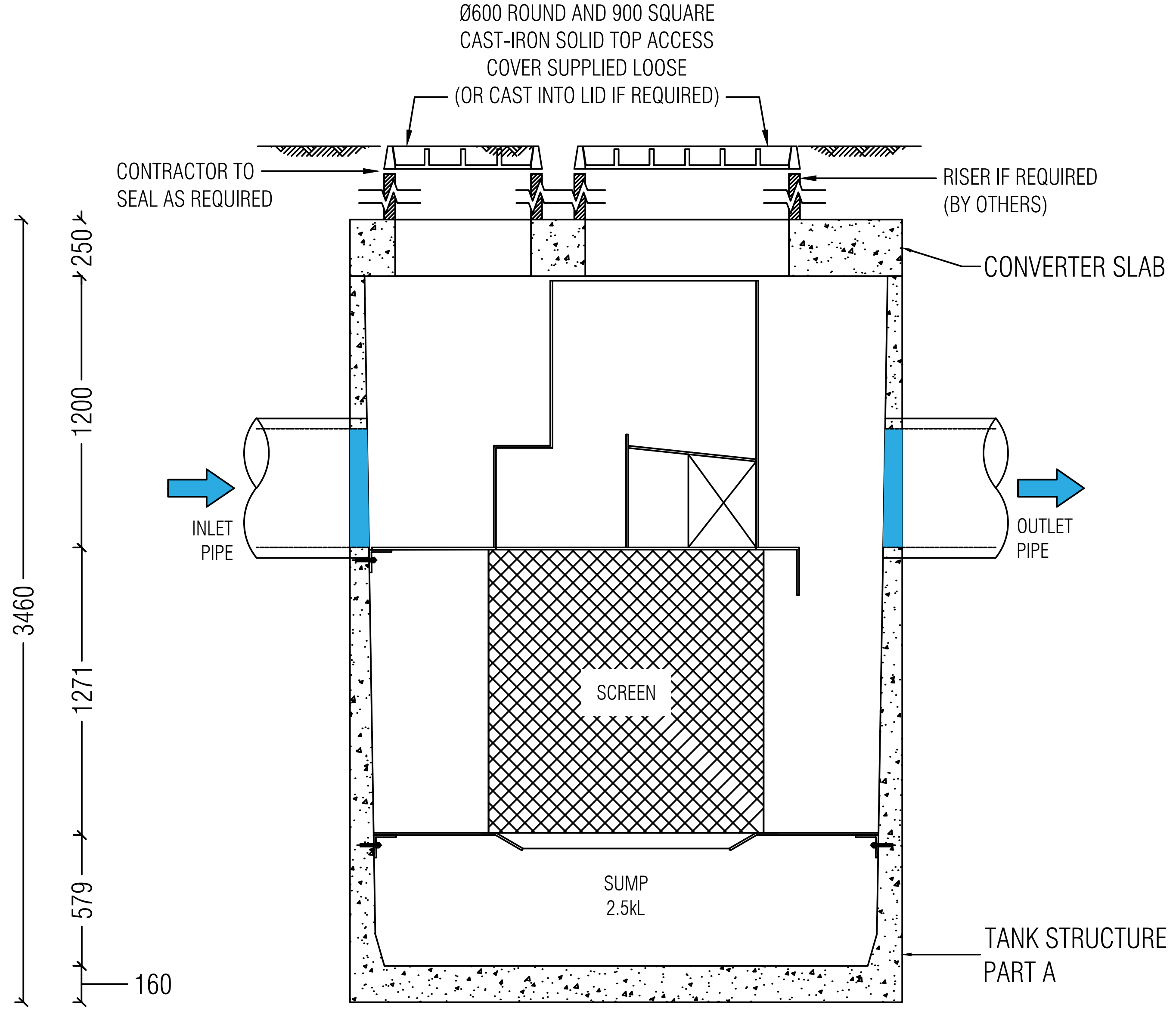


OCEANSAVE PLAN



OCEANSAVE SECTION

LAST MODIFIED: 25-02-19

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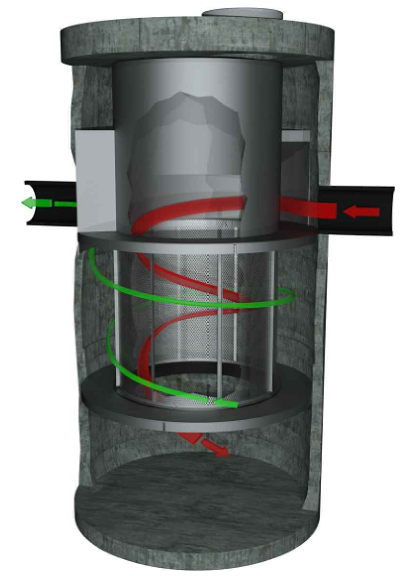
TREATABLE FLOWRATE [L/s]	155
MAXIMUM TOTAL FLOWRATE [L/s]	765
WEIR HEIGHT [mm]	500



SITE SPECIFIC DATA REQUIREMENTS

TOTAL FLOWRATE THROUGH INLET [L/S]	[ ]

PIPE DATA:	I.L.	MATERIAL	DIAMETER
INLET PIPE	[ ]	[ ]	[ ]
OUTLET PIPE	[ ]	[ ]	[ ]

UPPER TANK WEIGHT	TBC
LOWER TANK WEIGHT	TBC

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SPECIFICATION DRAWING

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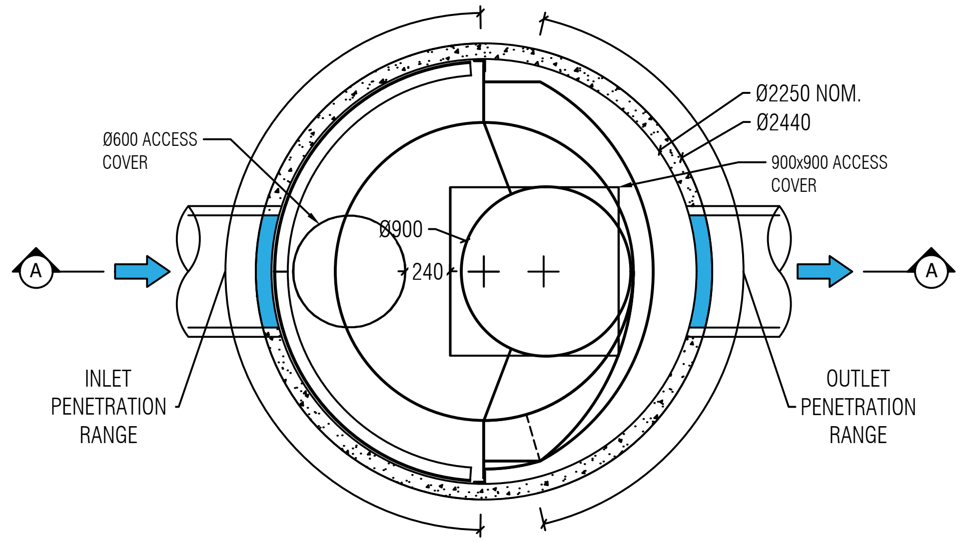

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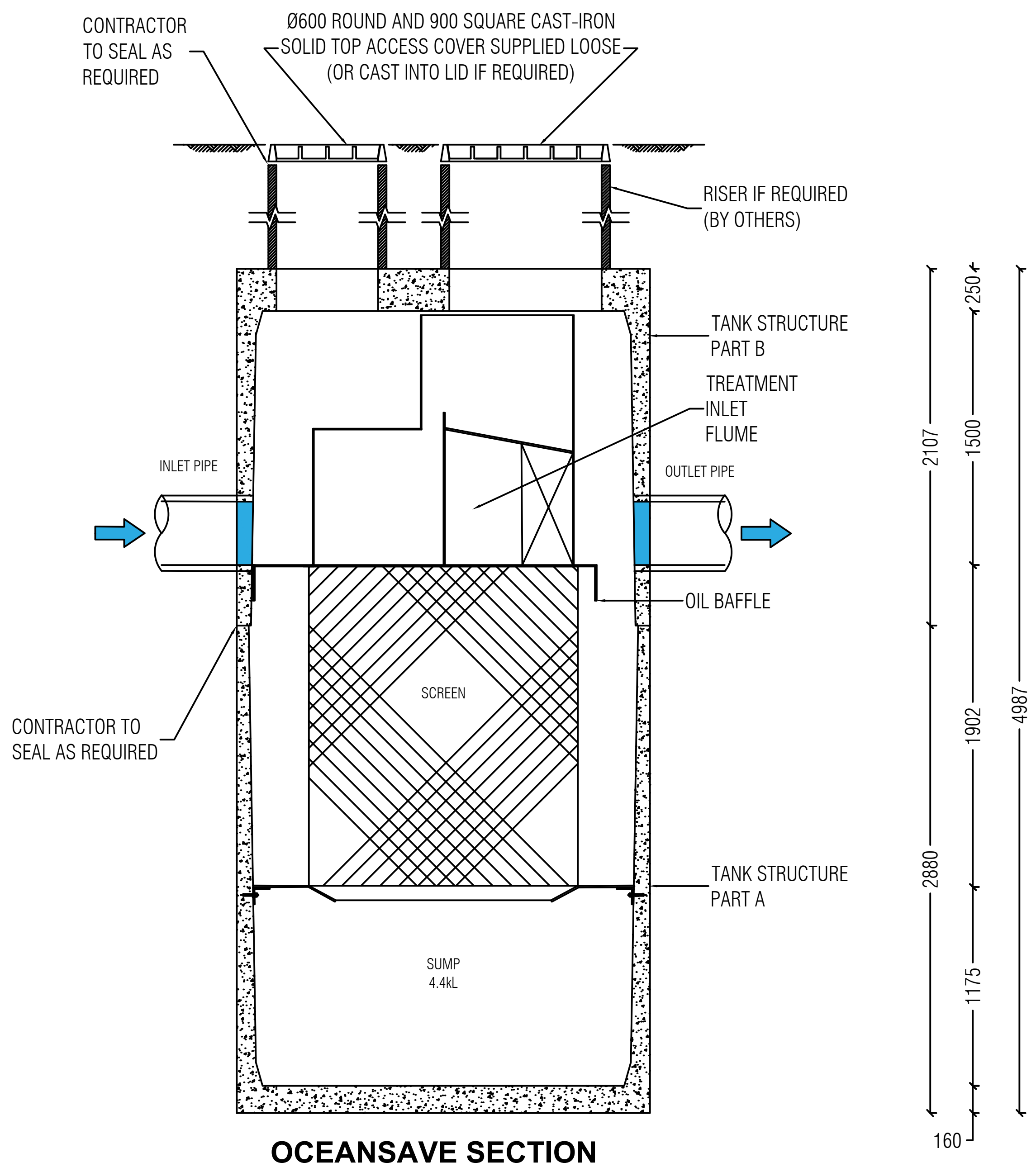

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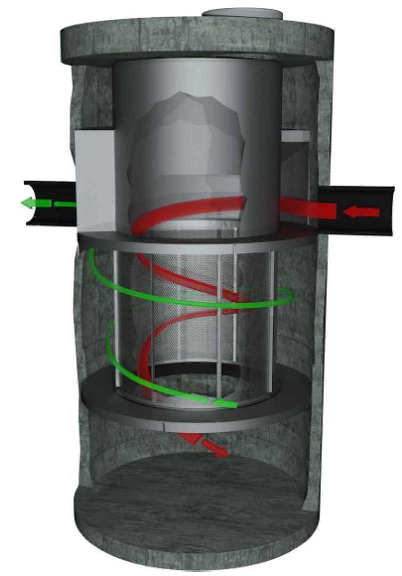
TREATABLE FLOWRATE [L/s]	XXX
MAXIMUM TOTAL FLOWRATE [L/s]	XXX
WEIR HEIGHT [mm]	900



SITE SPECIFIC DATA REQUIREMENTS

FLOWRATE INTO DIVERSION CHAMBER[L/S] [ ]

PIPE DATA:	I.L.	MATERIAL	DIAMETER
INLET PIPE	[ ]	[ ]	[ ]
OUTLET PIPE	[ ]	[ ]	[ ]

UPPER TANK WEIGHT	11160kg
LOWER TANK WEIGHT	7360kg
UPPER TANK WEIGHT	TBA
UPPER TANK WEIGHT	TBA

NOTE: TANK SUPPLIED IN TWO PARTS; PARTS A & B TO BE JOINED ON SITE

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SPECIFICATION DRAWING

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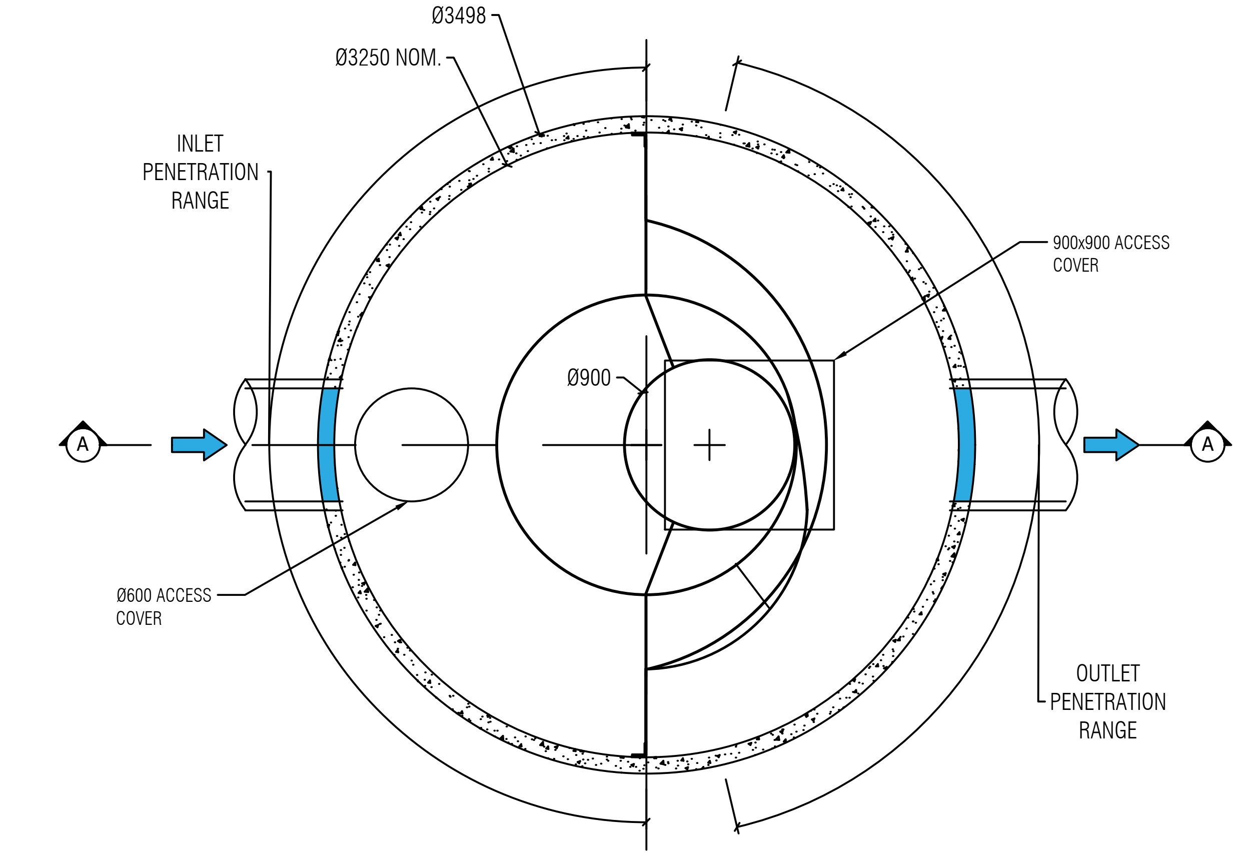
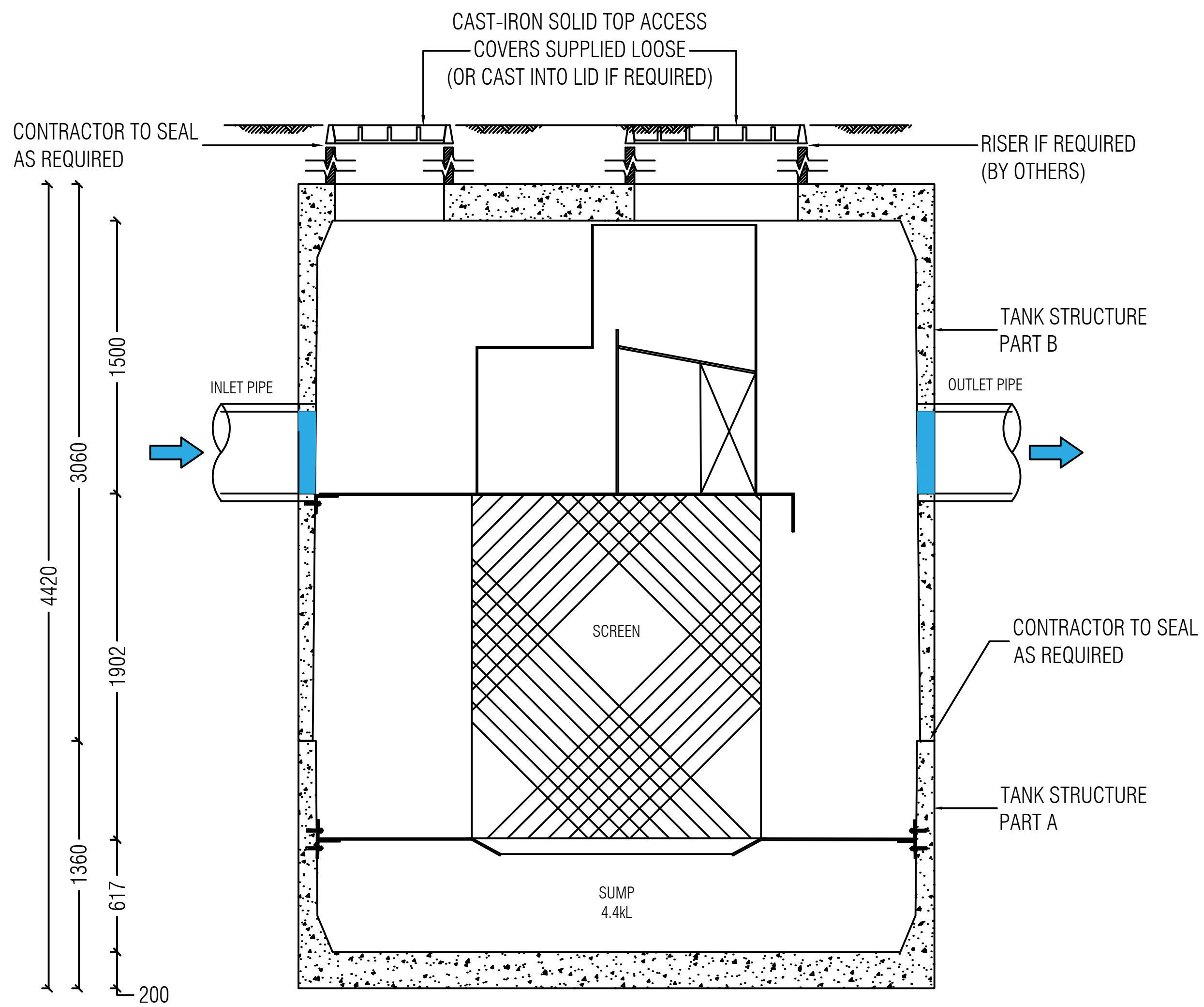


OCEANSAVE PLAN



OCEANSAVE SECTION

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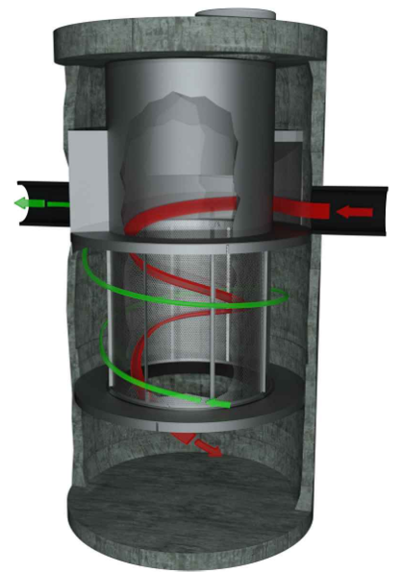
TREATABLE FLOWRATE [L/s]	XXX
MAXIMUM TOTAL FLOWRATE [L/s]	XXX
WEIR HEIGHT [mm]	900



SITE SPECIFIC DATA REQUIREMENTS

TOTAL FLOWRATE THROUGH INLET [L/S]	[ ]

PIPE DATA:	I.L.	MATERIAL	DIAMETER
INLET PIPE	[ ]	[ ]	[ ]
OUTLET PIPE	[ ]	[ ]	[ ]

UPPER TANK WEIGHT	11160kg
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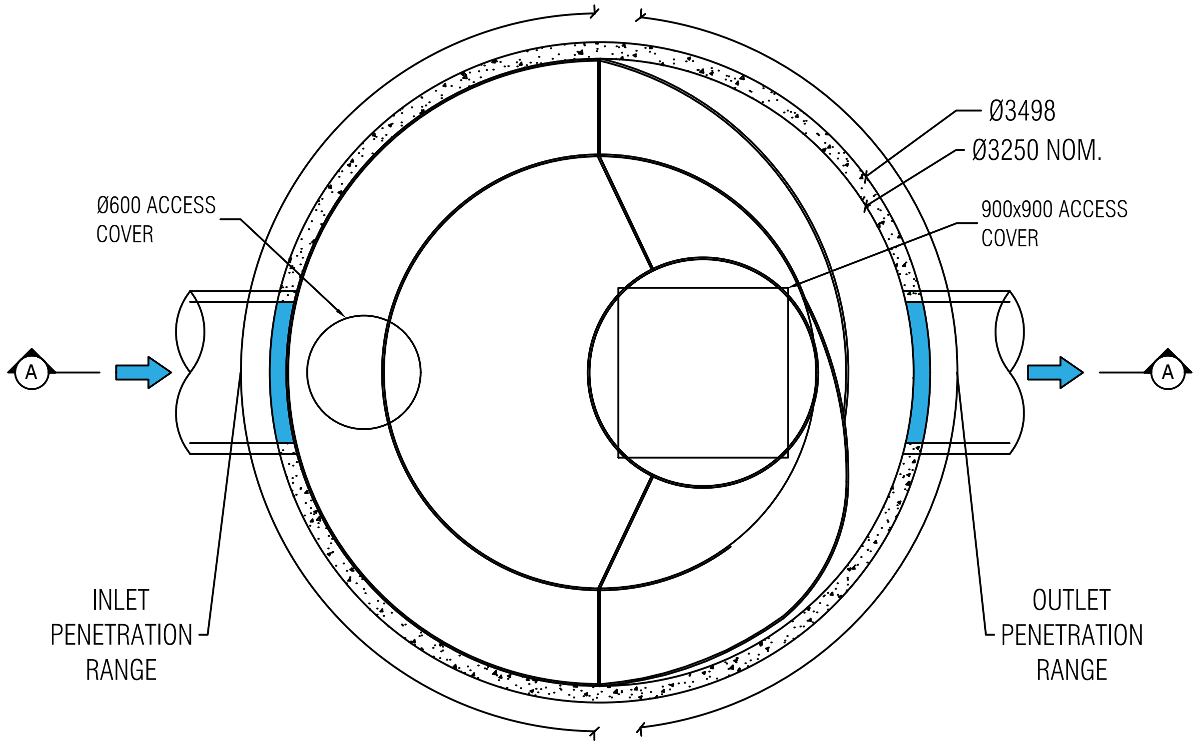
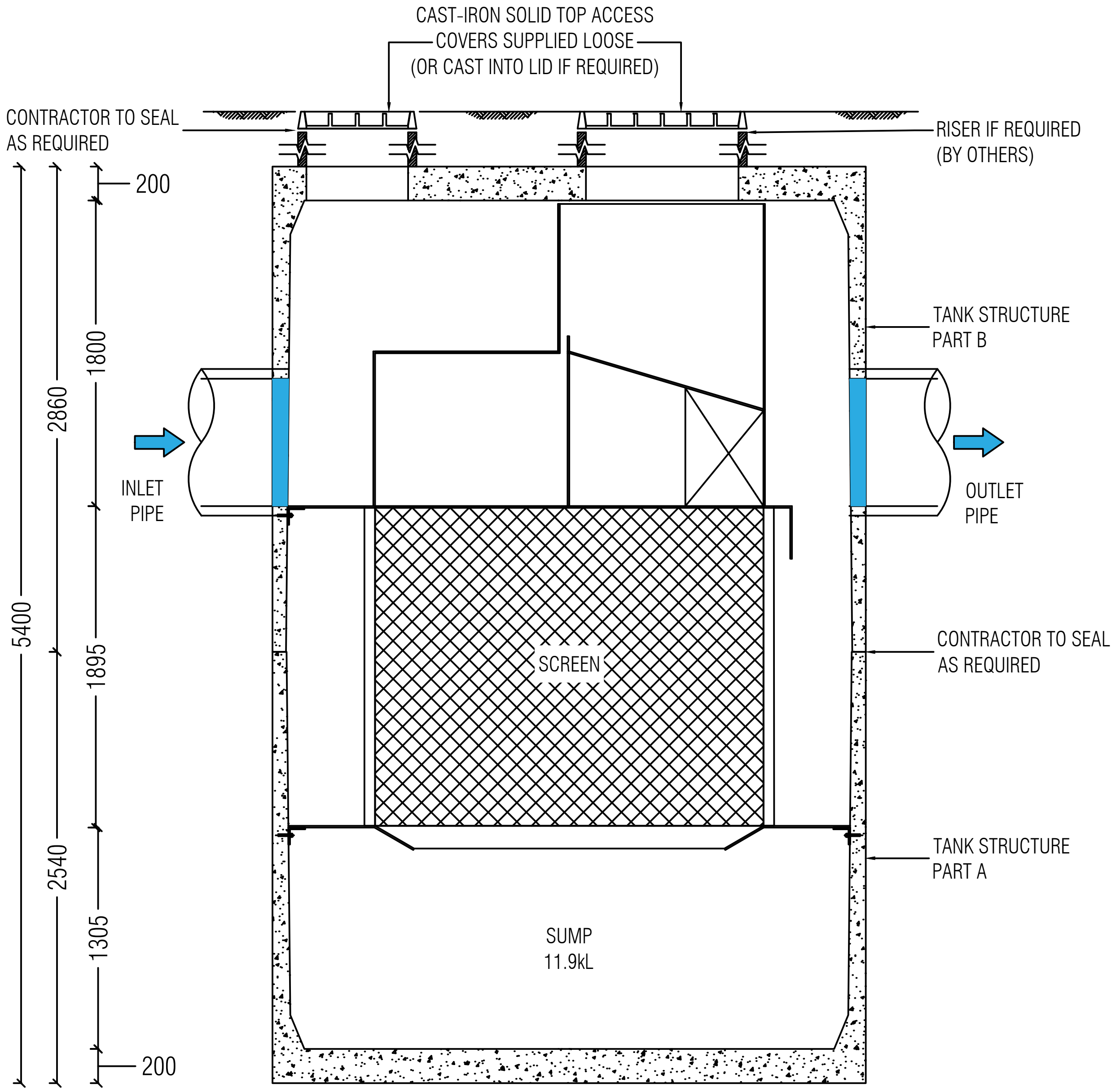


OCEANSAVE PLAN



OCEANSAVE SECTION

LAST MODIFIED: 25-02-19

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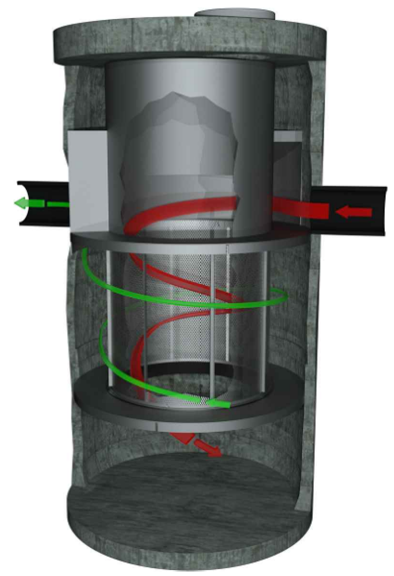
TREATABLE FLOWRATE [L/s]	580
MAXIMUM TOTAL FLOWRATE [L/s]	1580
WEIR HEIGHT [mm]	1000



SITE SPECIFIC DATA REQUIREMENTS

TOTAL FLOWRATE THROUGH INLET [L/S]	[ ]

PIPE DATA:	I.L.	MATERIAL	DIAMETER
INLET PIPE	[ ]	[ ]	[ ]
OUTLET PIPE	[ ]	[ ]	[ ]

UPPER TANK WEIGHT	TBC
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OCEANSAVE 2318
SPECIFICATION DRAWING

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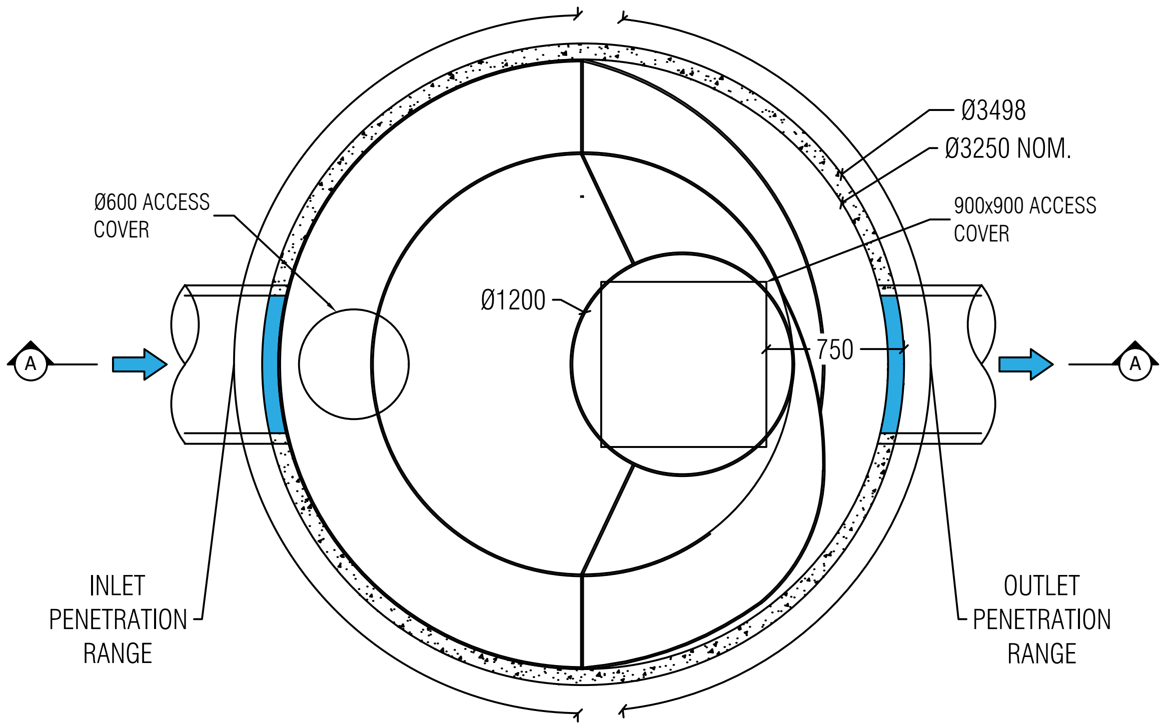
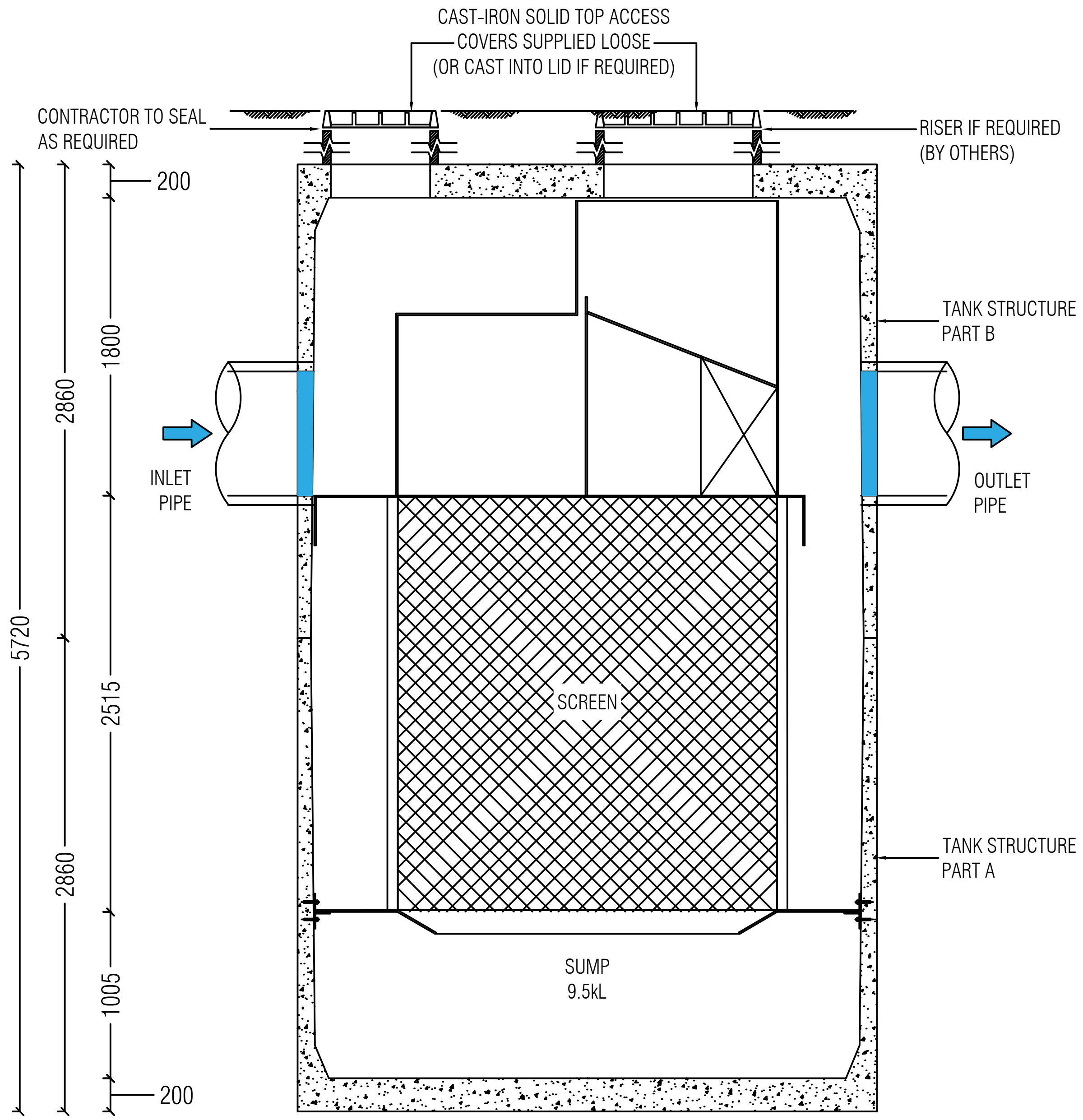


OCEANSAVE PLAN



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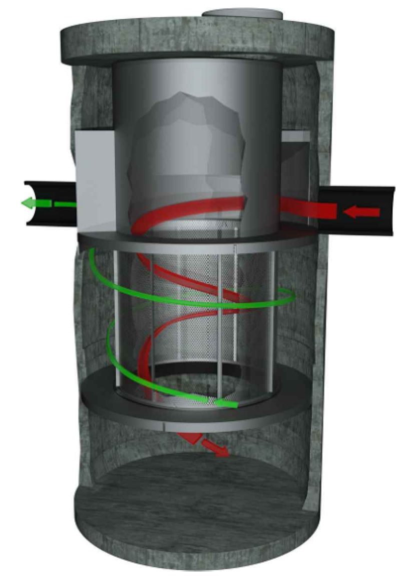
TREATABLE FLOWRATE [L/s]	840
MAXIMUM TOTAL FLOWRATE [L/s]	1680
WEIR HEIGHT [mm]	1200



SITE SPECIFIC DATA REQUIREMENTS

TOTAL FLOWRATE THROUGH INLET [L/S]	[ ]

PIPE DATA:	I.L.	MATERIAL	DIAMETER
INLET PIPE	[ ]	[ ]	[ ]
OUTLET PIPE	[ ]	[ ]	[ ]

UPPER TANK WEIGHT	10630kg
LOWER TANK WEIGHT	11160kg

NOTE: TANK SUPPLIED IN TWO PARTS; PARTS A & B TO BE JOINED ON SITE

GENERAL NOTES

1. OCEANSAVE WATER QUALITY STRUCTURE SHALL BE IN ACCORDANCE WITH ALL DESIGN DATA AND INFORMATION CONTAINED IN THIS DRAWING. CONTRACTOR TO CONFIRM STRUCTURE MEETS REQUIREMENTS OF THE PROJECT.
2. PRECAST STRUCTURE SUPPLIED WITH CORE HOLES TO SUIT OUTER DIAMETER OF NOMINATED PIPE SIZE / MATERIAL.
3. PRECAST STRUCTURE SHALL MEET W80 WHEEL LOAD RATING ASSUMING A MAXIMUM EARTH COVER OF 2.0m AND A GROUND WATER ELEVATION AT, OR BELOW, THE OUTLET PIPE INVERT ELEVATION. ENGINEER TO CONFIRM ACTUAL GROUNDWATER ELEVATION.PRECAST STRUCTURE SHALL BE IN ACCORDANCE WITH AS3600.
4. ALL WATER QUALITY TREATMENT DEVICES REQUIRE PERIODIC MAINTENANCE. REFER TO OPERATION AND MAINTENANCE MANUAL FOR GUIDELINES AND ACCESS REQUIREMENTS.
5. SITE SPECIFIC PRODUCTION DRAWING WILL BE PROVIDED ON PLACEMENT OF ORDER.
6. DRAWING NOT TO SCALE.

INSTALLATION NOTES

A. ANY SUB-BASE, BACKFILL DEPTH, AND/OR ANTI-FLOTATION PROVISIONS ARE SITE SPECIFIC DESIGN CONSIDERATION AND SHALL BE SPECIFIED BY THE SITE CIVIL ENGINEER.
B. CONTRACTOR TO PROVIDE ALL EQUIPMENT WITH SUFFICIENT LIFTING AND REACH CAPACITY TO LIFT AND SET THE STRUCTURE (LIFTING DETAIL PROVIDED SEPARATELY).
C. CONTRACTOR TO INSTALL AND LEVEL THE STRUCTURE, APPLY SEALANT TO ALL JOINTS AND TO PROVIDE, INSTALL AND GROUT INLET AND OUTLET PIPES.
D. CONTRACTOR TO TAKE APPROPRIATE MEASURES TO PROTECT SCREEN & SEPARATION CYLINDER COMPONENTS DURING INSTALLATION

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OCEAN PROTECT
OCEANSAVE 2324
SPECIFICATION DRAWING

LAST MODIFIED: 25-02-19

Appendix D OceanSave® Operation & Maintenance Manual

This appendix provides an operation and maintenance manual for OceanSave®, produced by Ocean Protect.

OceanSave

Operations & Maintenance Manual

Table of Contents

***Rev:** 1 **Last Updated:** Feb 2020*

Introduction

The primary purpose of stormwater treatment devices is to capture and prevent pollutants from entering waterways, maintenance is a critical component of ensuring the ongoing effectiveness of this process. The specific requirements and frequency for maintenance depends on the treatment device and pollutant load characteristics of each site. This manual has been designed to provide details on the cleaning and maintenance processes as recommended by the manufacturer.

The OceanSave is a vortex type engineered stormwater management device designed to remove litter, gross pollutants, sediment and associated pollutants from stormwater runoff. It removes all particles 5 mm and greater from stormwater flows, including neutrally buoyant material. It also removes some suspended solids and free-floating oil and grease via the internal baffle.

The OceanSave is a system that effectively captures and retains a broad range of pollutants.

Why do I need to perform maintenance?

Adhering to the maintenance schedule of each stormwater treatment device is essential to ensuring that it works properly throughout its design life.

During each inspection and clean, details of the mass, volume and type of material that has been collected by the device should be recorded. This data will assist with the revision of future management plans and help determine maintenance interval frequency. It is also essential that qualified and experienced personnel carry out all maintenance (including inspections, recording and reporting) in a systematic manner.

Maintenance of your stormwater management system is essential to ensuring ongoing at-source control of stormwater pollution. Maintenance also helps prevent structural failures (e.g. prevents blocked outlets) and aesthetic failures (e.g. debris build up).

Health and Safety

Access to an OceanSave unit requires removing heavy access covers/grates, additionally it might become necessary to enter into a confined space. Pollutants collected by the OceanSave will vary depending on the nature of your site. There is potential for these materials to be harmful. For example, sediments may contain heavy metals, carcinogenic substances or objects such as broken glass and syringes. For these reasons, all aspects of maintaining and cleaning your OceanSave require careful adherence to Occupational Health and Safety (OH&S) guidelines.

It is important to note that the same level of care needs to be taken to ensure the safety of non-work personnel, as a result it may be necessary to employ traffic/pedestrian control measures when the device is situated in, or near areas with high vehicular/pedestrian activity.

Personnel health and safety

Whilst performing maintenance on the OceanSave, precautions should be taken in order to minimise (or when possible prevent) contact with sediment and other captured pollutants by maintenance personnel. In order to achieve this the following personal protective equipment (PPE) is recommended:

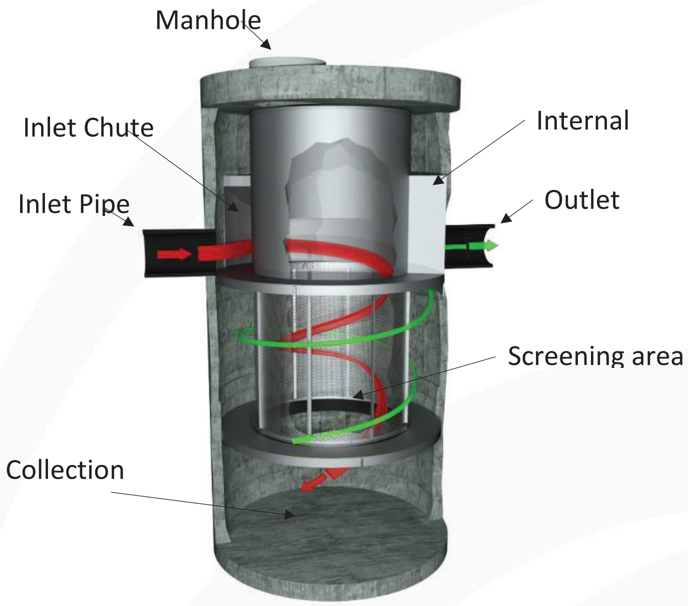
- Puncture resistant gloves
- Steel capped safety boots,
- Long sleeve clothing, overalls or similar skin protection
- Eye protection
- High visibility clothing or vest

During maintenance activities it may be necessary to implement traffic control measures. Ocean Protect recommend that a separate site specific traffic control plan is implemented as required to meet the relevant governing authority guidelines.

Whilst the minor maintenance for the OceanSave can be performed from surface level, there will be a need to enter the pit (confined space) during major services. It is recommended that all maintenance personnel evaluate their own needs for confined space entry and compliance with relevant industry regulations and guidelines. Ocean Protect maintenance personnel are fully trained and carry certification in confined space entry requirements.

How does it Work?

The OceanSave employs a unique screen design that maximizes hydraulic capacity and pollutant removal whilst simultaneously cleaning the screen surface. During operation, a tangential inlet causes stormwater to swirl in the circular treatment chamber. Buoyant materials migrate to the centre of the treatment chamber and rise above the screen while non-floating pollutants are trapped in the storage sump below.



During a storm, pipe flow enters the inlet structure where it is directed tangentially to the circular screen. The system builds driving head and forces water down into the screening area. This creates a vortex action with high tangential velocities across the face of the screen relative to the normal velocities through the screen. This indirect screening feature simultaneously cleans the screen surface whilst removing debris from stormwater. Floatable material is captured in the screening zone. There is also a baffle wall outside the screening zone that allows for the storage of hydrocarbons. Sediment and settable material fall into the sump below the screening area with treated stormwater exiting through the screen to the outlet pipe.

At higher flow rates, a portion of the runoff spills over the weirs located on either side of the inlet structure without affecting the treatable flow rate of the OceanSave. At the end of the storm water drains down to the pipe inverts further promoting the settling of fine suspended debris into the storage sump.

Given the unique component design the device can have multiple inlet/outlet pipes coming at a range of angles generally up to 270 degrees between inlet and outlet. Furthermore, any debris that accumulates behind the screen can be cleaned at time of routine maintenance without dismantling of the screen itself. The refined design of the OceanSave technology utilises the proven performance of the indirect vortex style gross pollutant traps whilst improving characteristics such as configuring and associated installation and maintenance.

Maintenance Procedures

To ensure optimal performance, it is advisable that regular maintenance is performed. Typically, the OceanSave requires a minor service every 6 months and a major service every 12 to 24 months.

Primary Types of Maintenance

The table below outlines the primary types of maintenance activities that typically take place as part of an ongoing maintenance schedule for the OceanSave.

	Description of Typical Activities	Frequency
Minor Service	Visual inspection of inlet aperture Removal of large floatable pollutants Measuring of sediment depth	At 6 Months
Major Service	Removal of accumulated sediment and gross pollutants. Inspection of screening element and cleaning every 2 years	At 12 Months

Maintenance requirements and frequencies are dependent on the pollutant load characteristics of each site. The frequencies provided in this document represent what the manufacturer considers to be best practice to ensure the continuing operation of the device is in line with the original design specification.

Minor Service

This service is designed to assess the condition of the device and record necessary information that will inform the activities to be undertaken during a major service.

1. Establish a safe working area around the access point
2. Remove access cover
3. Visually inspect the inlet aperture
4. Remove large floatable pollutants with a net
5. Measure and record sediment depth
6. Replace access cover

Major Service

This service is designed to return the OceanSave device back to optimal operating performance.

1. Establish a safe working area around the access point
2. Remove access cover
3. Using a vacuum unit remove any floatable pollutants
4. Decant water until water level reaches accumulated sediment
5. Remove accumulated sediment and gross pollutants with vacuum unit (if required)
6. Enter the device to inspect the screening element (every 2 years on larger units)
7. Use high pressure water to clean screen and sump area (if required)
8. Replace access cover

When determining the need to remove accumulated sediment from the OceanSave unit, the specific sediment storage capacity for the size of unit should be considered (see table below).

OceanSave Model	Unit Diameter (m)	Total Capacity (m^3)	Sump Storage Capacity (m^3)
OS-0606	1.2	1.5	0.8
OS-0809	1.5	2.8	0.8
OS-1112	2.2	8.0	2.5
OS-1515	2.2	11.0	4.4
OS-2318	3.2	28.0	11.9
OS-2324	3.2	33.0	9.5

Additional Types of Maintenance

The standard maintenance approach is designed to work towards keeping the OceanSave system operational during normal conditions. From time to time events on site can make it necessary to perform additional maintenance to ensure the continuing performance of the device.

Hazardous Material Spill

If there is a spill event on site, the OceanSave unit that potentially received flow should be inspected and cleaned. Specifically all captured pollutants from within the unit should be removed and disposed in accordance with any additional requirements that may relate to the type of spill event.

Blockages

The OceanSave internal high flow bypass functionality is designed to minimise the potential of blockages/flooding. In the unlikely event that flooding occurs around or upstream of the device location the following steps should be undertaken to assist in diagnosing the issue and determining the appropriate response.

1. Inspect the inlet aperture, ensuring that it is free of debris and pollutants
2. Decant water from OceanSave unit in preparation for confined space entry
3. Inspect the screen and flume as well as both inlet and outlet pipes for obstructions, if present remove any built up pollutants or blockages.

Major Storms and Flooding

In addition to the scheduled activities, it is important to inspect the condition of the OceanSave after a significant major storm event. The focus is to inspect for higher than normal sediment accumulation that may result from localised erosion, where necessary accumulated pollutants should be removed and disposed.

Disposal of Waste Materials

The accumulated pollutants found in the OceanSave must be handled and disposed of in a manner that is in accordance with all applicable waste disposal regulations. When scheduling maintenance, consideration must be made for the disposal of solid and liquid wastes. If the system has been exposed to any hazardous or unusual substance, there may be additional special handling and disposal methods required to comply with relevant government/authority/industry regulations.

Maintenance Services

With over a decade and a half of maintenance experience Ocean Protect has developed a systematic approach to inspecting, cleaning and maintaining a wide variety of stormwater treatment devices. Our fully trained and professional staff are familiar with the characteristics of each type of system, and the processes required to ensure its optimal performance.

Ocean Protect has several stormwater maintenance service options available to help ensure that your stormwater device functions properly throughout its design life. In the case of our OceanSave system we offer long term pay-as-you-go contracts and pre-paid once off servicing.

For more information please visit www.OceanProtect.com.au