hunterh2O

# East Oberon Sewerage Investigation

## Options Report

## Oberon Council

SEPTEMBER 2017

ABN 16 602 201 552

## Report Details

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## Document History and Status

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# Executive Summary

This report details an options investigation for the provision of reticulated sewerage to a residential area in East Oberon. The study area comprises 50 lots which are currently serviced by onsite sewerage management systems. Oberon Council plans to connect these properties in East Oberon to the Oberon sewerage system. The project is co-funded by Oberon Council and the NSW Government under the Restart NSW program.

A preliminary assessment was undertaken which evaluated the feasibility of a number of options for servicing the area including both a conventional and modified gravity sewerage system, a low pressure sewerage system, a vacuum sewerage system and a common effluent pumping system. The preliminary assessment indicated that both a conventional gravity sewerage system and low pressure sewerage system should be further investigated.

The analysis indicated that a low pressure sewer system is the recommended option as it would be more cost effective than a conventional gravity system for the study area and meets the required project objectives. The study area could be serviced by a single low pressure sewerage system that would discharge directly to the inlet works at the proposed new Oberon Sewerage Treatment Plant. A summary of the infrastructure requirements to service the study area via a low pressure system is provided below:

- Grinder pumping units, boundary kits and electrical connection for 50 properties; and decommissioning of existing septic tanks;
- Approximately 2,940 m of low pressure mains ranging in diameter from 53 mm to 76 mm, and approximately 4,000 m of 53 mm diameter pipe for house connections.

The estimated capital cost for the low pressure system is $1,420,000, which includes all overheads and contingencies, which equates to a cost of approximately $28,500 per lot. The total whole of life cycle cost is approximately $1,586,000.

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# 1 Introduction

This report details an options assessment for the provision of reticulated sewerage services to a residential area in East Oberon. It has been prepared by Hunter H2O Holdings Pty Ltd on behalf of Oberon Council.

## 1.1 Study Area

Oberon is a small town in the central tablelands of New South Wales. It is approximately 125 km west of Sydney and 40 km southeast of Bathurst. The town has a population of approximately 2,500 people and the majority of the town is serviced by a reticulated sewerage system.

The study area comprises two areas on the eastern edge of the town that are currently serviced by onsite sewerage management systems comprising septic tanks and effluent absorption trenches at individual properties. Area 1 comprises approximately 45 lots in Albion Street, On Avon Avenue and Shakespeare Avenue, and is zoned Large Lot Residential under the Oberon Local Environmental Plan (LEP) 2013. Area 2 comprises five lots in Werrina Avenue and is zoned General Residential under the Oberon LEP 2013. The lots in the study area range in size from approximately 3,000 $m^2$ to 4.0 Ha. An overview of the study area is provided in Figure 1-1.

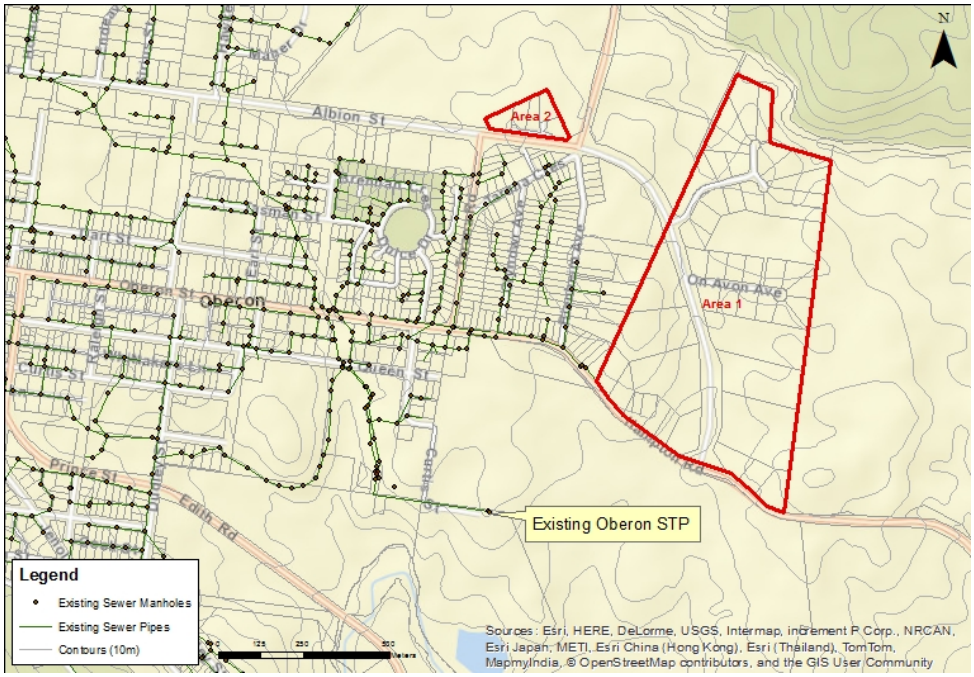


*Figure 1-1 East Oberon Study Area Overview*

## 1.2 Objectives

Oberon Council plans to connect unsewered properties in East Oberon to the Oberon sewerage system. The project is co-funded by Oberon Council and the NSW Government under the Restart NSW program. The proposed sewerage system will:

- Provide levels of service to all residential properties in East Oberon that is similar to other residents in Oberon
- Improve environmental and public health standards in the service area
- Allow for further development in the East Oberon area
- Provide a robust, safe and efficient sewerage system
- Be delivered within the project budget.

# 2 Existing Sewerage Network

The Oberon sewerage network consists of a series of gravity sewer reticulation mains, sewage pumping station (SPS) and rising mains which drain to the Oberon Sewage Treatment Plant (STP).

The STP, located off Curtis Street, is a trickling filter plant that was constructed in the 1960's. The plant operates satisfactorily but does not meet contemporary environmental standards. A parallel project is currently underway for an upgrade of the STP, co-funded by the NSW Government under the Restart NSW program. The upgrade will consist of constructing a new STP on, or adjacent to, the existing STP site.

Oberon Council nominated two connection points for the East Oberon area to connect into the existing sewerage system:

- Manhole AO4 near the intersection of Duckmaloi Road and Blenheim Avenue
- Direct connection to the inlet works at the new STP. For the purposes of this investigation, it was assumed that the new STP would be located immediately north of the current STP site, and that there were no constraints on pipeline route through the land between Duckmaloi Road and the proposed STP site.

Assessment of the capacity of the existing sewerage system was outside the scope of this project.

# 3 Design Criteria and Hydraulic Loading Forecast

This section provides a summary of the adopted design criteria and hydraulic loading forecast for the study area. Further details are presented in **Appendix A** (Technical Note 1).

## 3.1 Design Criteria

The following design criteria will be used to undertake the analysis:

- Council's Level of Services (LoS) found in Oberon Council's Development Servicing Plans (DSP) for Water Supply and Sewerage April 2017 Exhibition Draft
- Water Services Association of Australia (WSAA) Gravity Sewerage Code of Australia 02-2014 Version 3.1
- WSAA Pressure Sewerage Code of Australia 07-2007 Version 1.1

## 3.2 Hydraulic Loading Forecast

The theoretical sewer design flows were estimated using the *WSAA Sewerage Code* (Water Services Association of Australia, 2014). Theoretical sewer loadings are defined in terms of Equivalent Persons (EP) where 1 EP is the equivalent sewage loading from an average person.

The WSAA Code recommends an average dry weather flow allowance 0.0021 L/s/EP. It was assumed that each property in the study area was equivalent to 2.3 EP, based on the occupancy rate of 2.3 persons per dwelling from the 2016 Census.

The WSAA Code also describes the Design Flow as comprising of three components:

1. Peak Dry Weather Flow **(PDWF)** representing the peak sewage discharge from connected properties and is a function of the average dry weather sewage flow from connected properties;
2. Groundwater Infiltration **(GWI)** representing the long term non-rainfall dependent infiltration into the sewerage network from groundwater;
3. Peak (rainfall dependent) inflow and infiltration **(IIF)** representing the peak (rainfall dependent) inflow and infiltration into the sewerage network.

The Design Flow is therefore defined by the following equation:

**Design Flow (DF) = PDWF + GWI + IIF**

The allowance for the wet weather component of the design flow loading to the sewerage system has been calculated using the following for each proposed sewerage collection system:

- Gravity sewerage system – Estimated using WSA 02 Appendix C
- Low pressure sewerage system – Estimated using WSA 02 Appendix C with a factor of 0.2 applied to the wet weather component of the design flow calculation i.e. 20% of GWI and RDII

The theoretical loadings for existing development are summarised in Table 3-1, and future loadings are summarised in Table 3-2. The outflow from a low pressure sewer system would be dependent on the number of simultaneous pumps in operation and should be refined during concept design.

*Table 3-1 Theoretical Loadings – Existing*

| Option | Area | Lot Yield | EP | ADWF (L/s) | PDWF (L/s) | Design flow; 1-in-2 year (L/s) |
|---|---|---|---|---|---|---|
| Conventional Gravity System | Area 1 | 45 | 104 | 0.22 | 1.17 | 2.43 |
| | Area 2 | 5 | 12 | 0.02 | 0.23 | 0.41 |
| | **Total** | **50** | **115** | **0.24** | **1.40** | **2.85** |
| Low Pressure Sewer System | Area 1 | 45 | 104 | 0.22 | 1.17 | 1.42 |
| | Area 2 | 5 | 12 | 0.02 | 0.23 | 0.27 |
| | **Total** | **50** | **115** | **0.24** | **1.40** | **1.69** |

*Table 3-2 Theoretical Loadings – Future (full development)*

| Option | Area | Lot Yield | EP | ADWF (L/s) | PDWF (L/s) | Design flow; 1-in-2 year (L/s) |
|---|---|---|---|---|---|---|
| Conventional Gravity System | Area 1 | 90 | 207 | 0.43 | 1.95 | 4.29 |
| | Area 2 | 10 | 23 | 0.05 | 0.39 | 0.72 |
| | **Total** | **100** | **230** | **0.48** | **2.34** | **5.01** |
| Low Pressure Sewer System | Area 1 | 90 | 207 | 0.43 | 1.95 | 2.42 |
| | Area 2 | 10 | 23 | 0.05 | 0.39 | 0.45 |
| | **Total** | **100** | **230** | **0.48** | **2.34** | **2.87** |

# 4 Options Development

The following two-step approach was used to develop the preferred option:

1. Develop a long list of options and apply screening criteria to short list 2-3 options

2. Assess the short listed options in terms of technical, financial, social and environmental impacts and selected the preferred option.

The following long list of options were included as potential options for servicing the study area:

- Conventional gravity sewerage system;
- Modified gravity sewerage system;
- Low pressure sewerage system;
- Septic tank effluent pumping; and
- Vacuum sewerage system.

The following screening criteria were applied to each of the options in the long list:

- Technical feasibility including operational complexity;
- Capital costs;
- Operation and maintenance costs;
- Social impacts;
- Environmental impacts; and
- Ability to meet project objectives, as listed in Section 1.2

The long list of potential options and the screening criteria were summarised in Technical Note 2, which can be found in **Appendix B**. The options assessment recommended that both a conventional gravity system and low pressure sewer system be given further consideration.

The options discussed in this report have been based on the information available at the time of assessment. The required infrastructure will be subject to survey, geotechnical investigation, assessment of groundwater and flood levels, and environmental investigation. Contour information was available at 10 m intervals only and required depths for infrastructure are estimates only.

The system capacity will need to allow for two residential houses for each existing lot, as requested by Council. This allows for future development comprising subdivision and/or dual occupancy.

## 4.1 Option 1 – Conventional Gravity System

The study area drains away from the existing Oberon sewerage system and comprises two drainage catchments roughly divided by On Avon Avenue. All properties in Area 2 and properties in Area 1 to the north of On Avon Avenue (including those on the northern side of the street) drain generally to the north. Properties in Area 1 south of On Avon Avenue (including those on the southern side of the street) drain generally to the south to a low point near the intersection of Albion Street and Duckmaloi Road.

The proposed infrastructure layout for a conventional gravity system is shown in **Exhibit 1** (connection to MH AO2) and **Exhibit 2** (connection directly to new STP).The desktop review indicates that approximately half of the properties would drain to a proposed SPS (referred to as SPS 1) in the north of the area. Flows from SPS 1 would be pumped into the gravity catchment of a second proposed SPS (SPS 2) which would be located at the low point near the intersection of Duckmaoli Road and Albion Street. SPS 2 would pump to either MH AO2 or the proposed new STP. Infrastructure has been sized with sufficient capacity for future flows from the study area. Smaller capacity pumps, sized for existing loadings, were not considered as an interim servicing option, as minimum velocity requirements would not be achieved in the rising mains, and detention times in the rising main under existing loadings are not considered excessive.

The proposed SPS 1 would be located near the rear boundary of 45 Shakespeare Close. Due to the small size and flow requirements, a package pump station, which is fitted out with pumps, valves and pipework, would be a suitable lower cost option as compared to a traditional cast in-situ chamber. The pump station would require a DN 1.5 m wet well with an estimated depth of 5 – 6 m. The station would be fitted with two submersible macerator pumping units (one duty and one backup unit). The pump station would discharge into the proposed SPS 2 catchment via approximately 655 m of DN80 mm rising main along Shakespeare Avenue and Albion Street. In order to meet the minimum velocity requirements in the rising main, the station would need to operate at approximately 4 L/s. The pump station would therefore need to be capable of delivering 4 L/s at 40 m head.

The proposed SPS 2 would be located near the intersection of Duckmaloi Road and Albion Street. Due to the small size and flow requirements, a package pump station would again be a suitable lower cost option. The pump station would require a DN 1.5 m wet well with an estimated depth of 5 – 6 m. The station would be fitted with two submersible macerator pumping units (one duty and one backup unit) capable of delivering 6 L/s.

For Option 1A, the pump station would discharge into the existing manhole AO4 via approximately 650 m of DN80 mm rising main along Duckmaloi Road. The pump station would need to be capable of delivering 6 L/s at 31 m head.

For Option 1B, the pump station would discharge directly to the new STP via approximately 570m of DN80 mm rising main, through the property to the south of Duckmaloi Road. It has been assumed that there are no restrictions on the pipeline route through this privately owned land. The pump station would need to be capable of delivering 6 L/s at 27 m head.

In addition to the two new SPS and rising mains, approximately 3,600 m of 150mm gravity main would be required to provide each lot with a point of connection to the new sewerage system. At least half of these gravity mains would be located within private property due to the topography of the study area. The remaining pipes would be located within road reserves. It is not possible to accurately determine the required pipe depths from the 10 m contours but it is estimated that pipe depths would range from minimum depth up to 4 - 5 m.

On-property works would also be required for each property including redirection of house drains, decommissioning of existing septic tanks and provision of house connections to the sewer mains. The estimated average length of house connection pipes is 50 m per property based on a review of aerial photography of the study area.

A summary of the required infrastructure requirements to service the study area via a gravity sewerage system is provided below:

- 3,600 m x DN150 mm gravity mains
- Property connection pipes; allowance of 2,500 m x DN100
- 50 x decommissioning of existing septic tanks
- SPS 1: DN 1.5 m wet well approximately 5 – 6 m deep, two pumps (one duty, one standby) capable of delivering 4 L/s at 40 m
- SPS 2: DN 1.5 m wet well approximately 5 – 6 m deep, two pumps (one duty, one standby) capable of delivering 6 L/s at 31 m (Option 1A) or 6 L/s at 27 m (Option 1B)
- 1,305 m x DN 80 mm rising main (Option 1A) or 1,225 m x DN80 mm rising main (Option 1B)

## 4.2 Option 2 – Low Pressure Sewerage System

A low pressure sewer system consists of a network of interconnected pressure pipes which deliver sewage flows to the downstream sewerage system. A small storage vessel is installed on each individual property which collects sewage from the dwelling. The storage vessel is fitted with a

grinder pumping unit which discharges the sewage through the pressure pipe network. The small diameter pressure pipes are laid in narrow trenches at relatively shallow and constant depths.

There are several manufacturers and suppliers of low pressure systems. The pumps generally have a near vertical H-Q curve and can operate over a range of head conditions. The systems can incorporate a remote terminal unit (RTU) to control the operation of pumps in the system via time based control rules or via integration with SCADA. This can be used to modulate flows in the system leading to a reduction in peak flows, or it can be used to create periodic flushing waves or reduce detention times. The control strategy can be alerted as development occurs.

A preliminary layout for the proposed low pressure sewer system is shown in **Exhibit 3** (connection to MH AO2) and **Exhibit 4** (direct connection to new STP). Preliminary analysis indicates that approximately 2,930 m of low pressure main sizes, from 53 mm to 76 mm diameter, would be required to provide each lot with a connection point. Pipelines would be laid at minimum depth and within road reserves. The pipes are sized with sufficient capacity to accommodate flows from future development (total of 100 lots) provided that an appropriate control strategy is implemented to modulate the flows in the system. The control strategy would also need to incorporate periodic flushing waves to meet minimum velocity requirements in some sections of main under existing loading conditions.

The control strategy would limit the number of simultaneous pumps in operation, or force several pumps to operate simultaneously to generate flushing velocities. For a typical residential dwelling, each pump is expected to operate for up to 30 minutes per day on average, therefore for a system of this size it is possible to schedule pumps so that only one or two units are operating at any given time across the day. It is recommended that computer modelling is undertaken at the design stage to confirm pipe sizes and system operation and to develop an appropriate control strategy. The computer modelling would also need to consider pumping arrangements following power failure.

An assessment of whether odour control is required and the available options for odour control should be undertaken at the concept design stage. It is preferable to develop an appropriate control strategy to sufficiently reduce detention times and avoid the need for odour control. Air filters may also be installed at each unit to minimise odours if required.

Each property would have its own pump / tank unit consisting of a grinder pump located inside a holding tank and a boundary box. Each house is connected to the tank inlet via conventional house drains, with the pump unit typically located between the house and existing septic tank. The existing household sewer line is typically intercepted and redirected to the holding tank. New pipes would need to be provided between the holding tanks and the low pressure mains laid in the street. The majority of houses drain towards the rear of the lot and away from the street and the estimated length of house connections is about 80 m per property based on review of aerial photography. Existing septic tanks would also need to be decommissioned. Some houses may also need upgrades to their electrical switchboard prior to connection of the pressure sewer units.

A summary of the infrastructure requirements to service the study area via a low pressure system is provided below:

- Grinder pumping units, boundary kits and electrical connection for 50 properties
- 50 x decommissioning of existing septic tanks
- Low pressure mains:
    - Property connection pipes: allowance of 4000 m x DN53 mm polyethylene (PE) pipe
    - 1,230 m x DN53 mm PE pipe
    - 455 m x DN63 mm PE pipe
    - 1,255 m x DN76 mm PE pipe

The above requirements are for Option 2A (connection to MH AO4). The requirements for Option 2B are the same with the following exception:

- Length of DN76 mm PE pipe is reduced to 1,175 m

The above analysis was undertaken to determine indicative pipe lengths and diameters only. No design work was undertaken for the low pressure system. It is recommended that computer modelling of the proposed low pressure system is undertaken at the design phase to optimise the pipe sizes, determine the required locations for air release valves and develop an appropriate control strategy.

# 5 Options Assessment

This section provides an assessment of the two short listed options.

## 5.1 Technical Assessment

An assessment of technical matters was undertaken in order to compare the conventional gravity and low pressure systems. The assessment is summarised in Table 5-1.

*Table 5-1 Technical Assessment*

| Item | Conventional Gravity Sewerage | Low Pressure Sewerage |
|---|---|---|
| Performance | Provides level of service that is similar to existing Oberon residents | Provides level of service that is similar to existing Oberon residents with some restrictions on usage during power outage |
| | Potential for increase in inflow/infiltration as system ages | System is sealed; less potential for inflow/infiltration |
| System reliability | Meets design criteria | Meets design criteria |
| Flexibility and Adaptability | System has been sized with sufficient capacity for future connections (50 additional lots) | System has been sized with sufficient capacity for future connections (50 additional lots) |
| | Infrastructure requirements for new connections are minimal | New connections require tank, pump and boundary kit |
| | Minimal flexibility on pipeline route and SPS location | More flexibility on pipeline route |
| Maintainability | System can be maintained using standard maintenance materials and practices | System can be maintained using standard maintenance materials and practices. However, as this is a new technology for Oberon it will require staff training. |
| | Council responsible for maintenance of two additional SPS. No additional future requirements. | Council responsible for maintenance of 50 pump units (up to 100 units in the future) |
| | Council is generally not responsible of maintenance of system upstream of property connection point | Council would be responsible for maintenance of pump units located on private property |
| Impact on downstream sewerage system | An assessment of the capacity of the downstream sewerage reticulation is outside the scope of this project however some comments on potential impact is provided below. | |
| | Reticulation system downstream of the connection point would need to have capacity for up to an additional 5.0 L/s under future loading conditions (Option 1A).<br>No impact on downstream reticulation system for Otpion1B | Reticulation system downstream of the connection point would need to have capacity for up to an additional 2.9 L/s under future loading conditions (Option 2A).<br>No impact on downstream reticulation system for Option 2B |
| Other issues | Requires directional drilling under Duckmaloi Road | Requires directional drilling under Duckmaloi Road |
| | Typical excavation would be open trench; increased depth of excavation in comparison to low pressure sewer | Typical excavation would be open trench; excavation depths are minimised |

## 5.2 Financial Assessment

Preliminary cost estimates have been developed for the proposed augmentations and are based on either the NSW Reference Rates Manual (Department of Primary Industries Office of Water, 2014) or costs obtained from suppliers. The estimates include:

- Survey, Investigation, Design and Project Management (SID) costs; the SID component can vary from 5% to 20% depending on the complexity of the project. An allowance of 10% of the project cost was applied for the pipeline cost estimates;
- An inherent risk contingency; includes an allowance for uncertainty in the scope of work, uncertainty in the costs to be applied and uncertainty in site conditions. An allowance of 30% of the contract rate is recommended at the feasibility stage and was applied to the cost estimates;
- The contingent risk accounts for factors beyond the control of the designers or constructors, such as industrial issues, adverse weather, availability of labour and materials and extensions of time due to unforeseen circumstances. A contingency allowance of 20% was applied for all estimates.

A summary of the proposed capital costs for each servicing option is provided in Table 5-2, along with the average cost per property.

*Table 5-2 Summary of Capital Costs*

| Option | Capital Cost Estimate | Capital Cost Estimate per Property |
|---|---|---|
| 1A (gravity) | $2,442,000 | $48,840 |
| 1B (gravity) | $2,429,000 | $48,580 |
| 2A (low pressure) | $1,430,000 | $28,600 |
| 2B (low pressure) | $1,420,000 | $28,400 |

A life cycle cost analysis was also prepared for each of the servicing options. The analysis was undertaken for a 30-year period using a discount rate of 7% p.a. The estimated was based on the following assumptions:

- Power usage for the sewer pump stations was estimated based on annual pumped volume of 1.2 x ADWF and power costs were applied at 35c per kWh;
- Annual power costs for low pressure sewer was assumed to be $50/house
- Maintenance costs were based on Hunter Water Corporation's Operating Cost Estimating Guideline for water and sewer (Hunter Water Corporation, 2012), or manufacturer's recommendations. Maintenance costs for existing assets were excluded from the analysis.
- Pumps were assumed to have a design life of 15 years.

A summary of the NPV analysis is provided in Table 5-3.

*Table 5-3 Whole of Life Cycle Cost Summary*

| Option | NPV Capital Cost | NPV Operation & Maintenance Cost | NPV Total Cost |
|---|---|---|---|
| 1A (gravity) | $2,442,000 | $221,000 | $2,663,000 |
| 1B (gravity) | $2,429,000 | $221,000 | $2,650,000 |
| 2A (low pressure) | $1,430,000 | $166,000 | $1,596,000 |
| 2B (low pressure) | $1,420,000 | $166,000 | $1,586,000 |

Details of the preliminary cost estimates for the proposed infrastructure are provided in **Appendix C**.

## 5.3 Social Assessment

A summary of the potential social impacts for each of the options is provided in Table 5-4.

*Table 5-4 Social Assessment*

| Item | Conventional Gravity Sewerage | Low Pressure Sewerage |
|---|---|---|
| Odour | Potential for odour generation at the proposed SPS. To be assessed during concept design. | Potential for odour generation at the discharge point due to long sewage detention time. To be assessed during concept design. |
| Noise | Potential noise generation from two additional SPS | Minimal noise generation expected from pump units |
| Visual amenity | Visual amenity may be reduced by the introduction of structures (two additional SPS) in an established residential area | Minimal visual impact from underground tanks |
| Private property disruption | High level of disruption during construction as large portion of new mains would be located within private property; access may be difficult. Minimal ongoing disruption. | High level of disruption during construction as installation of new tanks units is required on private property; access may be difficult. Some ongoing disruption when access is required for tank/pump maintenance. |
| Land purchase/ easements | Land purchase required for SPS 1 and possibly SPS 2; easement required for SPS 1 rising main (Option 1A and 1B) and SPS 2 rising main (Option 1B only) | No land purchase or easements required for Option 2A. No land purchase required for Option 2B; easement required for Option 2B for low pressure man between Duckmaloi Road and STP |

## 5.4 Environmental Assessment

A summary of the potential environmental impacts for each of the options is provided in Table 5-5.

*Table 5-5 Environmental Assessment*

| Item | Conventional Gravity Sewerage | Low Pressure Sewerage |
|---|---|---|
| Environmental health of study area | Improvement due to decommissioning of existing septic tanks and removal of effluent from environment | Improvement due to decommissioning of existing septic tanks and removal of effluent from environment |
| Risk of sewage overflow to environment | Minimal risk as system is adequately sized. Overflow may occur as result of blockages or power failure at SPS. | Minimal risk as system is sealed. Overflow may occur as result of pump or power failure at individual tanks. |
| Disruption during construction | High | High |
| Tree removal | Some tree removal is likely to be required on private property | Less likely to be required than for conventional gravity sewerage |

| Item | Conventional Gravity Sewerage | Low Pressure Sewerage |
|---|---|---|
| Impacts on flora and fauna | To be assessed as part of REF at concept design stage | To be assessed as part of REF at concept design stage |
| Impacts on European and Aboriginal heritage | To be assessed as part of REF at concept design stage | To be assessed as part of REF at concept design stage |

## 5.5 Ability to Meet Project Objectives

The project objectives, and the ability of each option to meet each objective, is summarised in Table 5-6.

*Table 5-6 Ability to Meet Project Objectives*

| Item | Conventional Gravity Sewerage | Low Pressure Sewerage |
|---|---|---|
| Provide levels of service to all residential properties in East Oberon that is similar to other residents in Oberon | Yes | Yes; with some restrictions on usage during power outage |
| Improve environmental and public health standards in the service area | Yes | Yes |
| Allow for further development in the East Oberon area | Yes; with increased flexibility in comparison to low pressure sewerage | Yes |
| Provide a robust, safe and efficient sewerage system | Yes | Yes |
| Be delivered within the project budget. | No; total estimated capital cost exceeds $2 million | Yes; total estimate capital cost is approximately $1.43 million |

## 5.6 Options Assessment Summary

A summary of the options assessment is provided below:

- Technical; both options provide a sound technical solution. A conventional gravity sewerage system is the preferred option from a technical perspective due to higher level of performance, flexibility and adaptability and maintainability.
- Financial; a low pressure sewerage system is preferred from a financial perspective as it has the lower cost for both capital and whole of life cycle costs. The preliminary project cost estimates indicate that a low pressure would be about 60% of the cost of a conventional gravity sewerage system.
- Social; a conventional gravity sewerage system has the potential for more odour, noise and visual impact than a low pressure sewerage system. It would also create more disruption during construction. It would, however, provide less ongoing disruption to residents than a low pressure sewerage system.
- Environmental; the environmental impacts of each option are expected to be similar.

- Ability to meet project objectives; both options meet the project objectives with the exception of the project budget. The cost of a conventional gravity sewerage system is expected to exceed the project budget.

# 6 Summary and Recommendations

Two options were investigated for the provision of reticulated sewerage to East Oberon. The area does not drain via gravity to the existing sewerage system. All analysis has been based on a desktop review of available information and a brief site visit. As contour information was only available at 10 m intervals, all infrastructure requirements and locations are considered preliminary.

The analysis indicated that a low pressure sewer system would be more cost effective than a conventional gravity system for the study area and meets the required project objectives. The estimated capital cost for a low pressure system is $1,430,000 for Option 2A and $1,420,000 for Option 2B, which includes all overheads and contingencies. Both low pressure sewerage options have an estimated capital cost of approximately $28,500 per existing lot. Option 2B is preferred in comparison to Option 2A as it bypasses the existing sewerage network and discharges directly to the STP. No modifications to the existing network would need to be undertaken and a provision for the new low pressure main could be incorporated into the design of the new STP inlet works.

It is recommended that detailed computer modelling of the proposed low pressure system is undertaken during the concept design stage.

# 7 References

Department of Primary Industries Office of Water. (2014). *NSW Reference Rates Manual Valuation of water supply, sewerage and stormwater assets.* Sydney: Department of Primary Industries.

Hunter Water Corporation. (2012). *Operating Cost Estimating Guideline - Water and Sewer.*

Water Services Association of Australia. (2014). *Sewerage Code of Australia Part 1: Planning and Design.*

# Exhibits

Proposed SPS 1
DN1.5m wet well
4L/s at 40m

Proposed rising main
655m x DN80

AO4

Proposed Connection Point to
Exisitng Sewerage System

Proposed rising main
650m x DN80

Proposed SPS 2
DN1.5m wet well
6L/s at 31m

## Legend

- Proposed SPS
- Proposed Gravity Main
- Proposed Rising Main
- Existing Manhole
- Existing Sewermain
- Study Area
- Contours (10m)
- Existing STP
- Proposed new STP site

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EAST OBERON SEWERAGE
INVESTIGATION
Option 1A - Gravity System

| | | | |
|---|---|---|---|
| SCALE: NTS | PR. No: 4893 | EXHIBIT 1 | A3 |
| DRN: AD CHK: DA | 15/08/2017 | | |
| File Name: Oberon - Gravity Option 1A |  | | |

Area 2

Area 1

Proposed SPS 1
DN1.5m wet well
4L/s at 40m

Proposed rising main
655m x DN80

Proposed SPS 2
DN1.5m wet well
6 L/s at 27m

Proposed Connection Point at
New STP Inlet Works

Proposed rising main
570m x DN80

## Legend

- Proposed SPS
- Proposed Gravity Main
- Proposed Rising Main
- Existing Manhole
- Existing Sewermain
- Study Area
- Contours (10m)
- Existing STP
- Proposed new STP site

hunterh2O

EAST OBERON SEWERAGE
INVESTIGATION
Option 1B - Gravity System

| | | | |
|---|---|---|---|
| SCALE: NTS | PR. No: 4893 | EXHIBIT 2 | A3 |
| DRN: AD CHK: DA | 15/08/2017 | | |
| File Name: Oberon - Gravity Option 1B | |  | |

Area 2

Area 1

AO4

Proposed Connection Point to Existing Sewerage System

## Legend

- Proposed Low Pressure Main (DN 53)
- Proposed Pressure Main (DN 63)
- Proposed Pressure Main (DN 76)
- Existing Manhole
- Existing Sewermain
- Study Area
- Existing STP
- Proposed new STP site
- Contours (10m)

hunterh2o

EAST OBERON SEWERAGE INVESTIGATION
Option 2A - Low Pressure System

| | | | |
|---|---|---|---|
| SCALE: NTS | PR. No: 4893 | EXHIBIT 3 | A3 |
| DRN: AD CHK: DA | 15/08/2017 | | |
| File Name: Oberon - Pressure Sewer Option 2A | | © COPYRIGHT INFORMATION | |

Area 2

Area 1

Proposed Connection Point at New STP Inlet Works

## Legend

- Proposed Pressure Main (DN 53)
- Proposed Pressure Main (DN63)
- Proposed Pressure Main (DN 76)
- Existing Manhole
- Existing Sewermain
- Study Area
- Existing STP
- Proposed new STP site
- Contours (10m)

hunterh2O

EAST OBERON SEWERAGE INVESTIGATION
Option 2B - Low Pressure System

| | | | |
|---|---|---|---|
| SCALE: NTS | PR. No: 4893 | EXHIBIT 4 | A3 |
| DRN: AD CHK: DA | 15/08/2017 | | |
| File Name: Oberon - Pressure Sewer Option 2B |  | | |

# Appendix A: Technical Note 1: Design Criteria and Hydraulic Loading Forecast

| | | | |
|---|---|---|---|
| To: | Gidi Azar<br>Oberon Council | From: | Angela Dwyer<br>Hunter H2O |
| CC: | Chris Schumacher | Date: | 24/07/2017 |

Subject: Technical Note 1 – Design Criteria and Hydraulic Loading Forecast

## Introduction

Hunter H2O has been engaged by Oberon Council to undertake Part 2 of the East Oberon Sewerage Project for Stage 1 - Investigation Consultant's Brief. The project has been co-funded by Oberon Council and the NSW Government under the Restart NSW program.

The project includes connecting un-sewered customers in East Oberon to the Oberon sewerage system to provide East Oberon with similar levels of service to other customers in Oberon, improve environmental and public health standards and allow for further development in the East Oberon area.

The objective of Stage 1 of the consultancy brief is to investigate options that meet the project requirements and recommend the option that provides the best outcomes to Council in terms of cost, environmental performance, social outcomes and risks.

The requirements of the investigation include:

- Sewerage system is required to transfer all sewage loads from properties to the existing sewerage system
- Wet weather infiltration to the system be limited to no more than 50% of the dry weather flows
- Overflows from any component of the system is not allowed
- System capacity to allow for two residential houses for each existing lot to allow for future development comprising subdivisions and/or dual occupancy

This technical note details the design criteria and hydraulic loading forecast that will be adopted for the project.

## Design Criteria

The following design criteria will be used to undertake the analysis:

- Council's Level of Services (LoS) found in Oberon Council's Development Servicing Plans (DSP) for Water Supply and Sewerage April 2017 Exhibition Draft
- Water Services Association of Australia (WSAA) Gravity Sewerage Code of Australia 02-2014 Version 3.1
- WSAA Pressure Sewerage Code of Australia 07-2007 Version 1.1

## Hydraulic Loading Forecast

Hydraulic loadings and design flows for dry and wet weather have been estimated using the flow estimation methods in *WSA 02 Appendix C Flow Estimation for Undeveloped Areas*. Figure 1 shows the three components used to calculate the design flow. The dry weather component consists of the Peak Wet Weather Flow (PDWF) and the wet weather component consists of Ground Water Infiltration (GWI) and Rainfall Dependent Inflow and Infiltration (RDI).

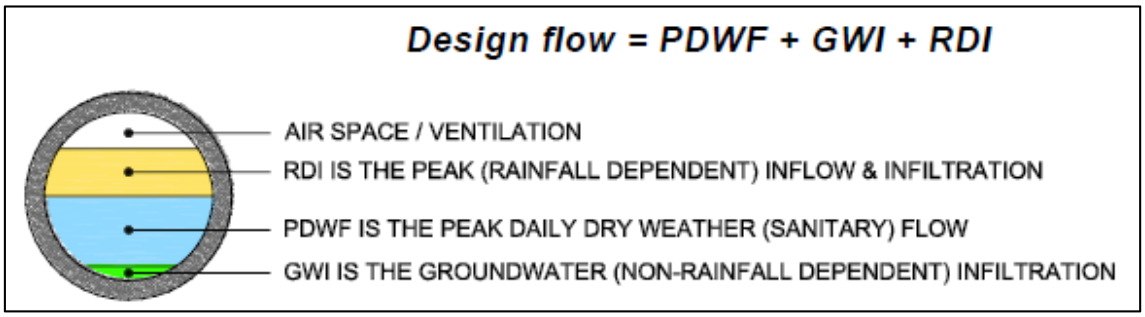


*Figure 1 WSA 02 Flow Estimation for Undeveloped Areas*

The wet weather component of the design flow has been calculated by adding an additional allowance for the quantities of water that enter a sewerage system during wet weather through inflow and infiltration (I/I) at openings into the collection system.

The allowance for the wet weather component of the design flow loading to the sewerage system has been calculated using the following for each proposed sewerage collection system:

- Gravity sewerage system – Estimated using WSA 02 Appendix C
- Low pressure sewerage system – Estimated using WSA 02 Appendix C with a factor of 0.2 applied to the wet weather component of the design flow calculation i.e. 20% of GWI and RDI

The service areas represented in Figure 1 of the Stage 1 – Investigation Consultant's Brief show 50 lots (45 lots - Area 1, 5 lots - Area 2) forming the area of scope for East Oberon. This value has been used for the purpose of estimating the hydraulic loadings for East Oberon. It should be noted that Council's DSP shows that the number of estimated tenements (ET) in 2017/18 for the East Oberon service area is a backlog of 60 ET.

The following assumptions have been used to calculate the hydraulic loadings:

- The combined average daily sanitary flow into the sewerage system from domestic sources (ADWF) was taken as 180 L/d/EP or 0.0021 L/s/EP from WSA 02 Appendix C
- Ratio of EP to ET of 2.3 from latest Census Quickstat data
- Assumed gross area for each lot of the un-sewered area of 800 $m^2$. It is considered that using the actual lot area in a rural residential area would result in an unrealistically large wet weather contribution.
- Portion of pipe inverts below groundwater table is 100%
- The 1 hour duration rainfall intensity at the location for an average recurrence interval of 2 years ($I_{1,2}$) has been taken from the average of Sydney and Dubbo from WSA 02 Table C2
- The portion of the gross plan area likely to be covered by impervious structures that drain directly to the storm water system is 70%

A summary of the hydraulic loadings calculated for the East Oberon area is outlined in Table 1. It should be noted that the outflow from a low pressure sewer system would be dependent on the number of simultaneous pumps in operation and will be further refined during the options assessment.

If you have any questions on the technical note, please do not hesitate to contact me on the below details.

Regards,
Angela Dwyer
Project Manager
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E angela.dwyer@hunterh2o.com.au

*Table 1 Hydraulic Loadings East Oberon*

| Stage | Sewerage Collection System | Area | Lots | ET | EP | ADWF | Contributing Area | PDWF | GWI | $IIF_1$ | Design $Flow_1$ |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | L/s | Ha. | L/s | L/s | L/s | L/s |
| Existing | Low Pressure | Area 1 | 5 | 5 | 12 | 0.02 | 0.40 | 0.23 | 0.01 | 0.17 | 0.27 |
| | | Area 2 | 45 | 45 | 104 | 0.22 | 3.60 | 1.17 | 0.09 | 1.17 | 1.42 |
| | | Total Area | 50 | 50 | 115 | 0.24 | 4.00 | 1.40 | 0.10 | 1.34 | 1.69 |
| | Conventional Gravity | Area 1 | 5 | 5 | 12 | 0.02 | 0.40 | 0.23 | 0.01 | 0.17 | 0.41 |
| | | Area 2 | 45 | 45 | 104 | 0.22 | 3.60 | 1.17 | 0.09 | 1.17 | 2.43 |
| | | Total Area | 50 | 50 | 115 | 0.24 | 4.00 | 1.40 | 0.10 | 1.34 | 2.85 |
| Future | Low Pressure | Area 1 | 10 | 10 | 23 | 0.05 | 0.80 | 0.39 | 0.02 | 0.31 | 0.45 |
| | | Area 2 | 90 | 90 | 207 | 0.43 | 7.20 | 1.95 | 0.18 | 2.16 | 2.42 |
| | | Total Area | 100 | 100 | 230 | 0.48 | 8.00 | 2.34 | 0.20 | 2.47 | 2.87 |
| | Conventional Gravity | Area 1 | 10 | 10 | 23 | 0.05 | 0.80 | 0.39 | 0.02 | 0.31 | 0.72 |
| | | Area 2 | 90 | 90 | 207 | 0.43 | 7.20 | 1.95 | 0.18 | 2.16 | 4.29 |
| | | Total Area | 100 | 100 | 230 | 0.48 | 8.00 | 2.34 | 0.20 | 2.47 | 5.01 |

[1] Values based on the 1 hour duration rainfall intensity for an average recurrence interval of 2 years

# Appendix B: Technical Note 2: Feasible Options

| | | | |
|---|---|---|---|
| To: | Gidi Azar<br>Water Oz | From: | Angela Dwyer<br>Hunter H2O |
| CC: | Chris Schumacher<br>Oberon Council | Date: | 14/08/2017 |

Subject: Technical Note 2 – Feasible Options

## Introduction

Hunter H2O has been engaged by Oberon Council to undertake Part 2 of the East Oberon Sewerage Project. The project has been co-funded by Oberon Council and the NSW Government under the Restart NSW program.

Hunter H2O submitted Technical Note 1 – Design Criteria and hydraulic loading forecast on 24/07/2017.

This technical note (Technical Note 2) details the long list of potential options to service the study area, and applies screening criteria to select a short list of options for further assessment.

The following long list of options were included as potential options for servicing the study area:

- Conventional gravity sewerage system;
- Modified gravity sewerage system;
- Low pressure sewerage system;
- Septic tank effluent pumping; and
- Vacuum sewerage system.

The following screening criteria were applied to each of the options in the long list:

- Technical feasibility including operational complexity;
- Capital costs;
- Operation and maintenance costs;
- Social impacts;
- Environmental impacts; and
- Ability to meet project objectives as specified in the project brief and listed below:
    - Provide level of service to all residential properties in East Oberon that is similar to other Oberon residents;
    - Improve environmental and public health standards in the service areas;
    - Allow for further development in East Oberon;
    - Provide a robust, safe and efficient sewerage system; and
    - Be delivered within the budget.

## Study Area Overview

The study area is located in East Oberon and comprises approximately 50 lots. An overview of the study area is provided in Figure 1.

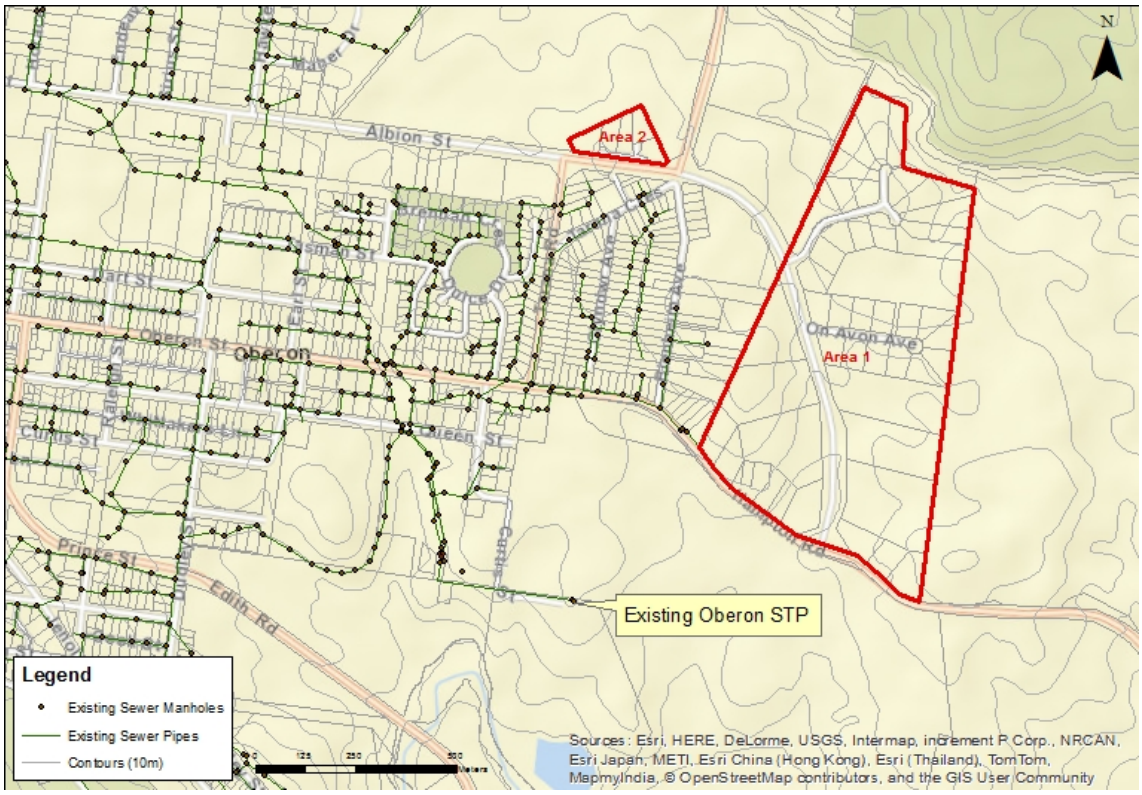


*Figure 1 East Oberon Study Area Overview*

Area 1 comprises approximately 45 lots, ranging in size from approximately 4,000 $m^2$ to 4.0 Ha. Properties to the north of On Avon Avenue (including those on the northern side of the street) drain generally to the north. Properties south of On Avon Avenue (including those on the southern side of the street) drain generally to the south to a low point near the intersection of Albion Street and Duckmaloi Road. Elevations across Area 1 range from approximately 1,060 m to 1,100 m AHD.

Area 2 comprises five lots in Werrina Avenue, ranging in size from approximately 3,000 $m^2$ to 4,000 $m^2$. The area drains generally to the northeast, away from the existing sewerage system. Elevations across Area 2 range from approximately 1,090m to 1,100m AHD.

Council nominated connection points to the existing sewerage system. The nominated connection point for Area 1 was MH BO2 near the intersection of Duckmaloi Road and Blenheim Avenue, or directly to the new Sewerage Treatment Plant (STP) south of Duckmaloi Road. The nominated connection point for Area 2 was MH AAH8 in Tarana Road.

## Sewerage Options

The options discussed in this technical note have been based on the information available at the time of assessment. The required infrastructure will be subject to survey, geotechnical investigation, assessment of groundwater and flood levels, and environmental investigation. Contour information was available at 10 m intervals only.

The system capacity will need to allow for two residential houses for each existing lot, as requested by Council. This allows for future development comprising subdivision and/or dual occupancy.

A summary of each option, and the screening criteria, is provided in Table 1, at the end of this technical note.

## Conventional Gravity Sewerage System

Gravity collection systems have been the most widely used systems in the past and are currently used throughout Oberon. Based on the topography of the East Oberon area, it is anticipated that two new sewerage pumping stations (SPS) would be required; one for the lots in Area 2 and the northern half of Area 1, and a second SPS for the lots in the southern section of Area 1. It is estimated that approximately 3,600m of DN150 gravity main and 1,400 to 1600m of DN100 rising main would also be required, in addition to house connections. Flows from the entire area could be pumped to the either MH BO2 in Duckmaloi Road or the new STP.

The advantages of a conventional gravity system for East Oberon include:

- Known technology;
- Council is familiar with operation and maintenance of systems;
- Provides residents with similar level of service to existing Oberon residents;
- Flexibility for future growth, as the system would have spare capacity by virtue of minimum infrastructure sizing; and
- Lower cost for future connections.

Disadvantages of a conventional gravity system for East Oberon include:

- High capital cost;
- Potential noise, odour and visual impact from proposed SPSs;
- Council would likely need to purchase land for two SPSs;
- Two additional SPS for Council to operate and maintain;
- Less flexibility on pipeline route and excavation depth in comparison to pressure sewerage options, and more tree clearing is likely to be required; and
- Majority of lots slope away from the street, requiring large amount of construction on private property.

It is recommended that a conventional gravity system is further considered in the options development.

## Modified Gravity Sewerage System

Conventional gravity sewer systems can be unaffordable for small communities. The objective of a Modified Gravity System (MGS) is to provide a collection system at a lower cost than a conventional system but with a lower level of service. The features of a MGS include:

- Use of access chamber lift stations to reduce pipe depths and trench excavations;
- Replacing access chambers with modified lamp holes;
- Smaller diameter reticulation mains; and
- Flatter grade sewers.

Conventional gravity sewerage system design codes were developed by sewerage authorities and aimed to provide reliable service to larger and more densely populated urban areas (Urban Water Research Association of Australia (UWEAA) , 1996). However to design a sewerage system to the same standards for smaller communities may not be required. The lower levels of service generally provided by the MGS may provide better value for money for smaller communities with minor inconveniences (e.g. more frequent sewer blockages, more frequent overflows during wet weather, and vehicle access restrictions due to reduced cover over the pipework). Any overflows from small community sewerage systems however would be smaller than those of larger towns.

There would be some cost savings in comparison to a conventional gravity sewerage system for East Oberon however it is likely that two pump stations would still be required to service the area. Cost savings could be achieved with the use of reduced pipe diameter (DN100 instead of DN150), fewer access chambers and the use of access chamber lift stations. However, it is difficult to quantify the number of access chamber lift stations and resulting reduction in trench excavations based on the 10 m contours. Due to the topography, the majority of gravity mains

would need to be constructed at the rear of properties which would reduce the opportunities for access chamber lift stations due to limited access for future maintenance.

Advantages of a modified gravity system for East Oberon include:

- Reduced capital cost in comparison to conventional gravity;
- Known technology, similar to conventional gravity;
- Council is familiar with operation and maintenance of systems;
- Some flexibility for future growth; and
- Low cost for future connections.

Disadvantages of a modified gravity system for East Oberon include:

- Capital cost is still high, although lower than for a conventional gravity system;
- Potential noise, odour and visual impact from proposed SPSs;
- Two additional SPS for Council to operate and maintain, plus additional access chamber lift stations;
- Less flexibility on pipeline route and excavation depth in comparison to pressure sewerage options, and more tree clearing is likely to be required;
- Majority of lots slope away from the street, requiring large amount of construction on private property;
- Higher potential for blockages and overflows in comparison to a conventional gravity system; and
- Reduced level of service to residents in comparison to existing Oberon residents

Due to the lower level of service, a modified gravity system is not recommended for further investigation for East Oberon.

### Low Pressure Sewerage System

A low pressure sewer system consists of a network of interconnected pressure pipes which deliver sewage flows to the downstream sewerage system. A small storage vessel is installed on each individual property which collects sewage from the dwelling. The storage vessel is fitted with a grinder pumping unit which discharges the sewage through the pressure pipe network. The small diameter pressure pipes are laid in narrow trenches at relatively shallow and constant depths.

There are several manufacturers and suppliers of low pressure systems. The pumps generally have a near vertical H-Q curve and can operate over a range of head conditions. The systems can incorporate a remote terminal unit (RTU) to control the operation of pumps in the system via time based control rules or via integration with SCADA. This can be used to modulate flows in the system leading to a reduction in peak flows, or it can be used to create periodic flushing waves or reduce detention times.

It is estimated that approximately 3,000 m of pressure main would be required to service the lots in the study area, ranging in size from DN40mm to DN90mm. Pipe sizes would need to be increased above the minimum diameters required for existing development in order to accommodate future growth in the area. The initial requirements would be for 50 tanks, pumping units and boundary connection kits (BCKs). Infrastructure sizing and location would be determined during the next phase of the project.

Advantages of a low pressure sewer system for East Oberon include:

- Lower capital cost in comparison to conventional gravity system;
- Increased flexibility on pipeline route and depth in comparison to conventional gravity system, construction throughout private property can be reduced;
- Reduced pipe length in comparison to gravity options, as lots on both side of the street can connect to a common main;
- Reduced potential for inflow and infiltration in comparison to gravity options; and
- Ability to modulate flows based on operational needs of system.

Disadvantages of a low pressure sewer system for East Oberon include:

- New technology for Oberon, and Council is not familiar with operation and maintenance of systems;
- Council would need to develop agreement with property owners for access and maintenance of system;
- Less flexibility to accommodate unforeseen future growth;
- Some usage restrictions on homeowners;
- Reduced level of service for residents during power outage (assuming that Council owned SPS have backup generators), and pump outs may be required during prolonged power outages;
- Although minimal, there are ongoing power cost for homeowners; and
- Higher costs for future connections.

It is recommended that a low pressure sewerage system is further considered in the options development.

### Common Effluent Pumping

Common effluent pumping is a type of pressure sewer system, in which sewage flows into a conventional septic tank to capture solids. The liquid effluent flows to a holding tank that contains a pump and control devices, and is then pumped to a network of pressure mains. There may be opportunities to retrofit the existing septic tanks, however often a majority of tanks need to be replaced over the life of the system due to insufficient capacity, deterioration of concrete tanks or leaks (Water Services Association of Australia, 2007).

Advantages of a common effluent pumping system for East Oberon include:

- Increased flexibility on pipeline route and depth in comparison to conventional gravity system;
- Reduced pipe length in comparison to gravity options, as lots on both side of the street can connect to a common main; and
- Some existing septic tanks may be able to be reused.

Disadvantages of a common effluent pumping for East Oberon include:

- It is unknown how many existing septic tanks would need to be replaced. Replacement of septic tanks would be more expensive than provision of a new tank for low pressure sewer option;
- Less flexibility to accommodate unforeseen future growth, and septic tanks would need to be constructed for future connections;
- Ongoing desludging costs for homeowners, in addition to power costs and sewer charges;
- Council would need to develop agreement with property owners for access and maintenance of pumping units;
- Some usage restrictions for residents, as for septic tanks (e.g. household chemicals);
- Reduced level of service for residents during power outage (assuming that Council owned SPS have backup generators), and effluent pump out may be required during prolonged power outages; and
- High costs for future connections.

Improvement in grinder pump technology have generally made low pressure sewer a more suitable option than common effluent pumping. Further investigation of a common effluent pumping system is therefore not recommended for East Oberon.

### Vacuum Sewerage System

Vacuum sewerage systems consist of a centrally located vacuum pump which draws sewage through a collection pipe network to a collection tank. The sewage is then pumped to the sewage treatment plant from the collection tank. Each house or group of houses is provided with a valve pit (also known as a 'pot') fed by gravity and an interface valve. When the level in

the ‘pot’ reaches an upper limit, the valve is actuated and the pot contents are drawn as a slug of liquid and air into a small bore sewer.

The cost of a vacuum pump station is higher than a conventional sewerage pumping station. Vacuum sewerage systems typically become cost effective when a single pump station can service several hundred, or even several thousand, lots and replace the need for multiple sewage pumping stations. Most vacuum systems are found in areas of flat land (Flovac Systems, 2013).

Advantages of a vacuum system for East Oberon include:

- Power is required at the vacuum pumping station only; and
- Reduced potential for inflow and infiltration in comparison to gravity options.

Disadvantages of a vacuum system for East Oberon include:

- High capital cost per property due to small number of lots;
- New technology for Oberon, and Council is not familiar with operation and maintenance of systems;
- Increased operational complexity in comparison to other options - systems require regular expert maintenance which is usually carried out on a contract basis; and
- Council would need to develop agreement with property owners for access and maintenance of system

Further investigation of a vacuum sewerage system is not recommended for East Oberon.

## Recommendations

It is recommended that a conventional gravity and low pressure sewerage system are selected for further options development.

## References

Flovac Systems. (2013). *The Choice between Vacuum, Gravity and Low Pressure.*

Urban Water Research Association of Australia (UWEAA) . (1996). *Affordable Water Supply and Sewerage for Small Communitiies - Investigation Design and Management Handbook.*

Water Services Association of Australia. (2007). *Pressure Sewerage Code of Australia WSA 07-2007 Version 1.1.*

*Table 1. Comparison of Sewerage Options for East Oberon*

| Option | Infrastructure Description | Financial Assessment | Technical Assessment | Social Impact | Environmental Impact | Ability to meet project objectives | Recommendation |
|---|---|---|---|---|---|---|---|
| Conventional gravity sewerage system | Minimum two new SPS<br>Appox 3,600m DN150 gravity main plus house drainage lines<br>Approx 1,500m rising main | High capital cost; O&M costs high due to two new SPS | Known technology | Construction in private property<br>Potential odour and noise generation from SPS<br>Visual impact of SPS | Improvement in environmental health of study area<br>May require use of chemicals for odour control | High | Select for further analysis |
| Modified gravity sewerage system | Minimum two WWPS<br>Appox. 3,600m DN100 gravity main plus house drainage lines<br>Approx. 1,500m rising main | High capital cost; some cost savings in comparison to conventional gravity sewerage<br>Increased operational costs in comparison to conventional gravity | Known technology<br>More prone to blockages than conventional gravity system. | Construction in private property<br>Potential odour and noise generation from SPS<br>Visual impact of SPS | Improvement in environmental health of study area<br>Potential increase in sewage overflows in comparison to other options<br>May require use of chemicals for odour control | Reduced in comparison to conventional gravity | Discard |

| Option | Infrastructure Description | Financial Assessment | Technical Assessment | Social Impact | Environmental Impact | Ability to meet project objectives | Recommendation |
|---|---|---|---|---|---|---|---|
| Low pressure sewerage system | Approx. 3,000m low pressure sewer pipe plus house connections<br>50 x tanks, pump units and BCKs | Lower capital cost than gravity options<br>O&M cost high | Council does not currently have low pressure sewerage system; will require staff training<br>Reduced potential for infiltration in comparison to gravity options | Will require public education to ensure user knows how to deal with emergencies, avoid blockages and other maintenance problems. | Improvement in environmental health of study area<br>May require use of chemicals for odour control | High | Select for further analysis |
| Common effluent pumping | Approx. 3,000m pipe<br>Modification or replacement of existing septic tanks; new pumps and connection kits | Capital cost difficult to estimate<br>O&M costs high | Condition of existing septic tanks is unknown; new tanks may be required | Homeowners must still maintain septic tank and be responsible for pump out of solids | Improvement in environmental health of study area | Low | Discard |
| Vacuum sewerage system | Not developed | Capital cost high<br>O&M costs high | Not considered suitable for East Oberon | Not considered | Not considered | Low | Discard |

If you have any questions on the technical note, please do not hesitate to contact me on the below details.

Regards,

Angela Dwyer
Project Manager
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E angela.dwyer@hunterh2o.com.au

# Appendix C: Preliminary Cost Estimates

**EAST OBERON SEWERAGE INVESTIGATION**

PRELIMINARY PROJECT ESTIMATE

Hunter H2O Project N0: 4893

Option 1A - Gravity Sewerage System discharging to MH AO4

Date of Estimate: Sep-17

Note: Costs obtained from the NSW Office of Water Reference Rates Manual June 2014

*Estimated Contract Award Sum*

| ITEM | DEPTH | QUANTITY | UNIT | RATE | SUB-TOTAL (Inc. change in CPI) | TOTAL | COMMENT |
|---|---|---|---|---|---|---|---|
| **CHANGE IN CPI** | | | | | | | |
| Pipeline: Jun-14 to Sep-17 | | 1.045 | | 4.5% | | | |
| **1. Pipes** | | | | | | | |
| Sewer Reticulation - DN150 | <1.5m | 1,200 | m | 159.00 | $ 199,310 | | NSW Reference Rates Manual |
| Sewer Reticulation - DN150 | 1.5-3.0m | 1,200 | m | 232.00 | $ 290,817 | | NSW Reference Rates Manual |
| Sewer Reticulation - DN150 | 3.0-4.5m | 1,200 | m | 332.00 | $ 416,169 | | NSW Reference Rates Manual |
| Rising Main - DN100 | <1.5m | 1,305 | m | 100.00 | $ 136,320 | | NSW Reference Rates Manual |
| Property Connections - allow 50m DN100 per property | <1.5m | 2,500 | m | 136.00 | $ 355,164 | | Typical Supplier Cost |
| | | | | | | $ 1,397,779 | |
| **2. Additional Items** | | | | | | | |
| Sewer Pump Station | | 2 | Item | 100,000.00 | $ 200,000 | | Typical Supplier Cost |
| | | | | | | $ 200,000 | |
| **3. Establishment / Disestablishment** | | | | | | | |
| Establishment / Disestablishment | | 1 | Item | 30,000.00 | $ 30,000 | | |
| | | | | | | $ 30,000 | |
| **Total Estimated Contract Award Sum** | | | | | | **$ 1,627,779** | A |
| Design (includes Survey, Investigation Design and Project Management) | | | | | | | |
| *Allow 20% of Contract Award Sum* | | 20% of A | | | | $ 325,556 | B |
| Inherent Risk | | | | | | | |
| Feasibility Stage - allow 30% of Contract Award Sum | | 30% of A | | | | $ 162,778 | C |
| Contingency | | | | | | | |
| Future Assets - allow 20% of Contract Award Sum | | 20% of A | | | | $ 325,556 | D |
| **Total Preliminary Project Estimate** | | A + B + C + D | | | | **$ 2,442,000** | |
| **Average Cost per Property** | | | | | | **$ 48,840** | |

**EAST OBERON SEWERAGE INVESTIGATION**

PRELIMINARY PROJECT ESTIMATE

Hunter H2O Project N0: 4893

Option 1B - Gravity Sewerage System discharging to new STP

Date of Estimate: Sep-17

Note: Costs obtained from the NSW Office of Water Reference Rates Manual June 2014

*Estimated Contract Award Sum*

| ITEM | DEPTH | QUANTITY | UNIT | RATE | SUB-TOTAL (Inc. change in CPI) | TOTAL | COMMENT |
|---|---|---|---|---|---|---|---|
| **CHANGE IN CPI** | | | | | | | |
| Pipeline: Jun-14 to Sep-17 | | 1.045 | | 4.5% | | | |
| **1. Pipes** | | | | | | | |
| Sewer Reticulation - DN150 | <1.5m | 1,200 | m | 159.00 | $ 199,310 | | NSW Reference Rates Manual |
| Sewer Reticulation - DN150 | 1.5-3.0m | 1,200 | m | 232.00 | $ 290,817 | | NSW Reference Rates Manual |
| Sewer Reticulation - DN150 | 3.0-4.5m | 1,200 | m | 332.00 | $ 416,169 | | NSW Reference Rates Manual |
| Rising Main - DN100 | <1.5m | 1,225 | m | 100.00 | $ 127,964 | | NSW Reference Rates Manual |
| Property Connections - allow 50m DN100 per property | <1.5m | 2,500 | m | 136.00 | $ 355,164 | | Typical Supplier Cost |
| | | | | | | $ 1,389,422 | |
| **2. Additional Items** | | | | | | | |
| Sewer Pump Station | | 2 | Item | 100,000.00 | $ 200,000 | | Typical Supplier Cost |
| | | | | | | $ 200,000 | |
| **3. Establishment / Disestablishment** | | | | | | | |
| Establishment / Disestablishment | | 1 | Item | 30,000.00 | $ 30,000 | | |
| | | | | | | $ 30,000 | |
| **Total Estimated Contract Award Sum** | | | | | | **$ 1,619,422** | A |
| Design (includes Survey, Investigation Design and Project Management) | | | | | | | |
| *Allow 20% of Contract Award Sum* | | 20% of A | | | | $ 323,884 | B |
| Inherent Risk | | | | | | | |
| Feasibility Stage - allow 30% of Contract Award Sum | | 30% of A | | | | $ 161,942 | C |
| Contingency | | | | | | | |
| Future Assets - allow 20% of Contract Award Sum | | 20% of A | | | | $ 323,884 | D |
| **Total Preliminary Project Estimate** | | A + B + C + D | | | | **$ 2,429,000** | |
| **Average Cost per Property** | | | | | | **$ 48,580** | |

**EAST OBERON SEWERAGE INVESTIGATION**

PRELIMINARY PROJECT ESTIMATE

Hunter H2O Project N0: 4893

Option 2A - Low Pressure Sewerage System discharging to MH AO4 Date of Estimate: Sep-17

Note: Costs obtained from the NSW Office of Water Reference Rates Manual June 2014

*Estimated Contract Award Sum*

| ITEM | DEPTH | QUANTITY | UNIT | RATE | SUB-TOTAL (Inc. change in CPI) | TOTAL | COMMENT |
|---|---|---|---|---|---|---|---|
| CHANGE IN CPI | | | | | | | |
| Pipeline: Jun-14 to Sep-17 | | 1.045 | | 4.5% | | | |
| 1. Pressure Sewer System | | | | | | | |
| Grinder Pumping Units, bounday kits, electrical connection | | 50 | Item | 5,300.00 | $ 265,000 | | Typical Supplier Cost |
| Installation (OTR) | | 50 | Item | 5,000.00 | $ 250,000 | | Typical Supplier Cost |
| DN 53.2 PE Pressure Main | <1.5m | 1,230 | m | 75.00 | $ 92,250 | | Typical Supplier Cost |
| DN 63.6 PE | <1.5m | 455 | m | 85.00 | $ 38,675 | | Typical Supplier Cost |
| DN 76.3 PE | <1.5m | 1,255 | m | 95.00 | $ 119,225 | | Typical Supplier Cost |
| Property Connections (allow 80m DN53.2 per property) | <1.5m | 4,000 | m | 75.00 | $ 300,000 | | Allowance |
| Allowance for Electrical Switchboard Upgrades | | 25 | Item | 200.00 | $ 5,000 | | |
| | | | | | | $ 1,070,150 | |
| 2. Establishment / Disestablishment | | | | | | | |
| Establishment / Disestablishment | | 1 | Item | 30,000.00 | $ 30,000 | | |
| | | | | | | $ 30,000 | |
| Total Estimated Contract Award Sum | | | | | | $ 1,100,150 | A |
| Design (includes Survey, Investigation Design and Project Management) | | | | | | | |
| *Allow 20% of Contract Award Sum* | | 20% of A | | | | $ 220,030 | B |
| Inherent Risk | | | | | | | |
| Feasibility Stage - allow 30% of Contract Award Sum | | 30% of A | | | | $ 110,015 | C |
| Contingency | | | | | | | |
| Future Assets - allow 20% of Contract Award Sum | | 20% of A | | | | $ 220,030 | D |
| Total Preliminary Project Estimate | | A + B + C + D | | | | $ 1,430,000 | |
| Average Cost per Property | | | | | | $ 28,600 | |

**EAST OBERON SEWERAGE INVESTIGATION**

PRELIMINARY PROJECT ESTIMATE

Hunter H2O Project N0: 4893

Option 2B - Low Pressure Sewerage System discharging to new STP

Date of Estimate: Sep-17

Note: Costs obtained from the NSW Office of Water Reference Rates Manual June 2014

*Estimated Contract Award Sum*

| ITEM | DEPTH | QUANTITY | UNIT | RATE | SUB-TOTAL (Inc. change in CPI) | TOTAL | COMMENT |
|---|---|---|---|---|---|---|---|
| CHANGE IN CPI | | | | | | | |
| Pipeline: Jun-14 to Sep-17 | | 1.045 | | 4.5% | | | |
| 1. Pressure Sewer System | | | | | | | |
| Grinder Pumping Units, bounday kits, electrical connection | | 50 | Item | 5,300.00 | $ 265,000 | | Typical Supplier Cost |
| Installation (OTR) | | 50 | Item | 5,000.00 | $ 250,000 | | Typical Supplier Cost |
| DN 53.2 PE Pressure Main | <1.5m | 1,230 | m | 75.00 | $ 92,250 | | Typical Supplier Cost |
| DN 63.6 PE | <1.5m | 455 | m | 85.00 | $ 38,675 | | Typical Supplier Cost |
| DN 76.3 PE | <1.5m | 1,175 | m | 95.00 | $ 111,625 | | Typical Supplier Cost |
| Property Connections (allow 80m DN53.2 per property) | <1.5m | 4,000 | m | 75.00 | $ 300,000 | | Allowance |
| Allowance for Electrical Switchboard Upgrades | | 25 | Item | 200.00 | $ 5,000 | | |
| | | | | | | $ 1,062,550 | |
| 2. Establishment / Disestablishment | | | | | | | |
| Establishment / Disestablishment | | 1 | Item | 30,000.00 | $ 30,000 | | |
| | | | | | | $ 30,000 | |
| Total Estimated Contract Award Sum | | | | | | $ 1,092,550 | A |
| Design (includes Survey, Investigation Design and Project Management) | | | | | | | |
| *Allow 20% of Contract Award Sum* | | 20% of A | | | | $ 218,510 | B |
| Inherent Risk | | | | | | | |
| Feasibility Stage - allow 30% of Contract Award Sum | | 30% of A | | | | $ 109,255 | C |
| Contingency | | | | | | | |
| Future Assets - allow 20% of Contract Award Sum | | 20% of A | | | | $ 218,510 | D |
| Total Preliminary Project Estimate | | A + B + C + D | | | | $ 1,420,000 | |
| Average Cost per Property | | | | | | $ 28,400 | |

## *Option 1A - Conventional Gravity Sewerage System*

| NOTE | YEAR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PERIOD NO | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | |
| | CAPITAL COSTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SPSs, rising mains and gravity mains | $ 2,442,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | $ 2,442,000 |
| | TOTAL CAPITAL COSTS | $ 2,442,000 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ 2,442,000 |
| | OPERATION & MAINTENANCE COSTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SPS Power | | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 721 | $ 21,630 |
| | SPS maintenance | | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 480,000 |
| | RENEWALS AND REPLACEMENT COSTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SPS - Pump replacmemnt | | | | | | | | | | | | | | | | $ 40,000 | | | | | | | | | | | | | | | | $ 40,000 |
| | TOTAL OPERATING COSTS | | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 56,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 541,630 |
| | TOTAL COSTS | $ 2,442,000 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 56,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 16,721 | $ 2,983,630 |

| | |
|---|---|
| Discount Rate | 7.0% |
| NPV CAPITAL COST | $ 2,442,000 |
| NPV O&M | $ 221,000 |
| NPV TOTAL COST | $ 2,663,000 |

## *Option 1B - Conventional Gravity Sewerage System*

| NOTE | YEAR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PERIOD NO | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | |
| | CAPITAL COSTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SPSs, rising mains and gravity mains | $ 2,429,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | $ 2,429,000 |
| | TOTAL CAPITAL COSTS | $ 2,429,000 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ 2,429,000 |
| | OPERATION & MAINTENANCE COSTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SPS Power | | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 690 | $ 20,700 |
| | SPS maintenance | | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 16,000 | $ 480,000 |
| | RENEWALS AND REPLACEMENT COSTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | SPS - Pump replacmemnt | | | | | | | | | | | | | | | | $ | $ 40,000 | | | | | | | | | | | | | | | $ 40,000 |
| | TOTAL OPERATING COSTS | | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 56,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 540,700 |
| | TOTAL COSTS | $ 2,429,000 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 56,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 16,690 | $ 2,969,700 |

| | |
|---|---|
| Discount Rate | 7.0% |
| NPV CAPITAL COST | $ 2,429,000 |
| NPV O&M | $ 221,000 |
| NPV TOTAL COST | $ 2,650,000 |

## *Option 2A - Low Pressure Sewerage System*

| NOTE | YEAR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PERIOD NO | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | |
| | CAPITAL COSTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Low pressure system | $ 1,430,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | $ 1,430,000 |
| | TOTAL CAPITAL COSTS | $ 1,430,000 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ 1,430,000 |
| | OPERATION & MAINTENANCE COSTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Power | | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 75,000 |
| | Low pressure system - allow $200 per property per year | | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 300,000 |
| | RENEWALS AND REPLACEMENT COSTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Low pressure system - pump replacement | | | | | | | | | | | | | | | | | $ 125,000 | | | | | | | | | | | | | | | $ 125,000 |
| | TOTAL OPERATING COSTS | | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 135,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 425,000 |
| | TOTAL COSTS | $ 1,430,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 135,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 1,855,000 |

| | | | |
|---|---|---|---|
| Discount Rate | | | 7.0% |
| NPV CAPITAL COST | | | $ 1,430,000 |
| NPV O&M | | | $ 166,000 |
| NPV TOTAL COST | | | $ 1,596,000 |

## *Option 2B- Low Pressure Sewerage System*

| NOTE | YEAR | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | TOTAL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PERIOD NO | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | |
| | CAPITAL COSTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Low pressure system | $ 1,420,000 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | $ 1,420,000 |
| | TOTAL CAPITAL COSTS | $ 1,420,000 | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ - | $ 1,420,000 |
| | OPERATION & MAINTENANCE COSTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Power | | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 2,500 | $ 75,000 |
| | Low pressure system - allow $200 per property per year | | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 300,000 |
| | RENEWALS AND REPLACEMENT COSTS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | Low pressure system - pump replacement | | | | | | | | | | | | | | | | $ 125,000 | | | | | | | | | | | | | | | | $ 125,000 |
| | TOTAL OPERATING COSTS | | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 135,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 425,000 |
| | TOTAL COSTS | $ 1,420,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 135,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 10,000 | $ 1,845,000 |

| | |
|---|---|
| Discount Rate | 7.0% |
| NPV CAPITAL COST | $ 1,420,000 |
| NPV O&M | $ 166,000 |
| NPV TOTAL COST | $ 1,586,000 |