South West Drainage Scheme

Port Pirie

Port Pirie Regional Council

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Tonkin CONSULTING

a better approach

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1 Introduction

1.1 Project Brief

The Port Pirie Regional Council has commissioned Tonkin Consulting to investigate the requirements for a stormwater outfall to serve developable land to the south of Risdon Park South. The outfall is to follow an alignment through rural land to the west of the area and consider the benefits of incorporating a potential storage area to the west of Port Davis Road. The investigation has included hydrological and hydraulic modelling of the pre-existing catchment (prior to recent development) and the proposed future development to establish an outfall size and storage volume requirements for the developments. This report describes the analysis and provides a stormwater management strategy to protect existing and future development in the area from the 100 year ARI flood event.

1.2 Background

Land to the south of Port Pirie between Port Davis, Senate and Three Chain Roads is zoned as Residential, Rural Living and deferred urban. A drainage strategy for the area was developed in the 1960s and involved extending the Ferme Street Drain. This proposed extension was never implemented.

The construction of recent developments has included provision of retention storage to contain stormwater runoff from the various sites. This requirement was put into place in the interim to address the lack of an overall drainage strategy. These developments were approved with the knowledge that an outfall would need to be constructed at some future date as the extent of development increased.

During a January 2007 rainfall event, a number of recently constructed homes in a new subdivision came close to being inundated. This made Council aware of the significance of a larger upstream rural catchment that drains through the land zoned for development, including the recently developed land. This became an issue of concern as the existing retention storage within the development was designed to cater for the runoff from the existing development only. Due to this additional upstream catchment, it was determined that the low-lying land situated below the low point on Senate Road would also be potentially subject to flooding during periods of high and extended rainfall. It was believed that a number of dwellings had been constructed with a finished floor level at or below the level of Senate Road making them prone to flooding during a significant event.

The Port Pirie Stormwater Management Plan (2009) as well as a further options study investigated alternative strategies of providing an outfall for the area. Port Pirie Council concluded that providing an outfall through the Ferme Street drain was not the most preferred and practical strategy as existing hydraulic capacity constraints and the encroachment of development over time had substantially increased the cost of upgrading and extending the Ferme Street drain.

As the land is subject to a number of current development proposals, further refinement of the stormwater management strategy is being pursued. A preferred alignment for the drain has been identified. This study looks to determine the outfall and associated detention storage volumes and requirements.

The study also considers the interim measures that would need to be put into place to facilitate further development in the area prior to the construction of the outfall.

1.3 Catchment Description

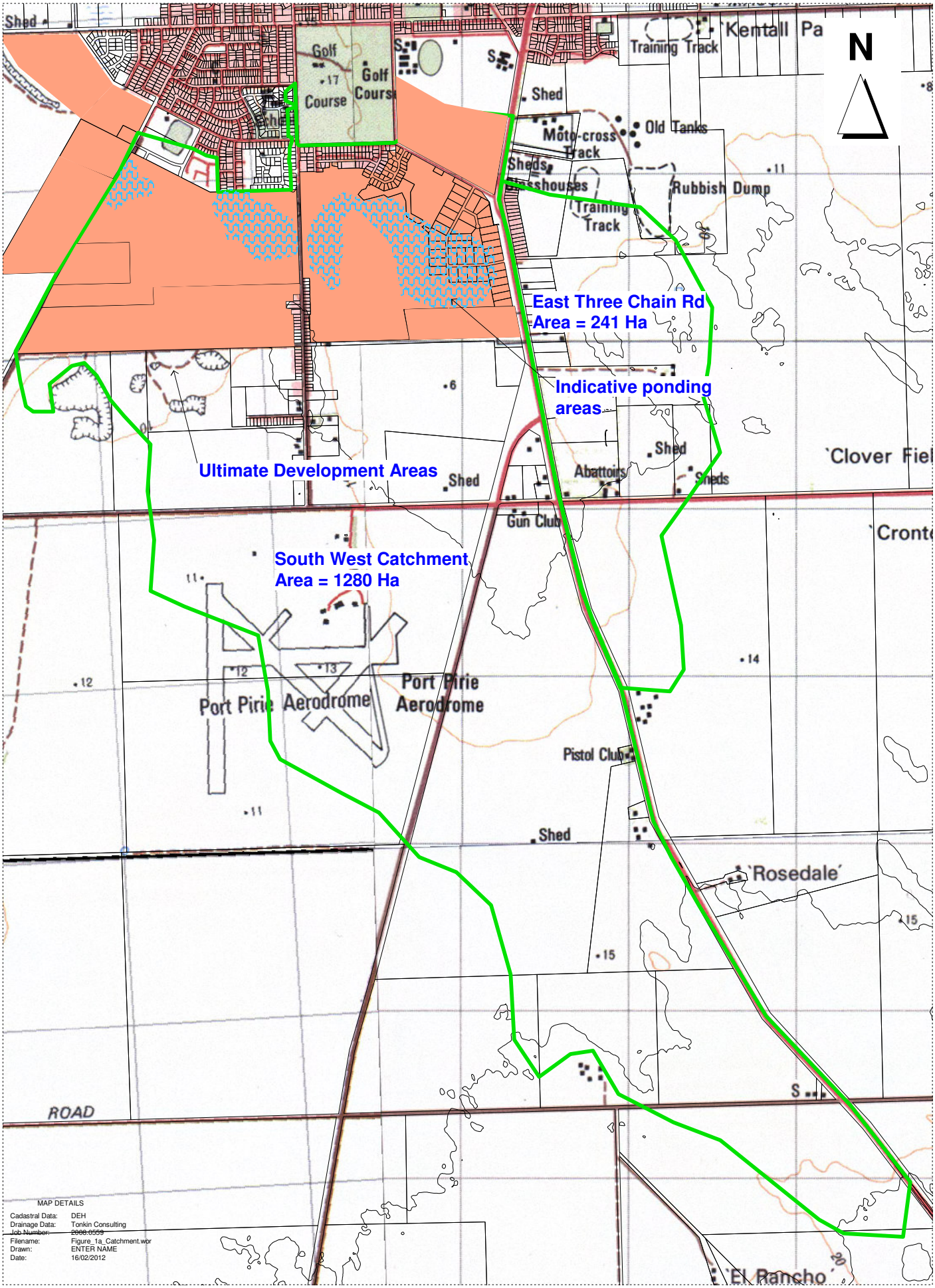
The area immediately south of the existing urban development in Risdon Park is low lying and consists of a number of shallow depressions. The area currently has no direct outfall. Port Davis and Senate Roads form additional barriers for flood flows before floodwaters can discharge towards the west. The catchment contributing to this low lying area is estimated to be over

1520ha based on 1m contour lines derived from photogrammetry of the region. The catchment area is shown in Figure 1.1. The catchment grades to the north with slopes of 0.2% to 0.3% with a number of shallow depressions along an undefined broad flow path. The majority of this area is used for general farming and cropping. The shallow grade and largely pervious nature of the land would indicate that runoff from this catchment would be infrequent. However, the low-lying areas would be at risk of flooding without some form of mitigation work.

Approximately 250 ha of vacant land south of Risdon Park South, including areas subject to flooding, has been zoned for residential and rural living and deferred urban development. Approximately 30 ha of this land been approved for development when the civil infrastructure is in place. The developments approved to date rely on retention storage in the allocated reserve for the management of stormwater generated from the sites.

1.4 Existing Site Storage

Existing storage on the site is contained haphazardly in natural shallow depressions throughout the area. Storage is also present in the form of an existing swale constructed by Council in 2011 from Wattle Drive (approx.) discharging at Senate Road. This swale was constructed to protect the development to the north from the flood flows originating from the large rural catchment upstream. The swale also collects some urban catchment from the allotments south of Pelham Road. The volume of the swale is approximately 1400m^3. This storage intercepts the floodwaters from the upstream catchment, and its capacity is reached in small to medium storm events. It is not recommended to direct additional development runoff toward this swale.



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South Western Outfall Study

Catchment Plan

Figure 1.1

2 Hydrological Analysis

2.1 Flood Hydrology

A DRAINS hydrological model of the catchment has been developed to determine the predevelopment flows and to determine flows from the developed catchment together with detention storage requirements. The model data was initially created as GIS layers and then imported into the DRAINS user interface. The model catchments have been subdivided to reflect the different land uses and natural division of the local topography. The model was initially used to assess the current (or predevelopment) hydrology, i.e. before the development areas either side of Senate Road have been subdivided. Drainage upgrades, sizing and detention storage requirements for ultimate development of the areas defined in Figure 4.1 were then investigated using the model.

2.1.1 Subcatchment Delineation

The catchments have been broken down into a number of smaller subcatchments. Catchment boundaries have been drawn based on previous drainage studies, survey information, contour data, DTM data and the location of the drainage infrastructure. In some instances, additional field investigations were required to determine the flow directions.

2.1.2 Runoff Coefficients

Runoff coefficients were determined from analysis of land use, aerial photography and the likely level of development. Runoff coefficients have been selected to reflect new development that is likely to occur within the identified areas. The average level of impervious area is approximately 42% over the gross area.

2.1.3 Times of Concentration

Times of concentration have been calculated for each subcatchment based on the longest length of the flow path to the outlet of the subcatchment with an allowance made for the slope of the land.

2.1.4 Rainfall Runoff Losses

An initial loss / continuing loss model was used to model runoff from the pervious areas of the catchment for assessment of the local drainage system.

An initial loss of 40mm and 60mm was modelled for urban and rural catchments respectively. A continuing loss of 3 mm/hr was used for all events.

A 60 mm initial loss was applied to the southern rural catchment to reflect the additional losses that would be expected due to land use and flood storage.

2.1.5 Model Analysis

The hydrodynamic module of the DRAINS model was used to undertake the analysis of storage and flood routing through the proposed development areas and the outfall. This module undertakes a more rigorous analysis of the storage in the detention basins and the interconnecting swales assumed in the modelling.

2.2 Water Balance Analysis

In addition to the modelling of peak flows using DRAINS, a water balance model was set up and used to assess options for re-use. The model was also used to assess the feasibility of retaining stormwater to enable development of the area to progress prior to an outfall being constructed.

2.2.1 Analysis Method

The water balance model was used to simulate the behaviour of the active buffer storage in the detention basins, pumping rates, storage basin size, and potential irrigated area using a daily time step. The model was run with over 100 years of rainfall. An allowance for seepage and evaporation losses from storage has been incorporated into the modelling.

For the re-use options, a range of pump rates, storage sizes and irrigation demands have been used to calculate the volume of stormwater that can be utilised.

The runoff estimated considered an initial loss of 1mm/day and generally only included the directly connected impervious areas. Typically, an average volumetric runoff coefficient of 0.38 was adopted.

3 Existing Flood Extents

3.1 Floodplain Mapping

The existing 100 year average recurrence interval flood plain has been mapped using the results of the modelling described above. The floodplain is shown in Figure 3.1. The extent of flooding shown correlates with observations and photographs of flooding made by Port Pirie Council after the 2007 flood event.

The floodplain has been derived using the available contour data provided. No allowance has been included for the following;

- Restrictions to flow due to elevated Roadway levels
- Obstruction by buildings in areas of existing development
- Overtopping of the Broughton River

3.2 Hydraulic Assessment

A one-dimensional steady-state hydraulic model of the existing floodplain was created using the HEC-RAS computer model. 100mm contour data was used to develop the model and define the flood path. The model extended from Aerodrome Road to approximately 50m downstream of Port Davis Road.

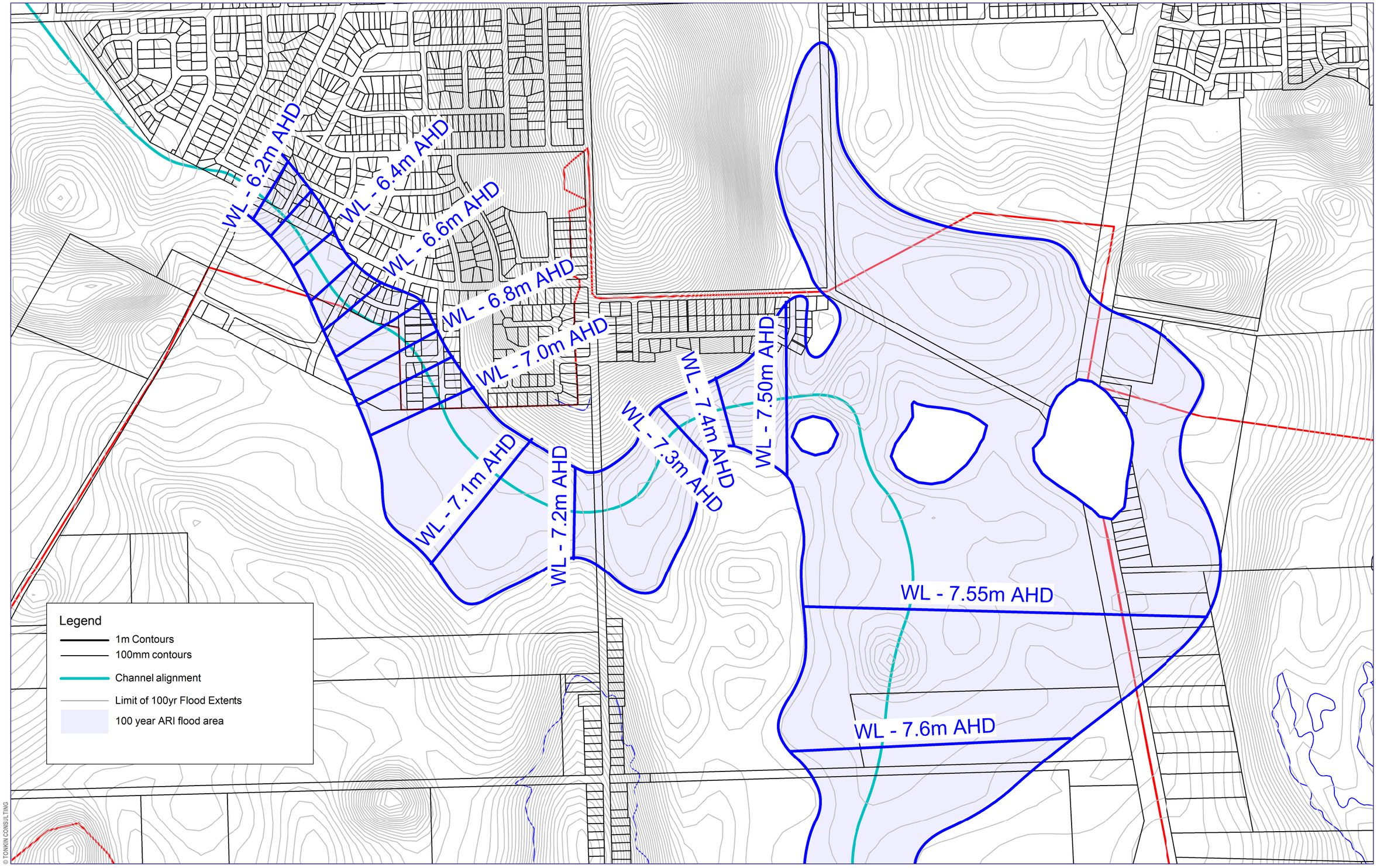
A Manning's roughness coefficient of 0.035 to 0.06 was adopted in the modelling for the floodplain. These coefficients were assessed based on aerial photography.

Flows were taken from the DRAINS hydrological model for existing flows.

3.3 Results

The floodplain map shows that some existing development is likely to be affected by large storm events, primarily in the developed area east of Senate Road.

The mapping shows that much of the area zoned for future development lies within the floodplain. If development of this area is undertaken in the short term, arrangements for protection of the development from inundation will be required.



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Filename:	Existing Flood Extents
Revision:	A
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Drawn:	JO

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EXISTING 100 YEAR ARI FLOOD EXTENTS

Figure 3.1

4 Stormwater Management Strategy

4.1 Introduction

The following section outlines the approach taken to size the outfall and calculate detention storage requirements to cater for the future development of the area. The analysis was based on a number of assumptions that differed from the 2009 Options Study, including:

- No upstream storage has been provided to reduce peak flows generated from the main southern rural catchment
- The modelling assumes only the main parcels of land either side of Senate Road immediately south of the existing development are included.

The infrastructure sizing and detention storage requirements have been based on considering the total catchment response in a 100 year ARI event. This results in a higher flood storage requirement than would typically be used if only flood storage to reduce peak flows to the predevelopment level from an individual development was considered. This is because the critical catchment response is a 24hr storm compared to a 1-2 hour storm for an individual development site.

4.2 2009 Options Study

The previous Options Study that was prepared by Tonkin Consulting in 2009 examined a range of outfall capacities and detention storage volumes to determine the costs and issues associated with providing an outfall for the subject land.

The Study investigated 7 main options including a gravity channel outfall with varying alignments and flow rates, pumped and gravity options to the Ferme Street Drain and retention options with reuse. The investigation recommended an open channel outfall to the Ferme Street Drain entering at Balmoral Road or Port Davis Road. The estimated costs of these options were in the range of $4.6M to $4.7M which included the detention storage requirement. Since this Study, further restrictions on the ability to upgrade the Ferme Street Drain downstream of Port Davis Road made it prohibitive to construct a drain along this alignment.

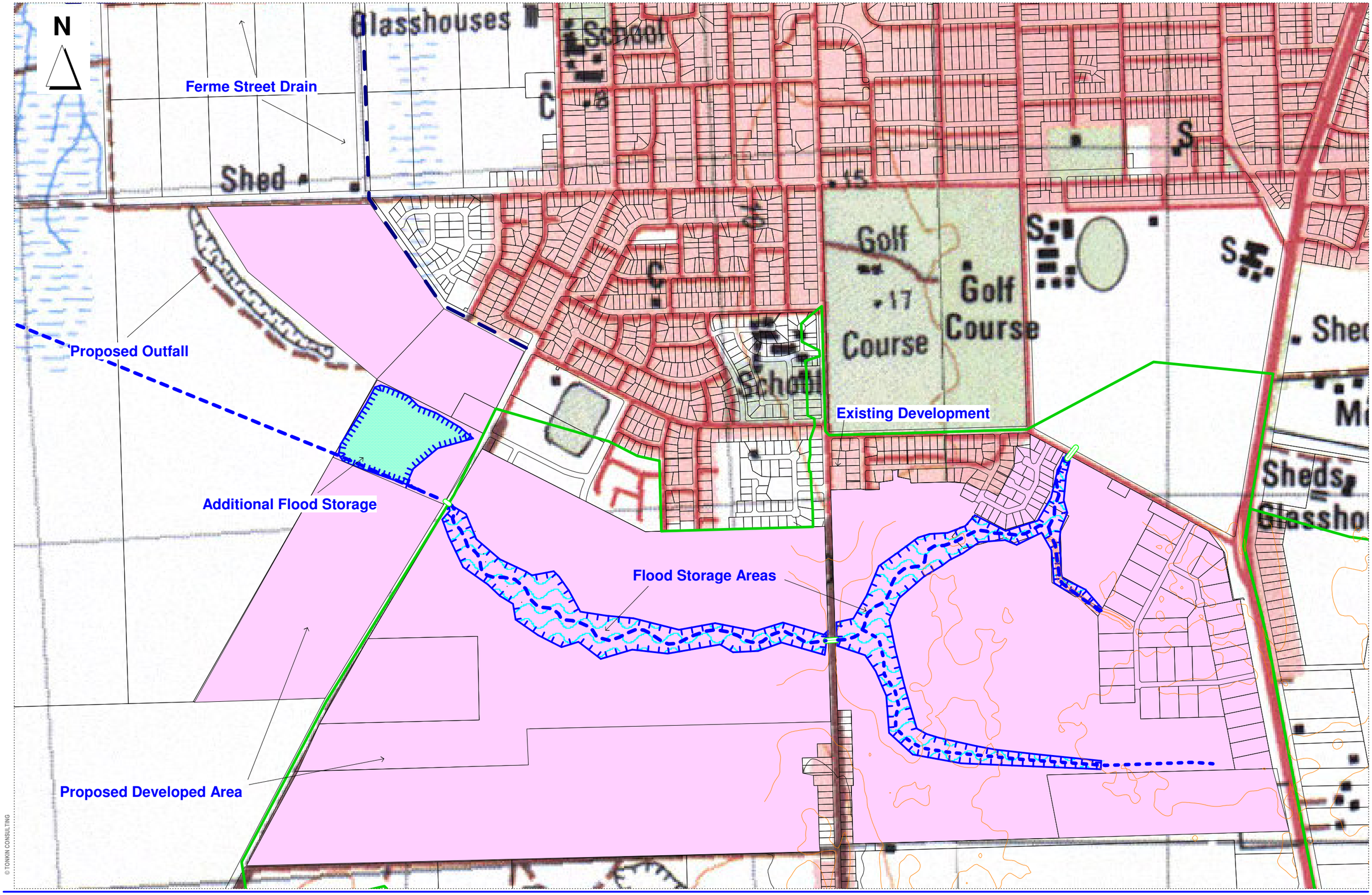
The report has been included in Appendix A for further reference.

4.3 Stormwater Outfall and Development Storage Requirements

The outfall size for the catchment and the detention storage requirements within the future development areas are interrelated. A large outfall size would require limited or no detention storage and a small outfall would correspond to a very large storage. The size of the outfall was established to have capacity to cater for the peak 100 year ARI flows from the existing catchment without detaining these flows. The storage was then sized to ensure the peak flows do not exceed the outfall capacity after the area becomes developed. The areas that are assumed to be developed are shown in Figure 4.1. This includes both the current developable land, the areas zoned for deferred urban rural and some general farming areas. Areas that are not identified in Figure 4.1 will need to provide their own detention storage to allow them to be developed.

4.3.1 Outfall sizing

An outfall was initially sized to cater for the 100 year ARI event assuming pre-existing development conditions from the South Western catchment. The DRAINS modelling incorporated existing storage areas that naturally occur or that were contained by the main road embankments. These were identified using aerial photography and contour data. The existing residential areas to the north of the future developable land were included as shown in Figure 4.1. No further storage was included in the catchment and the outfall has been sized to allow the pre-development flow to pass through without further detention.



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South Western Drainage Outfall

Outfall Alignment & Development Area

Figure 4.1

The DRAINS hydrological analysis established a predevelopment design flow of 5.3m^3/s for the 100 year ARI flood, resulting from a 24 hour rainfall event.

The calculated predevelopment peak design flow was used to determine the storage volumes required for future development on the east and west sides of Senate Road.

4.4 Detention Storage Volume for Current Developable Land

Detention storage requirements for the current developable land (a portion of the ultimate development) within the study area were determined. The current developable land includes the areas that are likely to be developed initially on either side of Senate Road as shown in Figure 4.2. It was assumed these areas exhibited an average imperviousness of 42% (refer Section 2.1).

The detention storage volume requirements to maintain peak pre-development outflows were determined using the DRAINS model. The storage volume requirement was proportioned between the two development areas based on the gross development area. The modelling estimated the storage volume requirements within the maximum flood level limits and minimum flow rates within each development as shown in Figure 4.2. A summary of the storage requirements for the development area is given in Table 4.1.

The minimum infrastructure sizing and constraints, including outfall channel geometry, culvert sizes, maximum 100 year flood levels and design flows are provided in Figure 4.2.

Table 4.1 Developer Only Storage Requirements

Gross Development Area (ha)	Storage Volume (m^3)	Unit Storage Volume (m^3/ha)
166	157,500	840

4.4.1 Detention Storage for Ultimate Development

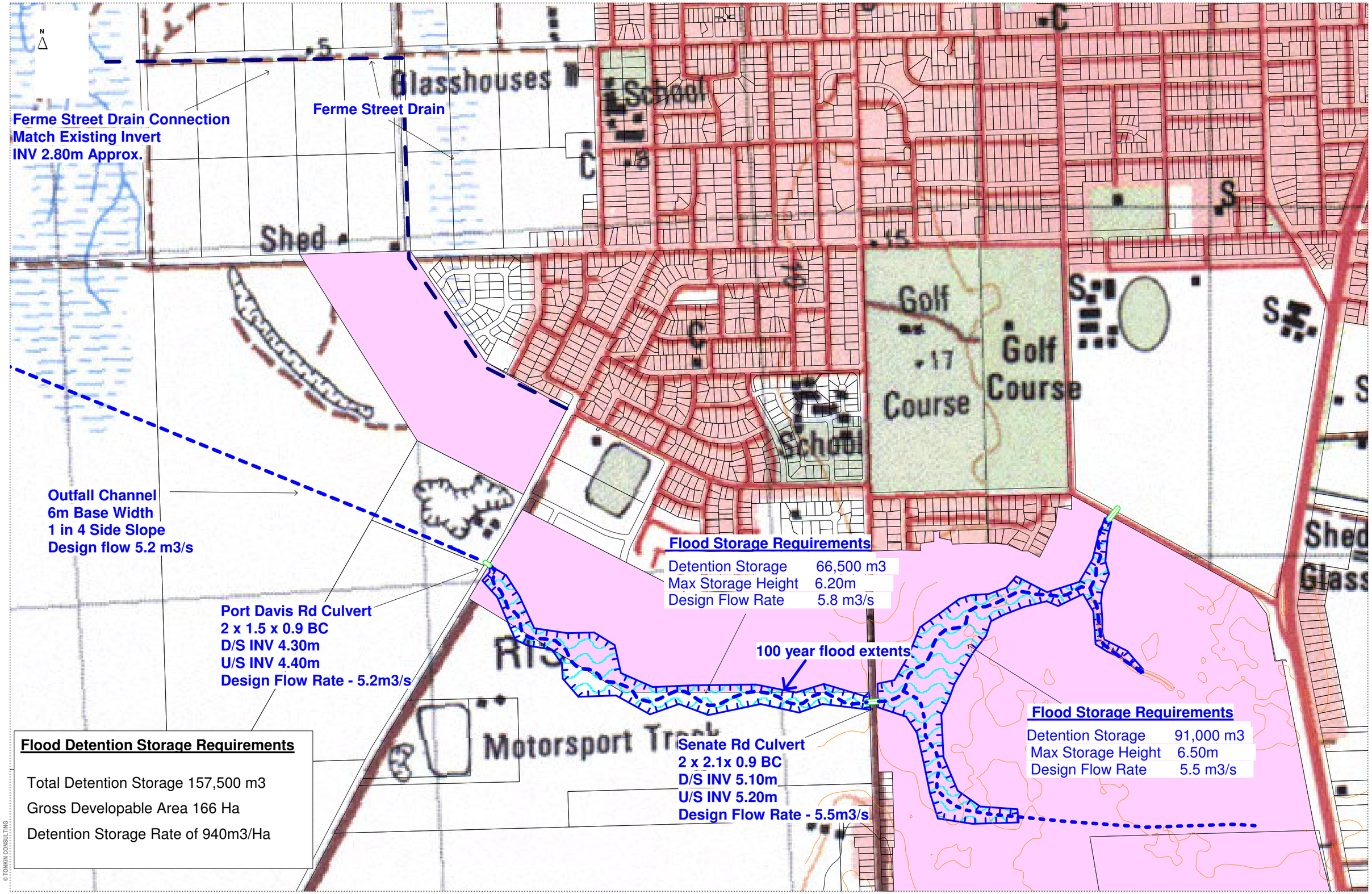
The ultimate development area for the outfall has been defined as the area given in Figure 4.1. An existing quarry, located on the western side of the development and along the proposed alignment of the drain outfall, could potentially be used as a detention storage area.

The storage volume and unit area storage volume requirements for each location are provided in Table 4.2. The minimum infrastructure sizing and constraints, including outfall channel geometry, culvert sizes, maximum 100 year flood levels and design flows are provided in Figure 2.3.

Table 4.2 Developer Storage Requirements

Development Location	Gross Development Area (ha)	Detention Storage Volume (m^3)	Unit Area Storage Volume (m^3/ha)
East Senate	132.5	91,000	800[a]
West Senate	139.5	85,000	1075[a]
West Port Davis Road	59.5	64,000	1075

a Unit Storage Volume based on currently developable areas.



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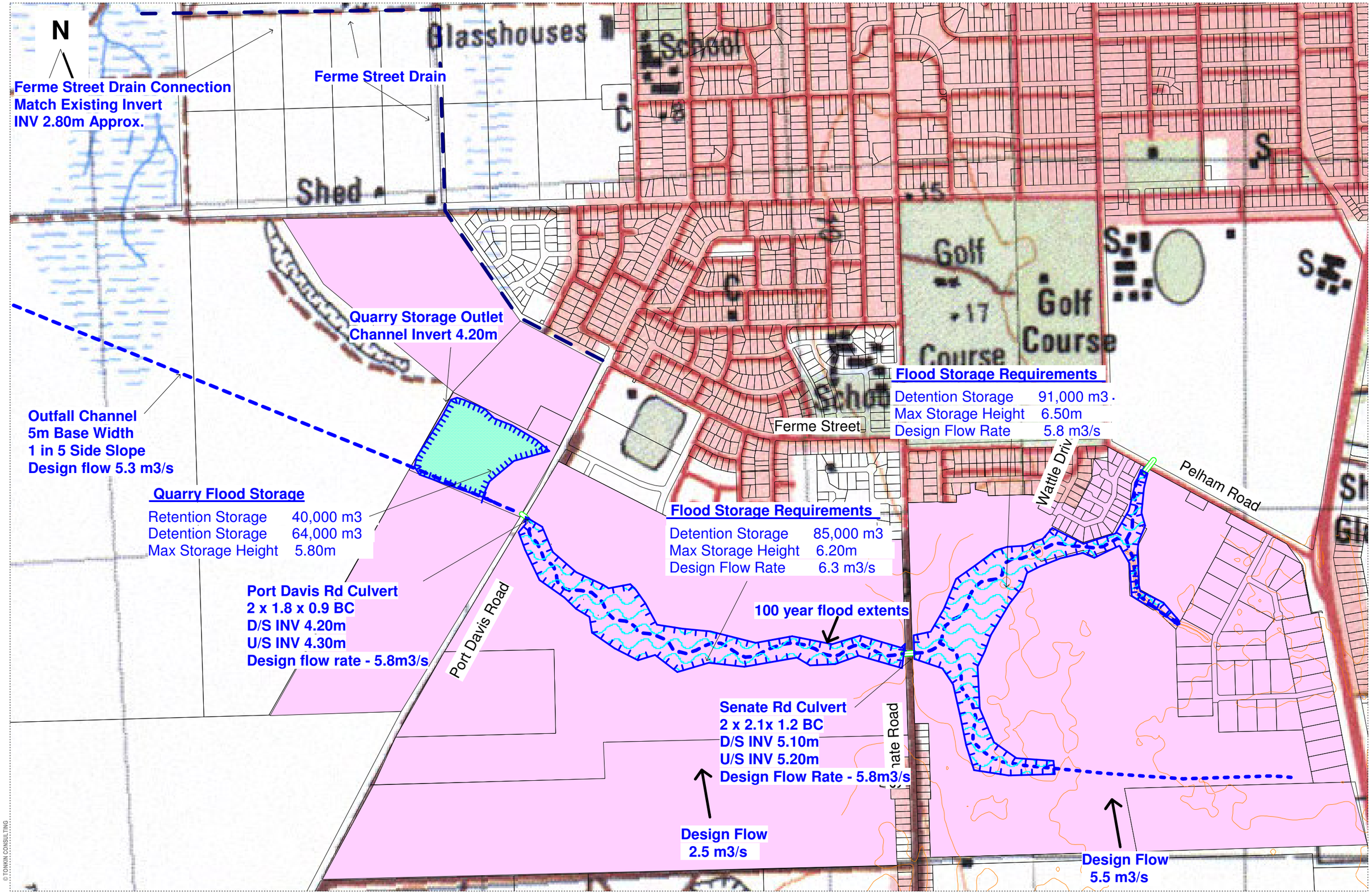
South Western Drainage Outfall

Infrastructure Requirements

Current Developable Land Detention Storage

Figure 4.2



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Date:	22/06/2012

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South Western Drainage Outfall

Infrastructure Requirements

Detention Storage Ultimate Development

Figure 4.3

4.5 Broughton River Flood Risk Assessment

There is anecdotal evidence suggesting that the Broughton River could flood towards Port Pirie along (or adjacent to) Three Chain Road during a significant or extreme event. No formal assessment has been completed to determine the potential frequency and magnitude of such an event. The flat terrain between the Broughton River and the development site would indicate that any flows would be subject to significant storage along the floodplain and would be likely to exhibit a slow velocity and flow rate. Providing significant storage within the development and an outfall with a large capacity would be beneficial for the mitigation of any potential flood flows.

4.6 Interim Stormwater Management Arrangements

It is understood that it may be a number of years before the outfall is able to be constructed. For this reason an analysis has been undertaken to consider what measures would be necessary to enable initial development of the area to proceed while ensuring new and existing development is provided with an adequate level of flood protection and drainage prior to the outfall being constructed.

4.6.1 Design Considerations

Three options have been investigated, using the quarry site for storage (Section 4.6.2), constructing a section of the outfall channel (Section 4.6.3) and utilising it for retention of stormwater or constructing the outfall channel in its entirety.

Regardless of the option selected, the following key design criteria will need to be achieved:

- Existing and new development should be protected from inundation during a 1 in 100 year flood during the interim period.
- The development should not act to increase the magnitude of the peak flows downstream of the development
- The development should not act to increase the frequency of flows downstream of the development

4.6.2 Quarry Site

Flow Assessment

This option involves using the quarry as retention storage. Flows from the proposed development would be directed to the quarry using swales and culverts as proposed for the ultimate scheme.

The existing potential capacity of the quarry site is 75,000m^3 corresponding to a level of 5.0m AHD. Modifications have been proposed to increase the capacity of the quarry as part of the Ferme Street drain design (Refer Appendix C). This proposes to increase the height of the quarry bank to a level of 6.0m AHD.

A water balance was undertaken to assess the potential for stormwater to spill from the storage.

A daily water balance analysis was undertaken using over 100 years of rainfall data for the Port Pirie Airport as described in Section 2.2. The analysis calculated water levels within the quarry site and development areas for a 25, 50, 75 and 100 percent of development of the current developable area. The retention volume estimate for each stage of development includes the quarry site together with a portion of the detention storage required for the development. An infiltration loss of 4mm/day was used while ignoring losses from the swales and constructed wetlands provided further up in the developed catchment. Runoff from the large rural catchment has not been included as this would only occur for long duration rainfall events (larger than a 1 in 20 year event).

The modelling results shown in Figure 4.4, Figure 4.5, Figure 4.6 and Figure 4.7 indicate that if a formal outfall is not constructed, peak levels within the retention storage area would only peak a small number of times based on the historical data.

The peak water level reached in the retention basin for various levels of development is given in Table 4.3. This indicates the retention system could allow a certain extent of development to occur without the outfall being constructed. The modified quarry site has been designed to spill when water levels reach 5.5m AHD (refer appendix C). Some spillage of the basin would therefore occur at around 50% of development of the currently developable land.

These estimates do not include the large rural contributing catchment previously mentioned above as well as other modelling assumptions. However, there is a relatively well defined flow path downstream of the quarry, which is the natural path followed by flows from the upstream catchment. Provided that an adequate spillway is available from the quarry basin, the retention and detention within the system is considered adequate to return flows to their pre-development level.

Based on the above, it is considered that the quarry could be used to facilitate development of up to 25% of the upstream currently developable land prior to construction of the outfall.

Table 4.3 Maximum Retention Water Levels

Current Developable Land	**25%**	**50%**	**75%**	**100%**
Max Retention Storage Level (mAHD)	4.7	5.6	6.0	6.3

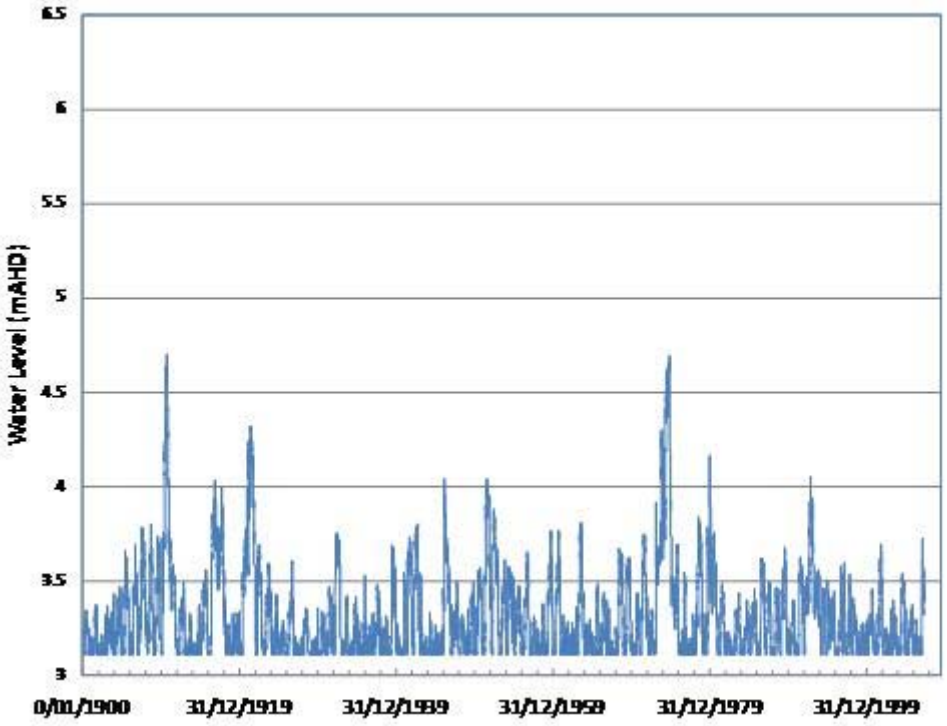


Figure 4.4 Retention Pond Level for 25% Currently Developable Land

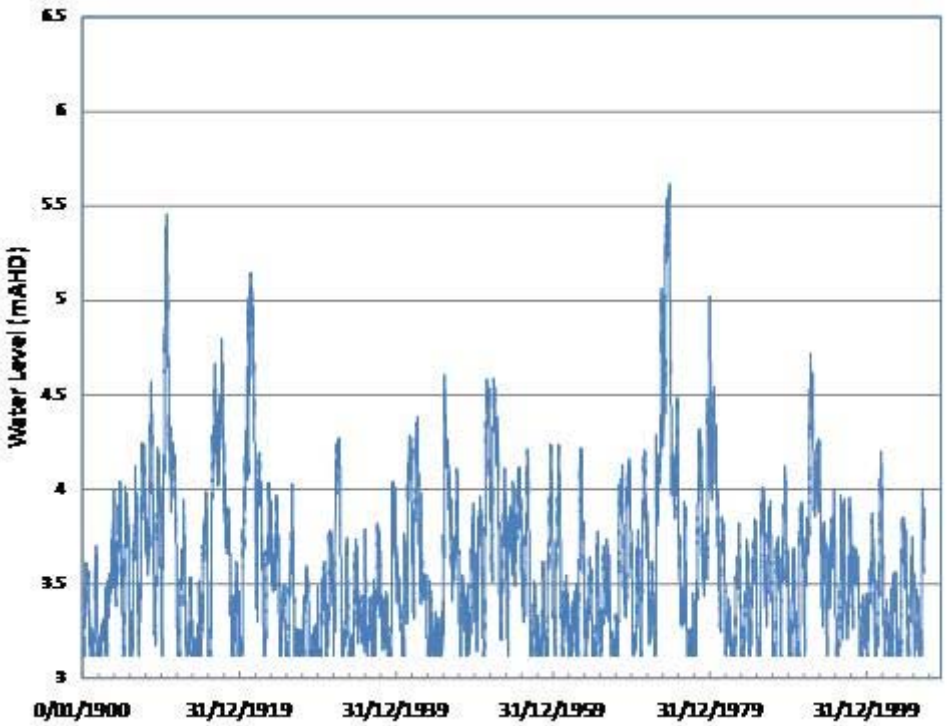


Figure 4.5 Retention Pond Level for 50% Currently Developable Land

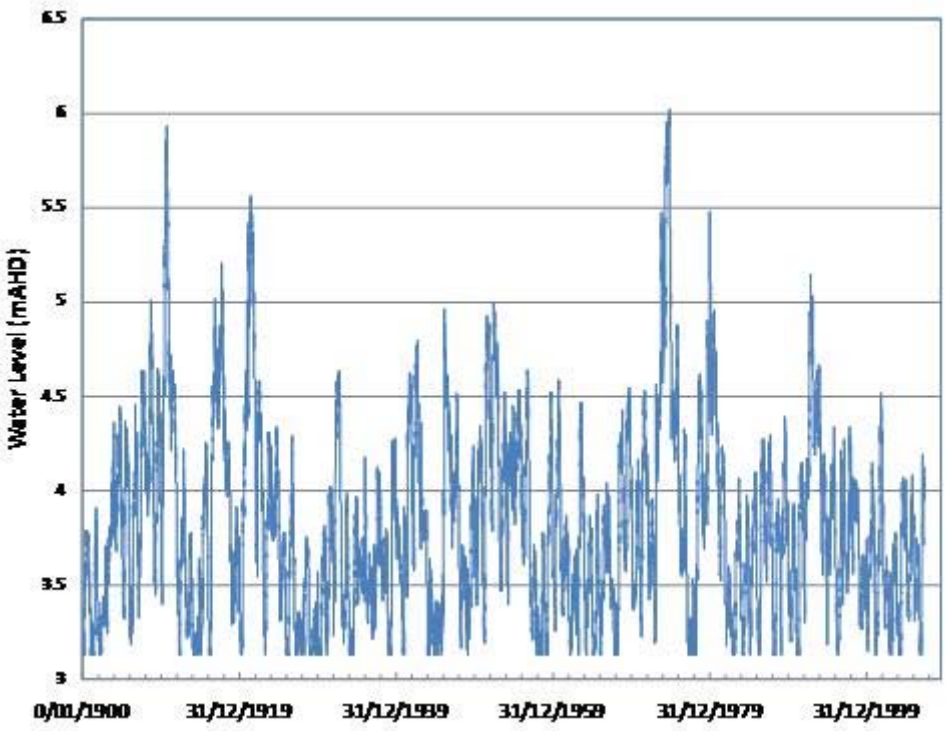


Figure 4.6 Retention Pond Level for 75% Currently Developable Land

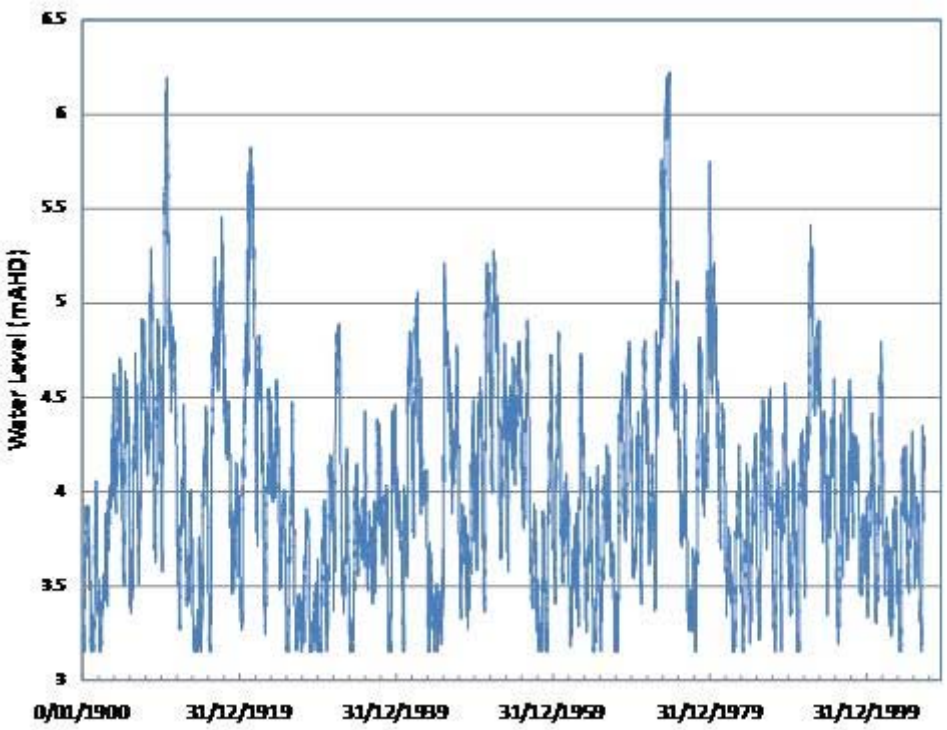


Figure 4.7 Retention Pond Level for 100% Currently Developable Land

Reuse Option

Development of a stormwater reuse scheme at the quarry site could be considered to utilise flows from the catchment. The recycled water could feasibly be used for irrigation of the adjacent school oval. The oval is approximately 1.5ha in size. Recycled water could also be used to top up the wetland and water features, and irrigate the reserve areas within the upstream developments. If reuse is implemented there would be negligible runoff that would spill past the quarry site after construction of an outfall or elevated spill level.

The results of the modelling shown in Figure 4.8 provide spill and reuse volumes and water demand utilisation amounts.

There would be no requirement to construct a formal outfall before the developments are 50% constructed if the reuse scheme is implemented (provided protection from the 1 in 100 year ARI event is achieved).

Furthermore, if the reuse scheme is implemented, the actual outfall geometry and frequency of discharge could be limited to within the ultimate storage capacity of the quarry and the lower levels of the land between Senate Road and Port Davis Road. Such an alternative proposal is considered further in Section 5.5.

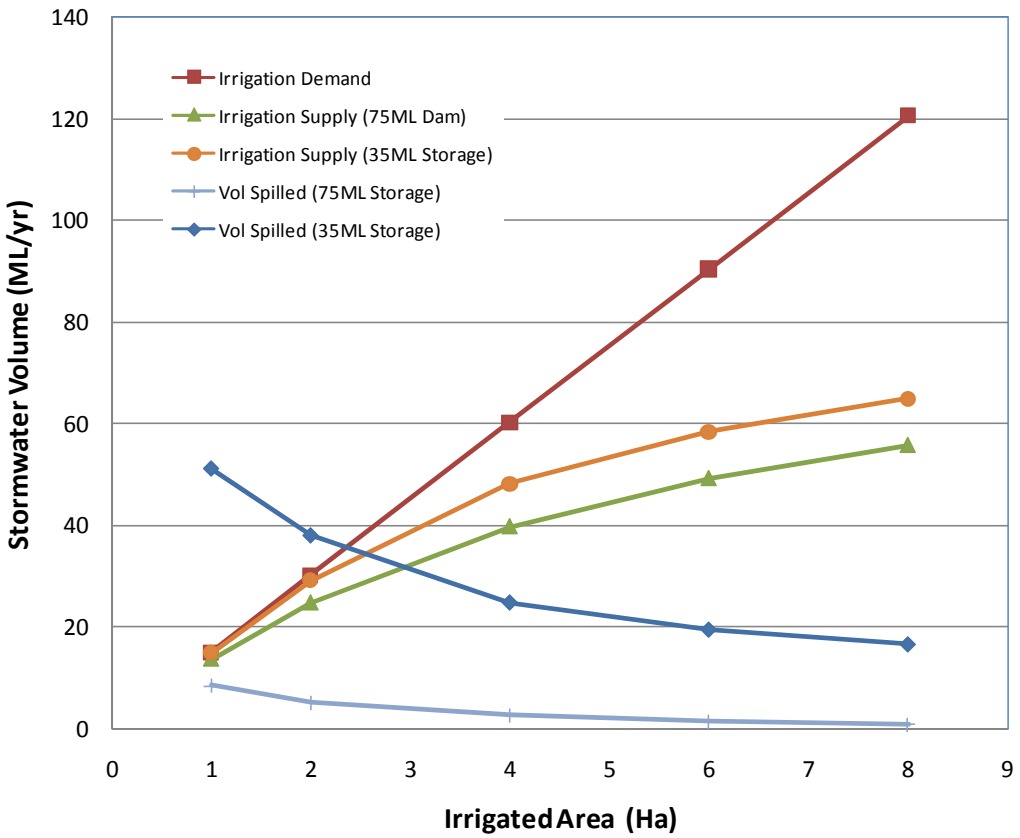


Figure 4.8 Reuse and Spill Volumes for 50% Stage development

4.6.3 Development of the outfall with no storage

The DRAINS model was modified to investigate the additional capacity required if the quarry was not used for detention storage in the system. If the quarry site cannot be utilised for storage, the capacity of the outfall drain is required to be increased to 7m^3/s to contain the higher peak flows experienced.

4.6.4 Development Prior to Outfall Construction

An alternative to using the quarry site for storage is to construct a portion of the outfall channel in the development area as retention storage to allow for development to occur before the construction of the outfall channel downstream. In this arrangement, the constructed portion of the channel would have no outlet and would act as a retention basin.

The portion of the outfall channel that is constructed to act as a retention basin should be located outside of the existing floodplain (Figure 3.1). This will prevent existing upstream flows being intercepted by the basin and ensure that only the additional flows from the development are retained. In addition, to isolate the basin from upstream flows, stormwater would need to be piped to the basin.

A bank constructed to a height of 7.4m AHD downstream of the basin is proposed to prevent spill to the west of Port Davis Road and redirect flows back toward the original flow path during large events.

If the outfall was constructed in the development area to coincide with the ultimate capacity required, a cross section of the outfall that would meet the requirements is included below (Refer Figure 2.10).

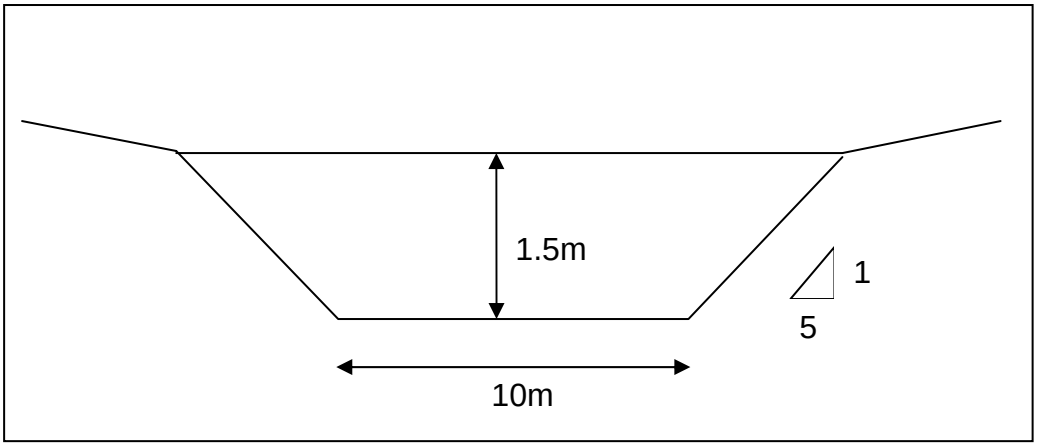


Figure 4.9 Outfall Cross Section

The potential capacity of the outfall storage within the development area outside of the flood zone is approximately 13,125m^3, as shown in Figure 4.10.

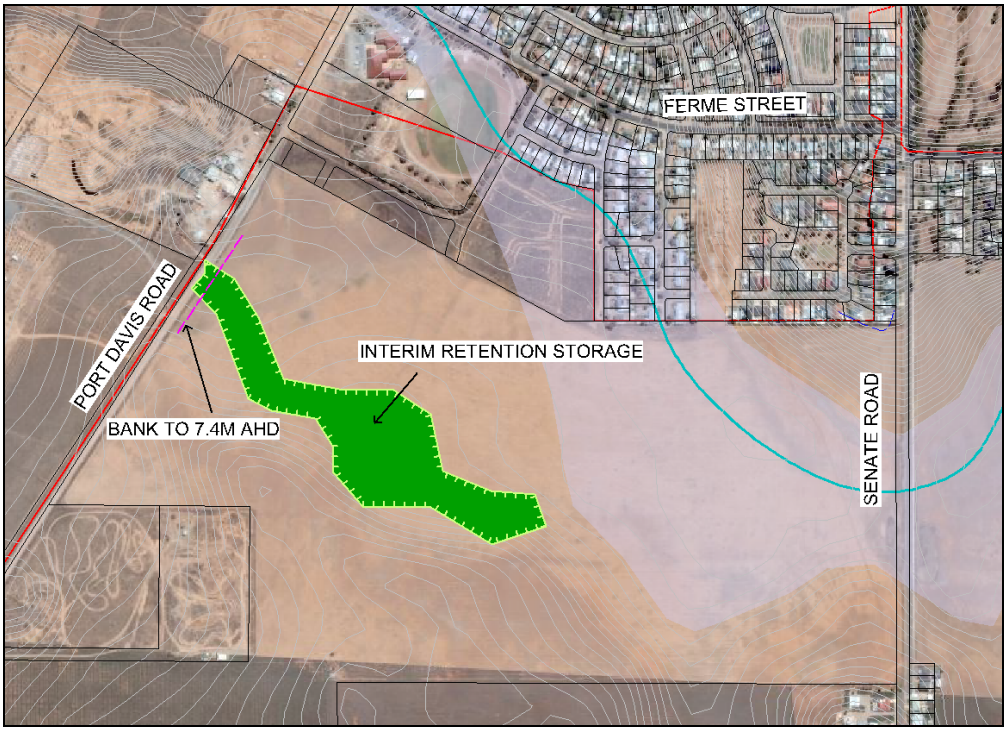


Figure 4.10 Outfall Storage Capacity within Development Area West of Senate Road

A daily water balance analysis was undertaken using over 100 years of rainfall data for Port Pirie as described in Section 2.2. The analysis calculated the length of channel required (based on the cross section in Figure 4.9) per 1ha of impervious catchment.

The water balance model assumes evaporation losses only, and does not include any seepage loss. Therefore the estimate is considered conservative. Runoff from the large upstream catchment has not been included as this is assumed to bypass the storage area.

The modelling results shown in Figure 2.12 indicate that if approximately 100m of channel is constructed (2100m^3 volume) per 1ha of impervious area, the channel will overflow very few times based on the historical data. It is likely that on re-use occasions, there would be significant flows from the upstream catchment and overflows under these conditions would be acceptable.

The water balance model indicates that a certain extent of development could occur without the downstream section of the outfall being constructed.

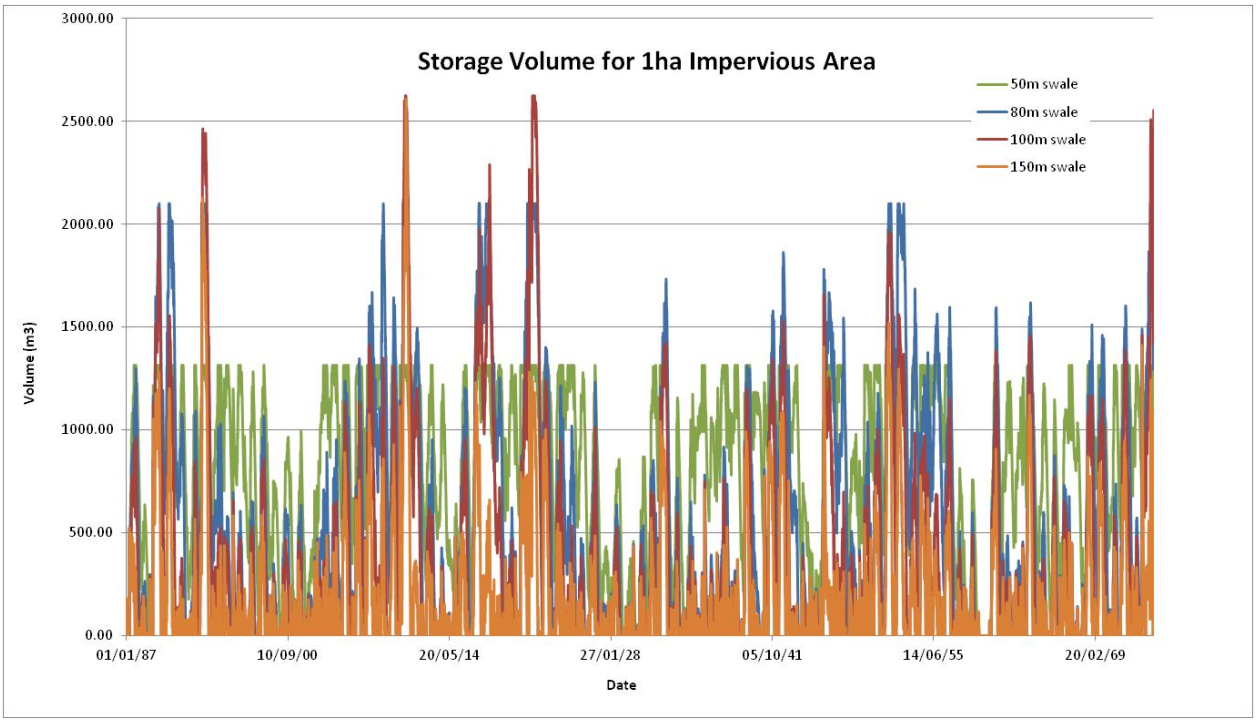


Figure 4.11 Storage Requirements per 1ha Impervious area

Based on the storage extents shown in Figure 4.11, runoff from approximately 6.2ha of impervious area could be accommodated. This would equate to 14.9ha of development based on 42% impervious area.

If development is undertaken in the area downstream of Senate Road, prior to an outfall being constructed, it will be necessary for allotments to be filled to a minimum level of 7.5m AHD to provide 300mm freeboard to the 100 year flood. In addition, a flowpath will need to be maintained to the south of any development, of adequate width to allow flood flows to bypass the development and not impact upstream flood levels.

5 Infrastructure Requirements

5.1 Introduction

The sizing of the outfall infrastructure for the current developable land and the ultimate development has been determined in Section 4. This section examines the indicative cost, land acquisition requirements and other measures that the developers should employ as a component of a new development.

5.2 Stormwater Outfall

The construction cost for both options (current and ultimate) includes the flood detention storage for the currently developable land located within the developers' property or on the developers' property and the adjacent quarry. The key items that drive the cost include; construction of the outfall with an average depth of 2m below existing ground level and the additional excavation to maximize the storage volume at the quarry site (refer Appendix C).

The cost estimate excludes any infrastructure located on the developers' property. A summary of the construction costs are given in Table 5.1 and a more detailed breakdown of the various components of the work is provided in Appendix B.

Table 5.1 Indicative Construction Cost Estimates

Description	Currently Developable Land ($)	Ultimate Development ($)
Culverts	236,000	115,000
Outfall Drain[a]	856,000	839,000
Quarry Detention[a]	-	448,000
Miscellaneous	115,000	115,000
Total (ex GST)[b]	**1,207,000**	**1,685,000**

Notes:

a) Due to the limited survey information for the outfall alignment, earthworks quantities and construction costs for the Outfall Drain and the Quarry Detention are indicative only. Detailed costing is subject to defining a final alignment and undertaking land acquisition negotiations.

b) The construction cost estimate does not include detention storage formation costs on developer-owned lands.

5.3 Estimated Land Area Requirement

An estimate of the footprint required for the outfall and detention storage is given in Figure 4.3. The land area includes the outfall channel with an assumed width of 25m. This includes an allowance for the channel and an adjacent maintenance track. The ultimate footprint will depend on the agreed alignment, depth of invert below natural ground levels and the geometry of the channel.

The primary difference between the two options is the area of land that is required within the land owned by the developer. It is understood that this land represents the highest value cost component, as a reduction in the detention area will have a corresponding increase in allotment yield for the developer. The inclusion of the quarry site as part of the storage would mean an additional 3ha (approximately) of developer land would not have to be used for detention. This would equate to an additional 40 lots (if a development density of 13 lots/ha is assumed).

Table 5.2 Indicative Land Requirements for Stormwater Infrastructure

Description	Currently Developable Land (ha)	Ultimate Development (ha)
Outfall Drain (north Kingston Road)	1.5	1.5
Outfall Drain (south Kingston Road)	2.2	2.2
Quarry Site[a]	1.2	5.8
Developer Land[b]	20	23.5
Total	**24.9**	**33**

Notes:

a) Detention storage area required on the quarry site. Total quarry site area is approximately 8.5ha.

b) Area estimated based on an assumed simplified earthworks formation and average batter slopes to reach formation level of development. Actual land required may vary. A portion of this area would be considered a contribution to the reserve allocation.

5.4 Individual Drainage Element Considerations

In working through the design development of the outfall and the staged approval of the developments a number of factors need to be considered further as identified as follows:

5.4.1 Quarry Site

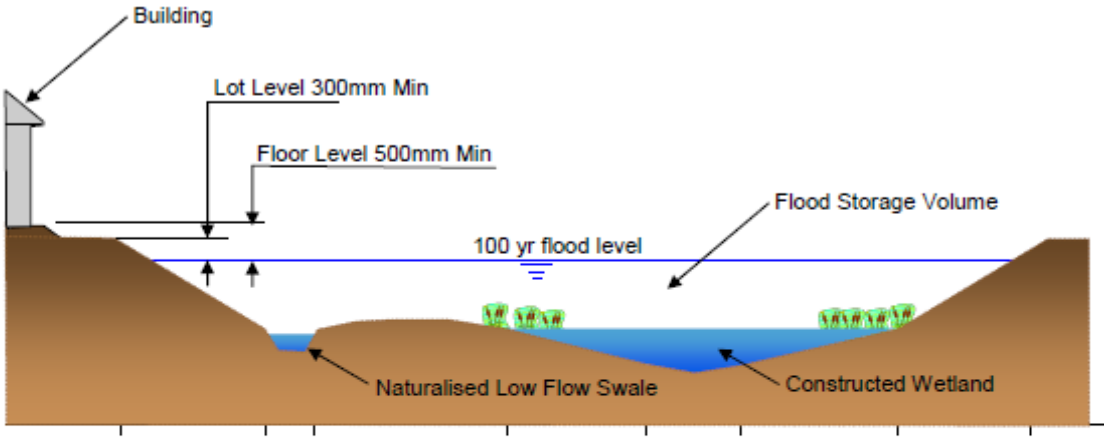
The quarry site requires reshaping to make it usable as a detention storage area and/or reuse storage. A storage volume of 35,000m^3 and 75,000m^3 could be achieved for an outfall invert level of 4.0m and 5.0m AHD respectively. This provides significant storage which could be used for reuse as outlined in Section 4.5 and Section 5.5.

5.4.2 Development Area Stormwater Management Measures

The design and orientation of the storage provided in the development areas will depend on how the developers present the development. The maximum flood levels given in Figure 2.2 and Figure 2.3 are maximum levels at critical points, usually the upstream end of the development (or at Wattle Street for the land to the east of Senate Road) with a decrease in flood levels and available storage heading downstream. A component of the approval process will be to demonstrate the maximum design flows are properly managed to ensure the maximum flood level is not exceeded in the development swales.

The developer needs to ensure that all development is constructed with sufficient freeboard above the 100 year flood level identified as discussed in section 4.

The developer also needs to ensure adequate water quality measures are built into the development to prevent silt accumulation within the outfall swale. Measures such as sediment traps and wetlands should be integrated into the design to improve water quality. A sketch of a typical water treatment arrangement is provided in Figure 3.1. It is expected that wetlands and associated areas might comprise between 2 and 3% of the developable area to achieve adequate stormwater quality requirements. It is also recommended that a number of linear wetlands be built into the outfall channel. Figure 5.1 also provides recommended minimum lot and floor levels.



Section A- A

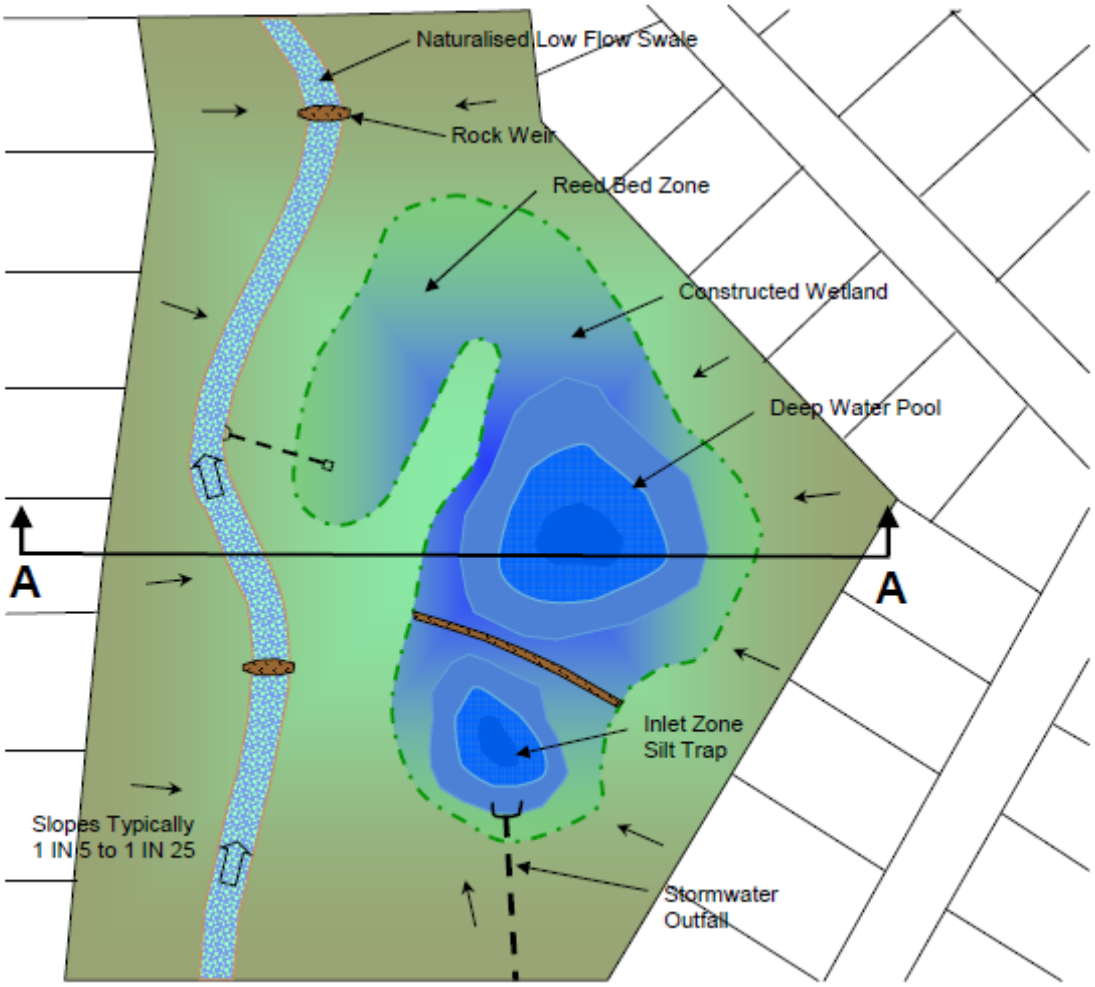


Figure 5.1 Development Stormwater Management Schematic

5.5 Alternative Outfall Design

An alternative outfall has been proposed which involves using the quarry site as a more formal reuse storage site. Changes in the nature and elevation of the outfall would be included if the quarry site use was found to be practical. Depending on the level of reuse employed, the outfall is likely to spill less frequently than a 1 in 10 year event. Construction of the outfall 1 m higher than presently proposed would reduce the volume of excavation required and the channel would be a low depression rather than a formal swale.

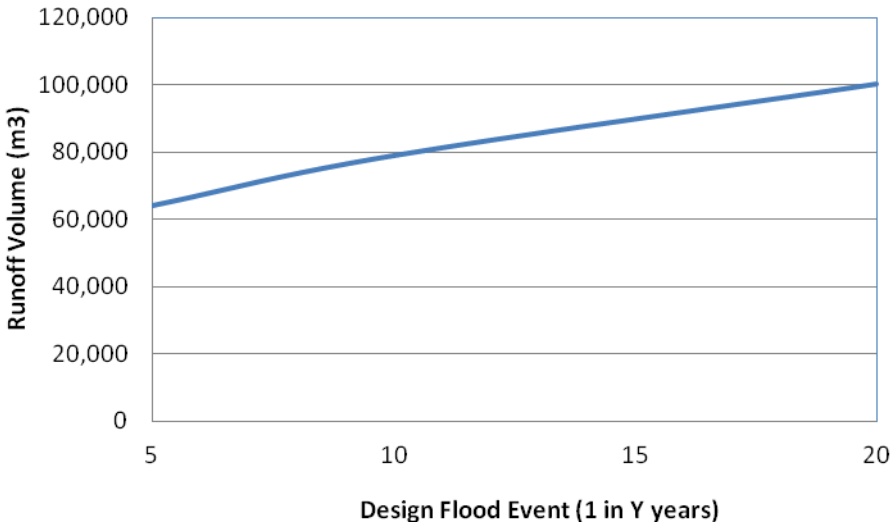


Figure 5.2 Flood Event Volumes for Stage 1 developed catchment

The potential reuse volume could approach 130 ML/year which would provide a valuable resource to be used for irrigating adjacent green spaces and topping up wetland features during dry periods. The potential reuse volume is shown in Figure 5.3 together with expected annual spill volumes based on the period of modelling.

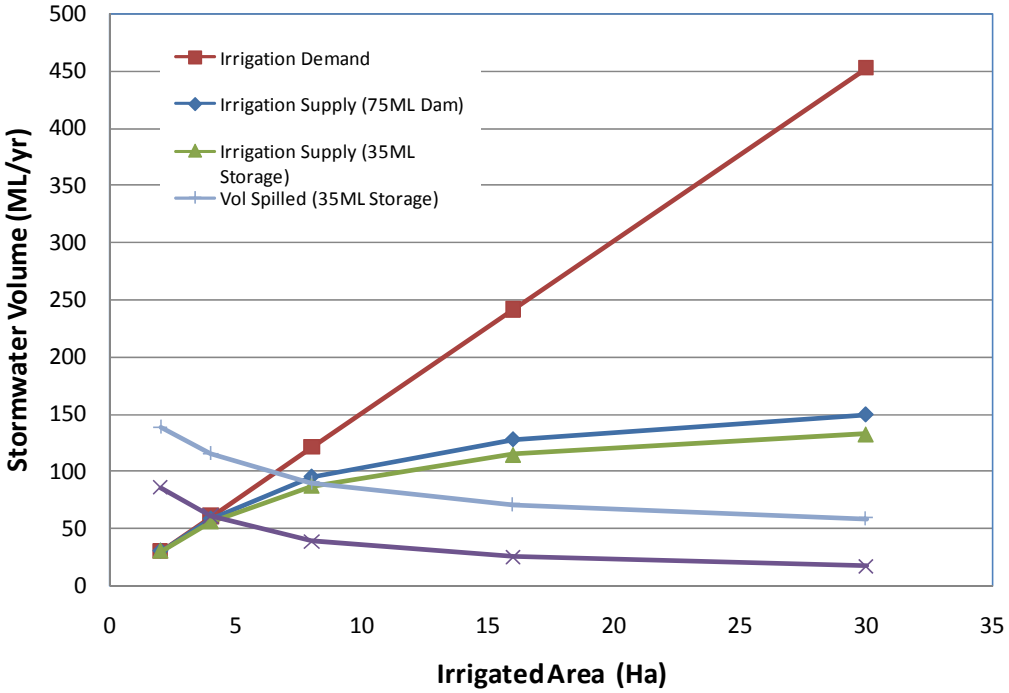


Figure 5.3 Reuse and Spill Volumes for full development

6 Summary

The Study investigated the preferred outfall option and detention storage requirements for the South West Drainage Scheme. An outfall size has been designed to correspond to the predevelopment flow conditions. The existing catchment comprises primarily rural land with a catchment area of over 1,520ha. 345ha has been identified for future development.

The key findings of the report include:

1. The existing 100 year flood flow is approximately 5.3m^3/s at Port Davis Road. If the quarry site is not used for storage, the flow is increased to approximately 7m^3/s.
2. A detention storage of between 800m^3/ha to 1075m^3/ha is required within the currently developable land.
3. A total detention storage of 255,000m^3 is required for the ultimate development scenario.
4. Estimated construction costs for the outfall are $1.7 million.
5. Additional costs should be considered for detention storage requirements within the development areas and the costs of obtaining easements for the outfall downstream of Port Davis Road.
6. 9.5ha of land downstream of Port Davis Road and 22ha within the development land is required for drainage infrastructure.
7. Development could proceed while the details of the outfall were finalised provided adequate retention storage and a safe overflow path was provided during a significant flood event.
8. A stormwater reuse scheme could be incorporated and would likely extend the timeframe in which the outfall would be required.

The key recommendations for the study include:

1. Council and developers adopt this report as the basis for negotiations and guidance on managing stormwater for the South West Drainage Scheme.
2. The detention storage requirements, design flows and maximum flood levels as provided in this report be adopted.
3. Suitable freeboard requirements for development above the calculated 100 year ARI flood event be provided.
4. Wetlands and water quality treatment devices thought-out the development to achieve Council stormwater quality objectives should be included.

Appendix A

2009 Options Study Report

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20080559LA4/IX/IX

13 October 2009

Port Pirie Regional Council
PO Box 45
PORT PIRIE SA 5540

Attention: Len Wilton

Dear Len

SOUTH WEST DRAIN OUTFALL - MODELLING EXTENSION

As previously requested we have undertaken the drainage outfall assessment for this proposed development area and reported our initial findings in our letter dated 30 July 2009. Following discussions at our meeting dated 1st September we have reviewed the details and consider further variations to the options to manage the stormwater runoff from the catchment.

Background

The area of land subject to development proposals, located south of existing development (between the Port Davis, Senate and Three Chain Roads), is prone to flooding from large storm events. The proposed development area has no formal or natural drainage outfall.

A new outfall and/or detention storages are needed to protect existing and future development during flood events. Due to the issues related to the acquisition of land for the outfall, several alternative alignment options have been investigated. This report summarizes our findings.

Assessment

A total number of seven drainage alignment options have been assessed. These include various outfall alignments, providing an alternative outfall alignment to the south along property boundaries, pumping stormwater runoff to the Ferme Street Drain, using gravity system to direct stormwater runoff to the Ferme Street Drain, and retaining all runoff onsite with varying degrees of reuse. Each of the options is described further below.

All options have been developed to a concept level only and require further investigation to confirm the preliminary design sizes presented below. Limited work has been undertaken to estimate the indicative areas of land required within the development area to accommodate the detention / retention storage. The estimated areas have been based on providing batter slopes of 1 in 8 for the excavation of storage. The detention / retention volume estimates assumes the development and reserve areas are the same for all options.

Option 1 Lower Detention Storage with High Discharge Rate Outfall

The drainage system proposes an open channel running from the downstream end of the proposed development area, across Lot 1 and 48 and discharges into the low lying area near the western outlet of the Ferme Street Drain. The system requires the downstream open channel to have minimum base width of 6m and side slope of 1 in 3. A sketch of the proposed works is shown in the attached Layout Plan (Option 1).

Option 2 More Detention Storage with Low Discharge Rate at the Outfall

The drainage system for Option 2 follows the same alignment as Option 1. Larger detention storage within the development area have been sized to reduce the discharge rate at the outfall to 4.5m^3/s. The system requires the downstream open channel to have minimum base width of 3m and side slope of 1 in 3. A sketch of the proposed works is shown in the attached Layout Plan (Option 2).

Option 3 Alternative Outfall Alignment to the South Following Property Ownership Boundaries using Option 1 Upstream Storage Sizes

Due to the land acquisition issues at the downstream, an alternative outfall alignment has been assessed. It runs along the eastern boundary of Lot 2, continues along the southern boundary of Lot 2 and 48, then runs along the western boundary of Lot 48 and discharges into the into the low lying area near the western outlet of the Ferme Street Drain. The drainage system requires the downstream open channel to have a minimum base width of 6m and side slope of 1 in 3 in order to achieve the same outfall rate as Option 1. A sketch of the proposed works is shown in the attached Layout Plan (Option 3).

Option 4 Stormwater Runoff Pumped to Ferme Street Drain

This option looks to discharge the stormwater from the development area into the existing Ferme Street Drain. As the capacity of the existing Ferme Street Drain is limited, a low discharge rate a pump option has been considered with only minor upgrades to the outfall channel.

This option proposes that a rising main running along Port Davis Road discharges into the existing Ferme Street Drain. Two different pumping rates had been analysed, 0.25 m^3/s and 0.5m^3/s.

To pump stormwater at 0.25 m^3/s would require the proposed developable areas to provide 230,000m^3 of detention storage. However, if pumping at 0.5m^3/s a 215,000m^3 of storage needs to be provided. A sketch of the system is shown in the attached Layout Plan (Option 4).

Option 5 Gravity System to Ferme Street Drain

A gravity outfall discharging into the Ferme Street Drain was assessed. The existing drain would require upgrading to cater for an increase in flow from the additional catchment area. The potential to upgrade the section of the existing Ferme Street Drain immediately downstream of Port Davis Road is limited due to development on each side of the drain. Therefore the proposed gravity system should connect into the Ferme Street Drain immediately to the west of the recently developed land on the southern side of the drain.

The two options considered propose an open channel only and a partly piped system to the west of the recently developed area. The options require the proposed development area to provide approximately 124,000m^3 and 142,000 m^3 detention storage at a maximum discharge rate of 3.2m^3/s (open channel) and 2.0m^3/s (open channel and underground pipe). A sketch of the proposed works is shown in the attached Layout Plan (Option 5).

Option 6 Total Retention Storage Required in a 100 Year ARI Event

Total runoff from the upstream rural catchment (1,085ha) and urban development area (340ha) in a 100 year ARI event was found to be 250,000m^3 and 234,000m^3 respectively. Very large retention storages are required (in addition to utilisation/disposal of this volume over a period of 5 to 10 days in order for the system to have capacity for consecutive events) to retain all the stormwater runoff on site. This option is the least feasible due to due to the requirement to empty the retention storage and the large land requirement.

Option 7 Total Retention Volume Required with Reuse Strategies Adopted

For the proposed development area, the likely allotment yield is approximately 1,500 dwellings. If assuming each provides 20kL tank, the total tank volume of 30,000m^3 does not significantly offset against the storage estimate provided above in Option 6.

Options Summary

The relationship between the outfall discharge rate and the required detention storage within the proposed development area for Option 1 to 6 is summarized in Table 1. It shows that larger detention storages are required to detain stormwater within the proposed development area to achieve a lower discharge rate for the outfall.

Cost Estimates

Indicative capital cost estimates for Option 1 to 5 are shown below:

- Option 1: $4.7M
- Option 2: $5.5M
- Option 3: $6.3M
- Option 4: (a) $7.0M for pumping at 500L/s
  (b) $7.0M for pumping at 250L/s
- Option 5: (a) $4.6M for open channel outfall to Ferme Street Drain
  (b) $5.6M for partly piped outfall to Ferme Street Drain

It should be noted that these costs do not include easement/reserve acquisition costs. Costs for the basin and channel storage assume that excavation volumes based on the existing available survey. The outfall volumes have been estimated assuming an existing natural surface level. A detailed breakdown of the costs for each option is shown in the attached Indicative Cost Estimates Spreadsheet.

Table 1 Summary of upstream storage volumes and the discharge rate at the outfall for Option 1 to 6

Option 1	Basins	Channel	External	TOTAL	Min Land	Rural
Large New Outfall	vol	vol	vol	vol	Area	vol
	m^3	m^3	m^3	m^3	ha	m^3
outlet = $10m^3/s$	19,000	24,000	8,000	51,000	5.0	175,000
Option 3	**Basins**	**Channel**	**External**	**TOTAL**	**Min Land**	**Rural**
Large New Outfall	vol	vol	vol	vol	Area	vol
	m^3	m^3	m^3	m^3	ha	m^3
outlet = $10m^3/s$	20,000	25,000	8,000	53,000	5.1	175,000
Option 2	**Basins**	**Channel**	**External**	**TOTAL**	**Min Land**	**Rural**
Small New Outfall	vol	vol	vol	vol	Area	vol
	m^3	m^3	m^3	m^3	ha	m^3
outlet = $4.5m^3/s$	52,000	20,000	10,000	82,000	9.5	175,000
Option 5	**Basins**	**Channel**	**External**	**TOTAL**	**Min Land**	**Rural**
Gravity to Ferme St Drain	vol	vol	vol	vol	Area	vol
	m^3	m^3	m^3	m^3	ha	m^3
outlet = $3.2m^3/s$ (a)	65,000	47,000	12,000	124,000	11.5	195,000
outlet = $2.0m^3/s$ (b)	80,000	47,000	15,000	142,000	12.8	195,000
Option 4	**Basins**	**Channel**	**External**	**TOTAL**	**Min Land**	**Rural**
Pump to Ferme St Drain	vol	vol	vol	vol	Area	vol
	m^3	m^3	m^3	m^3	ha	m^3
$0.5m^3/s$ pump	145,000	40,000	30,000	215,000	15.4	195,000
$0.25m^3/s$ pump	160,000	40,000	30,000	230,000	16.5	195,000
Option 6					**Min Land**	**Total**
Retention Storage	Storage volume required to retain the 100yr ARI				Area	vol
					ha	m^3
Rural(1085ha)					60	250,000
Urban(340ha)					18.9	234,000

Key Issues

Key issues associated with each of option are summarized below:

Option 1 and 2

- Land acquisition for downstream open channel construction

Option 3

- Land acquisition for downstream open channel construction

- Longer open channel needs to be constructed at the downstream end

Option 4

- Risk/maintenance costs associated with pump system
- Limited upgrading to the Ferme Street Drain to the outfall will be required

Option 5

- Need to upgrade from Ferme Street Drain to a 100yr ARI standard requiring land acquisition and upgrade of culverts
- Providing higher gravity outfall flow rates will reduce the requirement

Option 6 and 7

- Significant land requirement for large retention storages construction within the new development area

Recommendation

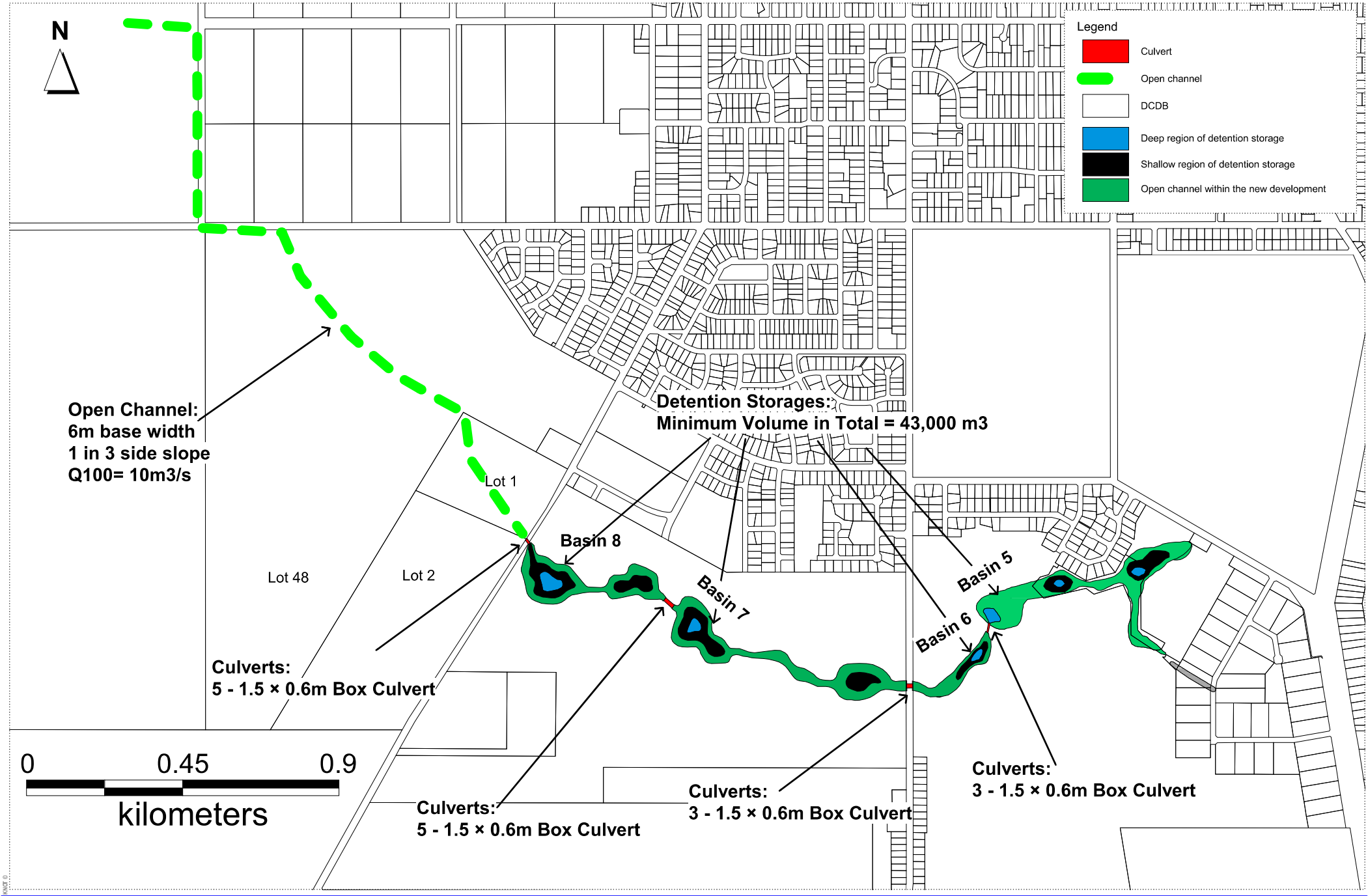
Option 1 and 5(a) appear to be the lowest cost solution while Option 5(b) is the lowest cost solution that requires the smallest extent of easements. These options are worthy of further design development and optimisation of outfall capacity to detention volume to confirm there feasibility.

Please do not hesitate to contact the undersigned should you have any inquiries. We would be pleased to discuss any aspect of this project in further detail if required.

Yours faithfully
TONKIN CONSULTING

DW SEELIGER, MIEAust
Chartered Professional Engineer

Enc Drainage Outfall Layout Plan for Option 1 to 5
Indicative Construction Cost Estimate for Option 1 to 5



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MAP DETAILS

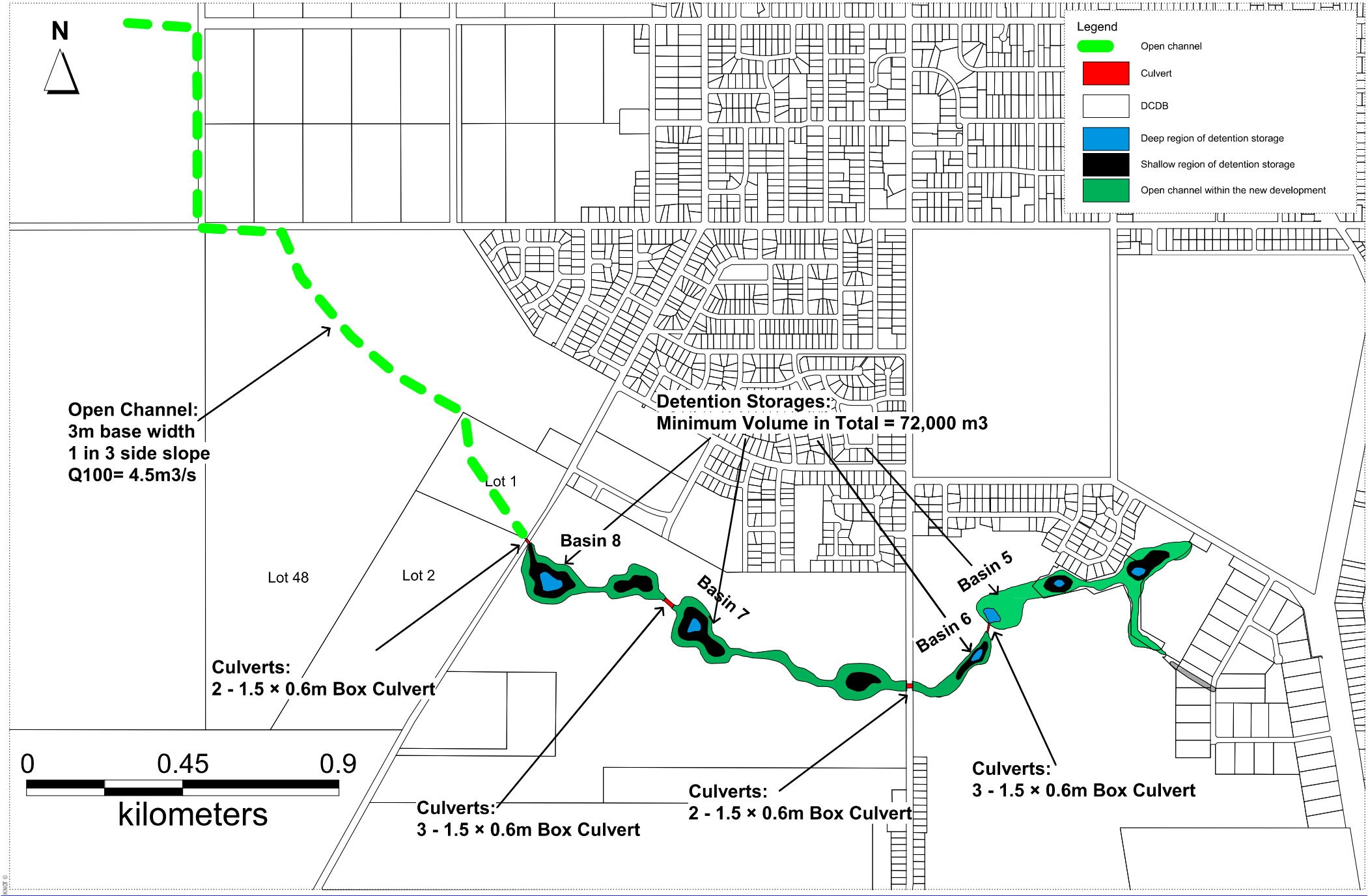
Cadastral Data:	PBBI Australia
Drainage Data:	Tonkin Consulting
Job Number:	2008.0559
Filename:	Risdon Park Option 1.wor
Drawn:	Irene Xiong
Date:	16/06/2009

Port Pirie Regional Council

South Western Drainage Outfall

Layout Plan - Option 1

Figure 1



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Job Number:	2008.0559
Filename:	Risdon Park Option 2.wor
Drawn:	Irene Xiong
Date:	16/06/2009

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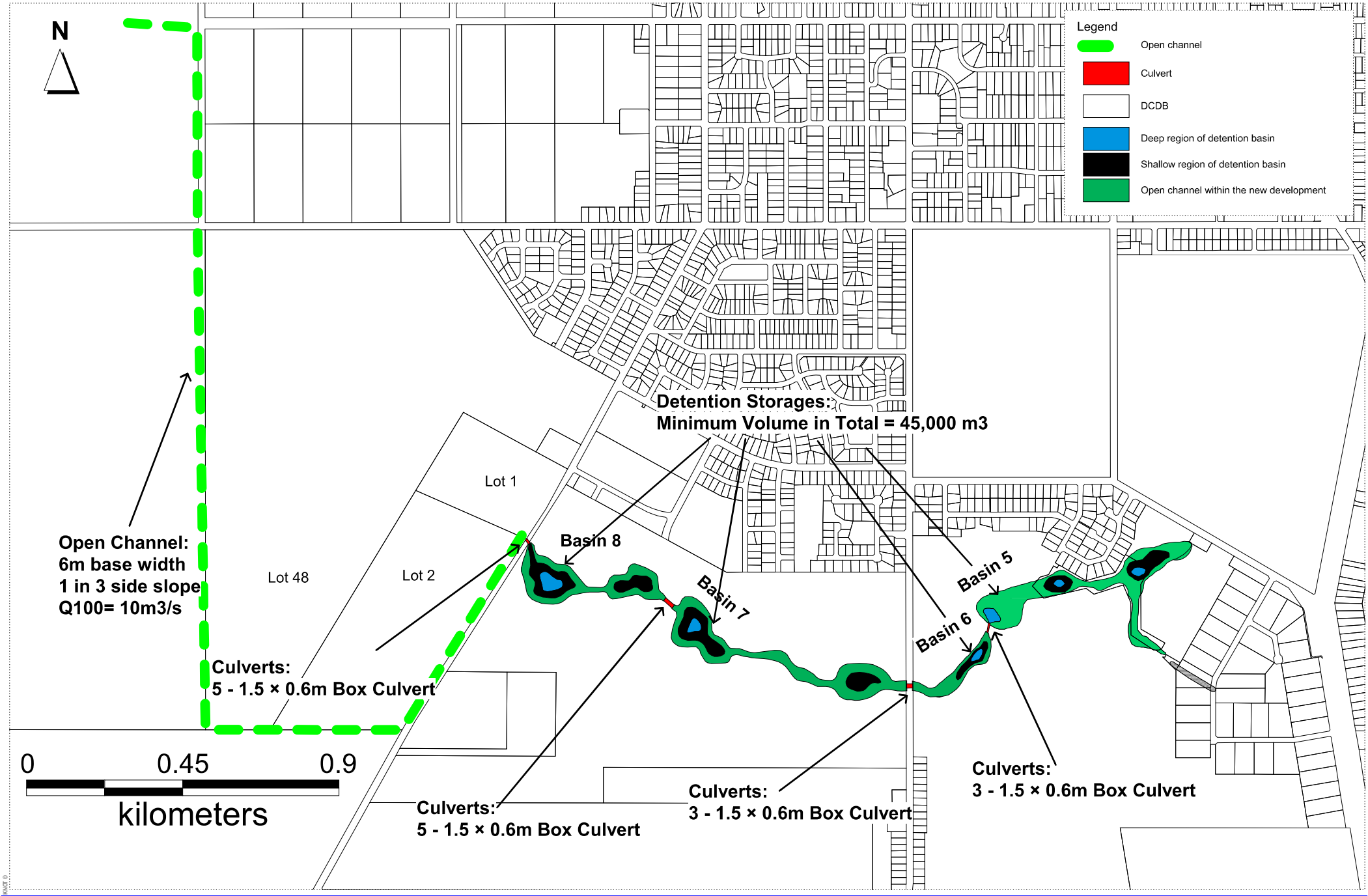
South Western Drainage Outfall

Layout Plan - Option 2

Figure 2



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Drawn:	Irene Xiong
Date:	16/06/2009

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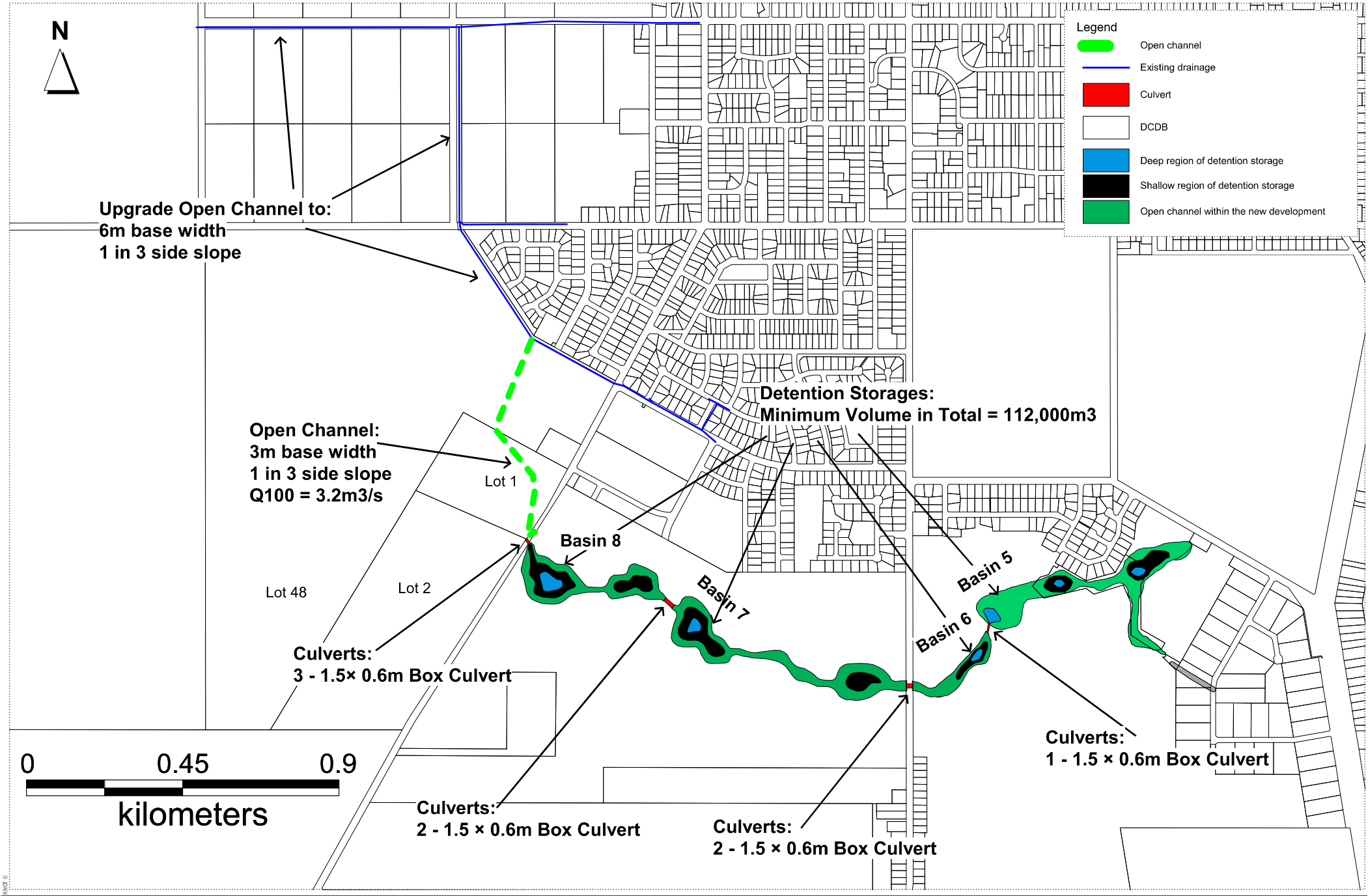
South Western Drainage Outfall

Layout Plan - Option 3

Figure 3



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Filename:	Risdon Park Option 5.wor
Drawn:	Irene Xiong
Date:	16/06/2009

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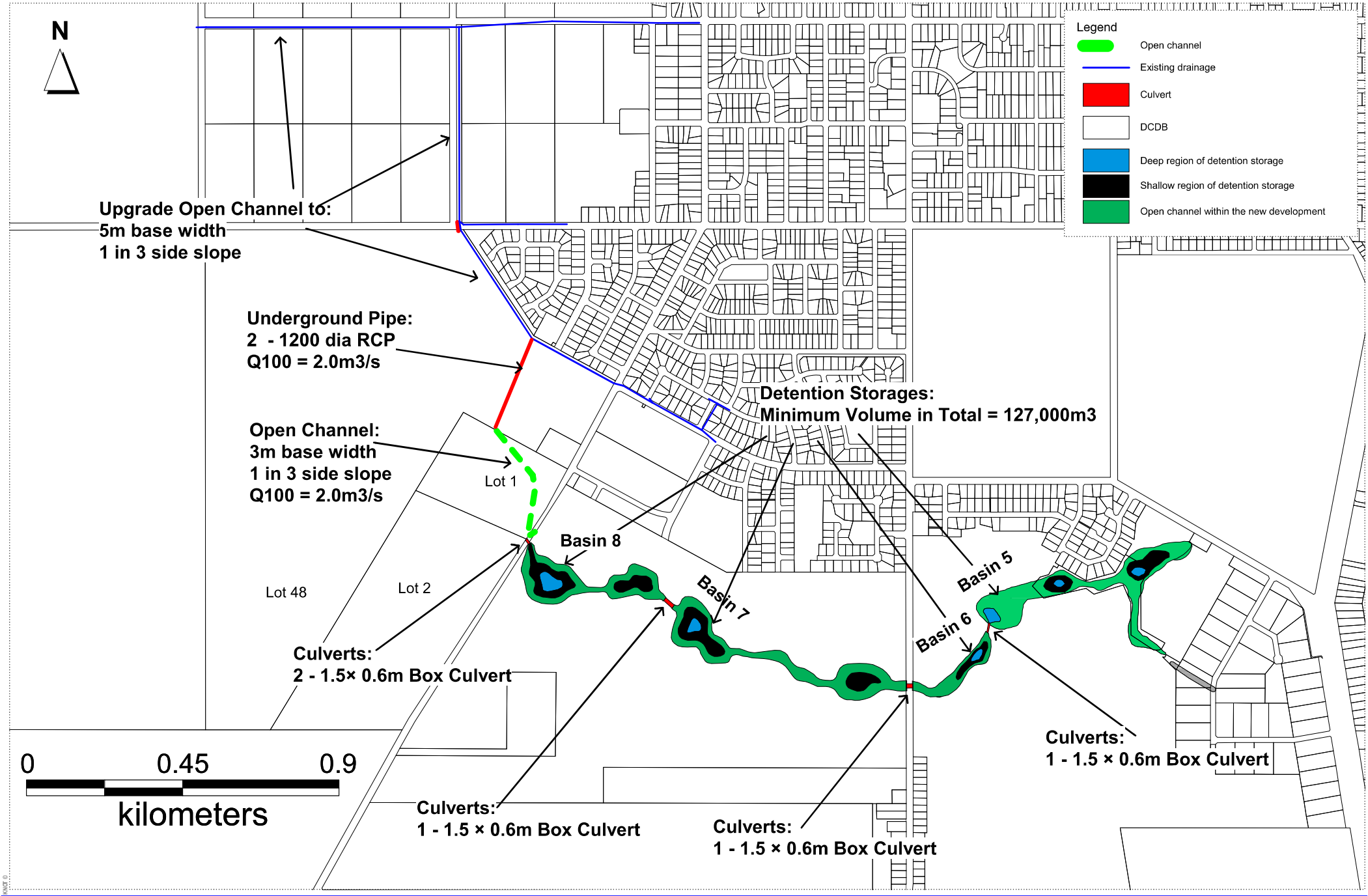
South Western Drainage Outfall

Layout Plan - Option 5a

Figure 5



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MAP DETAILS

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Drainage Data:	Tonkin Consulting
Job Number:	2008.0559
Filename:	Risdon Park Option 5b.wor
Drawn:	Irene Xiong
Date:	16/06/2009

Port Pirie Regional Council

South Western Drainage Outfall

Layout Plan - Option 5b

Figure 6

INDICATIVE CONSTRUCTION COST ESTIMATE

Project: **South West Drainage Outfall Option 1**
Job No: 2008.0559
Date: July 2009

Estimater: IX
Reviewer: DWS

Item No	Description	Unit	Qty	Rate	Cost
1	**Preliminaries**				
	Establishment & setting out	item	1	$260,000	$260,000
2	**Stormwater drainage**				
	1500mm wide x 600mm high box culvert	m	315	$1,200	$378,000
	450mm diameter RCP	m	50	$280	$14,000
	Headwall	item	42	$3,500	$147,000
	Rural detention basin	item	1	$330,000	$330,000
3	**Outfall Channel from Port Davis Road to Balmoral Road Drain**				
	Site preparation, clearing & grubbing	item	1	$10,000	$10,000
	Strip, stockpile and re-spread topsoil	m^2	42000	$3	$126,000
	Cut to spoil	m^3	55000	$15	$825,000
	Trimming and finishing of batter slopes	m^2	26000	$2	$52,000
	Erosion control	item	1	$5,000	$5,000
	Re-seeding	m^2	42000	$3	$126,000
4	**Detention Basin / Channel**				
	Site preparation, clearing & grubbing	item	1	$15,000	$15,000
	Strip, stockpile and re-spread topsoil	m^2	45000	$3	$135,000
	Cut to fill assuming excavated soils can be reuse on site	m^3	71000	$8	$568,000
	Trimming and finishing of batter slopes	m^2	38000	$2	$76,000
	Erosion control	item	1	$12,000	$12,000
	Re-seeding	m^2	45000	$3	$135,000
5	**Miscellaneous**				
	Testing	item	1	$25,000	$25,000
	Cleaning up	item	1	$20,000	$20,000
	Demobilise	item	1	$15,000	$15,000
		Total			$3,274,000
		20% Contingencies			$654,800
		10% Locality Allowance			$327,400
		Total (inc GST)			**$4,681,820**

Notes: Cost estimates provided by Tonkin Consulting are based upon historic cost information and experience, and do not allow for latent conditions, changes in scope and market conditions (ie competition, escalation, changes to public and private utility policies in regards to relocation and augmentation of services).

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Landscaping costs are not included

INDICATIVE CONSTRUCTION COST ESTIMATE

Project: **South West Drainage Outfall Option 2**
Job No: 2008.0559
Date: July 2009

Estimater: IX
Reviewer: DWS

Item No	Description	Unit	Qty	Rate	Cost
1	**Preliminaries**				
	Establishment & setting out	item	1	$330,000	$330,000
2	**Drainage Infrastructure**				
	1500mm wide x 600mm high box culvert	m	195	$1,200	$234,000
	450mm diameter RCP	m	50	$280	$14,000
	Headwall	item	26	$3,500	$91,000
	Rural detention basin	item	1	$330,000	$330,000
3	**Outfall Channel from Port Davis Road to Balmoral Road Drain**				
	Site preparation, clearing & grubbing	item	1	$15,000	$15,000
	Strip, stockpile and re-spread topsoil	m^2	36000	$3	$108,000
	Cut to spoil	m^3	43000	$15	$645,000
	Trimming and finishing of batter slopes	m^2	26000	$2	$52,000
	Erosion control	item	1	$5,000	$5,000
	Re-seeding	m^2	36000	$3	$108,000
4	**Detention Basin / Channel**				
	Site preparation, clearing & grubbing	item	1	$20,000	$20,000
	Strip, stockpile and re-spread topsoil	m^2	87000	$3	$261,000
	Cut to fill assuming excavated soils can be reuse	m^3	147000	$8	$1,176,000
	Trimming and finishing of batter slopes	m^2	65000	$2	$130,000
	Erosion control	item	1	$12,000	$12,000
	Re-seeding	m^2	87000	$3	$261,000
5	**Miscellaneous**				
	Testing	item	1	$25,000	$25,000
	Cleaning up	item	1	$20,000	$20,000
	Demobilise	item	1	$15,000	$15,000
		Total			$3,852,000
		20% Contingencies			$770,400
		10% Locality Allowance			$385,200
		Total (inc GST)			**$5,508,360**

Notes: Cost estimates provided by Tonkin Consulting are based upon historic cost information and experience, and do not allow for latent conditions, changes in scope and market conditions (ie competition, escalation, changes to public and private utility policies in regards to relocation and augmentation of services).

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Landscaping costs are not included

INDICATIVE CONSTRUCTION COST ESTIMATE

Project: **South West Drainage Outfall Option 3**
Job No: 2008.0559
Date: July 2009

Estimater: IX
Reviewer: DWS

Item No	Description	Unit	Qty	Rate	Cost
1	**Preliminaries**				
	Establishment & setting out	item	1	$350,000	$350,000
2	**Drainage Infrastructure**				
	1500mm wide x 600mm high box culvert	m	315	$1,200	$378,000
	450mm diameter RCP	m	50	$280	$14,000
	Headwall	item	42	$3,500	$147,000
	Rural detention basin	item	1	$330,000	$330,000
3	**Outfall Channel from Port Davis Road to Balmoral Road Drain**				
	Site preparation, clearing & grubbing	item	1	$15,000	$15,000
	Strip, stockpile and re-spread topsoil	m^2	80000	$3	$240,000
	Cut to spoil	m^3	105000	$15	$1,575,000
	Trimming and finishing of batter slopes	m^2	58000	$2	$116,000
	Erosion control	item	1	$10,000	$10,000
	Re-seeding	m^2	80000	$3	$240,000
4	**Detention Basin / Channel**				
	Site preparation, clearing & grubbing	item	1	$5,000	$5,000
	Strip, stockpile and re-spread topsoil	m^2	45000	$3	$135,000
	Cut to fill assuming excavated soils can be reuse on site	m^3	71000	$8	$568,000
	Trimming and finishing of batter slopes	m^2	35000	$2	$70,000
	Erosion control	item	1	$12,000	$12,000
	Re-seeding	m^2	45000	$3	$135,000
5	**Miscellaneous**				
	Testing	item	1	$25,000	$25,000
	Cleaning up	item	1	$20,000	$20,000
	Demobilise	item	1	$15,000	$15,000
		Total			$4,400,000
		20% Contingencies			$880,000
		10% Locality Allowance			$440,000
		Total (inc GST)			**$6,292,000**

Notes: Cost estimates provided by Tonkin Consulting are based upon historic cost information and experience, and do not allow for latent conditions, changes in scope and market conditions (ie competition, escalation, changes to public and private utility policies in regards to relocation and augmentation of services).

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Landscaping costs are not included

INDICATIVE CONSTRUCTION COST ESTIMATE

Project: **South West Drainage Outfall Option 4a - 0.5m3/s pump**
Job No: 2008.0559
Date: July 2009

Estimater: IX
Reviewer: DWS

Item No	Description	Unit	Qty	Rate	Cost
1	**Preliminaries**				
	Establishment & setting out	item	1	$450,000	$450,000
2	**Drainage Infrastructure**				
	1500mm wide x 600mm high box culvert	m	75	$1,200	$90,000
	450mm diameter RCP	m	50	$280	$14,000
	Headwall	item	10	$3,500	$35,000
	Rural detention basin	item	1	$330,000	$330,000
3	**Detention Basin / Channel**				
	Site preparation, clearing & grubbing	item	1	$20,000	$20,000
	Strip, stockpile and re-spread topsoil	m^2	146000	$3	$438,000
	Cut to fill assuming excavated soils can be reuse on site	m^3	248000	$8	$1,984,000
	Trimming and finishing of batter slopes	m^2	126000	$2	$252,000
	Erosion control	item	1	$3,000	$3,000
	Re-seeding	m^2	126000	$3	$378,000
4	**Pump Station**				
	Pump Sump	item	1	$100,000	$100,000
	Pump (2X500L/s)	item	2	$100,000	$200,000
	New pump suction pipes and valves & manifolding	item	1	$150,000	$150,000
	Concrete hardstand around pump station	item	1	$25,000	$25,000
	600mm rising main from Port Davis Road to Ferme St Drain	m	475	$500	$237,500
	Electrical & Controls upgrade assuming power available at the site	Item	1	$150,000	$150,000
5	**Miscellaneous**				
	Testing	item	1	$15,000	$15,000
	Cleaning up	item	1	$3,000	$3,000
	Demobilise	item	1	$2,000	$2,000
		Total			$4,876,500
		20% Contingencies			$975,300
		10% Locality Allowance			$487,650
		Total (inc GST)			**$6,973,395**

Notes: Cost estimates provided by Tonkin Consulting are based upon historic cost information and experience, and do not allow for latent conditions, changes in scope and market conditions (ie competition, escalation, changes to public and private utility policies in regards to relocation and augmentation of services).

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Landscaping costs are not included

INDICATIVE CONSTRUCTION COST ESTIMATE

Project: **South West Drainage Outfall Option 4b - 0.25m3/s pump**
Job No: 2008.0559
Date: July 2009

Estimater: IX
Reviewer: DWS

Item No	Description	Unit	Qty	Rate	Cost
1	**Preliminaries**				
	Establishment & setting out	item	1	$460,000	$460,000
2	**Drainage Infrastructure**				
	1500mm wide x 600mm high box culvert	m	45	$1,200	$54,000
	450mm diameter RCP	m	50	$280	$14,000
	Headwall	item	6	$3,500	$21,000
	Rural detention basin	item	1	$330,000	$330,000
3	**Detention Basin / Channel**				
	Site preparation, clearing & grubbing	item	1	$25,000	$25,000
	Strip, stockpile and re-spread topsoil	m^2	157000	$3	$471,000
	Cut to fill assuming excavated soils can be reuse on site	m^3	270000	$8	$2,160,000
	Trimming and finishing of batter slopes	m^2	137000	$2	$274,000
	Erosion control	item	1	$8,000	$8,000
	Re-seeding	m^2	137000	$3	$411,000
4	**Pump Station**				
	Pump Sump	item	1	$80,000	$80,000
	Pump (2X250L/s)	item	2	$70,000	$140,000
	New pump suction pipes and valves & manifolding	item	1	$100,000	$100,000
	Concrete hardstand around pump station	item	1	$20,000	$20,000
	450mm rising main from Port Davis Road to Ferme St Drain	m	475	$300	$142,500
	Electrical & Controls upgrade assuming power available at the site	Item	1	$100,000	$100,000
5	**Miscellaneous**				
	Testing	item	1	$25,000	$25,000
	Cleaning up	item	1	$20,000	$20,000
	Demobilise	item	1	$15,000	$15,000
		Total			$4,870,500
		20% Contingencies			$974,100
		10% Locality Allowance			$487,050
		Total (inc GST)			**$6,964,815**

Notes: Cost estimates provided by Tonkin Consulting are based upon historic cost information and experience, and do not allow for latent conditions, changes in scope and market conditions (ie competition, escalation, changes to public and private utility policies in regards to relocation and augmentation of services).

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Landscaping costs are not included

INDICATIVE CONSTRUCTION COST ESTIMATE

Project: **South West Drainage Outfall Option 5**
Job No: 2008.0559
Date: July 2009

Estimater: IX
Reviewer: DWS

Item No	Description	Unit	Qty	Rate	Cost
1	**Preliminaries**				
	Establishment & setting out	item	1	$290,000	$290,000
2	**Drainage Infrastructure**				
	1800mm wide x 900mm high box culvert (upgrade culvert)	m	40	$2,000	$80,000
	1500mm wide x 600mm high box culvert (15m culverts)	m	75	$1,200	$90,000
	450mm diameter RCP	m	50	$280	$14,000
	Headwall	item	14	$3,500	$49,000
	Rural detention basin	item	1	$330,000	$330,000
3	**Outfall Channel - Port Davis Road to Ferme St drain outlet**				
	Site preparation, clearing & grubbing	item	1	$20,000	$20,000
	Strip, stockpile and re-spread topsoil	m^2	23000	$3	$69,000
	Cut to spoil (new channel & widening existing Ferme Street drain)	m^3	21000	$15	$315,000
	Trimming and finishing of batter slopes	m^2	20000	$2	$40,000
	Erosion control	item	1	$5,000	$5,000
	Re-seeding	m^2	23000	$3	$69,000
4	**Detention Basin / Channel**				
	Site preparation, clearing & grubbing	item	1	$15,000	$15,000
	Strip, stockpile and re-spread topsoil	m^2	90000	$3	$270,000
	Cut to fill assuming excavated soils can be reuse on site	m^3	140000	$8	$1,120,000
	Trimming and finishing of batter slopes	m^2	70000	$2	$140,000
	Erosion control	item	1	$15,000	$15,000
	Re-seeding	m^2	70000	$3	$210,000
5	**Miscellaneous**				
	Testing	item	1	$25,000	$25,000
	Cleaning up	item	1	$20,000	$20,000
	Demobilise	item	1	$15,000	$15,000
		Total			$3,201,000
		20% Contingencies			$640,200
		10% Locality Allowance			$320,100
		Total (inc GST)			**$4,577,430**

Notes: Cost estimates provided by Tonkin Consulting are based upon historic cost information and experience, and do not allow for latent conditions, changes in scope and market conditions (ie competition, escalation, changes to public and private utility policies in regards to relocation and augmentation of services).

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Landscaping costs are not included

INDICATIVE CONSTRUCTION COST ESTIMATE

Project: **South West Drainage Outfall Option 5**
Job No: 2008.0559
Date: July 2009

Estimater: IX
Reviewer: DWS

Item No	Description	Unit	Qty	Rate	Cost
1	**Preliminaries**				
	Establishment & setting out	item	1	$290,000	$290,000
2	**Drainage Infrastructure**				
	1800mm wide x 900mm high box culvert (upgrade culvert)	m	20	$2,000	$40,000
	1500mm wide x 600mm high box culvert (15m culverts)	m	75	$1,200	$90,000
	1050mm diameter RCP (twin pipes)	m	420	$900	$378,000
	450mm diameter RCP	m	50	$280	$14,000
	Headwall	item	16	$3,500	$56,000
	Rural detention basin	item	1	$330,000	$330,000
3	**Outfall Channel - Port Davis Road to Ferme St drain outlet**				
	Site preparation, clearing & grubbing	item	1	$20,000	$20,000
	Strip, stockpile and re-spread topsoil	m^2	20000	$3	$60,000
	Cut to spoil (new channel & widening existing Ferme Street drain)	m^3	17000	$15	$255,000
	Trimming and finishing of batter slopes	m^2	16000	$2	$32,000
	Erosion control	item	1	$5,000	$5,000
	Re-seeding	m^2	20000	$3	$60,000
4	**Detention Basin / Channel**				
	Site preparation, clearing & grubbing	item	1	$15,000	$15,000
	Strip, stockpile and re-spread topsoil	m^2	107000	$3	$321,000
	Cut to fill assuming excavated soils can be reuse on site	m^3	176000	$8	$1,408,000
	Trimming and finishing of batter slopes	m^2	90000	$2	$180,000
	Erosion control	item	1	$15,000	$15,000
	Re-seeding	m^2	90000	$3	$270,000
5	**Miscellaneous**				
	Testing	item	1	$25,000	$25,000
	Cleaning up	item	1	$20,000	$20,000
	Demobilise	item	1	$15,000	$15,000
		Total			$3,899,000
		20% Contingencies			$779,800
		10% Locality Allowance			$389,900
		Total (inc GST)			**$5,575,570**

Notes: Cost estimates provided by Tonkin Consulting are based upon historic cost information and experience, and do not allow for latent conditions, changes in scope and market conditions (ie competition, escalation, changes to public and private utility policies in regards to relocation and augmentation of services).

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Landscaping costs are not included

Appendix B

Detailed Cost Estimate

INDICATIVE CONSTRUCTION COST ESTIMATE

Project: **South West Drainage Outfall Stage 1 development**
Job No: 2008.0559
Date: Aug 2012

Estimater: JO
Reviewer: KSS

Item No	Description	Unit	Qty	Rate	Cost
1	**Preliminaries**				
	Establishment & setting out	item	1	$40,000	$40,000
2	**Drainage Infrastructure**				
	2100mm wide x 900mm high box culvert (2 x 10m)	m	20	$2,400	$48,000
	1800mm wide x 900mm high box culvert (2 x 15m)	m	30	$1,900	$57,000
	2100mm wide x 1200mm high box culvert (2 x 15m)	m	30	$2,600	$78,000
3	**Outfall Channel**				
	Site preparation, clearing & grubbing	item	1	$20,000	$20,000
	Strip, stockpile and re-spread topsoil	m^2	37250	$3	$104,300
	Cut to spoil	m^3	19500	$15	$292,500
	Trimming and finishing of batter slopes	m^2	30000	$2	$60,000
	Erosion control	item	1	$10,000	$10,000
	Re-seeding	m^2	37250	$3	$111,750
4	**Miscellaneous**				
	Testing	item	1	$15,000	$15,000
	Cleaning up	item	1	$12,000	$12,000
	Demobilise	item	1	$15,000	$15,000
		Total			$863,550
		20% Contingencies			$172,710
		10% Locality Allowance			$86,355
		10% Design			$86,355
		Total (inc GST)			**$1,329,867**

Notes: Cost estimates provided by Tonkin Consulting are based upon historic cost information and experience, and do not allow for latent conditions, changes in scope and market conditions (ie competition, escalation, changes to public and private utility policies in regards to relocation and augmentation of services).

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Landscaping costs are not included

INDICATIVE CONSTRUCTION COST ESTIMATE

Project: **South West Drainage Ultimate Development Outfall**
Job No: 2008.0559
Date: Aug 2012

Estimater: JO
Reviewer: KSS

Item No	Description	Unit	Qty	Rate	Cost
1	**Preliminaries**				
	Establishment & setting out	item	1	$40,000	$40,000
2	**Drainage Infrastructure**				
	2100mm wide x 900mm high box culvert (2 x 10m)	m	20	$2,400	$48,000
	1800mm wide x 900mm high box culvert (2 x 15m)	m	30	$1,900	$57,000
	2100mm wide x 1200mm high box culvert (2 x 15m)	m	30	$2,600	$78,000
	750 dia RCP	m	20	$950	$19,000
3	**Outfall Channel from Port Davis Road to Ferme Street Drain**				
	Site preparation, clearing & grubbing	item	1	$15,000	$15,000
	Strip, stockpile and re-spread topsoil	m^2	23000	$3	$69,000
	Cut to spoil	m^3	38000	$10	$380,000
	Trimming and finishing of batter slopes	m^2	23000	$2	$46,000
	Erosion control	item	1	$5,000	$5,000
	Re-seeding	m^2	28000	$3	$84,000
4	**Quarry Site Detention Storage**				
	Site preparation & removal of contaminated material	item	1	$100,000	$100,000
	Strip, stockpile and re-spread topsoil	m^2	10000	$3	$30,000
	Cut to fill assuming excavated soils can be reuse	m^3	18000	$8	$144,000
	Trimming and finishing of batter slopes	m^2	8000	$2	$16,000
	Erosion control	item	1	$12,000	$12,000
	Re-vegetation	m^2	18000	$1.0	$18,000
5	**Miscellaneous**				
	Testing	item	1	$15,000	$15,000
	Cleaning up	item	1	$12,000	$12,000
	Demobilise	item	1	$15,000	$15,000
		Total			$1,203,000
		20% Contingencies			$240,600
		10% Locality Allowance			$120,300
		10% Design			$120,300
		Total (inc GST)			**$1,852,620**

Notes: Cost estimates provided by Tonkin Consulting are based upon historic cost information and experience, and do not allow for latent conditions, changes in scope and market conditions (ie competition, escalation, changes to public and private utility policies in regards to relocation and augmentation of services).

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Landscaping costs are not included

Appendix C

Quarry Site Concept Design Arrangement

LEGEND

RL 6.00	EXISTING LEVEL
IL 4.00	DESIGN LEVEL

ABBREVIATIONS

B.C.	BOX CULVERT
CH	CHAINAGE
D	DEPTH

WIDEN

Approx IL 2.80

BALMORAL ROAD

CH956IL3.08

Road 3.86

Road 3.19

Road 4.17

KINGSTON

2/2.4x1.2 B.C.
IL3.38

CH1500

ROAD

IL 3.30

RL 5.45

IL 3.19

FUTURE B.C.

FERME STREET DRAIN
1981 DESIGN

PROPOSED CHANNEL

DETENTION BASIN
(Refer INSET)

2/2.4x1.2 B.C.
IL3.74
(CH 2220)

IL 4.00

MOUND

0.22%

CH2584

IL 4.00

0.05%

Q100
Say D=1.5

DRAIN TO BE OMITTED

CH2700
IL4.65
NS6.48
D=1.83

Q100
D=1.5

0.05%

FERME STREET DRAIN

CH3000
D=2.01

0.05%

RL 6.68m

PORT DAVIS ROAD

SENATE ROAD

GLYNDE
ESTATE

NOTE:
EXISTING PONDS IN GLYNDE ESTATE
BECOME DETENTION BASINS.
Approximate I.L. 5.50
EXTEND AS NECESSARY.

0.05%

CH3600
IL5.70
NS6.69
D=1.59

0.05%

CH3800

2/2.4x1.2 B.C.
IL5.21
NS=7.45
D=2.24

Scale 0 50 100 150 200 250 Metres

RL 5.80

RL 4.20

CHANNEL

RL 6.00

POND STORAGE

BASE R.L.	VOLUME (m^3)
3.0	0
4.0	35000
4.5	55000
5.0	76000
5.5	99000

RL 4.50

RL 3.80

RL 6.00

MOUND

RL 4.30

RL 2.80

RL 2.80

DETENTION

R.L. 5.5 - R.L. 4.0 = 64000m^3

RL 2.80

RL 3.30

BASE R.L. 3.0m.-TYP

RL 5.60

TOP R.L. 6.0m.-TYP

Approx 20m

WATER 2.78

CHANNEL I.L.4.00m
HENCE Q100 R.L. 5.50m

RL 4.30

RL 6.00

CHANNEL

ROAD

DAVIS

PORT

B.C.

INSET

Scale 0 10 20 30 40 50 Metres

PRELIMINARY

No.	DESCRIPTION	DATE	INIT.
A	ISSUED FOR APPROVAL	APRIL 08	SWC

AMENDMENTS

ASSOCIATION

CLIENT

M & J MEYERS

MCE Consulting Engineers Pty Ltd
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DESIGNED SWC

DRAWN PJC

APPROVED

DATE

TITLE

PORT PIRIE
DRAINAGE CONCEPT
GLYNDE ESTATE TO BALMORAL ROAD
LAYOUT PLAN

SCALE AS SHOWN

DATE APRIL 2008

JOB No. 1297

SHEET 1 OF 1

DRAWING NO. 1297-01

REV. A