Port Pirie Stormwater Harvesting

Yield Investigation

Port Pirie Regional Council

February 2014

Ref No. 20131423FR1A

Tonkin CONSULTING
a better approach

Document History and Status

Rev	Description	Author	Reviewed	Approved	Date
A	For Client Comment	EAJ	KSS	TDC	19 February 2014

Contents

Tables

Figures

Appendices

1 Introduction

The Port Pirie Regional Council has formed a strategic team to assess the potential water supply options to offset demand on the Morgan-Whyalla pipeline for town irrigation. The preferred option is to use the Black Sands Emplacement Area (BSEA) to the north of the township as a stormwater storage and reuse basin. At present, studies have been undertaken by various consultants assessing the feasibility of certain aspects of the project with a focus on identifying any potential factors that would make the project unviable.

To provide further certainty as to the cost and feasibility of this project, the Port Pirie Regional Council has engaged Tonkin Consulting to undertake a more detailed assessment of the potential yields from each of the three detention basins (Dead Horse Creek (DHC), Wandearah, and Moppett) and size the associated stormwater harvesting pump stations and rising mains.

As part of this investigation the following tasks were undertaken:

- Recent reuse investigations were reviewed.
- Water balance modelling using a daily time step was undertaken to assess the yield and design pumping rates from each basin (Dead Horse Creek, Wandearah and Moppett basins).
- Pump stations and rising mains were sized to pump the water from each basin to the BSEA.
- An opinion of cost for the construction of the pump stations and rising mains was developed.

2 Water Balance Modelling

2.1 Study Area Description

The study area is approximately 605 hectares in size and encompasses the centrally developed area of the township, including residential areas and the commercial city centre. For the purposes of this investigation the study area was divided into four large catchments, one for each of the four basins (Dead Horse Creek, Wandearah, Moppett Road and Cemetery) within the study area. These basins comprise the framework of the stormwater harvesting scheme with the intent to harvest water from each of the basins and transfer via new pump stations and rising mains to the BSEA. The study area is shown below in Figure 2.1.

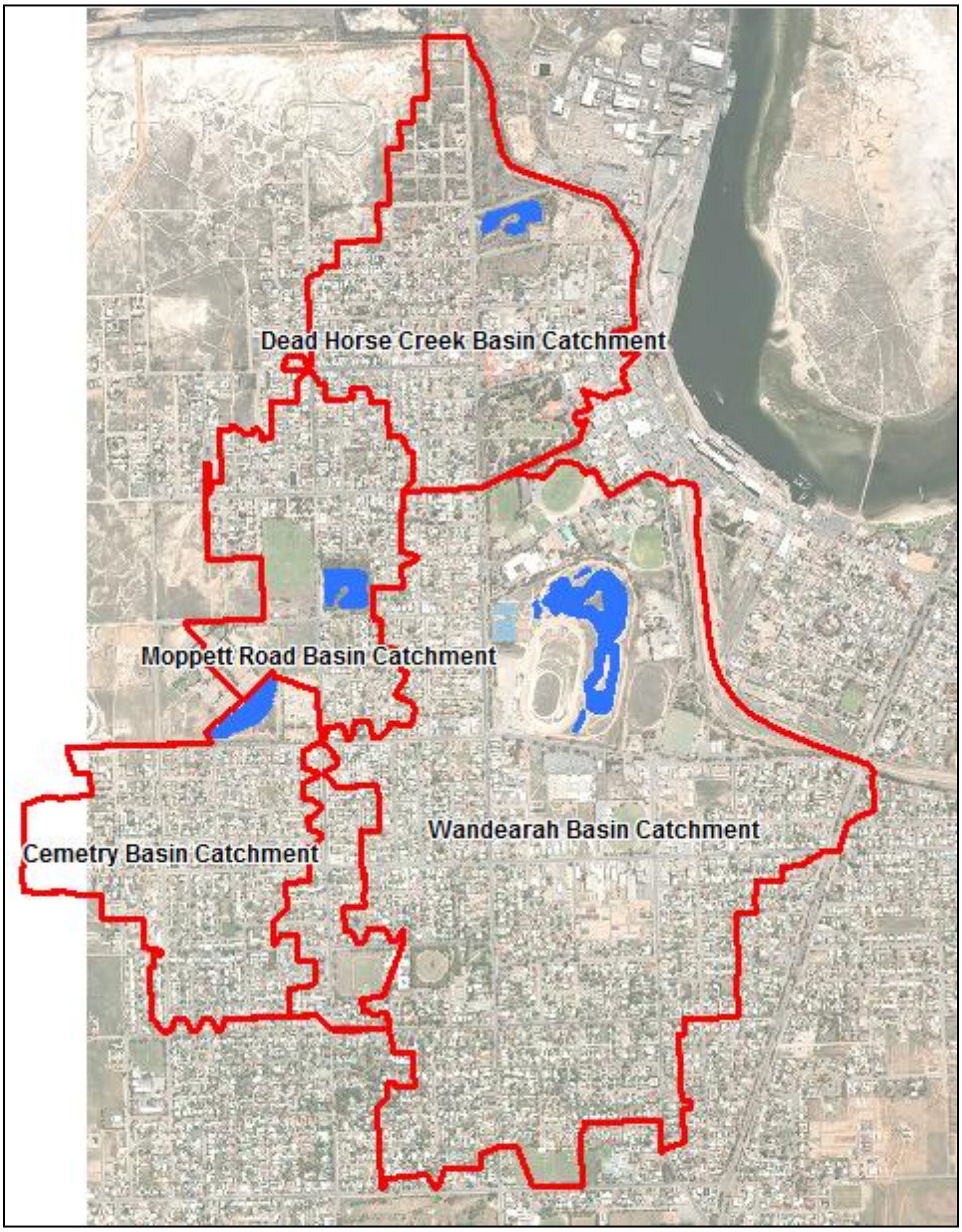

Figure 2.1 Study Area

2.2 Modelling Process

The water balance modelling was carried out using the Storm Water Management Model (SWMM) which is a dynamic rainfall-runoff model used to simulate runoff quantity and quality from single or long term (continuous) rainfall events (United States EPA, 2010). SWMM was first developed in 1971 and continues to be widely used throughout the world (United States EPA, 2010). The latest edition of SWMM, version 5 was used for this investigation and was produced by the Water Supply and Water Resources Division of the U.S. Environmental Protection Agency's National Risk Management Laboratory with assistance from the consulting firm of CDM, Inc (United States EPA, 2010).

2.3 Model configuration

An image of the model configuration taken from SWMM is shown in Figure 2.2.

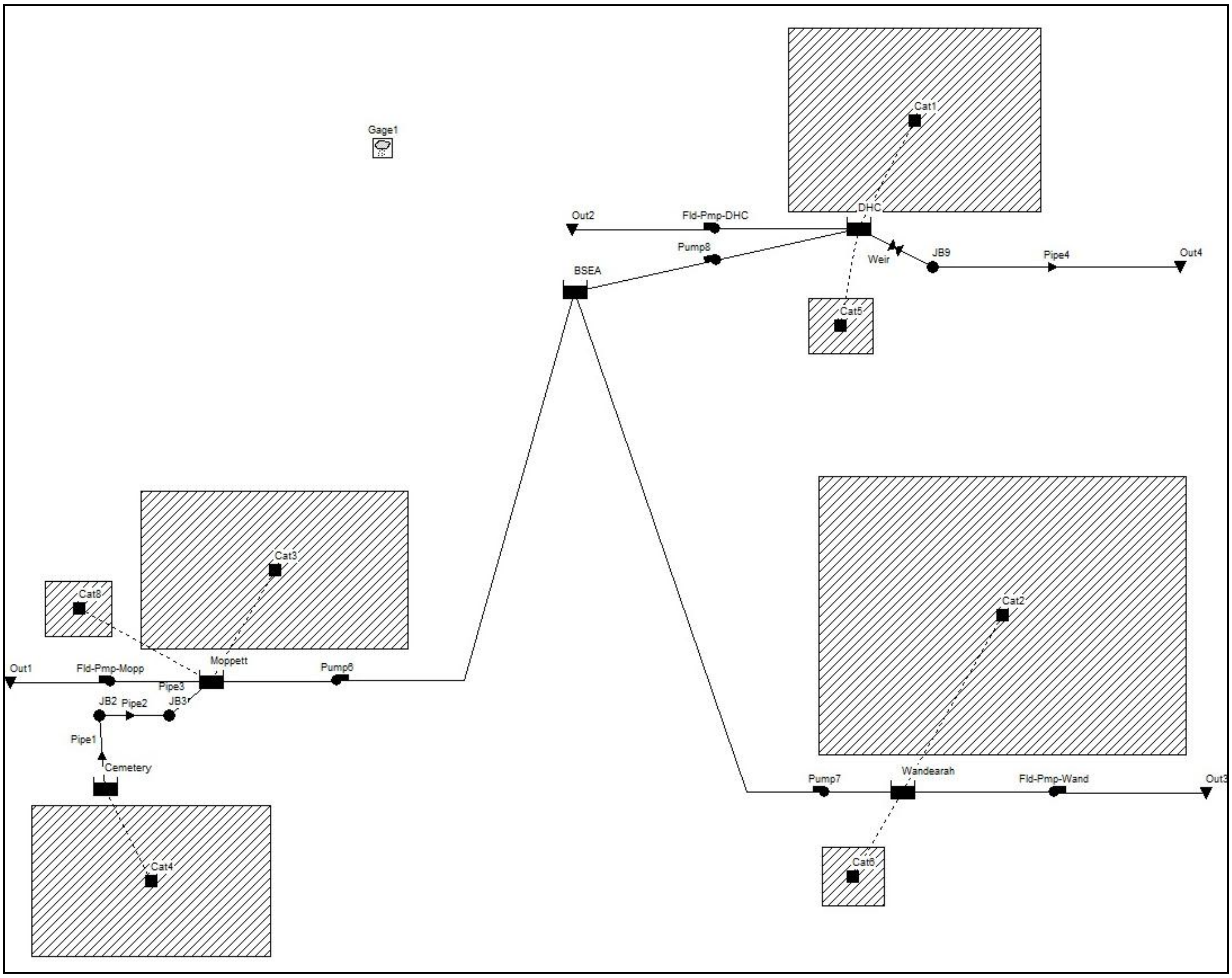

Figure 2.2 Model Configuration

2.4 Modelling Parameters and Input Data

2.4.1 Catchments Areas and Impervious Area Percentages

Sub-catchment data including Impervious Area Percentages (IAP) for both existing and long term (30-50 year time horizon) development levels was adopted from the Port Pirie Flood Study (Tonkin Consulting, 2013). This data was originally developed as part of the Port Pirie Stormwater Management Plan (SMP) (Tonkin Consulting, 2013). Each of the four catchments was delineated along existing sub catchment boundaries. The DHC catchment was delineated assuming that upgrade works have been carried out to the DHC wetland diverting additional flow from the City Centre catchment. A single IAP was then generated for each of the four catchment areas by taking an average (weighted by area) of the IAP of each of the sub catchments within each catchment. Adopted values for each catchment are detailed in Table 2.1.

Table 2.1 Catchment Areas and Impervious Area Percentages

Catchment	Area (ha)	Existing IAP (%)	Long Term IAP (%)
Dead Horse Creek Basin	114.9	28	36
Wandearah Basin	314.3	22	32
Moppett Road Basin	92.3	18	21
Cemetery Basin	83.6	22	27

2.4.2 Catchment Depression Storage and Infiltration

Depression storage values of 1mm for the impervious catchment areas and 3mm for the pervious areas were adopted based on typical values recommend in the SWMM user manual. Pervious area infiltration was modelled in SWMM using Horton’s infiltration method. Input parameters were selected such that no runoff was produced from the pervious portion of each catchment area. This is a conservative assumption, as during intense or long duration storm events some runoff from the pervious areas which include parks and gardens is likely to occur.

2.4.3 Rainfall Data

Daily total rainfall data was obtained from the Australian Bureau of Meteorology (BOM) for the Port Pirie Aerodrome, Port Germein and Crystal Brook gauging stations. These stations were chosen as the recorded data had minimal gaps and they are located within a reasonable proximity to the Port Pirie Township. After undertaking a sensitivity analysis (as detailed in Section 2.5.2) the Port Germein rainfall data was adopted as the primary data source for this investigation.

Modelling Time Step

Total rainfall data for the above gauging stations was not available in a recording frequency less than 24 hours; for a recording period of sufficient length. As such, a daily time step was adopted for the water balance modelling undertaken as part of this investigation.

Table 2.2 Summary of Rainfall Data Used

Gauge no.	Description	Distance from Port Pirie	Recording Period
021118	Port Pirie Aerodrome	5.0km South of the Town Centre	2006 – Present
019037	Port Germein	18.6km North, situated along the coast	1882 – Present
021016	Crystal Brook	26.9km South-East, situated inland near Wirrabara Forest Reserve	1881 – Present

2.4.4 Evaporation Data

Average monthly class A pan evaporation data was obtained from the BOM for the Port Pirie Township, Latitude -33.1791, Longitude 138.0083. The data input into the model is outlined in Table 3.3.

Table 2.3 Monthly Evaporation (mm/day)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
9.01	8.74	6.54	4.39	2.72	1.95	2.14	2.82	3.86	5.34	7.09	8.29

2.4.5 Detention Basin Height vs Area Data

Height vs area data for the DHC and Wandearah basins were taken from the most recent DRAINS models, created as part of the Port Pirie SMP updates (Tonkin Consulting, 2013). This data accounts for the proposed expansion to DHC wetland to the south of George Street which has been estimated to approximately double the storage capacity based on the available area for construction, assuming 1:5 batter slopes, and a basin invert matching that of the existing wetland.

Data for the Cemetery and Moppett basins was derived by generating contours for each basin from the Digital Terrain Model (DTM) prepared by Aerometrex and used as part of the Port Pirie Flood Study (Tonkin Consulting 2013). This data was cross checked against the existing DRAINS models and ‘As Constructed’ drawings of the basins.

Basin Infiltration and Standing Water Levels

Infiltration through the DHC, Wandearah and Moppett basins was not modelled as it was assumed that the invert of the basins was below groundwater level, as evident by what appears to be a permanent water level in the basin. The standing water level of these basins was adopted as the basin invert. Additionally, to account for the rainfall landing on the standing water surface, a catchment, of area equal to that of the standing water surface, with IAP of 100% was linked to each of the basins. Table 2.4 summarises the input data for each basin.

The Cemetery basin is linked to the Moppett basin via a gravity main located at its invert (1.6mAHD). This basin does not appear to have a permanent water level and as such, infiltration through this basin was modelled in SWMM using a set of Green-Ampt parameters for suction head, conductivity, and initial deficit; assuming a Sandy Clay soil type.

Table 2.4 Detention Basin Input Data

DEAD HORSE CREEK		
Height (mAHD)	Depth (m)	Area (m^2)
0.2	0	16840
1.3	1.1	24390
1.4	1.2	44800
1.6	1.4	159390

WANDEARAH		
Height (mAHD)	Depth (m)	Area (m^2)
0.08	0	13400
0.2	0.12	35280
1.6	1.52	76900
1.8	1.72	92570
2.0	1.92	134500
2.5	2.42	219350

MOPPETT		
Height (mAHD)	Depth (m)	Area (m^2)
1.1	0	170
1.2	0.1	200
1.4	0.3	560
1.6	0.5	690
1.8	0.7	5770
2	0.9	12010
2.2	1.1	18160
2.4	1.3	20310
2.6	1.5	21130
2.8	1.7	21910
3.0	1.9	23350

CEMETERY		
Height (mAHD)	Depth (m)	Area (m^2)
1.6	0	500
2	0.4	2950
2.2	0.6	12580
2.4	0.8	17410
2.6	1.0	19500

2.8	1.2	20890
3.0	1.4	22260
3.2	1.6	23790
3.4	1.8	25450
3.6	2.0	27080

2.4.6 Flood Pumps

For the purposes of this investigation it was assumed that the flood protection pumps at DHC, Wandearah and Moppett Basins had been upgraded to the duty points recommended in the Port Pirie SMP (Tokin Consulting, 2013). Pump working ranges were selected based on assessing the recommendations made in the SMP and providing adequate working range for the stormwater harvesting pumps. Table 3.5 details the flood pump working ranges and duty points adopted.

Table 2.5 Flood Pump Parameters

Pump	Duty (L/s)	Startup Level (mAHD)	Shutoff Level (mAHD)
Dead Horse Creek	800	0.95	0.85
Wandearah	700	0.65	0.65
Moppett	600	2.0	2.0

2.4.7 Stormwater Harvesting Pumps

Initial stormwater harvesting pump duty points were selected by determining the flow rate required to discharge the volume of harvestable water (available between the flood pump startup levels and the basin standing water levels) within a 24 hour period. The initial duty points and working ranges used are detailed in Table 3.6. These initial duty points were later optimised as part of the modelling process with the results of this optimisation discussed in Section 2.5.3.

Table 2.6 Initial Harvesting Pump Parameters

Pump	Duty (L/s)	Startup Level (mAHD)	Shutoff Level (mAHD)
Dead Horse Creek	130	0.80	0.20
Wandearah	220	0.60	0.08
Moppett	25	1.95	1.1

2.5 Model Runs & Optimisation

2.5.1 Initial Runs

During this phase the model was checked for errors, input parameters were refined and a sanity check of the model output was undertaken. This process identified that minimal water was being harvested from the DHC wetland as the DN900 gravity outlet located at the basin invert level (0.2mAHD) was allowing water to discharge before it could be harvested. To provide adequate working volume for the DHC harvesting pumps a weir was placed in the model preventing flow to the DN900 gravity outlet until water reached a level of 0.85mAHD.

2.5.2 Sensitivity Analysis

As the gauging data obtained from the Port Pirie Aerodrome was deemed too short for use in water balance modelling, data from the other two stations was input into the model to determine which data produced results matching most closely, those obtained using the Port Pirie Aerodrome data set. Data from the Port Germein gauging station was found to produce very similar yields from each of the wetlands; within +/- 2%. In contrast data from the Crystal Brook gauging station produced yields approximately 25% higher. These results were somewhat expected as the Crystal Brook gauging station is located 26.9km inland from Port Pirie towards topography more conducive to higher precipitation.

2.5.3 Stormwater Harvesting Pump and Rising Main Optimisation

Selection of the optimal pumping duty for each basin was primarily based on the following two factors:

- Discharging the harvestable volume between the flood pump start up level and the standing water level, within a 24hour period.
- Harvesting a minimum 90% of the average maximum harvestable volume in ML/yr entering the basin.

To determine the average maximum harvestable volume in ML/yr for each basin, numerous iterations of the model were run using long tern IAP. A summary of these maximums is provided in table 2.7.

Analyses of the modelling results determined that for sizing of the DHC and Wandearah pumps, providing the capacity to pump out the volume of water between the flood pump start up level and the standing water level, within a 24hour period was the governing factor. For sizing of the Moppett pump, harvesting a minimum 90% of the maximum harvestable volume governed.

A model of the proposed stormwater harvesting rising main alignment (assuming a common transfer main to the BSEA) was then created using the computer program Bentley – Water Gems. The optimal pumping rates determined from the SWMM modelling were used as input parameters for each of the harvesting pumps within this model. Several iterations of the model were run taking into account various pumping scenarios to determine the optimal size of each section of the rising main; with an emphasis on balancing the combined capital cost of the pipeline and pumps and the discounted pumping cost.

Table 2.7 Average Maximum Harvestable Volumes

Pump	Harvestable Volume (ML/yr)
Dead Horse Creek	115
Wandearah	255
Moppett	100
Total	470

3 Modelling Outcomes & Recommendations

3.1 Estimated Yields

For the purposes of this investigation the pumps and rising mains were sized for future conditions using long term IAP. SWMM modelling results estimated the future combined yield from the each of the basins to be and average of 458ML/yr. For comparison, the model was also run for the existing level of development. The model estimated the existing combined yield from the system to be an average 352ML/yr. Table 4.5 below provides a breakdown of the estimated average yields from each basin.

Table 3.1 Average Basin Yields

Modelling Scenario	Dead Horse Creek (ML/yr)	Wandearah (ML/yr)	Moppett (ML/yr)
Existing	77	185	90
Future	92	252	114

3.2 Pump and Rising Main Sizes

For the purposes of sizing the stormwater harvesting pumps and rising mains it was assumed that transfer of stormwater from each of the basins to the BSEA would take place via a common transfer main. This assumption was made as previous investigation undertaken by SKM (2013) suggested it is unfeasible from a cost and flood risk perspective to transfer water from the Wandearah and Moppett basins to the DHC basin and then onto the BSEA via a single rising main. Figure 3.1 shows the proposed stormwater harvesting rising main alignment and recommended pipe sizes. Modelling results indicated that the optimal duty point for the stormwater harvesting pumps at DHC, Wandearah and Moppett basins is 130L/s, 220L/s and 60L/s respectively.

A scenario was also modelled in Water Gems where the upgraded flood pumps at DHC are discharging through the stormwater harvesting rising main towards the BSEA. Modelling showed that in order to accommodate this increased flow rate of 800L/s, the section of pipeline from the DHC off take to the BSEA would need to be increased in size to DN710. Additionally the section of pipeline from DHC basin to the transfer main inlet would need to be increased in size to DN500. Note – sizing of pipes for this scenario assumed that during times when the DHC flood pumps are operational the Wandearah and Moppett stormwater harvesting pumps would not be operating.

3.3 Opportunities for Reuse of Existing Pump Stations and Rising Mains

Previous investigation work by SKM (2013) indicated the existing DHC flood pumps have a combined duty of 114L/s and rising main size of DN250. This rising main currently discharges to the South of the BSEA. Given the proximity of the outlet, and provided this information is accurate, and the condition of this infrastructure can be proven fit for purpose, there may be scope to reuse this infrastructure in lieu of installing a new harvesting pump station and rising main at this site.

As noted in the Port Pirie Flood Study (Tonkin Consulting, 2013) the existing flood pumps at Wandearah have a combined duty of 130L/s making them unsuitable for reuse without, at minimum, a partial upgrade to a combined duty of 220L/s. The Port Pirie Flood Study (Tonkin Consulting, 2013) also highlights the uncertainty surrounding the size and condition of the existing rising main. The alignment of the rising main is also unfavourable as it currently discharges to the East, into the Port Pirie River.

The exact duty point of the Moppet pumps and size of the rising main is unknown. The Port Pirie SMP (Tonkin Consulting 2013) estimates a combined duty of 120L/s. If the duty and condition of these pumps can be proven it may be feasible to reuse them as part of the stormwater harvesting scheme. The existing rising main is known to discharge to the west making it unsuitable for reuse.

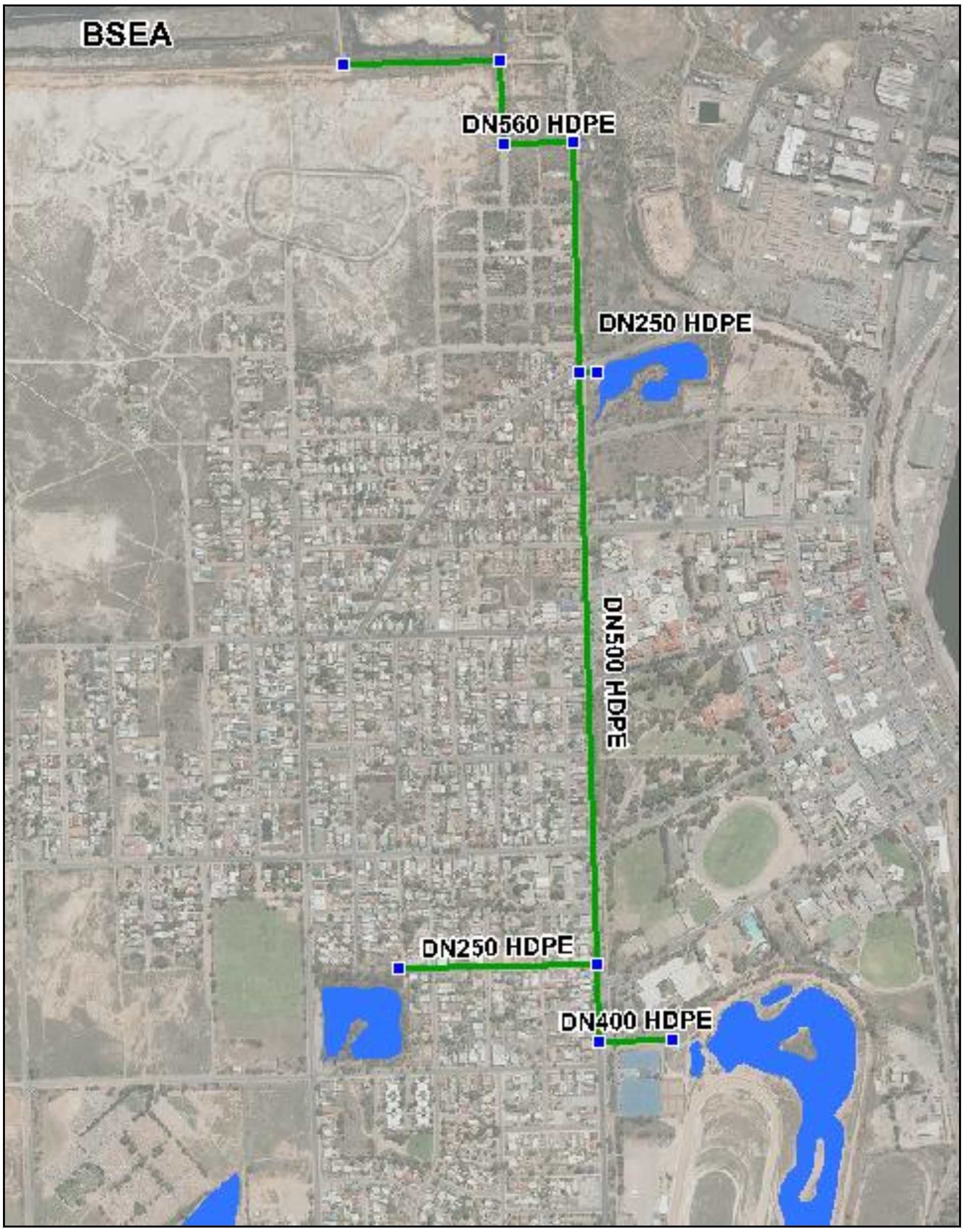

Figure 3.1 Proposed Stormwater Harvesting Alignment & Recommended Pipe Sizes

4 Opinion of Cost

An opinion of cost for the construction of the pump stations and rising mains (with sizes as recommended in Section 3.2 of this report) was developed. It was estimated that total construction cost of the three pump stations and associated rising mains and intake pipelines (totalling length of approx. 3.3km) to be $4.4 million inc. GST. This opinion of cost assumes that package pump stations are installed at the three basins and HDPE pipe material is used for all pipework. Due to the limitations of this investigation and the fact detailed design has not been undertaken a contingency factor of 30% has been adopted for this costing. Appendix A contains a detailed breakdown of this opinion of cost, including a list of items which have not been allowed for.

5 Limitations and Areas for Future Investigation

5.1 Limitations

The following are limitations of this investigation:

- The impacts on the harvestable yield from each basin if the DHC flood pumps are discharging through the stormwater harvesting rising main towards the BSEA have not been investigated.
- There is a level of uncertainty surrounding the exact capacities (height vs area) of each basin. Detailed survey of each basin is recommended to verify their capacity.
- The flood pump operating levels adopted as part of this investigation have been taken from previous investigations and need to be confirmed as there is a degree of uncertainty as to the current operating regime.
- This investigation did not consider the quality of water in the various basins and its suitability for reuse. The DHC and Wandearah basins have a standing water level which is close to the average tide level. This being the case, it is possible that the basins intersect saline groundwater which could affect the salinity of water harvested; particularly of low inflows. This aspect requires further investigation.

5.2 Future Investigation

The following are areas warranting further investigation:

- It is recommended that a detailed asset condition assessment of the existing pump stations including intake and rising mains is undertaken. This should include assessment of the existing controls system (Variable Speed Drives/SCADA) to determine the feasibility of reusing them as part of this stormwater harvesting scheme.
- Additional modelling should be undertaken to assess the impacts of various operational scenarios on the harvestable yield from the system. Scenarios could include:
  - The Wandearah and Moppett pumps not harvesting stormwater during operation of the DHC flood pumps.
  - The DHC, Wandearah and Moppett stormwater harvesting pumps not harvesting stormwater when the flood pumps at these basins are in operation i.e. offsetting the required flood pump duty with the stormwater harvesting pump duty. This would require modelling of various single ARI storm events.
- Further modelling should also be undertaken to assess the impacts of all foreseeable operational scenarios on the pump and pipe sizes to determine the most economical diameter of pumping main which minimises the combined capital and discounted pumping cost.
- Given outcomes of additional modelling undertake investigation into the feasibility of integrating and constructing simultaneously the stormwater harvesting and upgraded flood pump infrastructure.
- Liaise with SA Power Networks to negotiate a connection service for each of the proposed pump station sites.

6 Conclusions

This investigation estimates the average yield from the stormwater harvesting system to be 352ML/yr based on existing development conditions and 458ML/yr based on long term development conditions. Provided future detailed investigation demonstrates that there is capacity at the BSEA to store this volume of water and efficiently extract and distribute it for reuse, and that the quality of the water can be confirmed, this volume of yield appears adequate to meet the Port Pirie Regional Councils current and future irrigation requirements as outlined in the previous investigation by SKM (2013).

The recommended pump duty for the three pump stations (DHC, Wandearah and Moppett) is 130L/s, 220L/s and 60L/s respectively. The required diameters of the rising mains vary from DN250 at the Moppett basin end to DN560 at the BSEA. The opinion of cost to construct the three pump stations and associated rising mains and intake pipelines is $4.4 million inc. GST. In comparison the cost of the alternate pump configuration and rising main alignment investigated by SKM (2013) was substantially higher. It should be noted that some infrastructure proposed by SKM (2013) such as the BSEA infiltration and extraction system and transfer pipework and booster pumps would be required to facilitate the operation of this scheme. The investigation into, and costing of this infrastructure, is outside the scope of this investigation.

Additionally, this investigation suggests there may be scope to reuse the existing flood pumps at the DHC and Moppett basins as well as the DHC rising main as part of this reuse scheme. This has potential to reduce the overall construction costs.

This investigation has also raised concerns regarding the quality of water that could be harvested from each of the basins, particularly during low inflows, and its suitability for reuse. The interaction of the saline groundwater and its impact on stormwater quality, as it may affect the yields from each of the basins, requires further investigation.

Appendix A

Opinion of Cost

OPINION OF COST

Project: **Port Pirie Stormwater Harvesting - Yield Investigation**
Job No: 2013.1423
Date: 19/02/2014
Revision: A
Summary of works: Construction of 3 x pump stations and associated rising main to harvest water from the existing basins within the Port Pirie Township.
Estimated: Evan Johnson
Review: Ken Schalk

Item No	Description	Comment	Unit	Qty	Rate	Cost
	Preliminaries					
	Establishment		Item	1	$ 25,000.00	$ 25,000.00
	Insurances		Item	1	$ 15,000.00	$ 15,000.00
	Site facilities and security		Item	1	$ 100,000.00	$ 100,000.00
	Site management (QA, OHS&W)		Item	1	$ 30,000.00	$ 30,000.00
	Environmental management provisions		Item	1	$ 15,000.00	$ 15,000.00
	Traffic management		Item	1	$ 320,000.00	$ 320,000.00
	Set out survey		Item	1	$ 60,000.00	$ 60,000.00
	As-bulit verification Drawings		Item	1	$ 40,000.00	$ 40,000.00
	Compaction testing		Item	1	$ 15,000.00	$ 15,000.00
	Material Testing		Item	1	$ 5,000.00	$ 5,000.00
	Silt Control		Item	1	$ 10,000.00	$ 10,000.00
	Locate and protect existing overhead and underground services		Item	1	$ 100,000.00	$ 100,000.00
	Resident notification / Stakeholder engagement		Item	1	$ 15,000.00	$ 15,000.00
	De-mobilisation including removal of compound		Item	1	$ 10,000.00	$ 10,000.00
	Sub-Total					**$ 760,000.00**
	Pump Stations					
	Stripping of topsoil (150mm) and stockpile onsite		m^3	50	$ 7.00	$ 350.00
	Excavation for Pump and valve chambers		m^3	100	$ 120.00	$ 12,000.00
	Backfill around pump and valve chambers with 20mm screenings		m^3	100	$ 120.00	$ 12,000.00
	Electrical control panel steel reinforced concrete plinth		Item	3	$ 1,000.00	$ 3,000.00
	Moppett Road Package Pump Station (2 x pumps combined duty 60L/s)		Item	1	$ 75,000.00	$ 75,000.00
	Wandearah Package Pump Station (2 x pumps combined duty 220L/s)		Item	1	$ 105,000.00	$ 105,000.00
	DHC Package Pump Station (2 x pumps combined duty 130L/s)		Item	1	$ 90,000.00	$ 90,000.00
	Onsite connection of discharge manifold to rising main		Item	3	$ 3,000.00	$ 9,000.00
	Intake pipework to Moppett pump chamber DN250 HDPE PN6.3 PE100, up to 4.0 m deep.		Lin m	65	$ 350.00	$ 22,750.00
	Intake pipework to Wandearah pump chamber DN250 HDPE PN6.3 PE100, up to 4.0 m deep.		Lin m	125	$ 350.00	$ 43,750.00
	Intake pipework to DHC pump chamber DN250 HDPE PN6.3 PE100, up to 4.0 m deep.		Lin m	50	$ 350.00	$ 17,500.00
	Site reinstatement inc. grassing and shaping		m^2	750	$ 10.00	$ 7,500.00
	Provisional sum for items such as: - Access covers for chambers; - Security fencing, access roads; - Conduit installation from pump and valve chambers to control cabinet; - Cleaning of debris from within the pump chamber prior to commissioning; - Etc.		Item	3	$ 50,000.00	$ 150,000.00
	Sub-Total					**$ 547,850.00**
	Rising Main					
	Removal of pavement layers to subgrade		m^2	3700	$ 15.00	$ 55,500.00
	Supply and Install DN250 HDPE PN6.3 PE100, up to 2.0 m deep.		Lin m	433	$ 270.00	$ 116,910.00
	Supply and Install DN400 HDPE PN6.3 PE100, up to 2.0 m deep.		Lin m	310	$ 400.00	$ 124,000.00
	Supply and Install DN500 HDPE PN6.3 PE100, up to 2.0 m deep.		Lin m	1215	$ 470.00	$ 571,050.00
	Supply and Install DN560 HDPE PN6.3		Lin m	1106	$ 540.00	$ 597,240.00
	Supply and install of Isolation Valves		Item	6	$ 5,000.00	$ 30,000.00
	Supply and install of Flow Metres		Item	3	$ 5,000.00	$ 15,000.00
	Thrust blocks		Item	8	$ 1,000.00	$ 8,000.00
	Sub-base PM2-20, 250mm thick		m^2	3700	$ 25.00	$ 92,500.00
	Supply and place 50mm AC10, inc. prime		m^2	3700	$ 25.00	$ 92,500.00
	Line marking		Lin m	3700	$ 2.50	$ 9,250.00
	Pressure testing of pipeline		Item	4	$ 5,000.00	$ 20,000.00
	Sub-Total					**$ 1,731,950.00**

Sub-Total		**$ 3,039,800.00**
Contingency	30%	$ 911,940.00
GST	10%	$ 395,174.00
CITF Levy	0.25%	$ 10,867.29
Grand Total		**$ 4,357,781.29**

Note: **Cost estimates provided by Tonkin Consulting are based upon historic cost information and experience, and do not allow for:**

- Latent conditions
- Changes in scope
- Market conditions (i.e. competition, escalation)
- No allowance for site contamination and remediation
- No allowance for tree removal, assumed to occur during pre-strip phase of project
- No allowance has been made for the staging of these works
- No allowance for dewatering of excavations
- No allowance for trenching depth greater than 1.5m or excavation of rock
- No allowance for ETSA fees and connections
- No allowance for directional drilling of pipework
- No allowance for existing site services to be relocated or modified
- No allowance for connection and integration of pump controls into existing SCADA system
- No allowance for upgrading of SCADA Control Room and IT infrastructure
- No allowance for construction work outside of normal working hours
- No allowance for extended lead times on equipment
- No allowance for client costs such as engineering design, management, land acquisition, approvals etc.

These estimates are to be considered as indicative only, and are not purported to represent anything more than an indication of the cost of the scope of the work.

Tonkin Consulting recommend that an appropriately qualified quantity surveyor be consulted to provide detailed market cost inputs.