Neil M Craigie Pty Ltd
ACN 074 582 282 ABN 29 074 582 282

Waterway Management Consultants

STATEMENT OF EXPERT EVIDENCE

CITY OF GREATER GEELONG PLANNING SCHEME AMENDMENT C259

ARMSTRONG CREEK HORSESHOE BEND PRECINCT

STORM WATER MANAGEMENT STRATEGY (SWMS)

For: City of Greater Geelong

31 May 2014

Director ***Neil McKinnon Craigie*** *BE(Civil), MEngSci, MIEAust, CPEng*

Email: nmcraigie@bigpond.com
40 Jamieson Court, Cape Schanck, Vic. 3939, Australia
Mobile: 0427 510 053

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1. Name and Address

Neil McKinnon Craigie, 40 Jamieson Court, Cape Schanck, VIC, 3939.

2. Qualifications and Experience

B.E. (Civil), Monash University 1975

Grad. Course in Engg. Hydrology, UNSW 1976

M.Eng. Sci., Monash University 1981

After 14 years professional employment with the former Dandenong Valley Authority I commenced private practice as a waterway management consultant in 1989 and have worked continuously in this role since then.

I am a recognised expert in the field of surface water management, waterway management, and stormwater quality and quantity control measures. I have advised on such issues on numerous rural, semi-urban and urban developments throughout Victoria.

A Statement of Qualifications and Experience is attached as Appendix A.

3. Instructions

This statement has been prepared on the instruction of the City of Greater Geelong (CoGG). I was instructed to:

- prepare a concise summary of the key features of the Stormwater Management Strategy (SWMS) that I prepared for the Armstrong Creek Horseshoe Bend Precinct (ACHBP);

- review and respond to the submissions made to Planning Panels Victoria for Amendment C259 which relate to the ACHBP SWMS;

- prepare an expert witness statement consolidating the above for the purposes of the Panel Hearing;

- give evidence at the Panel Hearing.

4. Information Used and Relied Upon

To prepare this statement I have relied primarily on:

- my Storm Water Management Strategy (SWMS) report, "*Armstrong Creek Urban Growth Area, Horseshoe Bend Precinct, Stormwater Management Strategy, Version 8, October 2013"*.

- The sustainability and risk assessment report prepared jointly with my associate Pat Condina, dated 20 May 2014 and titled "*An Assessment of the sustainability of the proposed Sparrovale wetlands and assessment of the associated social, economic and environmental risks*".

I have also used my background knowledge and experience with work in the other Armstrong Creek Precincts. I prepared the review reports for the North East Industrial Precinct (NEIP), the Armstrong Creek East Precinct (ACEP) and the Town Centre Precinct (ACTCP). I prepared the revised SWMS report for the Armstrong Creek East Precinct (ACEP), and am currently continuing to assist with detail design of those waterways and treatment assets. I have also jointly prepared the SWMS for the Armstrong Creek West Precinct (ACWP) and more recently a draft SWMS for the Marshall Precinct in June 2012.

I have read all submissions received by Council relating to surface water management and respond to these in Section 6.

5. The ACHBP Stormwater Management Strategy

5.1 General

The SWMS focusses on future development stormwater management. It presents detailed information regarding subcatchment urban drainage systems, sediment basin and wetland sizing and levelling. It provides a functional design of the overall stormwater system through application of industry standard hydrologic and water quality modelling, to confirm compliance with best practice conditions and requirements of the relevant authorities-the City of Greater Geelong (CoGG) and the Corangamite Catchment Management Authority (CCMA).

In determining the most appropriate form and location of stormwater management assets the strategy assumes that the Sparrovale Farm lowlands will be converted to a freshwater wetland system managing runoff from development areas in the HBP.

The SWMS has also considered the following objectives:

- integration of surface water management features with open space;
- staged implementation constraints associated with differing land ownership across the HBP;
- rationalisation of subcatchment boundaries to optimise the strategic stormwater management value offered by integration of the Sparrovale lowland as a major freshwater wetland system treating runoff from the HBP catchments;
- creation of stormflow mitigation storages that avoid the use of high embankments (safety and cost grounds);
- protection of key flora/fauna habitat areas and sites of cultural heritage value;

- consolidation of drainage management assets wherever possible to minimise ongoing maintenance costs;

- encouragement for reuse of stormwater.

5.2 The Subcatchment Drainage Systems

Figures 1 and 2 have been extracted from the SWMS (and renumbered herein). Figure 1 illustrates the conceptual layout of subcatchments and main drainage lines for future development. Figure 2 shows the primary drainage assets.

The drainage system layout:

- incorporates the impacts of the proposed ACTCP railway corridor excavation;

- adopts the 4D road corridor as the catchment boundary divide between the HBP and surrounding precincts (NEIP, MP and ACWP) as well as the Southeast Grovedale/Trifilos Drain catchment north of the Railway;

- incorporates diversion of the Reserve Road subcatchment in the HBP (west of the 4D corridor) away from the Marshall precinct and back into the Sparrovale catchment;

- incorporates partial diversion of flows in the Trifilos Drain (Reserve Road) catchment across the Ring Road 4D corridor and back into the Sparrovale Farm wetlands via the proposed HBP main drainage system;

Other assumptions:

- The proposed 4D road corridor reservation is treated as rural land for the purposes of sizing of water quality and urban trunk drainage systems in

ACHBP. Future management of stormwater to best practice requirements in the 4D reservation will be the responsibility of the road authority.

- Piped drainage connections will be provided by developers to all separate titles within the ACHBP with overland flows to be conveyed in roads or reserves depending on flow magnitudes and road floodway safety guidelines.

- Subcatchment and piped drainage system layouts follow land ownership and existing road boundaries as far as practicable having regard to the natural fall of the land, so as to simplify future implementation of works.

- The ACTCP land will incorporate its own surface water management facilities such that existing rural flows and water quality will be effectively maintained for all events up to and including 100 years ARI.

- The small pockets of land in the HBP which drain south into the ACEP will be required to meet best practice conditions for stormwater quality treatment and maintain existing rural runoff peak flows (for all events up to and including 100 years ARI) prior to discharge over the HBP boundary.

5.3 Sizing and Performance of Primary HBP Assets

The four main stormwater management assets are the sediment basin/retarding basins (SBRB's) located at and upstream of the main sewer crossings of the north and south waterways as shown on Figure 2. These were sized to ensure sediment management across the HBP is adequate for the purposes of protection of the proposed open waterways within the HBP. A nominal treatment performance standard of 70% removal of Total Suspended Solids (TSS) was arbitrarily set in the MUSIC model to determine the minimum water surface area required for each asset to comply with this target.

The Normal Top Water Levels (NTWL's) were determined using the 0.5 m contour data plus as-built levels along the Barwon Water main sewer.

The airspace above NTWL for each asset was then utilised for flood retarding storage to manage peak flows and flood levels through the main drainage network. The RORB hydrologic model was used for all flood modelling. The results showed that peak 100 year ARI discharge to Sparrovale from the HBP will be 22.3 m^3/s for full development, compared with 12.2 m^3/s for existing conditions.

In addition to the four major treatment SBRB's, two extra sediment storages were included; (a) at Sparrovale Road on the north branch, and (b) at the combined outfall downstream of the precinct boundary, to protect the receiving Sparrovale wetlands.

A hypothetical wetland area was then added at the downstream end of the MUSIC model treatment train to quantify what additional treatment area would be required to ensure compliance with best management practice (BMP) stormwater quality treatment standards for the full precinct, should the proposal to utilise the Sparrovale wetlands area not materialize for some reason.

It was found that the extra wetland water surface area would need to be 7.5 ha. Allowing for maintenance access, sediment drying zones, batters and landscaping, the landtake for a wetland of this size is estimated to be at least 2.2*water surface area = 16.5 ha. This therefore represents the saving of developable land within the HBP boundaries that accrues with the use of Sparrovale wetlands for stormwater management purposes.

Open waterways in drainage reserves link the various SB's. A 100 year ARI capacity pipeline links the Reserve Road SBRB and the Sparrovale North (sewer crossing) SBRB.

5.4 Sparrovale Wetlands - Assets and Works

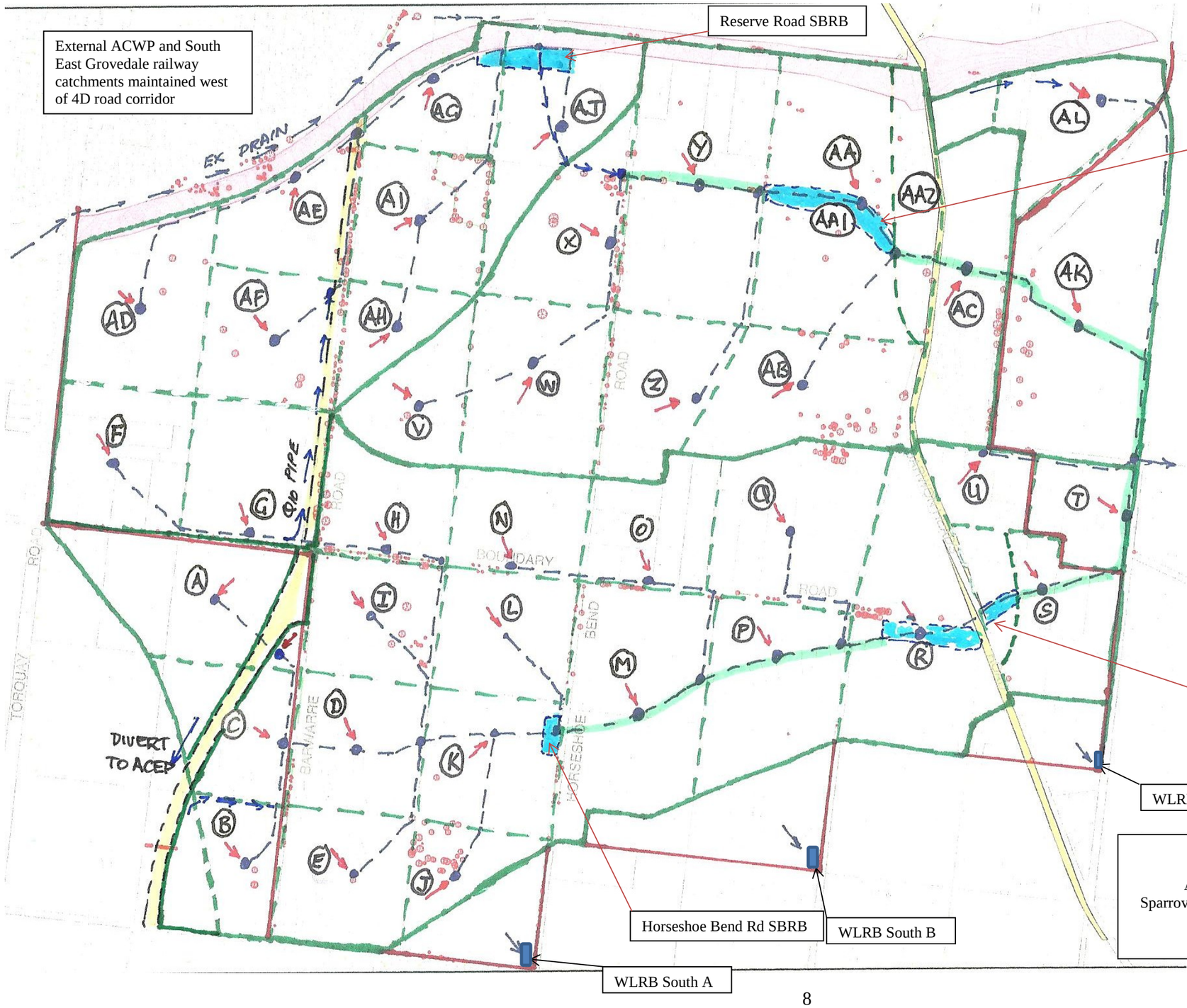
Figure 3 is an extract from the SWMS which summarises the inlet works and modifications required to facilitate use of the Sparrovale wetlands for stormwater management purposes. The wetland NTWL is set at 0.95 m so as to ensure long term security against sea level rise and to facilitate transfer of water into or out of the lower Barwon River pondage.

The modified coastal marsh vegetation identified within the easterly end of the Sparrovale wetlands is depicted on Figure 3. Survey data confirms the vegetation is established on land generally between 0.5-1.0 m AHD.

The wetlands proposal would result in virtually complete and permanent inundation of the vegetation by freshwater, unless protected by an embankment of sufficient height to separate it from the main wetlands.

The bank shown on Figure 3 will provide separation from the proposed freshwater wetland operating levels and an additional maintenance access route. Existing drains which cut through the vegetation zone will continue to service most of the lowpoints trapped by the existing Barwon River levee and the new embankment via the existing regulator outlet. In major floods the salt marsh zone will remain subject to inundation when wetland levels rise above the crest, and/or the Barwon River levee is overtopped.

To provide for maintenance drawdown in the main wetlands by gravity means the new embankment should incorporate a 600 mm diameter pipe culvert and gate valve or similar control on the alignment of the existing drain connecting to the regulator outlet under the Barwon River levee.



Sparrovale Farm
10 year ARI flood level is a minimum of 2.00 m AHD.

100 year ARI flood level is a minimum of 3.00 m AHD

Figure 1

Armstrong Creek Horseshoe Bend Precinct (HBP) showing adjusted Sparrovale/Reserve Rd drainage subcatchments, drainage lines and adopted stormwater management assets for fully developed conditions (as used in the RORB Hydrologic Model)

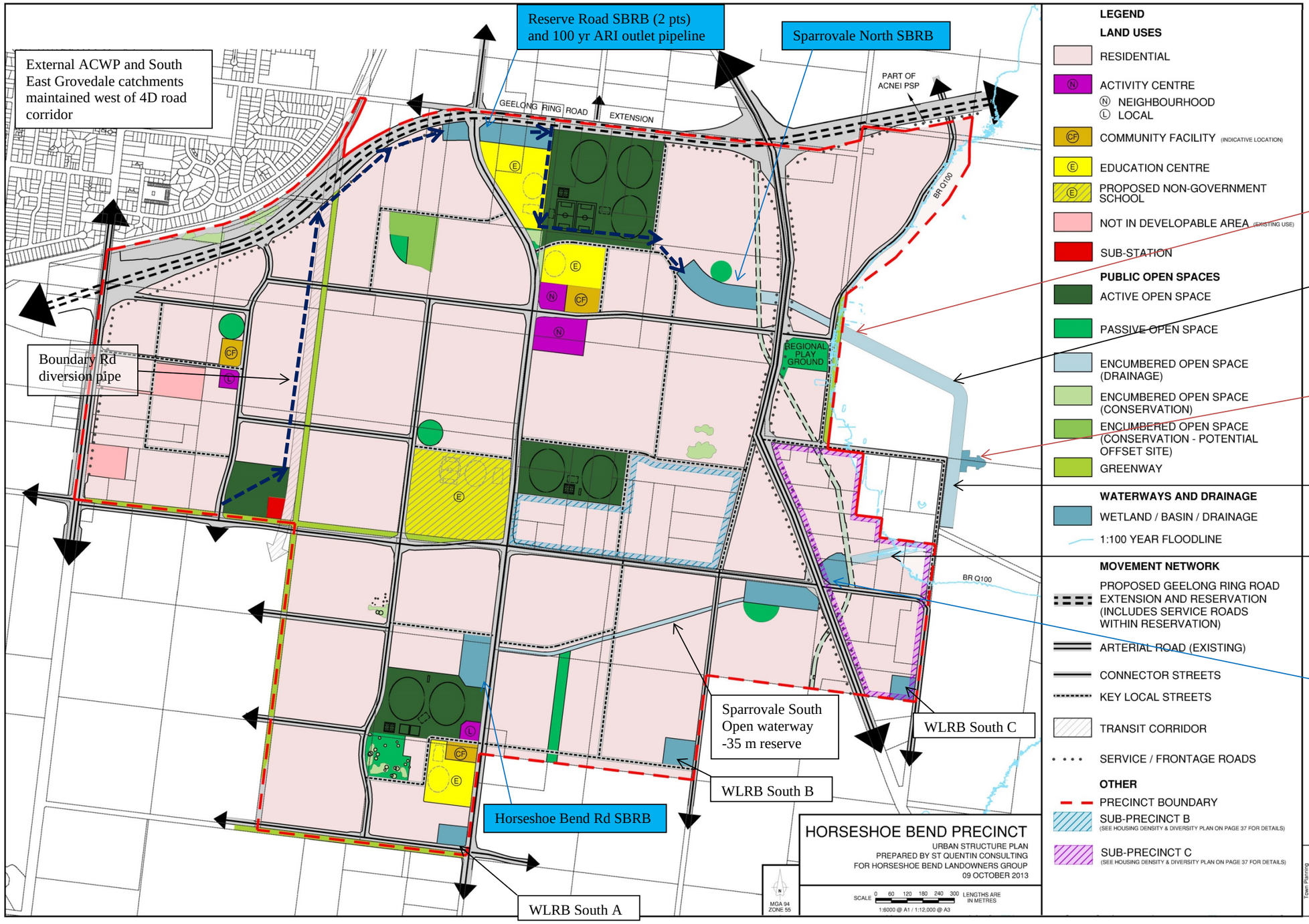


Figure 2

Armstrong Creek Horseshoe Bend Precinct Urban Structure Plan showing primary waterways and stormwater management

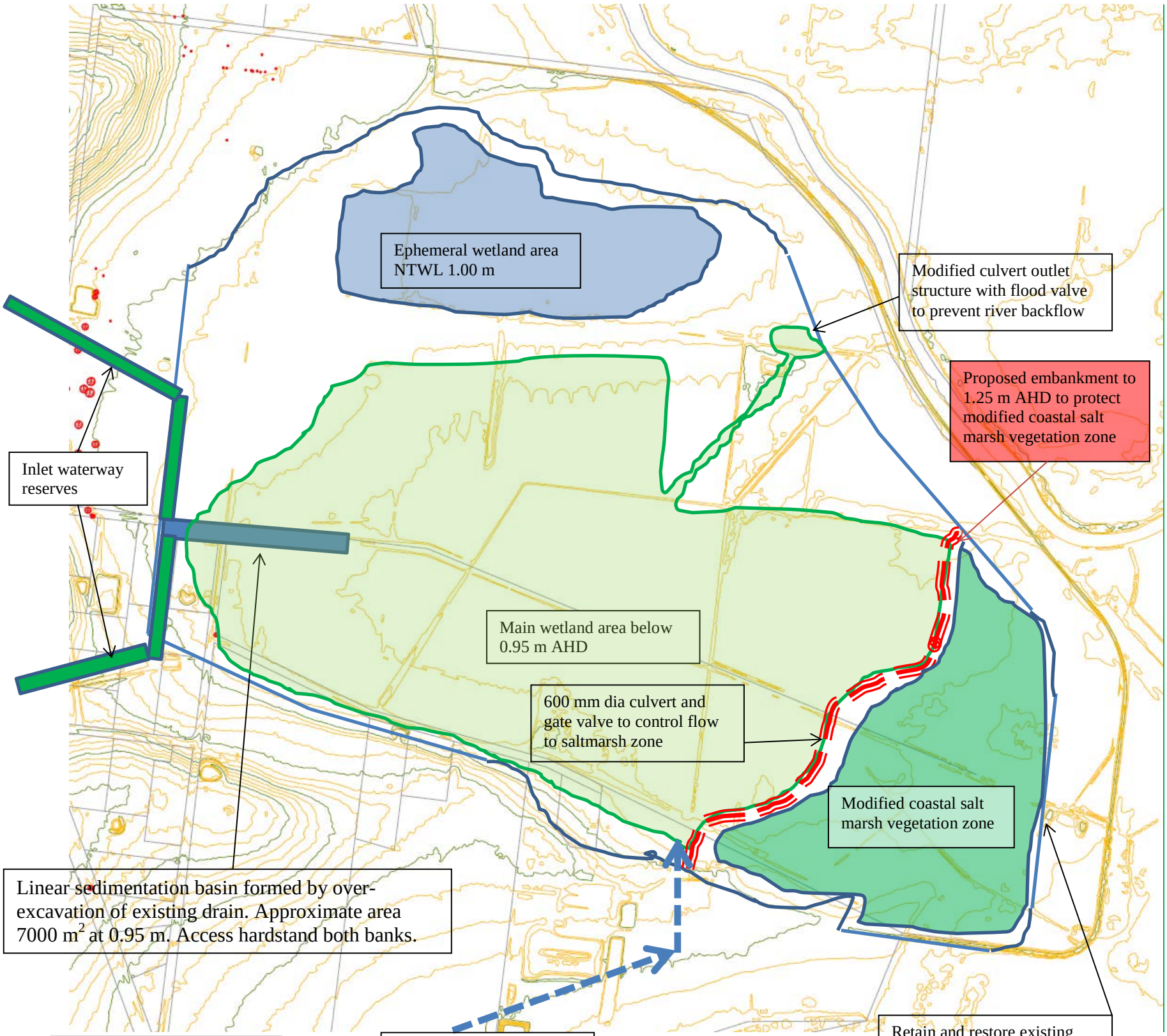


Figure 3

Recommended Boundaries of Area below 1.20 m AHD to be set aside for Armstrong Creek Growth Area Surface Water Management purposes.

Also showing recommended Development Contributions Plans works including inlet waterways, sedimentation basin, outlet structures and embankment to protect modified coastal salt marsh vegetation

6. The Submissions

This statement responds to issues relating to the ACHBP SWMS which have been raised in submissions to Amendment C259. A total of 42 submissions were received from landholders, developers, servicing authorities and other government and non-government agencies.

6.1 The Sparrovale Wetlands Issue

In general, the bulk of the submissions object to the full costs of the Sparrovale wetlands project, including land acquisition, being included as part of the DCP over a 10 year time period. The means of securing the necessary lands is also raised, but that aspect lies outside my technical expertise and will be addressed by others.

The securing of the properties at 1-87 Groves Road, Armstrong Creek and 109-215 Sparrovale Road, Charlemont (more commonly known as the Sparrovale and Cold Winds properties) is certainly necessary to facilitate the stormwater management needs for the Horseshoe Bend Precinct. Whilst the precinct Stormwater Management Plan acknowledges that there is limited development potential possible in advance of the Sparrovale wetland being brought on-line, ultimately the facility is critical to unlocking development of all the urban land within the precinct.

The SWMS identifies that the inclusion of the Sparrovale wetlands as part of the stormwater management system for HBP reduces constructed wetland area by a minimum of 7.5 ha which in turn results in developable land area being increased within the precinct by some 16.5 ha.

There is therefore a clear nexus between development of the precinct and the wetlands. Hence the purchase of the land is an appropriate item to be included in the Horseshoe Bend Development Contributions Plan. The cost of acquisition is to be equally apportioned between all the Horseshoe Bend landholders.

6.2 Is the Current DCP the Best Option?

Due to the massive area of the Sparrovale wetlands, evaporation and seepage losses are sufficient to entirely offset the impact of increased stormwater runoff frequency and seasonal volumes on the Ramsar listed wetlands downstream. No other management option can meet this important environmental performance criterion whilst avoiding impacts on privately owned land. However there are alternative options that can achieve best practice stormwater quality treatment with varying impacts on residual Sparrovale/Cold Winds lands.

In regard to overall costs a comparative analysis of these options is informative for assessing the overall Sparrovale wetlands project. Table 1 summarises costs and benefits of three different approaches using cost estimates derived from the current DCP items.

The results in Table 1 show that the proposed DCP with full purchase of Sparrovale wetlands is by far the preferred option on cost grounds.

Assumptions

- Where Cold Winds/Sparrovale lands are not purchased and are still impacted by increased runoff, compensation is allowed for at 50% of total acquisition cost based on the land valuations, or $2.475M/2=$1,237,500.

- Constructed wetland costs average $1M/ha of total land take based on the DCP estimates.

- Land acquisition for stormwater management assets within the HBP boundaries averages $485,000/ha based on land valuation estimates.

- Land take for constructed wetlands is 2.2 * wetland water surface area.

- Land acquisition for part of Sparrovale wetlands not affected by modified coastal salt marsh vegetation assumed to be $10,000/ha.

Table 1 Options Assessment

Option	Cost Components of Option	Total cost of option
1. No purchase of the Sparrovale wetlands. • Construct all stormwater treatment and quantity control within the HBP area including land purchase costs. • Extra 16.5 ha land take within HBP. • Compensate Sparrovale wetlands landowners for increased flooding impacts.	• DI- DR 1a to DI- DR 11 construction cost = $27,618,303. • Additional construction wetland costs in HBP at $1,000,000/hectare*16.5 ha = $16.5 M. • Estimated land acquisition costs for additional treatment $8,002,500 (16.5 ha of land at average of $485,000/ha). • Compensation payments to Sparrovale landowners = $1,237,500.	$53.36 M.
2. Current DCP works in HBP area and minimal works in Sparrovale wetlands. • Purchase 16.5 ha of Sparrovale wetlands • Constructed 7.5 ha wetlands • Compensate Sparrovale wetlands landowners for increased flooding impacts.	• DI- DR 1a to DI- DR 11 construction cost = $27,618,303. • Estimated construction costs in Sparrovale due to formal construction and planting requirements = $16.5 M. • Land acquisition costs of 16.5 Ha Sparrovale wetlands = $165,000. • Compensation for flooding in balance of Sparrovale wetlands = $1,237,500.	$45.52 M.
3. Current DCP works in HBP area and in Sparrovale wetlands. • Purchase of all of Sparrovale wetlands. • 10 year Management Plan.	• DI- DR 1a to DI- DR 11 construction cost = $27,618,303. • Sparrovale Construction DI-DR 12 = $2,472,557. • Management/Implementation Plan for 10 years, DI-DR 13 = $4,030,000. • Land Cost 1-87 Groves Rd = $752,000. • Land Cost 109-215 Sparrovale Road =$1,729,000	$36.60 M.

6.3 Are any cost savings possible in the 10 year Management Plan?

In my opinion there are some savings that could be made in the current plan as set out in the sustainability and risk assessment report prepared jointly with my associate Pat Condina, dated 20 May 2014 and titled "*An Assessment of the sustainability of the proposed Sparrovale wetlands and assessment of the associated social, economic and environmental risks*".

We accept the clear nexus between the need for the Sparrovale project and the development of HBP in full, and therefore support funding of the purchase of the land by HBP, together with the various investigations, reviews and Management Plans required to facilitate conversion of the land to wetland uses. It is also apparent that the project has potentially very high future social and environmental values which extend well beyond the HBP.

Appendix 1 of our report dated 20 May 2014 reviewed the DCP DI_DR_13 cost estimates. Whilst the quantities, rates and costs listed in the DI_DR_13 summary table are considered generally appropriate, it is suggested that some changes could be made for Items 2.2, 2.3, 3.3, and 5.1, 5.2 and 5.3 as set out below.

Some of these suggestions arise because of current lack of knowledge (e.g., there is no contaminated site audit and no levee audit), so it appears that some conservative estimates have been adopted in the current plan. Listing these unknowns as Prime Cost (PC) items in the DCP program schedules may be appropriate to protect everyone's interests.

DI_DR_13 Item	Issues of concern	Discussion
2.2 and 2.3	• Inspection and aerial photos indicate no large surface rubbish stockpiles are evident across the lowest parts of the properties. • Imported fill stockpiles appear to be mainly around the higher margins. • Estimates are high and appear to allow for offsite removal.	• Given the vast size of the site there is no reason why rubbish and contaminated fill cannot be disposed of onsite in landscape mounds or levee berms. • Audit costs OK but contamination treatment costs are likely far too high. • Should be a PC item subject to audit outcomes.

DI_DR_13 Item	Issues of concern	Discussion
3.2	• Existing levee may be largely abandoned after hydrodynamic review completed. As a minimum repair/rebuild works on existing levee will be required on Barwon River frontage.	• Should be a PC item after completion of hydrodynamic modelling review.
3.3	• Very high estimate for very low level works requirement within Sparrovale.	• Other than the inlet sediment basin itself (which will be a Council asset to manage into the future) there is no requirement for sediment removal across the general Sparrovale wetlands area now or for many decades into the future. • The inlet basin itself should not require sediment clearing within 5 years after its construction, because of the upstream sediment management assets. It is unlikely to be built within 5 years. • Maximum $50,000 over 10 years.
5.1	• Duplicates initial audit • Way too high given full repair of the levee will be carried out at the start- and then only if need is confirmed after hydrodynamic modelling review. Partial repairs/rebuild may only be required on the Barwon River frontage. • Any major flood damage repair required thereafter will not be a DCP item.	• Suggest biannual visual inspection (plus a check after floods) is all that is required for the final design levee systems. • Say $25,000 total over 10 years.
5.2	• Estimate too high • $10,000 initial first assessment is part of initial management plan and flora and fauna assessment. • Follow-up assessments should be 2 years afterwards, then at 5 years and 10 years.	• Suggest $30,000 total over 10 years.
5.3	• Conflicts with recommendations of water quality monitoring program we have supplied. • Estimate is too high.	• Short term need (say years 1-5) for Sparrovale is one site only at existing outlet. $5,000 in year 1. For years 2-9 this site should be $2,500/year. Total $27,500 for 10 years. • In years 5-10 two extra sites come online in Sparrovale. Assume both online at end year 5. • The wetland inlet site is $15,000 for the 5 years. • Ditto for the Barwon outlet. • Total $57,500-say $60,000 for 10 years.

6.4 How do the HBP DCP drainage costs compare elsewhere?

The total net developable area in the HBP is some 463 ha. For the total drainage cost of $36.6 M in the current DCP this equates to an average rate of $79,050/ha of residential development.

This figure may be compared with recent Melbourne Water contributory drainage scheme (DS) rates for new urban growth areas, which cover the costs of both hydraulic and water quality management, to the same standards as apply in the HBP.

For new schemes which have been investigated in detail in the new Wyndham growth areas the Melbourne Water website provides contribution rates for standard residential development. The data in Table 2 confirms that the HBP DCP drainage rate is significantly lower than for equivalent development in the new Wyndham growth areas.

Table 2 MWC Contributory Drainage Scheme Rates (residential)

Drainage Scheme	Hydraulic Contribution ($/ha)	Water Quality Contribution ($/ha)	Total contribution ($/ha)
Leakes Rd DS 4168	$82,263	$35,978	$118,241
Laverton Ck DS 4080	$71,538	$14,579	$86,117
Hogans Rd DS 8090	$95,195	$22,089	$117,284
Werribee West Dr DS 7716	$85,137	$6,411	$91,548
Sayers Dr DS 4072	$48,220	$59,249	$107,469
Davis Ck DS 8010	$49,682	$42,771	$92,453

6.5 General Issues Raised in the Submissions

The balance of relevant submissions and my general responses are listed in Table 3. The submission numbers accord with Council's schedule as supplied to me.

TABLE 3 C259 SUBMISSIONS AND RESPONSES (RELATING TO THE SWMS)

Number	Submitter	Submission	Response
14	A&I Balog	During periods of heavy rainfall, inundation of Sparrovale Farm and the Robinson Property spreads almost to Groves Road.	Agreed. Figure 2 (Sheet 2 of 2) in the SWMS report shows the extent of inundation expected from local HBP catchment runoff. During major Barwon River floods inundation is far deeper and more widespread than this.
		Flooding of the road has an impact on the broiler farm currently operating from the submitters site with the prevention of truck movements bringing chickens and feed into and out of the site.	The flood management strategy for the proposed Sparrovale wetlands will not exacerbate any flooding conditions associated with the operation of the broiler farm. The design and nature of the facility is to ensure that it operates with no net impact on surrounding landowners and this includes augmentation and repair of existing outlet controls to the Barwon River and Connewarre Wetlands.
		Schedule 4 to the UGZ should be amended to state that until Sparrovale wetlands are established no permit may be granted to construct a building or to construct and carry out works in connection with development of land in the Horseshoe Bend precinct. For development to proceed before the stormwater management system is in place there can be no certainty that there will not be significant adverse impacts as a result.	The SWMS provides for up to 25% development west of Barwon Heads Road without significant adverse impacts on downstream landowners. The PSP and Urban Growth Zone Schedule makes clear that any works on the Barwon Heads Road culverts to improve or increase capacity must trigger the delivery of the Sparrovale wetlands. The SWMS also identifies additional temporary measures required to suit early or out-of-sequence development.

TABLE 3 C259 SUBMISSIONS AND RESPONSES (RELATING TO THE SWMS)

Number	Submitter	Submission	Response
17	Armstrong Creek Pty Ltd	The 10 year Sparrovale Management Plan in the DCP is excessive and should be removed as a DCP item.	The Sparrovale wetland is critical to the development of the Horseshoe Bend Precinct. The 10 year Management Plan reasonably represents the overall capital cost of a staged implementation of the wetland project. The focus is on gradual conversion of degraded farmland to a sustainable wetland using weed control techniques, selective plantings and limited structural engineering works. Monitoring of the conversion process is an essential component of the project. Staging these works over a 10 year period is more economic and sustainable than attempting to construct in a short period of time. This funding is directly linked to ensuring the transition of this degraded farmland to a sustainable wetland system.
		Council should fund the recurrent management of the drainage system (as does Melbourne Water in metropolitan Melbourne) as they are the ultimate beneficiary of the revenue/rates generated by this item.	After completion of the 10 year conversion process, Council will maintain and manage Sparrovale wetlands in perpetuity and fund appropriate ongoing maintenance costs.
		The use of the DCP for maintenance costs does not justify a departure from the principles of the Water Act that such contributions must be fair and reasonable.	Not maintenance costs-it is a staged capital delivery process.

TABLE 3 C259 SUBMISSIONS AND RESPONSES (RELATING TO THE SWMS)

Number	Submitter	Submission	Response
		If the costs are not removed as a DCP item they should be greatly reduced along with the maintenance term.	The costs listed are considered to reasonably represent the staged implementation costs for the wetlands project.
		If the costs are not removed as a DCP item they should be apportioned amongst all users including those in precincts outside the HBP as the entire Armstrong Creek will utilise Sparrovale.	The Sparrovale Wetlands as a whole are required to service the HBP catchment as the primary downstream facility prior to discharge to the lower floodplain and estuary areas. The costs are also lower than alternative schemes. Refer to option cost comparison in Section 6.2. As a result, Sparrovale Wetlands are directly linked to the precinct for the purposes of a DCP Nexus.
		The land designated as a drainage corridor through the submitters land should be nominated as unencumbered (and part of the landowners public open space contribution) where the land is not solely performing a drainage function e.g. land that can be landscaped or provide community amenity.	The land nominated through the submitter's property is clearly flood prone land and will contain the open waterway to convey flood discharges in all storm events. It is standard practice to nominate such corridors as encumbered land.
		The Main Stormwater Drainage Plan (Plan 18) shows the stormwater down Boundary Road and then across the submitters property. The submitter contends that the stormwater should proceed down Boundary Road to the detention basin on the corner of Boundary Road and Barwon Heads Road.	The issue of the ultimate alignment of stormwater pipelines will be the subject of detailed design discussions between the landholder, service authorities and Council. It may be that an alternative location is possible for the nominated pipework with roadways and easements that align with subdivision outcomes being the most likely outcome.

TABLE 3 C259 SUBMISSIONS AND RESPONSES (RELATING TO THE SWMS)

Number	Submitter	Submission	Response
19	DFC	The amendment should be adjusted to provide flexibility to accommodate the proposed relocation of DCP item DI_DR_09 to Hooper's Paddock.	As set out in the SWMS (Section 6.8) there is always scope to renegotiate asset sizing and design and location during implementation.
		DFC want additional pipe infrastructure for drainage outfalls internal and external to their landholdings included in the DCP costings.	The pipe alignments provided for in the DCP are considered appropriate to suit major drainage needs.
21	Robinson	Submission argues that waters from the development will increase the volume of water flowing onto the submitters property.	Agreed. The land is to be acquired as part of the DCP and as such no adverse impacts for flooding will occur on the property prior to the purchase of the site for its future role in Sparrovale wetlands.
37	DEPI	The implementation of the Sparrovale wetland is important in protecting the Ramsar listed Hospital swamp from inappropriate storm water quality and volume.	Strongly agreed. Sparrovale wetland is the key to sustainable development of the HBP.
38	Horseshoe Bend Land-owners Group	The 10 year Sparrovale management plan should be removed from the DCP and the costs borne by Council as the drainage authority.	Refer to response to Submission 17 on the same issue

7. Declaration

In preparing this statement I have made all the enquiries that I believe to be desirable and appropriate, and that no matters of significance that I regard as relevant have to my knowledge been withheld from the Panel.

Neil M Craigie

BE Civil, MEngSci, MIEAust, CPEng

31 May 2014

Appendix A Statement Of Qualifications And Experience

Name: Neil McKinnon Craigie

Address: 40 Jamieson Court, Cape Schanck, Vic., 3939

Business Phone: 0427 510 053 **Email**: nmcraigie@bigpond.com

Professional Qualifications:

B.E. (Civil), Monash University 1975
Grad. Course in Engg. Hydrology, UNSW 1976
M.Eng. Sci., Monash University 1981

Professional Background:

1974 Joined Dandenong Valley Authority (DVA)
1980 Appointed as Design Engineer
1984 Appointed as Design and Investigation Engineer controlling hydrologic and hydraulic investigations, project design and engineering consultancy services
1989 Commenced private practice as a waterway management consultant.

Current Occupation: Waterways Management Consultant
trading as Neil M Craigie Pty Ltd

Affiliations: Member, Institution of Engineers Australia (MIEAust, CPEng)
Member, River Basin Management Society (RBMS)

Experience:
I have extensive experience in:

- river basin management,
- assessment and design of restoration works for degraded and/or unstable natural waterway systems,
- assessment and design of mitigation works to address the effects of urbanisation on waterway systems,
- investigation and design of drainage and flood management schemes of all forms and sizes in both urban and rural settings,
- troubleshooting and remedial design in urban drainage systems.
- investigation, design and ongoing management of wetland, lake and tidal waterway systems

Whilst with the DVA, I directed all hydrologic and hydraulic investigations, project design and consultancy services. I led the preparation of standards for stream restoration work and developed innovative techniques for evaluation and appraisal of waterway management problems. I have further refined and applied these techniques

since commencing private practice, in major studies throughout Victoria and in Far North and South-East Queensland.

In recent years, I have undertaken work in the field of environmental flows, providing hydraulic and waterway management input to multi-disciplinary teams. I was a team member for the Environmental Flow Assessment for the Lower Thomson and Macalister Rivers in Victoria (CRC Freshwater Ecology, 1999). Since 2000, I have assisted Dr Sandra Brizga on the environmental flow studies carried out for the Water Allocation and Management Plans (WAMPs) on the Pioneer and Logan Rivers, for the Water Resource Plans (WRP's) on the Mary and Maroochy Rivers in Queensland, and the River Processes Study on the Mary River. Each of these studies is a major multidisciplinary undertaking involving specialists from a range of disciplines, including hydrology, hydraulics, geomorphology, water quality, and ecology (aquatic and riparian vegetation, macroinvertebrates, fish, and other vertebrates such as turtles, platypus and dugong).

I have carried out and/or directed numerous hydrologic and hydraulic studies, utilising computer based models. I have particular expertise in retarding/retention basin design, several examples of which have featured novel outlet works designed to counteract high debris loads, mitigate sediment discharge, provide water quality treatment, and dissipate very high flow velocities.

In the field of management of natural waterway and floodplain systems, I and my associates have collaborated on a series of complex hydro-geomorphological investigations. These studies involved integration of unsteady-state two dimensional hydraulic modelling and fluvial geomorphology analyses to develop waterway management plans which recognise and address the governing physical processes (for example, the Tambo River at Bruthen, Badger Creek through Healesville Sanctuary, and Glenelg River sand transport studies).

In the urban areas I have been closely involved in the development and preparation of municipal/agency stormwater management plans across the greater Melbourne area.

I and my associates are continuing to play leading roles in conceptual planning and design of stormwater quantity and quality management systems involving open waterways, wetlands and lakes in many of the large residential estates being developed in greater Melbourne since the late 1990's (for example, Caroline Springs, The Waterways Estate, Tenterfield Estate, The Boardwalk Estate, Berwick Springs Estate, Beaumont Waters Estate, Torquay Sands, Lakeside at Pakenham, Pt Cook Gardens Estate, Lincoln Heath Estate, Marriott Waters, Martha Cove, Highlands Estate).

I am also active at the regional level with similar water management system planning (for example; Paynesville, Port Fairy, Warrnambool, Bendigo, Geelong/Bellarine Peninsula, Mornington Peninsula, Phillip Island/San Remo, Castlemaine, Traralgon, Warragul, Taggerty).

In conjunction with associates in the field of stormwater and wastewater quality treatment and aquatic biology, I have developed innovative approaches to design of stormwater quality management systems and all aspects of water sensitive urban design, and have applied these in a variety of urban, semi-urban and rural settings.

In 2009 I led the team responsible for assessment of drainage constraints and opportunities across the Investigation Areas forming part of the *Melbourne@5 million* review of the Urban Growth Boundary, for the Department of Planning and Community Development.

In conjunction with my associates, I have won UDIA Awards for Excellence for Water Sensitive Urban Design and Residential Development in 2000, 2002, 2003, 2004, 2005, 2007, 2008, 2009, 2010, 2011 and 2012, and the SIAV Award for Stormwater Innovation in 2004 and 2005 (2). I was the recipient of the ALDE Recognition Award in 2012.

In the rural areas I have jointly carried out investigations into redesign opportunities for irrigation drainage systems to mitigate sediment and nutrient loads, for Goulburn-Murray Water. This work culminated in the design and construction of a major artificial wetland system serving the Muckatah Depression Drainage Scheme in Northern Victoria. This project has since won the IEAust Engineering Excellence Award.

Since commencing private practice in 1989 I have also gained considerable experience as an expert witness, preparing and presenting numerous submissions to VCAT and various Planning Panels on drainage, waterway and floodplain management implications of proposed development projects throughout Victoria.

Neil M Craigie