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Waterway Management Consultants

STATEMENT OF EXPERT EVIDENCE

AMENDMENT C185
BALLARAT PLANNING SCHEME
and
EPA WORKS APPROVAL APPLICATION

CENTRAL VICTORIAN LIVESTOCK EXCHANGE (CVLX)

SURFACE WATER MANAGEMENT

For: RLX Investment Company Pty Ltd

5 June 2015

Director ***Neil McKinnon Craigie*** *BE(Civil), MEngSci, MIEAust, CPEng*
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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 Harwood Andrews. I was instructed to:

1. Review the exhibited materials and submissions;
2. Review the proposed SUZ15 and advise if any changes are considered necessary to the development plan requirements as they relate to my discipline;
3. Prepare a peer review of the exhibited materials as they relate to my discipline;
4. Provide any further relevant information; and

5. Prepare a written report and appear at a planning panel proposed for the week beginning 22 June 2015.

My discipline is surface water management including flooding and stormwater quality management. Waste treatment systems, irrigation design and groundwater management are covered by others.

4. Information Used and Relied Upon

I acknowledge receipt of full copies of the exhibited materials and submissions, including the Revised Concept Site Layout plan (Revision M), which is attached as Figure 1 to this statement.

In responding to my instructions, I have relied primarily on the Water Cycle Management Report by Geolyse[1], the Stormwater Investigation Report by Spiire[2], discussions with the report authors and other team members, and my independent check investigations.

I have also utilized information from the following sources:

- Site survey and aerial photography.
- Contemporary urban stormwater best management practice documents.
- Recorded rainfall data for the January 2011 flood event in Burrumbeet Creek around Miners Rest.

I have read all submissions received by Council. A summary of the key issues relating to my discipline of surface water management is provided in Section 7 and responses are contained in Section 8.

[1] Water Cycle Management Report, Central Victorian Livestock Exchange, Geolyse 1 December 2014,

[2] Stormwater Investigation Report, Central Victorian Livestock Exchange, Spiire, August 2014.

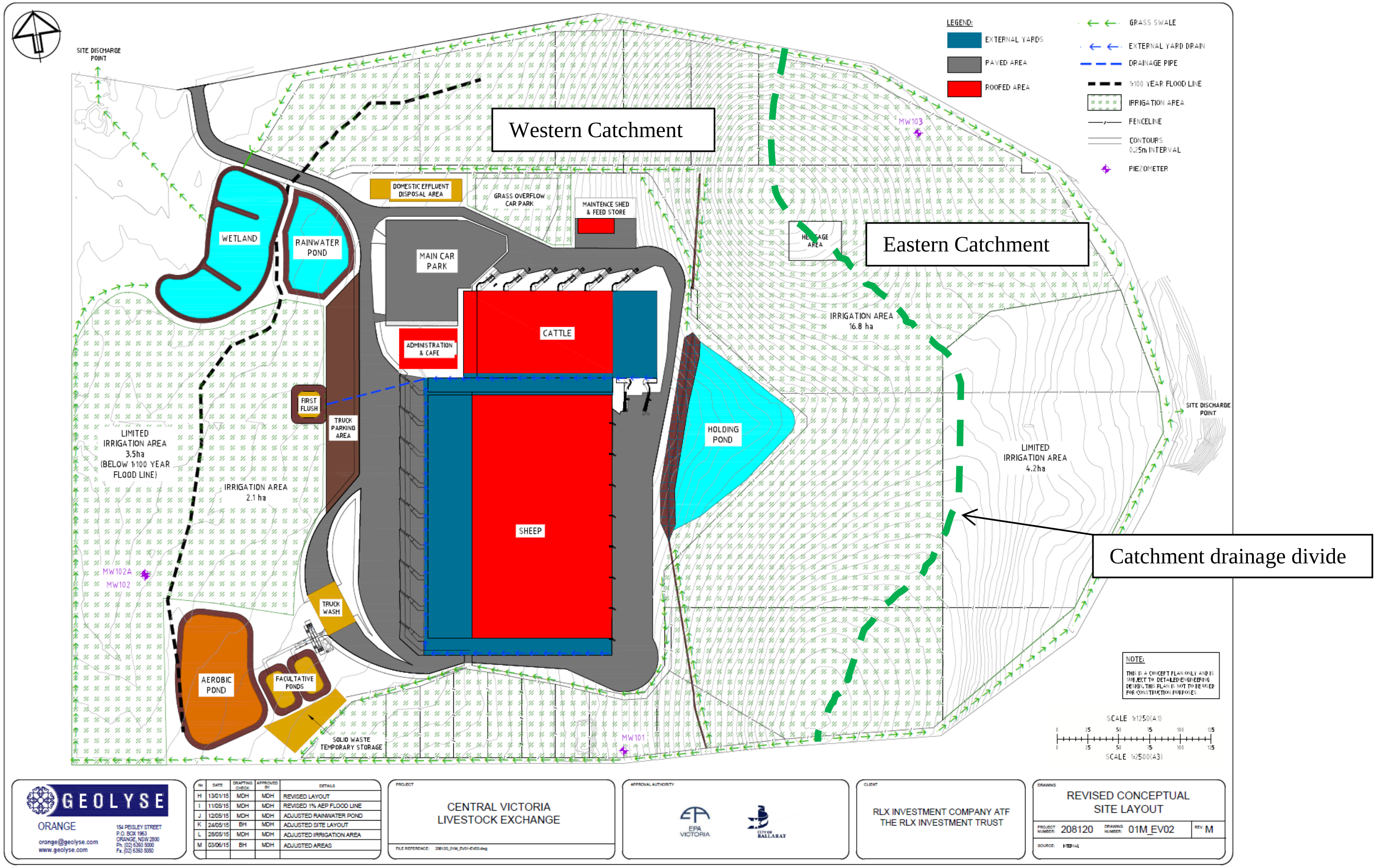

Figure 1 Revised Concept Site Layout Plan (Revision M) marked up to show the catchment drainage divide

5. The SUZ15 Development Plan Requirements

In regard to my discipline of surface water management, Schedule 15 to the Special Use Zone is comprehensive.

In my opinion the Development Plan requirements defined for a Flood Investigation, Stormwater Management Plan and an Operations and Environmental Management Plan are appropriate and sufficient and no changes are considered necessary.

6. Peer Review Outcomes

6.1 Summary of Current Strategy

In regard to surface water management quantity and quality issues the new CVLX facility adopts an effectively closed-cycle strategy to minimise demand on external supplies through:

- Onsite treatment, storage and disposal of animal and human wastes;
- Capture, treatment, storage and re-use onsite of roof water and surface runoff water;
- Reticulated water supply connection to backup onsite sources of water.

Of fundamental importance to the strategy is effective separation of water of differing qualities to minimise reuse treatment requirements, maximise onsite reuse, and mitigate offsite discharge of pollutants. To this end:

- No development-related stormwater discharge will occur to the eastern outfall from the site. This eastern catchment area will receive limited irrigation applications commensurate with land capability with treatment via perimeter swales.
- All development stormwater runoff is to be contained within the western outfall catchment as is shown on Figure 1.

- Roofwater is directed to a rainwater pond of 5 ML capacity which is protected against entry of other surface waters.
- Runoff from contaminated surfaces such as stock yards and the effluent from the truckwash, is also directed to the effluent management system.
- Surface runoff from large areas of the irrigation paddocks, other sealed trafficable areas and open space areas is directed via swales into a 0.4 ha wetland and recycled for the truckwash.

No effluent is able to escape from the waste treatment system other than by pumped transfer to the holding ponds so offsite disposal of water in the western catchment will only occur when the hydraulic capacity of some of the perimeter swales is exceeded or when the wetland is overflowing.

The Geolyse water balance modelling for the western catchment using the complete daily rainfall record for the site found that, on average:

- offsite discharge of water would be reduced from 21.5 ML/year under existing conditions to 7.1 ML/yr after full development;
- Total Suspended Solids (TSS) source loads generated from the site would be reduced by 97% (and by 78% compared to existing conditions);
- Total Phosporus (TP) source loads generated from the site would be reduced by 92% (and by 84% compared to existing conditions);
- Total Nitrogen (TN) source loads generated from the site would be reduced by 81% (and by 68% compared to existing conditions).

Such load removals are far in excess of contemporary best practice standards and represent an improvement in discharge quality compared to existing conditions. The reduction in site discharge volume represents 0.4% of overall catchment yield according to the Geolyse water balance modelling.

In regard to flood management issues the new CVLX facility locates all development outside the surveyed 100 year ARI flood line with the exception of some perimeter irrigation area swales and the wetland, and the entrance road, as can be discerned from Figure 1.

The Glenelg Hopkins Catchment Management Authority has indicated support for the wetland location provided it is created as an excavated asset below existing surface.

I am advised that the entrance road alignment cannot be altered due to requirements of VicRoads for connection to Sunraysia Highway.

The Geolyse XP-RAFTS modelling indicates that peak stormwater discharges from the western site catchment to the Sunraysia Highway culvert will be maintained at less than existing conditions for all flood events up to and including the 100 year ARI event.

6.2 Peer Review Findings

My peer review findings generally support the proposed strategy for managing surface water across the site as set out in the reports by Geolyse and Spiire. However there are some aspects of the conceptual design that in my opinion should be amended as part of the future detail design process.

Strategy Approach

The general strategy approach taken for water cycle management, and for flood management is supported and provides a solid basis for detail design to comply with all best practice expectations and the requirements of the Development Plan.

Methodology

Geolyse have used contemporary best practice hydrologic and hydraulic modelling approaches in their report:

- The XP-RAFTS hydrologic model has been used for peak flow assessments for the surface runoff system for before and after development scenarios.
- The MUSIC model has been used for surface runoff water quality assessments in the wetland catchment using daily rainfall data.
- A daily water balance model has been used to confirm overall water balances for both waste (effluent) management and stormwater runoff management systems.

The daily rainfall data covered 125 years of representative rainfall data for the site. This data is appropriate for use in the water balance model but not for wetland performance assessment. Current best practice recommendations are for 10 years of 6 minute duration rainfall data to be used in the MUSIC model for wetland design.

In regard to water quality aspects, input parameters are appropriate for pollutant load generation from the various surfaces in MUSIC. It is noted that higher nutrient concentrations have been specified for runoff generated from irrigation paddocks, compared with existing grazing conditions, and these adjustments are supported.

In regard to stormwater quantity aspects, some input parameters used by Geolyse in the MUSIC model are not fully consistent with current recommendations for pervious area runoff generation in the Ballarat region, or for wetland design:

- Mean annual evapotranspiration of 1232 mm/yr exceeds the long term local average of 1,031 mm/yr (hence under-estimating potential surface runoff from pervious areas);

- Soil storage and field capacity parameter values over-estimate the capacity of the soil to absorb rainfall (again under-estimating potential surface runoff from pervious areas but not impervious areas);
- Use of daily rainfall data instead of 6 minute rainfall data over-estimates runoff by >=6% (E2DesignLab 2015);
- Reuse extraction volumes were modelled as being available from the wetland regardless of water contents. Reuse potential from a constructed wetland is very limited due to the requirement to retain water to support the important aquatic vegetation that under-pins much of the pollutant removal capacity. It is noted that in the water balance model a 50 KL balance tank was included to accept overflows from the wetland and provide the means of extraction of water. I support that approach. It is also possible to add extra open water at the end of the wetland separated by a suitable barrier.
- The wetland was modelled as having a permanent pool of 7,000 m^3 (average depth = 1.73 m) and extended detention depth (EDD) of 1.0 m. Contemporary best practice would limit EDD to 0.5 m at most with the average depth across the treatment area being about 0.6 m. It may be that the high values were used by Geolyse as a simple offset for not including a dedicated tank in the model for reuse extraction purposes.

6.3 Water Quality Treatment and Reuse Supply Checks

An independent check has been carried out as part of this review with MUSIC parameters adjusted as follows:

- Soil storage capacity 120 mm, field capacity 50 mm (E2DesignLab 2015) for non-irrigated pervious areas;
- Soil storage capacity 120 mm, field capacity 40 mm for irrigated pervious areas (to account for irrigation impacts with follow-up rainfall);
- 6 minute rainfall data for 1986-1995 at Ballarat Aerodrome;

- Mean annual evapotranspiration 1,031 mm/yr varied with the monthly areal record for Ballarat;
- A 50 KL tank added after the wetland to provide for reuse extraction;
- Pollutant generation concentrations and percentage impervious values were retained as per the Geolyse model;
- Wetland volume reduced to 2,800 m^3 with extended detention depth of 0.5 m.

Table 1 summarises the results obtained in this review, compared with those reported by Geolyse in the December 2014 report.

Despite significant differences in predicted volumetric discharge offsite from the western catchment, both models are in agreement that:

- Post-development volumetric discharge volume and pollutant loads will be significantly reduced compared with existing pre-development conditions. These outcomes far exceed contemporary best practice management requirements for stormwater quality treatment.

- Mean annual supply of reuse water from rainfall and runoff by both the 5 ML rainwater pond and the wetland/50 KL tank are consistent which provides confidence in water supply arrangements recommended for the CVLX by Geolyse.

It is stressed that there is no difference in modelled outcomes for runoff generated from impervious areas in the development. In both models 100% imperviousness has been adopted for roof and sealed pavement catchments.

TABLE 1 MUSIC Model Results												
Parameter/ units	**Existing Conditions**		**Wetland**				**Offsite Discharge**		**Change from Existing Conditions**		**Change from Existing Conditions (% reduction)**	
			Inflow		**Outflow**							
	Geolyse	**This Review**	**Geolyse**	**This Review**	**Geolyse**	**This Review**	**Geolyse**	**This Review**	**Geolyse**	**This Review**	**Geolyse**	**This Review**
Flow ML/yr	21.5	32.4	22.5	37.7	7.1	37.1	7.1	21.0	-14.4	-11.4	-67%	-65%
TSS Kg/yr	559	886	4,190	7,600	124	581	124	384	-435	-502	-78%	-57%
TP Kg/yr	5.0	7.4	9.2	15.8	0.8	3.6	0.8	2.2	-4.2	-5.2	-84%	-70%
TN Kg/yr	26.0	40.6	43.0	70.5	8.2	70.5	8.2	22.7	-17.8	-17.9	-68%	-44%
Reuse Volumes			**Geolyse**	**This Review**								
Supplied by rainwater pond (nett of potable addition)			9.5	9.6								
Supplied by wetland/50 KL tank			15.8	16.1								

6.4 Peak Flow Checks

6.4.1 Existing Conditions

The XP-RAFTS model predictions for existing site runoff peak flows have been checked firstly using the Rational Method[3] and then the RORB[4] hydrologic model.

> *In regard to the application of the Rational Method, recent research for Engineers Australia has been published in Australian Rainfall and Runoff (ARR) Project 5, Stage 2 Report, dated June 2012. The report found that this method was appropriate, but suggested adjustment of the results for very small catchments as shown on Figure 5.3.6.*

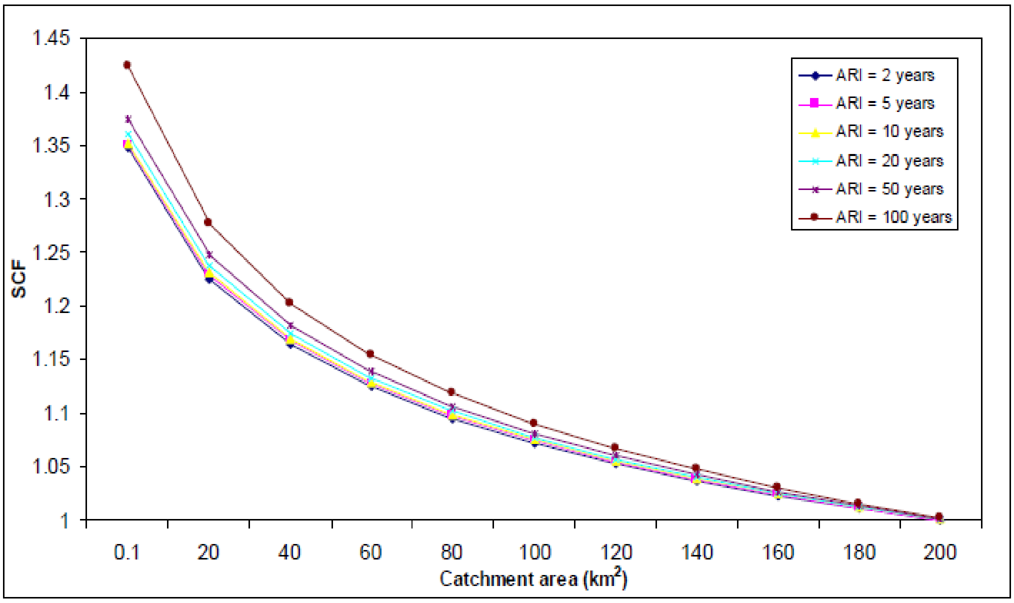

Figure 5.3.6 Relationship between scale correction factor (SCF) and catchment area

[3] The Rational Method ($Q_y=C_yi_yA$) has been used for over 150 years. It is interpreted as a probabilistic method to estimate a peak flow of selected ARI (Y) from an average rainfall intensity of the same ARI. It requires a “time of concentration” to fix the duration for the design rainfall intensity (i_y) and a “runoff coefficient” (C_y) to be selected.

[4] [4] RORB is the name given to an industry-standard Runoff Routing Model originally due to Laurenson EM and Mein RG. It is an interactive runoff and streamflow routing program that calculates catchment losses and streamflow hydrographs resulting from rainfall events and/or other forms of inflow to channel networks. It is used for flood estimation, spillway and retarding basin design and flood routing.

The RORB hydrologic model storage parameter K_c was “calibrated” to reproduce as closely as possible, the Rational Method peak flow estimates with initial loss of 10 mm and pervious area runoff coefficients of 0.2 for 1 year ARI, 0.4 for 10 year ARI and 0.6 for 100 year ARI events.

Calculated peak discharge estimates for the western catchment reported by Geolyse (2014) and obtained in this review are compared in Table 2. The RORB results are more conservative and considered to be the appropriate targets for detail design.

TABLE 2 Peak Discharge Estimates for Western Catchment and Existing Conditions

ARI (yrs)	Catchment Area (ha)	Estimated Peak Discharges (m3/s)		
		Geolyse	This Review	
		XP-RAFTS	Rational Method	RORB (Kc=0.5)
1	32.79	0.056	0.30	0.17
10		1.23	0.85	0.74
100		3.25	2.00	2.43

6.4.2 Post Development Conditions

The RORB model was then adjusted and used to simulate post-development conditions as per Figure 1, including roof areas to the rainwater pond, and sealed pavements and irrigation development areas to the wetland. Overflows from the rainwater pond cascade to the wetland. Both these storages were conservatively assumed to be at normal top water level (NTWL) at start of the storm events.

The main holding pond and its catchment were included to check if possible overflow could occur to the wetland. The holding pond NTWL was also assumed to be 1 m below spillway overflow level with active storage volume of 10 ML.

The stage-storage relations for all storages are summarised in Table 3 with the adopted outflow controls. All levels reasonably match site contours but are subject to change during detail design.

TABLE 3	**Proposed CVLX Holding Pond, Rainwater Pond and Wetland Characteristics**			
Asset	**Stage (m)**	**Area (m2)**	**Active Flood Storage (m3)**	**Comments**
Holding Pond	418.50	8,363	0	NTWL for pond
	419.50	14,556	10,000	0.5 m weir crest level
	420.00	18,000	18,000	Top of Bank
Rainwater Pond	411.00	2,700	0	0.5 m weir crest level NTWL for pond
	412.00	3,300	3,000	5.0 m weir crest level
	412.50	3,600	4,725	Top of Bank
Wetland	410.00	4,050	0	0.1 m shielded weir crest level NTWL for wetland
	410.50	4,250	2,075	3.0 m weir crest level Top of extended detention depth
	411.00	4,500	4,260	Top of bank

The effluent management system and its immediate catchment of 1.8 ha were assumed to be a closed system and excluded from the model. This reduced overall catchment area to 31 ha at the northwest corner of the site.

Irrigation paddocks were conservatively assumed to be 10% impervious to offset potential impacts of irrigation enhancing runoff in follow-up rain events. Low flows from the irrigation paddocks are directed to the wetland for treatment. Surcharges bypass the wetland and flow overland to the northwest corner of the site.

The RORB results for all storages and outflows are shown in Table 4.

Peak flow estimates at the northwest corner outfall reported by Geolyse and obtained in this review are compared in Table 5.

TABLE 4 RORB Results for Fully Developed CVLX

Asset	ARI (yrs)	NTWL (m)	Flood Level	Flood Storage (m3)	Peak Discharge (m3/s)	Critical Duration (hrs)
Holding Pond	1	418.50	<overflow	1,530	-	72
	10		<overflow	4,430	-	72
	100		<overflow	9,050	-	72
Rainwater Pond	1	411.00	411.09	275	0.03	9
	10		411.16	486	0.06	9
	100		411.24	714	0.10	9
Wetland	1	410.00	410.51	2,130	0.08	30
	10		410.69	2,890	0.51	9
	100		410.84	3,540	1.13	9
NW Corner outfall	1				0.08	30
	10				0.53	9
	100				1.23	9

TABLE 5 Post-development Model Results for Western Catchment

ARI (yrs)	Catchment Area (ha)	Estimated Peak Discharges in NW Corner (m3/s)	
		Geolyse	This Review
		XP-RAFTS	RORB (Kc=0.5)
1	31.00	0.02	0.08
10		0.41	0.53
100		2.02	1.23

The check results from this review confirm that the water management strategy proposed by Geolyse for the CVLX very effectively limits fully developed peak discharges to the northwest outfall to <u>less than existing conditions</u> for all ARI's up to and including the 100 year ARI event.

It is clear also that ample scope is available to optimise sizing and outlet configurations of the various ponds and the wetland, during detail design, to best match final site design requirements.

6.5 Additional Comments

The current concept plan on Figure 1 shows the wetland being located between the 10 year ARI and the 100 year ARI flood lines. The GHCMA have advised that there would be no objection to the wetland being so located, provided that it was formed in cut below natural surface without an embankment.

In my opinion this current concept raises some issues of concern:

1. Insufficient vertical level difference will be available to create the modelled extended detention depth and flood storage depth.
   - The wetland NTWL will need to be about 410.0 m in order to gain adequate vertical clearance to the invert of the culverts under Sunraysia Highway (408.95 m).
   - The proposed west frontage of the wetland matches the 10 year ARI flood level of 410.3 m.
   - Hence there is just 300 mm vertical water level rise available before free overflow occurs to the site outfall.
   - However the modelled extended detention depth is 500 mm and the 100 year flood depth is 840 mm.

2. the performance of the wetland could not be monitored during periods when it is flooded out by external catchment floodwaters.

3. No guarantee can be provided against inadvertent overflow escaping from the system when flooded out.

There are two options available to resolve these concerns:

   a) Provide a confining embankment to separate the wetland from the floodplain and ensure the extended detention and flood storage depths are fully contained on the east side.

b) Relocate the wetland either north or south with its westerly edge set no lower than the 100 year floodline.

Whilst either option will satisfy all key drainage and floodplain management requirements, it is my opinion that Option (a) is the best approach for the following reasons:

- The entrance road will form a barrier to northwards moving floodwaters and its alignment is fixed by VicRoads requirements. It will need to be formed at or above 100 year flood level so the finished road level will be ~411.00 m anyway to match in with the surveyed Sunraysia Highway formation.

- Culverts will be required under the entrance road near the north boundary to pass site discharges overflowing from the irrigation area swales as well as the external southeast catchment floodwater surcharges which are directed around the Sunraysia Highway frontage for events greater than 20 years ARI (as depicted on the GHCMA mapping). These culverts will also ensure flood levels effectively equalise on both sides of the entrance road for very large floods.

- The nett outcome is that the bulk of the wetland site shown on Figure 1 will in future be located in a backwater flood zone and not in a conveyance pathway.

- Maximum depth of flooding in the 100 year ARI flood across the wetland site is just 400 mm. The maximum height of the embankment would not need to exceed about 600 mm.

- Lesser depth of cut is required to create the wetland at its current location. Moving it further upslope will increase excavation depths and volumes because the NTWL will remain the same to still command the site drainage system.

- Retaining the current location maximises the area available for irrigation.

The opportunity is there to reshape the wetland and provide the embankment across the backwater zone to maximum crest level of 411.00 m, as indicated on the extract from the Site Concept Layout shown on Figure 2 below.

If required by GHCMA, compensatory earthworks can be carried out within the floodplain to maintain active flood storage volumes at relevant levels. An indicative area that could be excavated to balance volumes above the 10 year ARI event is shown on Figure 2.

GHCMA may require the Burrumbeet Creek hydraulic model to be re-run to verify final detail design with Option (a). This is likely to be necessary anyway to confirm design requirements for the culverts under the entrance road.

If Option (a) is not approved then one possible arrangement for the alternative Option (b) is shown on Figure 3.

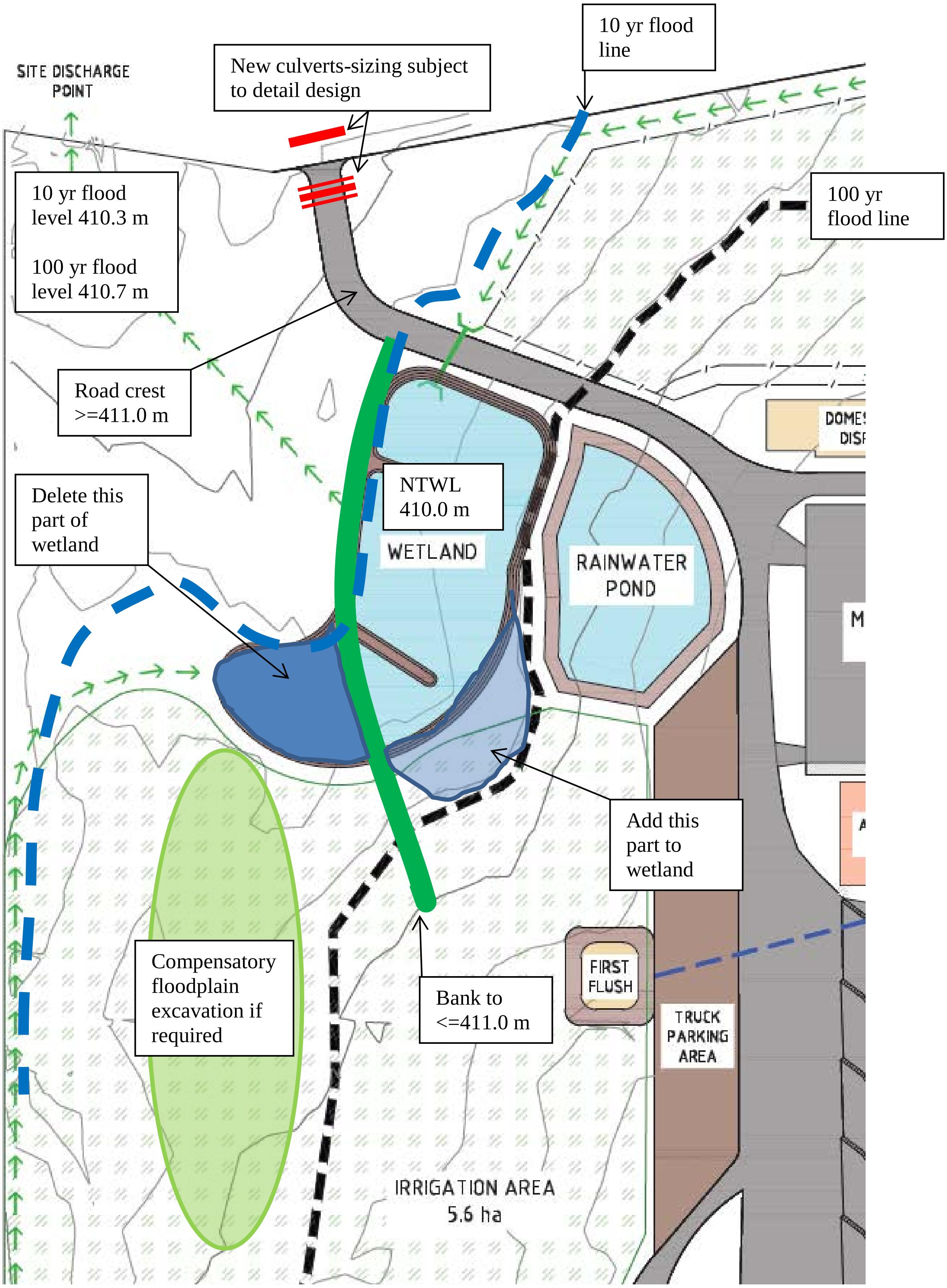

Figure 2 **Option (a) Suggested Amendment to Wetland Concept**

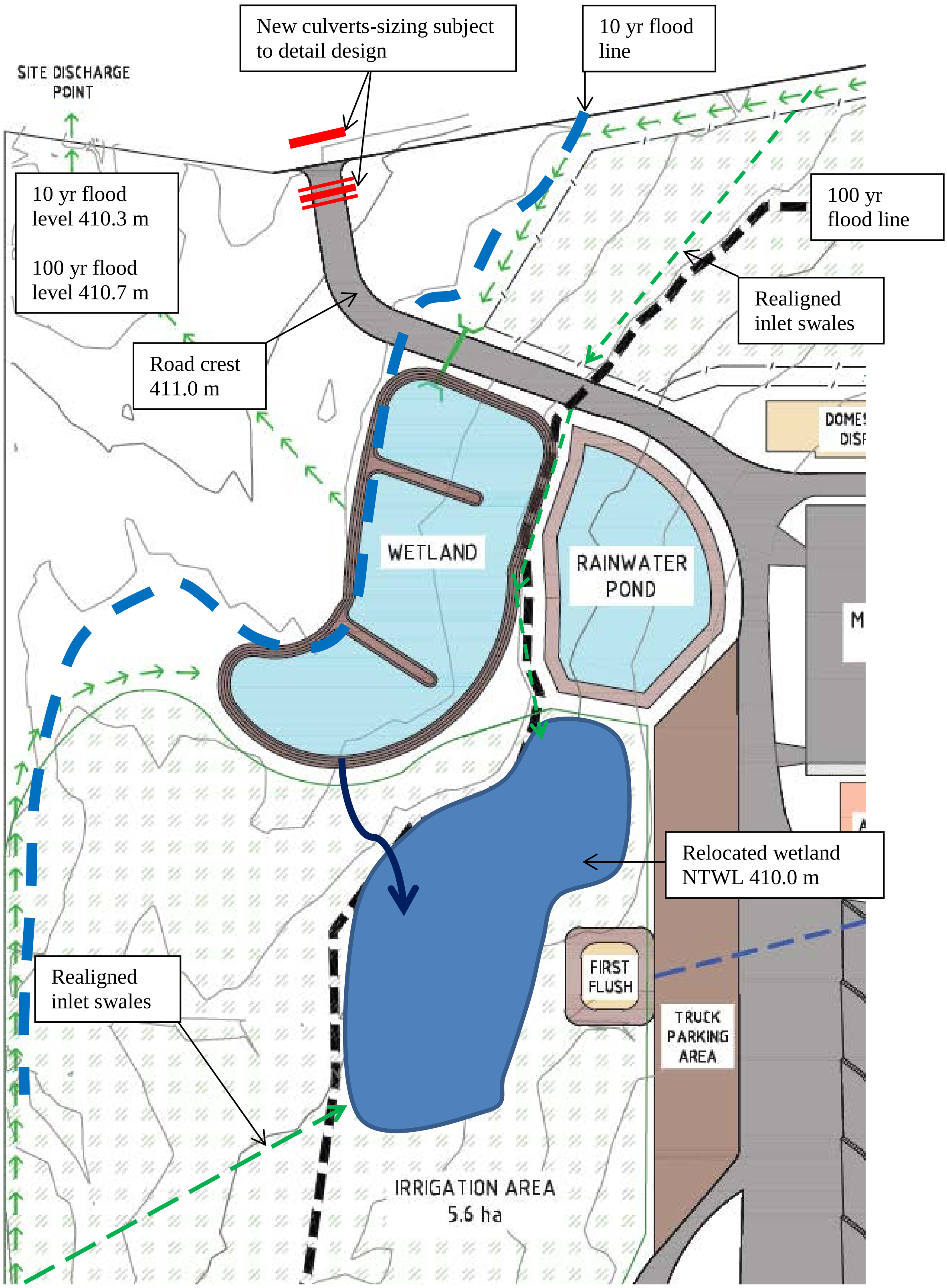

Figure 3 **Option (b) Relocated Wetland**

7. The Submissions to Amendment C185

This statement responds to issues relating to surface water management which have been raised in the submissions to Amendment C185 that have been supplied to me.

The issues raised in the submissions in my discipline can be summarised as:

- Additional runoff from the CVLX will aggravate flooding problems for existing homes on the south side of Albert Street, west of Victoria Street in Miners Rest.

- Threat of contamination of runoff waters entering Burrumbeet Creek from the CVLX;

Some of the submissions referred to the flooding problems experienced in parts of Miners Rest in the major event of January 2011. The inference was that with the CVLX in place flood risk and damages could only get worse in a repeat of such flooding.

8. Responses

Based on the check modelling completed in this review it is my opinion that the proposed strategy for managing surface runoff and flooding as set out in the Geolyse and Spiire reports will be able to:

1. maintain future post-developed peak rates of runoff to less than those for existing conditions;

2. supply the claimed volumes of roofwater and treated stormwater for site reuse;

3. ensure that future stormwater pollutant loads (TSS, TP and TN) will be much lower than discharged from the site under existing conditions. This outcome far exceeds best practice environmental objectives;

4. ensure future stormwater runoff volumes from the site are less than those for existing conditions to the western outfall and unchanged to the eastern outfall;

5. by also locating all major works outside the active floodplains, thereby avoid any detrimental impact on existing flood passage, conveyance and storage.

In regard to the claims of increased flood risk in Miners Rest associated with the CVLX in a repeat of the January 2011 event, there are several additional reasons why this cannot possibly occur.

To demonstrate, an extract of the GHCMA 100 year ARI flood-mapping is attached as Figure 4, marked up to show specific flood levels, points of interest and flowpaths for floodwaters. This figure shows that:

1. The drainage outfall for the CVLX is across and north from Sunraysia Highway which is well west and downstream of the flood-affected areas in Victoria Street/Albert Street/Dundas Street and James Court.

2. While some of the floodwaters escape under Sunraysia Highway via the existing culvert adjacent to the north west corner of the CVLX site, major overflow of the Highway occurs further west as depicted on Figure 4.

3. Tailwater flood levels along the north side of Sunraysia Highway at the CVLX catchment outfalls are 410 m or lower compared with levels >414 m at the areas previously affected by flooding upstream.

The January 2011 Flood Event

A further check was made by running the pre- and post-development RORB models with the recorded rainfall pattern at Ballarat Aerodrome for the January 2011 event. The rainfall total was 203 mm in 4 days. Due to the extended wet weather in the months prior to the event the catchments were in a state of saturated. It was assumed for conservatism that initial loss would have been no more than 5 mm with pervious area runoff coefficient rising to 0.8.

The results listed in Table 6 show that within CVLX the January 2011 storm event simulation was less severe than the design 100 year ARI event, except that the holding pond would be expected to just overtop to the wetland. The result again confirms that the CVLX will not detrimentally impact on flooding in the area in a repeat of this event.

TABLE 6 RORB Results for January 2011 Storm Event (for pre and post CVLX Conditions)

Asset	Scenario	Flood Level	Flood Storage (m3)	Peak Discharge (m3/s)
Holding Pond	Existing Conditions			
	Post CVLX	419.66	12,050	0.05
Rainwater Pond	Existing Conditions			
	Post CVLX	411.13	379	0.04
Wetland	Existing Conditions			
	Post CVLX	410.72	3,040	0.64
NW Corner outfall	Existing Conditions			1.18
	Post CVLX			0.68

Conclusion

From the work completed in this review it is my opinion that if designed, constructed and operated as set out in the documents given to me, it is not possible for the CVLX to detrimentally impact on flooding around or downstream or upstream of the site, nor on quality of surface water in Burrumbeet Creek.

9. 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

5 June 2015

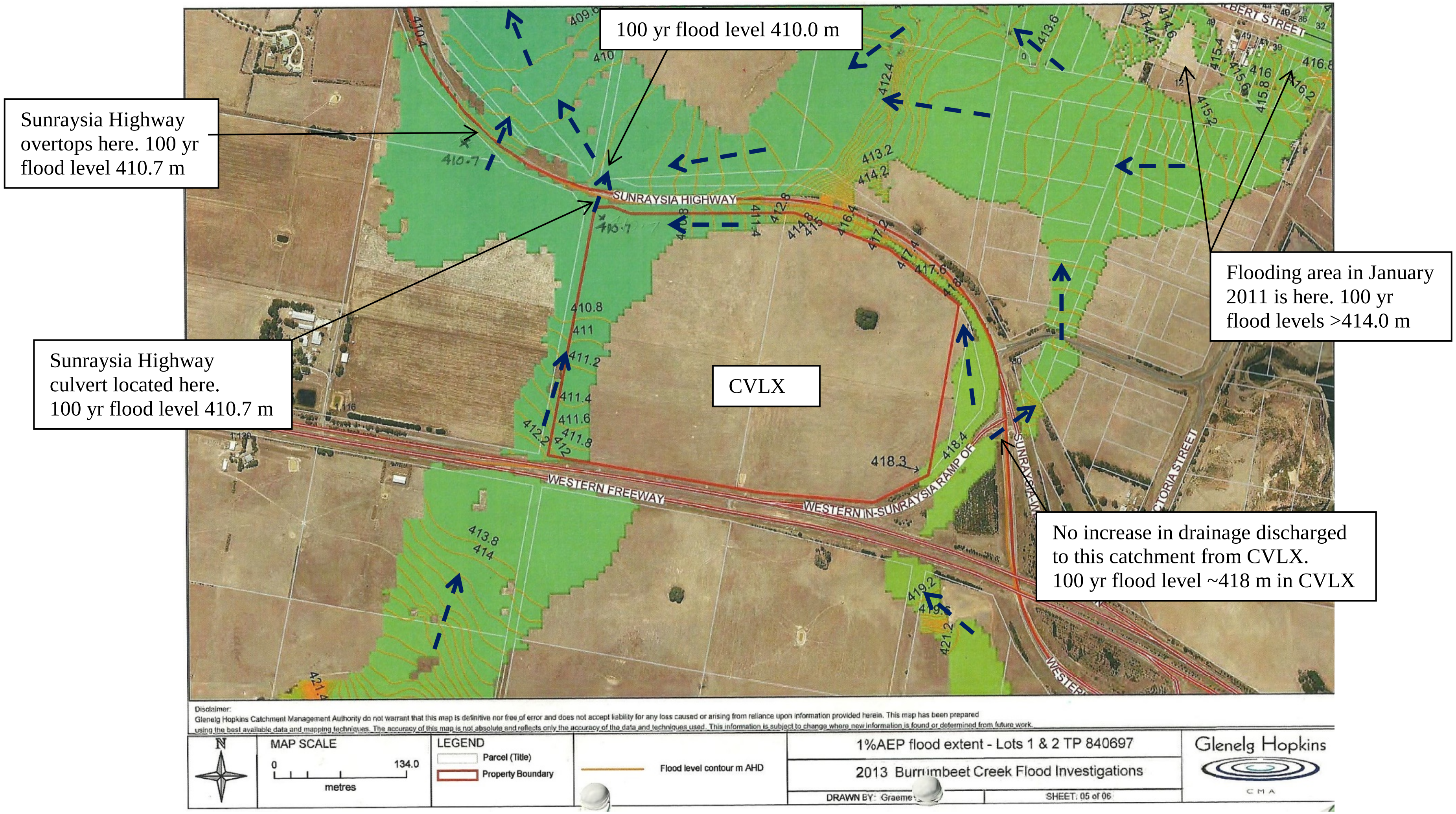

Figure 4 **100 year ARI Flood Mapping by GHCMA. Arrows indicate flowpath directions.**

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 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.

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.

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