BOX HILL/ BOX HILL INDUSTRIAL PRECINCT

Water Cycle Management

POST RE-EXHIBITION STRATEGY REPORT

Prepared for:

Department of Planning & Infrastructure

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Prepared by:

J. WYNDHAM PRINCE

CONSULTING CIVIL INFRASTRUCTURE ENGINEERS
& PROJECT MANAGERS

PO Box 4366
PENRITH WESTFIELD NSW 2750
P 02 4720 3300
F 02 4721 7638
W www.jwprince.com.au
E jwp@jwprince.com.au

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System

J. WYNDHAM PRINCE

CONSULTING CIVIL INFRASTRUCTURE ENGINEERS
& PROJECT MANAGERS

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WATER CYCLE MANAGEMENT – POST RE-EXHIBITION STRATEGY REPORT

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J. WYNDHAM PRINCE

CONSULTING CIVIL INFRASTRUCTURE ENGINEERS
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WATER CYCLE MANAGEMENT – POST RE-EXHIBITION STRATEGY REPORT

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1 EXECUTIVE SUMMARY

The Box Hill / Box Hill Industrial Precinct planning package was placed on re-exhibition in June 2012. Due to the changes that were included in the first round of Public Exhibition amendments (changes to playing field arrangements and increase in residential land), it was considered necessary to update the ILP to inform the community of these changes.

Further comments have been received associated with the Second Exhibition phase which have resulted in the need to further amend the Water Cycle Management Strategy for the Precinct.

The hydrology modelling has been updated to better reflect the likely development potential of the Precinct and an investigation into the basin strategy (including the reduction of a basin size) has been undertaken. These investigations have concluded that Basin BH01C could be reduced in size without adversely influencing flows throughout the Precinct.

Further refinements to the updated ILP have been undertaken to provide more opportunities for development, particularly within the Business Park to the south of Killarney Chain-of-Ponds.

To assist in providing an improved understanding of the timing requirements of the water management infrastructure within the Precinct, we have also undertaken an 'unstaged' assessment of post development flows to determine if another viable development sequence can be provided.

Detailed 2D Flood modelling has been completed to assess the effectiveness of the Precinct's Water Quantity Management Strategy. The flood assessment has shown that post development 100 year flows are controlled within the proposed detention basins as well as the riparian corridors within the Precinct.

The amendment to the basin strategy has had little impact on the total preliminary cost estimate for the water management devices. Therefore, it is expected that the cost of water management infrastructure remains at approximately $9,000 per lot.

The updated strategy will ensure that stormwater flows leaving the Precinct at the boundary are less than existing conditions and that flooding levels are not increased over existing conditions at any point outside the Precinct.

2 INTRODUCTION

In June 2012, a Post Exhibition Precinct Planning Package was exhibited for the Box Hill / Box Hill Industrial Precinct. Subsequent to this exhibition process, a number of submissions were received from various landowners and government agencies. The documents submitted that relate to the Water Cycle Management Strategy include:

- Welsh Property Consulting, letter of comments made on behalf of Mogul Stud Pty Ltd and Jundu Pty Ltd, by Robert Welsh, dated 10/08/2012.
- Cardno, report "Box Hill Post Exhibition DCP and Water Cycle Management Strategy – Flooding Review" dated 10/08/2012, also on behalf of Mogul Stud Pty Ltd and Jundu Pty Ltd.
- NSW Office of Environment & Heritage, letter by Lou Ewins dated 15/08/2012 (document ref: 12/27833)

As a result of these submissions a further investigation into the land use planning for the Precinct has been undertaken by the Masterplanner (AECOM), and the Department of Planning and Infrastructure. These investigations led to a revised Indicative Layout Plan (ILP) for the Precinct and therefore, an amendment is required to the Water Cycle Management Post Exhibition Strategy Report as previously developed by J. Wyndham Prince (JWP) in 2012 (JWP WCMPES 2012). The revised ILP is shown in Plate 2.1.

In response to further issues raised in the submissions, the following items have been included in the revised Water Cycle Management Strategy:

- An update to the hydrology modelling and the development of our amended basin strategy, which considered:
  1. Reducing the size and configuration of the large basin within the riparian corridor at the head of Northern Tributary, known as BH01C.
  2. Re-assessing the potential "unstaged" areas within the Precinct to determine if Stage 2 (as shown in Figure 9.1 of the previous report, provided in Attachment A) of the development can be provided prior to the regional detention systems being constructed.
- Updated flood modelling for the Precinct as a result of the amendments to the ILP, reflecting the updated basin strategy, which considered:
  3. The possibility of providing additional developable land in the Industrial Precinct along Killarney Chain-of-Ponds and adjacent the confluence of First Ponds Creek with Killarney Chain-of-Ponds.
  4. The refinement in developable light industrial land at the corner of Boundary Road and Windsor Road.
- Development of a Post Re-Exhibition Report that summarises the investigation and presents the results of this additional work.

This report should be read in conjunction of JWP's Box Hill / Box Hill Industrial Water Cycle Management Strategy Report completed in 2011 (JWP WCM 2011) and JWP's Box Hill / Box Hill Industrial Water Cycle Management Post Exhibition Strategy Report completed in June 2012 (JWP WCMPES 2012). Details of how each of the items raised in the submission have been addressed is provided within the following sections of this report.

Plate 2.1 – Amended ILP

3 PREVIOUS WATER CYCLE MANAGEMENT STRATEGIES

In February 2011, J. Wyndham Prince completed the development of a Water Cycle Management Strategy Report (JWP WCM 2011) to support the ILP for the Precinct, which was publicly exhibited on 12 October, 2011.

The key outcomes of this assessment were as follows:

- Development of an innovative basin strategy that looked at managing different Average Recurrence Intervals (ARI's) in separate sequential detention basins online to drainage flood / riparian corridors.
- Establishment of a Water Cycle Management Strategy that included a 'treatment train' approach, including 3 kL rainwater tanks on each lot, gross pollutant traps (GPT's) and twenty one (21) bio-retention raingardens throughout the Precinct to ensure pollutant reduction targets were met.
- Inclusion of eleven (11) detention basins to ensure post development flows from the Precinct are attenuated to less than the pre-development or existing conditions.
- Comprehensive flood modelling to assess the impacts of development within the Precinct and adjacent landowners.
- Development of detention basin concept plans.
- Development of a Preliminary Cost Estimate for all water management elements within the Precinct, to facilitate development of a Section 94 scheme for the Precinct.
- Confirmation that floodplain filling of portions of the catchment is possible with minimum impact on flood levels.
- Flood evacuation needs of the Precinct can be catered for within the future road design.
- As a result of a changed climate there would be a 0.3 m increase in flood levels throughout the Precinct by 2100.

Full details of the previous assessment can be found in the Water Cycle Management Strategy Report (JWP WCM 2011).

In June 2012, J. Wyndham Prince completed the development of a Post Exhibition Water Cycle Management Strategy Report (JWP WCMPES 2012) to support the updated ILP for the Precinct, which was publicly re-exhibited in June, 2012.

The key outcomes of this updated assessment were as follows:

- The removal of basins BH04 and BH05, an update to the hydrology modelling and the development of an amended basin strategy.
- Updated flood modelling for the Precinct as a result of the amendments to the ILP, reflecting the updated basin strategy.
- Development of an amended Basin Concept Plan to reflect the updated strategy.
- Update to the Preliminary Cost Estimates for all water management elements within the Precinct.
- Development of a Post Re-Exhibition Report that summarises the investigation and presents the results of this additional work.

Full details of the previous re-assessment can be found in the Water Cycle Management Post Exhibition Strategy Report (JWP WCMPES 2012).

4 PUBLIC RE-EXHIBITION OF DRAFT PRECINCT PLAN

A number of submissions were received as a result of the re-exhibition process that directly related to the Water Cycle Management Strategy for the Precinct. Details of the major items of concern and our responses are below.

4.1 Additional Developable Land

Possibility of gaining additional developable land within the Business Park along the Southern bank of Killarney Chain-of-Ponds and adjacent the confluence of Killarney Chain of Ponds with First Ponds Creek has been identified, which could be reclaimed from the floodplain, with compensatory storage to minimise the impact of flood levels within the site

A submission received suggested that the proposed filling of the floodplain could be pushed further into the drainage corridor without adversely impacting flood levels and that an additional seven (7) hectares of usable land could be made available for business park development.

The land in question was previously not considered for development due to a number of preliminary site constraints which suggested that development of this land was not viable:

- A preliminary assessment undertaken in early 2010, along with an updated flood hazard assessment undertaken during mid-2012 indicated that significant portions of the area were within the floodway and subject to high hazard flooding categorisation; and
- There is a wide strip of land through this area which is subject to a transmission easement, reducing its development potential.

The general consensus at the time was that the potential return in providing the development in these areas is likely to be prohibitive from a cost of construction point of view, hence this was not pursued any further at that stage.

Updated flood hazard categorisation has determined that less of the area in question is subject to high flooding hazard (or within the floodway), thereby increasing the potential developable area.

Due to being subject to high hazard categorisation, there are constraints to the developable area available along the eastern bank of First Ponds Creek immediately downstream of Windsor Road (refer to Figure 4.1). The submission indicated that compensatory storage would be required to offset the impact of filling in this area, however, this included cutting out a portion of the proposed light industrial area on the western bank of the development (refer to Figure 4.3).

In addition to this, a transmission easement still divides the area to the north, whilst all of this land is developable, only about 2 ha strip of land along the southern bank of Killarney Chain of Ponds would be available for buildings (refer to area shaded red in Figure 4.2). There may also be an issue with filling in an area within the transmission easement, as this will need to be agreed to and approved by Transgrid. The submission also claimed that more developable land could be reclaimed by pushing the industrial planning limits further north up into the Killarney Chain of Ponds drainage reserve, closer to the riparian corridor extents.

The submission also indicated that balanced cut and fill within the First Ponds Creek flood storage area outside of the defined flow paths and riparian corridors will allow for the increase in development area footprint without adversely impacting on flooding levels through the site.

It is noted that a significant portion of the proposed compensatory cut area proposed by the submission is within existing land already above the 100 year ARI flooding levels and within the designated proposed employment/light industrial land situated on the opposite (western) bank of First Ponds Creek (refer to Figure 4.2). This option effectively converts usable land into compensatory flood storage.

Notwithstanding this, a significant portion of the area to be reclaimed along the eastern bank of First Ponds Creek, is within an area that has previously been classified as high flood hazard (primarily due to flood depth - refer to Figure 4.2). It is our understanding that parts of the site in this area require approximately one (1) metre of fill to be raised above 100 year ARI flood levels, which is primarily why this land was not considered as a potential development area in the initial planning of the Precinct.

4.2 Flood Affected Developable Land

Some areas of the proposed development adjacent the riparian corridor at the downstream end of the site (both banks) are flood affected during the peak 100 year ARI storm event

The modelling undertaken as part of this re-exhibition assessment includes a refinement to the development extents of the proposed light industrial land at the corner of Windsor Road and Boundary Road, by improving the alignment of the development edge, increasing levels in the designated light industrial area and allowing for compensatory flood storage to minimise the impact on flooding downstream of the site. The potential development area is reduced by 1.5 ha (to 6.5 ha) from the extents previously proposed in the Post Exhibition ILP layout.

The submission also raised concerns regarding the flooding along the northern bank of Killarney Chain of Ponds (adjacent the downstream boundary of the site). This land zoning is rural residential, which is expected to provide flood-free areas for dwellings and access, but allows for flooding in other parts of the property. As long as there is flood-free areas at the frontage to the access road, there should not be any issues with flooding on the remainder of the lots (which back into the floodplain).

Further refinement of the surface modelling of the road frontages for the rural residential zoned lots in this area by providing minor filling will ensure that there is sufficient pad area (front 30 metres of each lot) for a dwelling and other assets above the design 100 year ARI flood event. The assessment undertaken indicates that the required additional filling will have negligible impact on flooding through the site (refer to Figure 4.1).

4.3 Cut & Fill Works Within E2 Environmental Conservation Area

There are significant cut and fill works proposed within the Environmental Conservation (E2) and Riparian Zone areas of the site. Recommendation that the proposed works be referred to a suitably qualified environmental engineer, to confirm that these works are acceptable with respect to environmental conservation.

The extent of cut and fill works proposed throughout the Environmental Conservation (E2) and Riparian Zone areas are generally outside existing stands of sensitive vegetation which are proposed to be retained. Minimal earthworks are proposed to take place within the existing vegetated extents.

The proposed earthworks within the riparian corridors are generally within non-sensitive areas and will include surface stabilisation and vegetation with native riparian species, and have been identified in the Precinct's DCP and Water Cycle Management Plan and will result in an improved riparian corridor functionality once the works are undertaken.

A "Control Activity Approval" under the Water Management Act 2000, will be required to be submitted to the NSW Office of Water, prior to or as part of any development application/s for work within Precinct's riparian corridor.

4.4 Development Staging

Recommendation that the staging plan is reviewed to include stages that can be "unstaged" outside the order as specified in the previous WCMP.

A submission has indicated that Stage 2 as defined in Figure 9.1 of the post exhibition Water Cycle Management Strategy (refer to Appendix A) has the potential to be constructed as an "unstaged" development without requiring regional basins to control discharge rates from the site.

JWP have undertaken a hydrological assessment and considered the development of Stage 2 in isolation and can confirm that 100 year ARI discharges **increase** at all points along the main watercourse downstream of the site as a result. Therefore, Stage 2 cannot be an "unstaged" development constructed in isolation without temporary detention devices being constructed to assist in managing discharges from the site.

Alternatively, Stage 2 may be developed independently if regional detention basin BH03B (within Stage 1) is constructed concurrently. Basin BH03B will provide sufficient detention for undeveloped upstream catchments to enable Stage 2 to release discharges without the requirement for an interim detention system.

4.5 Basin BH01C Area Reduction

Suggestion that further hydrological investigations be carried out, due to a preliminary assessment which proved that reducing the volume of Basin BH01C would allow for sufficient detention to reduce peak site discharges to below pre-development levels.

A preliminary assessment undertaken for a submission claimed that reducing the volume (and hence surface area) of Basin BH01C would allow for sufficient detention volume to reduce peak site discharges to pre-development levels, whilst increasing potential development areas by approximately 1.1 ha.

The results reported within the submission indicates a minor increase (0.5%) in 100 year ARI discharges within the northern tributary prior to the confluence with Killarney Chain of Ponds (Cardno, 2012 -Table 1). The governing requirement in the design of the detention systems was that existing condition flows are maintained within the riparian corridor through the site. Given this requirement and the results of the preliminary assessment presented in the submission, if there is an opportunity to reduce the size of this basin, it is unlikely that the full 1.1 ha as suggested will be available for development.

The changes in the landform required to provide additional 1.1 ha in surface area for development result in a detention basin volume loss of 15,500 m^3. The resulting stage/storage configuration provides a total volume of 52,500 m^3 (at TWL 35.8), which does not provide sufficient storage to assist the overall development to detain post development peak discharges to less than predevelopment levels throughout the site (i.e. there is some increase in discharges).

Information provided with the submission in relation to the proposed reduction in basin area indicated that the strategy adopted was a proportional reduction of cumulative volumes as adopted in the XP-RAFTS model, whilst maintaining the outlet arrangement.

JWP have reviewed the basin arrangement and can advise that Basin BH01C and the discharge outlet arrangement can be reconfigured and reduced to 58,000 m^3 (from 68,000 m^3), which will provide an expected additional 0.7 ha of developable land. The refined basin results in 100 year ARI discharges closer to the existing conditions, without exceeding the targets downstream. Whilst the flood modelling undertaken has been adjusted to cater for the reduction in Basin BH01C, it is considered that for the purposes of Precinct planning, the current BH01C land allocation remain so as to allow flexibility in the future detailed design phase for this portion of the Precinct.

4.6 Incorrect Reference to the Term "Flood Free"

The NSW Office of Environment and Heritage have indicated that the term "flood free" is being used incorrectly and suggested that the term be limited to lands above the local and regional PMF level.

We note that the term "flood free" as referred to in the Water Cycle Management strategy is in reference to those lands above the local and regional 100 year ARI flooding extents, since the majority of the planning on the site is in relation to the 100 year ARI flooding levels.

The context of the wording has always been in relation to the design peak 100 year ARI flooding levels and in future correspondence the event shall be nominated, i.e. "flood free during the peak 100 year ARI events".

4.7 Hydraulic Categorisation of the Floodplain

The NSW Office of Environment and Heritage recommends that "…flood storage also be determined for all flowpaths using a method consistent with the FDM and the 2007 Floodplain Risk Management Guidelines – Floodway Definition…"

We have indicated the Floodway extents on Figure 8.3 of the Post Exhibition Strategy Report (provided in Attachment A). It appears that OEH also requires an indication of areas defined as flood storage, in accordance with the relevant flood management guidelines.

The methodology required to determine flood storage areas is an iterative process which is considered unnecessary at the Precinct planning stage. Furthermore, The Hills Shire Council has agreed to the methodology adopted in the determination of the floodway within the Precinct as being suitable for this stage of the Precinct Planning process.

4.8 Flooding Emergency Management

The NSW Office of Environment and Heritage outlined other recommendations regarding flooding emergency management, including consultation with the State Emergency Services (SES).

OEH recommended that consideration should be given to when the peak local storm event coincides with the peak regional backwater event in the Hawkesbury/Nepean. We note that the coincidence of the peak local 100 year ARI storm event with the peak regional 100 year ARI storm event is expected to be a much rarer, significant event, with an average recurrence interval somewhat larger than 100 year probability. Furthermore, the regional 100 year ARI flood event (RL 17.3) is below the lowest level within the Precinct.

Notwithstanding this, it is noted that there should be a strategy in place to cater for this extremely rare event (as would be the case during the peak PMF event).

Regarding emergency flood evacuation, OEH also recommended:

- Consultation with the SES in the early stages of the planning process, due to the complex evacuation strategies throughout the Precinct;
- Option of evacuating locally to a refuge on-site within the higher closer ground above the regional PMF in consultation with the SES;

- Consideration of local catchment flooding coinciding with regional Hawkesbury/Nepean PMF flooding where local roads/access can be cut by localised flooding preventing safe evacuation; and
- Further consultation with the SES regarding the proposed strategy to "shelter in place" or relocate to higher ground within the Precinct for the local PMF flood event.

The evacuation plan previously presented in the original Water Cycle Management strategy report has now been updated to comply with the latest ILP, refer to Figure 4.4 for the updated evacuation plan.

The safe evacuation of residents during extreme flood events will need to be further assessed as part of any development application for land that is within the regional PMF extent as shown in Figure 4.4 of this report.

4.9 Ownership of Hydraulic and Hydrologic Modelling

The NSW Office of Environment and Heritage also recommended that The Hills Shire Council (THSC) be consulted in relation to the ownership of the hydrologic and hydraulic modelling.

Being a major, long-term stakeholder of the Precinct, We concur that The Hills Shire Council should have a share in the ownership of the relevant modelling files.

The Hills Shire Council has been provided with the appropriate models used in this assessment for use the future development of the Precinct.

5 UPDATED BASIN STRATEGY & HYDROLOGY MODELLING

As mentioned in Section 4.5, there has been a further detailed assessment due to the proposed reduction of Basin BH01C.

The amended basin strategy has concluded that a slight reduction in the basin volume of BH01C will not have an adverse effect on the detention performance of the entire catchment. Details of the amendments to the strategy are summarised in Table 5.1 below.

Table 5.1 – AMENDMENTS TO PRECINCT BASIN STRATEGY

Basin Location	2012 Basin Storage (Second Post Exhibition) (m^3)	2011 Basin Storage (Original Exhibition) (m^3)
BH01A	27000	15000
BH01B	25000	18000
BH01C	58000	54000
BH02A	25000	25000
BH02B	31000	30000
BH03A	15000	15000
BH03B	39000	35000
BH04	N/A	18000
BH05	N/A	50000
KC01	130000	120000
KC02	91000	91000
Totals	441000	471000

The strategy includes nine (9) detention basins, with a total storage volume of approximately 441,000 m^3. This arrangement provides an optimal solution to the flow management needs for the Box Hill / Box Hill Industrial Precinct.

The catchment areas have been adjusted in this assessment to be in accordance with the proposed extended development extents within the Business Park and reduction in Light Industrial area.

5.1 Discharge Estimates

As a result of the amendments to the basin strategy, the discharges from various locations throughout the catchment are provided in Tables 5.2 and 5.3 below, with a summary of the basins performance provided in Tables 5.4 and 5.5.

Table 5.2 – SUMMARY OF PEAK 2 YEAR ARI FLOWS

Location	Pre-Developed Node	Post-Developed Node	Pre-Development Max Flow, (m^3/s)	Post-Development Max Flow, (m^3/s)	Flow Ratio (Post/Pre)
Confluence of Killarney Chain-of-Ponds & First Ponds Creek	1.04	1.04	72.9	62.2	0.85
Northern Tributary	8.05c	8.05	15.0	10.9	0.73
Northern Tributary	8.08	8.08	20.3	15.5	0.76
Firsts Pond Creek @ Windsor	N7	N7	28.8	28.7	1.00
First Ponds Creek @ downstream of Boundary Rd	N9	N9	76.1	67.2	0.88
First Ponds Creek @ Treedale Drive	N10	N10	78.8	70.0	0.89
First Ponds Creek @ Chapman Road	N15	N15	89.4	80.7	0.90

Table 5.3 – SUMMARY OF PEAK 100 YEAR ARI FLOWS

Location	Pre-Developed Node	Post-Developed Node	Pre-Development Max Flow, (m^3/s)	Post-Development Max Flow, (m^3/s)	Flow Ratio (Post/Pre)
Confluence of Killarney Chain-of-Ponds & First Ponds Creek	1.04	1.04	197.7	175.0	0.89
Northern Tributary	8.05c	8.05	39.1	37.7	0.96
Northern Tributary	8.08	8.08	54.0	50.3	0.93
Firsts Pond Creek @ Windsor	N7	N7	75.3	75.2	1.00
First Ponds Creek @ downstream of Boundary Rd	N9	N9	210.0	189.1	0.90
First Ponds Creek @ Treedale Drive	N10	N10	217.1	196.3	0.90
First Ponds Creek @ Chapman Road	N15	N15	245.3	225.1	0.92

Table 5.4 – DETENTION BASIN PERFORMANCE AT 2 YEAR ARI

Location	Link Label	Max Inflow (m^3/s)	Max Outflow (m^3/s)	Storage Used (m^3/s)	Stage Used (m^3)
Northern Tributary	BH01A	15.3	3.5	27300	38.20
Northern Tributary	BH01B	18.3	5.3	16400	36.30
Northern Tributary	BH01C	9.2	6.9	22600	34.64
Terry Road Upstream	BH02A	15.4	2.7	21700	37.26
Terry Road Downstream	BH02B	2.8	2.3	14650	33.55
Northern Tributary	BH03A	6.6	2.3	17800	31.16
Northern Tributary	BH03B	10.5	3.5	8000	24.92
Killarney Chain-of-Ponds	KC01	35.5	14.1	48900	30.17
Killarney Chain-of-Ponds	KC02	15.0	13.4	29200	27.60

Table 5.5 – DETENTION BASIN PERFORMANCE AT 100 YEAR ARI

Location	Link Label	Max Inflow (m^3/s)	Max Outflow (m^3/s)	Storage Used (m^3/s)	Stage Used (m^3)
Northern Tributary	BH01A	32.0	17.1	32100	38.60
Northern Tributary	BH01B	38.7	30.5	27400	37.40
Northern Tributary	BH01C	44.3	20.5	57700	35.80
Terry Road Upstream	BH02A	32.6	15.9	34500	38.20
Terry Road Downstream	BH02B	16.5	9.8	30700	34.50
Northern Tributary	BH03A	15.6	8.9	21300	31.47
Northern Tributary	BH03B	21.9	10.3	38000	25.48
Killarney Chain-of-Ponds	KC01	78.3	41.3	130000	31.05
Killarney Chain-of-Ponds	KC02	44.1	37.7	89800	28.48

Details of the catchment assumption used in the XP-Rafts modelling for both the existing and developed conditions is provided in Appendix B

5.2 Modelling Discussion

The Post Re-Exhibition Basin Strategy amendments have resulted in flows throughout the Precinct to be managed to or below pre-development levels.

6 FLOOD MODELLING

6.1 Post Re-Exhibition Changes

There have been some minor updates to the flood modelling since the ILP was re-exhibited in June, 2012. The changes have occurred for a number of reasons including comments received during the public exhibition phase, refinements to the hydrologic models and refinement of the ILP. The changes made to the flood modelling are summarised as follows:

- Basin BH01C has been reduced and the outlet configuration is also slightly altered to that previously proposed.
- The light industrial area to the south-west of the Precinct has been adjusted to ensure development of this area is above the 100 year ARI flood level and does not result in adverse flood impacts downstream of the Precinct.
- The Environmental Living (E2) area to the north of Killarney Chain of Ponds at the downstream end of the site was adjusted to ensure a 30m wide, 100 year ARI flood-free frontage to the access road is provided.
- The industrial / employment areas to the south of Killarney Chain of Ponds and east of First Ponds Creek have been slightly increased in area and extended further towards the riparian corridor, increasing potential development area.

The TUFLOW flood models (described in the post-re-exhibition stage report) were modified to include the above changes. The scenarios assessed were as follows:

1. **Scenario 1 (Updated Base Case – Figures 6.1, 6.2 & 6.3)**
    - Updated surface modelling, including filling and some compensatory cut within the Light Industrial area of the precinct;
    - Some localised filling within the E2 residential areas north of Killarney Chain-of-Ponds adjacent Boundary Road;
    - Refined surface modelling of the Business Park area south of Killarney Chain-of-Ponds and east of First Ponds Creek, in accordance with the current ILP layout;
    - Updated surface of refined Basin BH01c and stage/discharge control information
2. **Scenario 2 (Figures 6.4, 6.5 & 6.6)**
    - Update surface modelling of Business Park by extending development further north into drainage reserve closer to allocated riparian corridor; includes some compensatory cut in flood area between extended development extents and riparian corridors;
3. **Scenario 3 (Figures 6.7, 6.8 & 6.9)**
    - Includes all updates as adopted in Scenario 2, with the inclusion of:
    - Removal of a portion of the proposed Light Industrial area, adjacent First Ponds Creek immediately downstream of Windsor Road

The results of the revised modelling are described in the following sections.

6.2 Flood Extent Mapping

For the updated post exhibition study, the post development 100 year ARI flood was reanalysed to account for the second post exhibition updates and submissions.

A series of maps have been developed for this study and are as follows:

1. 100 year ARI Depth Profile – All three post development scenarios
2. 100 year ARI Hazard Classification - All three post development scenarios
3. 100 year ARI Flood Difference Mapping - All three post development scenarios

In addition to these, the following PMF maps were developed for the post development case under Scenario 1:

1. Depth Profile
2. Hazard Classification

The post development 100 year ARI flood was reanalysed to account for the changes listed in Section 6.1 above. The revised flood extents, depth profile and hazard classification mapping for the updated developed case modelling in accordance with the scenarios outlined above for the 100 year ARI are shown on Figures 6.1, 6.2, 6.4, 6.5, 6.7 and 6.8, with the results of the PMF assessment shown on Figures 6.10 and 6.11.

6.3 Flood Difference Mapping

Flood Difference Maps have been prepared which indicate the difference in 100 year ARI flood levels (for each Scenario) between the existing case and the proposed development scenarios within the Precinct.

The results of the 100 year ARI flood difference mapping for each of the scenarios are shown in Figures 6.3 (Scenario 1), 6.6 (Scenario 2) and 6.9 (Scenario 3):

The figures indicate that development of the Precinct with the recommended controls, proposed site regrading, and compensatory storages will result in minor increases (maximum of 0.06 m) within the riparian corridor only, for flood levels outside the Precinct, with some minor increases in flood levels within the bounds of the Precinct.

The modelling of floodplain reclamation undertaken as part of the strategy development demonstrates a decrease in overall floodplain storage below the local flood extents. However, the reduction in discharges through implementation of detention systems and improved hydraulic conveyance and reshaping of the floodplain has resulted in no change in flood levels in Killarney Chain-of-Ponds downstream of the Precinct.

There is no part of the site below the regional 100 year ARI flood level (17.3) which has been proposed to be filled for development, hence there is no regional floodplain storage loss due to the development of the Precinct.

6.4 Flood Hazard Mapping

Flood Hazard Maps have been prepared which indicate the peak extent of various hazard categorization during the critical 100 year ARI flood event (for each Scenario).

A comparison between the current design case Scenario 1 and the proposed submission development scenarios (2 and 3) within the Precinct shows that the proposed fill extents do have a localised impact on flooding hazard within the drainage reserves. There is a visible increase in the high flood hazard categorized area (coloured red in Figure 6.5) within the Killarney Chain-of-Ponds and First Ponds Creek drainage corridors, adjacent the areas where the fill has been introduced. Some of this area has been reduced where the compensatory cut has been removed within the First Ponds Creek floodway (Figure 6.8).

This change in hazard categorisation may result in the need to undertake bank stabilization and would form part of the future detailed design of these portions of the creeklines

7 UPDATED BASIN CONCEPT AND COST ESTIMATE

With the confirmation of reduce basin storage volume at BH01C will ensure appropriate post development flow management across the Precinct, we have updated the preliminary engineering concept plan for BH01C together with updating the associated costs estimate for this basin. The preliminary engineering concept plans for BH02B and BH03B have also be updated to resolve a number of draft inconsistence within these plans.

Detail of the updated information from BH01C, BH02B and BH03B is provided in Appendix D.

8 CONCLUSION

The Box Hill / Box Hill Industrial Precinct planning package was placed on re-exhibition on 12 June, 2012. In response to a number of submissions made from both public and private stakeholders, a revised master planning and Indicative Layout Plan (ILP) have been developed. This revised ILP has resulted in the need to amend the Water Cycle Management Strategy for the Precinct.

The hydrological modelling has been updated to better reflect the likely development potential of the Precinct and an investigation into the basin and Staging strategy has been completed. These investigations have concluded that Basin BH01C could be reduced without adversely influencing flows throughout the Precinct.

Further to the previous investigation in the staged development of the Precinct, we have tested the merits of whether Stage 2 can be carried out as an "unstaged" development, and have concluded that Basin BH03B is required to detain predevelopment flows from future Stage 1 to allow for the construction of Stage 2, without causing increase in discharges from the Precinct.

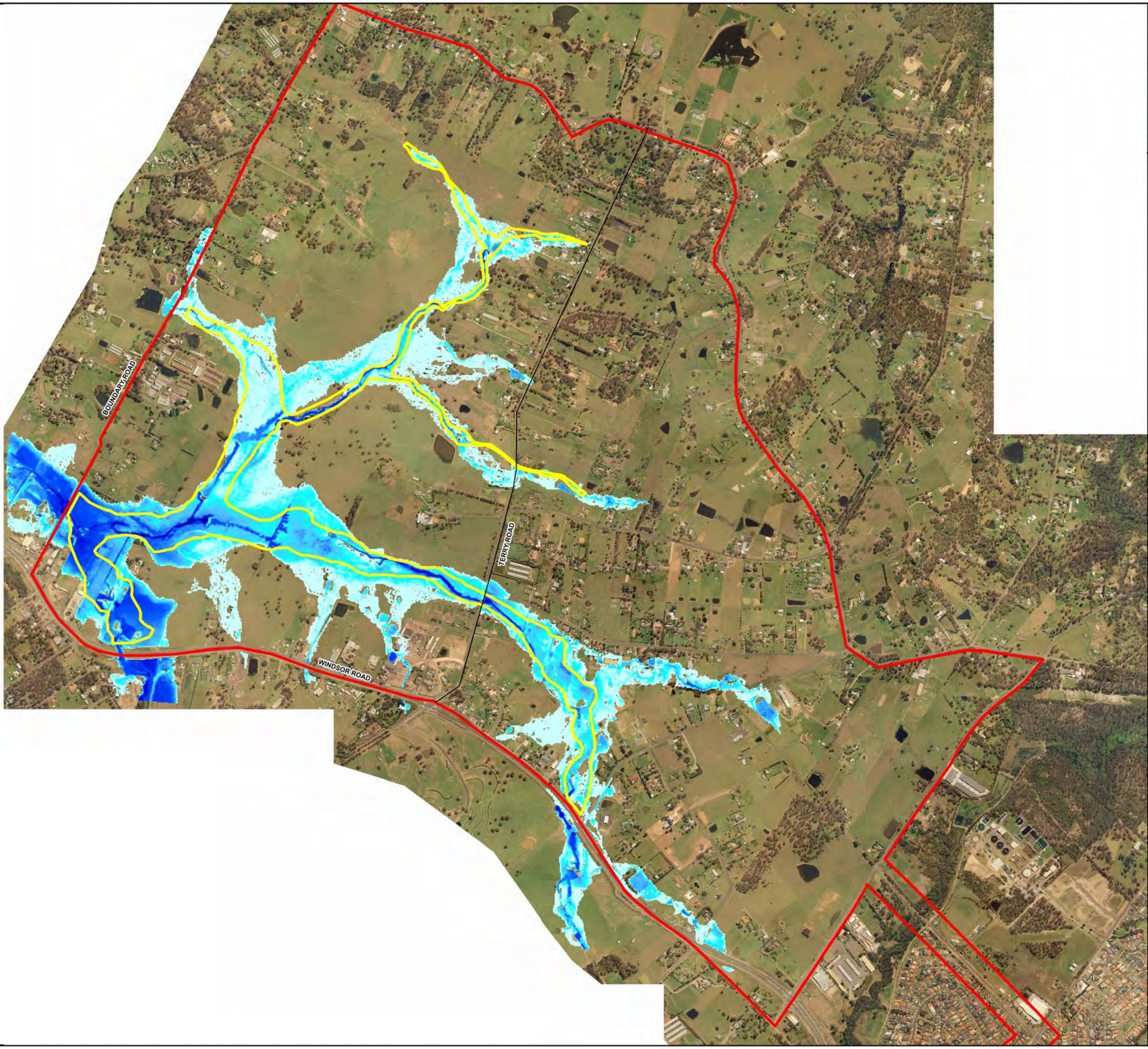
Flood modelling has been completed to assess the effectiveness of the Precinct's water quantity management strategies. The flood assessment shows that post development 100 year ARI flows are controlled and contained within the proposed detention basins and riparian corridors of the Precinct.

The strategy provides a balance between the riparian corridor functions, floodplain management, and development outcomes and will ensure that stormwater flows exiting the Precinct at the boundary are less than existing conditions. The water quality strategy developed for the Precinct will also ensure that the quality of stormwater discharging from the Precinct meets the requirements of OEH and will ensure stormwater pollutant impacts of urban development are mitigated.

9 REFERENCES

- Box Hill Post Exhibition DCP and Water Cycle Management Strategy – Flooding Review (Cardno, 2012).
- J. Wyndham Prince, Water Cycle Management Strategy report, 2011 (JWP WCM, 2011).
- J. Wyndham Prince, Water Cycle Management Post Exhibition Strategy report, 2012 (JWP WCMPES, 2012).
- NSW Floodplain Development Manual (FDM, 2005).
- NSW Office of Environment and Heritage – correspondence dated 15/08/2012
- OEH guidelines (OEH, 2009).

APPENDIX A – FIGURES FROM PREVIOUS WATER CYCLE MANAGEMENT REPORTS



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J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS
PO Box 4366 PENRITH WESTFIELD NSW 2750
P 02 4720 3300
F 02 4721 7538
W www.jwprince.com.au
E jwp@jwprince.com.au

LEGEND

Peak Flood Depth Profile (m)

- 0.0 to 0.5
- 0.5 to 1.0
- 1.0 to 1.5
- 1.5 to 2.0
- 2.0 to 2.5
- 2.5 to 3.0
- 3.0 to 3.5

Precinct Boundary

80% Flow Corridor/ Floodway

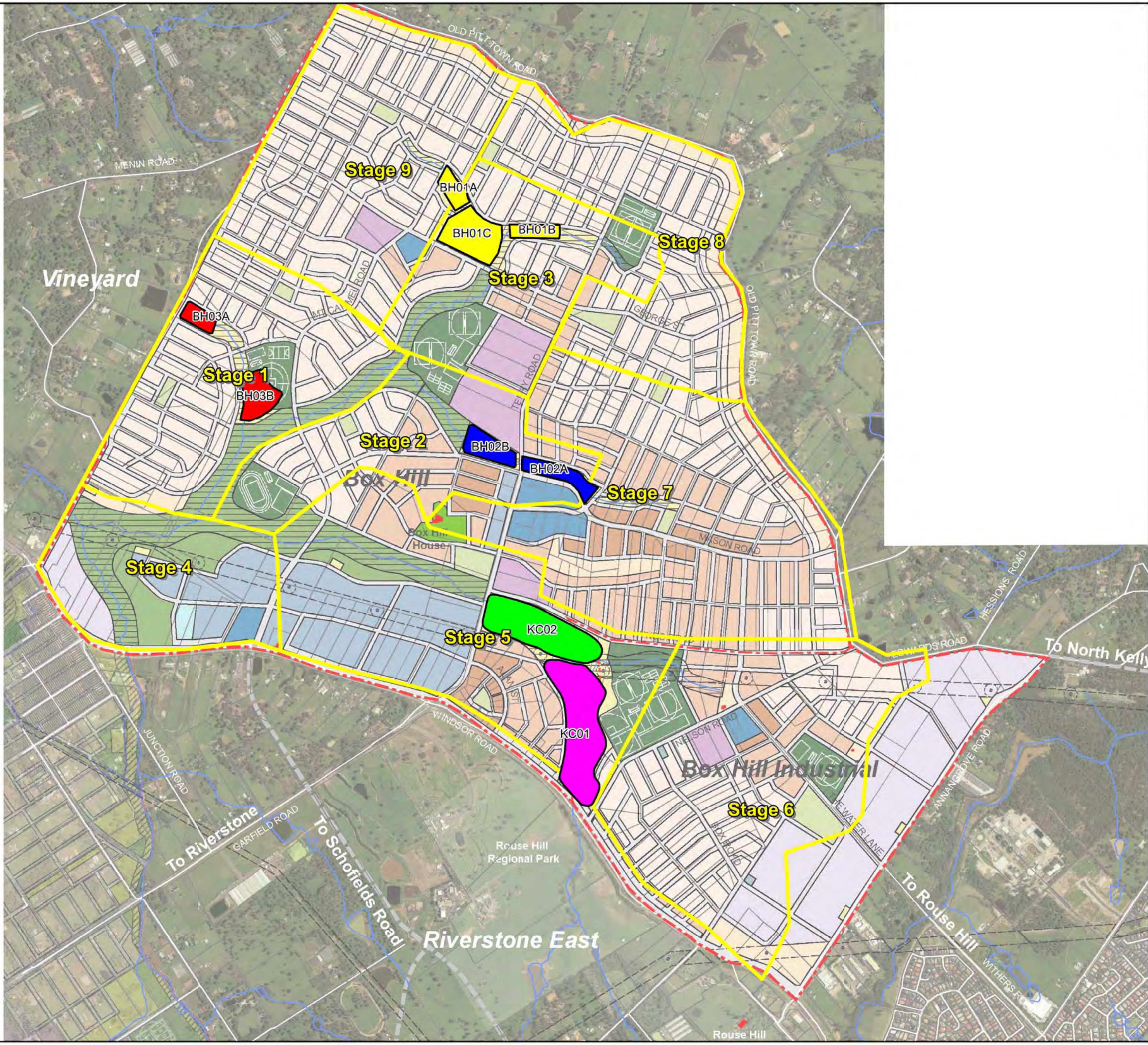
N
W E
S
Scale 1: 17,000 @ A3
200 0 200 m

Figure 8.3

Box Hill/ Box Hill Industrial Precinct

100 Year ARI
Existing Condition
Floodway Definition

File Name: 8979_PE_80%Flow_Fig8.3.wor
Date : 10/05/12 Issue : A



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PO Box 4366 PENRITH WESTFIELD NSW 2750
P 02 4720 3300
F 02 4721 7638
W www.jwprince.com.au
E jwp@jwprince.com.au

Servicing Stage	Basin to be constructed
Stage 1	BH03A
Stage 2	BH03B
Stage 3	BH01C
Stage 4	No basin needed
Stage 5	No basin needed
Stage 6	No basin needed
Stage 7	BH02A, KC02
Stage 8	BH01B
Stage 9	BH02B, KC01, BH01A

LEGEND

Staging Boundary

Region

N W E S

Scale 1: 17,000 @ A3

500 0 m

Figure 9.1

Box Hill/ Box Hill Industrial Precinct

Basin Servicing Strategy

File Name: 8979_Servicing_Stage
Date : 17/05/2012 Issue B

APPENDIX B – CATCHMENT AREAS AND ASSUMED % IMPERVIOUSNESS

Existing Conditions				
Node	**Pervious Area (ha)**	**Impervious Area (ha)**	**Total Area (ha)**	**% Impervious %**
N9U	16.30	1.63	17.93	9.1
N9e	14.63	0.00	14.63	0.0
N9c	16.66	1.85	18.51	10.0
N9f	18.50	3.27	21.77	15.0
N9d	27.85	4.92	32.77	15.0
N9b	17.60	1.96	19.56	10.0
N9a	21.66	2.41	24.07	10.0
4.01A	4.96	1.65	6.61	25.0
4.01	7.43	2.48	9.91	25.0
2.01	46.15	0.00	46.15	0.0
3.01	44.09	1.85	45.94	4.0
2.02	68.59	2.56	71.15	3.6
2.03	38.01	4.22	42.23	10.0
14.01B	3.47	0.00	3.47	0.0
4.02	22.79	1.48	24.27	6.1
4.03	20.45	0.53	20.98	2.5
4.04	4.15	0.11	4.26	2.6
2.04	3.34	0.21	3.55	5.9
5.01	29.44	0.58	30.02	1.9
5.02	32.78	3.08	35.86	8.6
5.03	39.03	2.11	41.14	5.1
13.01	3.60	1.44	5.04	28.6
5.04	29.76	0.57	30.33	1.9
14.01A	3.39	0.00	3.39	0.0
14.01	8.36	1.36	9.72	14.0
2.05	3.97	0.00	3.97	0.0
15.01	19.75	1.50	21.25	7.1
16.01	15.22	1.83	17.05	10.7
2.06	6.30	0.20	6.50	3.1
6.01	16.37	2.13	18.50	11.5
6.02	23.50	0.75	24.25	3.1
17.01	10.00	0.20	10.20	2.0
2.07	4.70	0.00	4.70	0.0
7.01	28.14	2.54	30.68	8.3
7.02	21.35	0.65	22.00	3.0
18.01	22.20	0.00	22.20	0.0
2.08	6.93	0.00	6.93	0.0
11.01	24.81	6.79	31.60	21.5
11.02A	17.97	1.14	19.11	6.0
11.02B	6.15	2.24	8.40	26.7
11.03A	26.31	0.00	26.31	0.0
11.03	22.10	0.73	22.83	3.2
8.01	37.35	2.82	40.17	7.0
8.02	39.93	1.04	40.97	2.5
8.03	29.95	1.34	31.29	4.3
8.04A	13.66	0.07	13.73	0.5
8.04	13.73	0.61	14.34	4.3
9.01	46.36	1.52	47.88	3.2
9.02	43.81	0.44	44.25	1.0

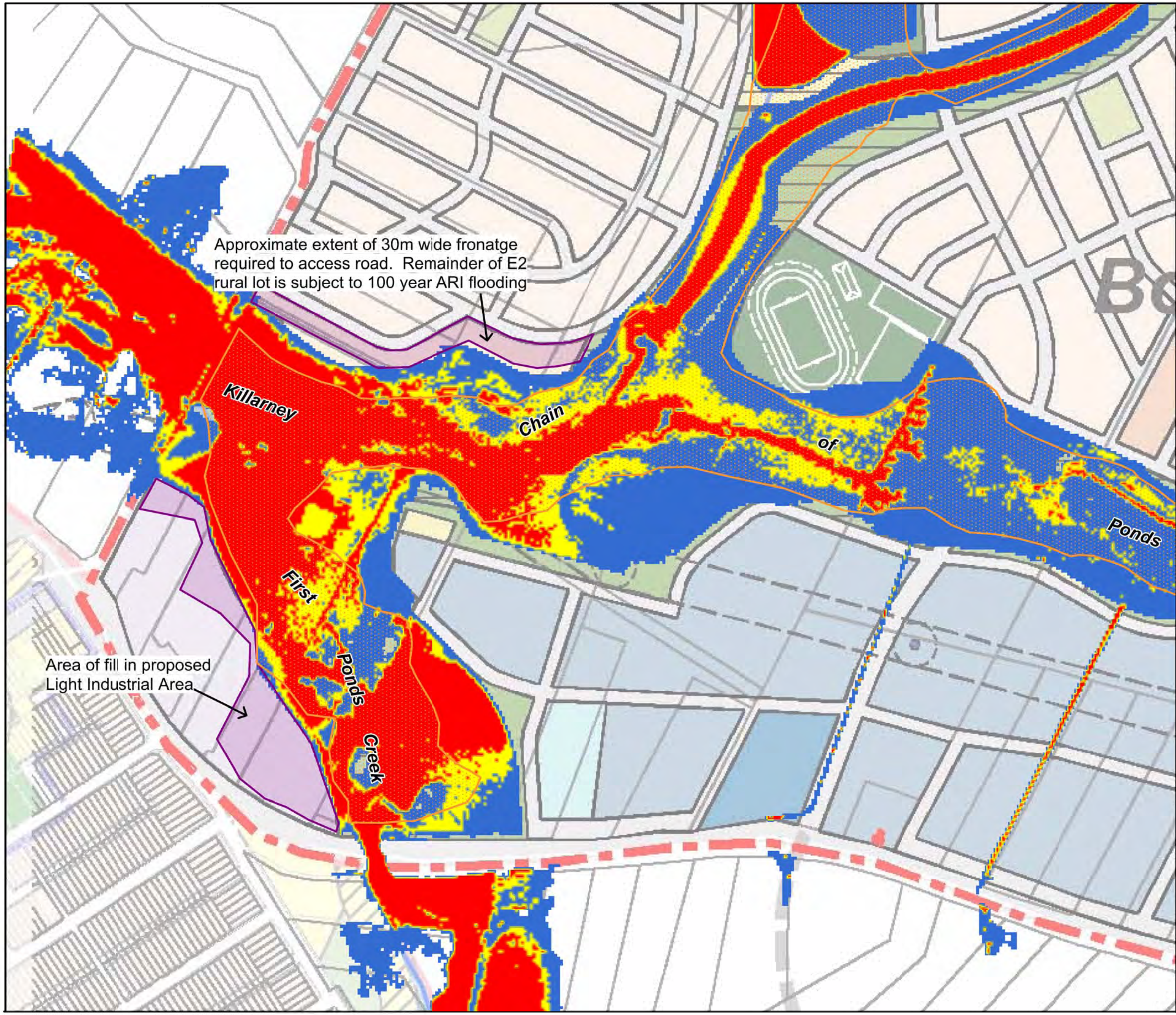
Existing Conditions				
Node	Pervious Area (ha)	Impervious Area (ha)	Total Area (ha)	% Impervious %
10.01	37.70	2.51	40.21	6.2
10.02	37.92	2.19	40.11	5.5
9.03	39.34	0.69	40.03	1.7
8.05	29.94	0.04	29.98	0.1
8.06	24.21	0.00	24.21	0.0
8.07	12.80	0.00	12.80	0.0
8.08	17.52	0.44	17.96	2.4
12.01	3.27	0.43	3.70	11.6
12.02	12.45	0.00	12.45	0.0
2.09	6.55	0.00	6.55	0.0
19.01	18.00	1.80	19.80	9.1
1.03	4.80	0.00	4.80	0.0
N6a	101.27	17.87	119.14	15.0
N5b	11.06	5.95	17.01	35.0
N5a	23.84	12.83	36.67	35.0
N4b	15.57	6.67	22.24	30.0
N4a	18.13	7.77	25.90	30.0
N3a	28.90	9.63	38.53	25.0
N2a	30.59	10.20	40.79	25.0
N1c	42.23	18.10	60.33	30.0
N1b	20.32	8.71	29.03	30.0
N1d	21.92	9.40	31.32	30.0
N1a	12.07	5.17	17.24	30.0
N1	0.00	0.00	0.00	0.0
N2	18.75	6.25	25.00	25.0
N3	31.71	10.57	42.28	25.0
N4	110.29	36.76	147.05	25.0
N5	129.57	69.77	199.34	35.0
N6	87.65	29.22	116.87	25.0
N7	64.00	22.10	86.10	25.7
1.02	6.50	0.00	6.50	0.0
20.01	10.40	1.05	11.45	9.2
21.01	8.47	2.25	10.72	21.0
1.04	0.80	0.18	0.98	18.4
N9	16.03	1.78	17.81	10.0
N10b	14.98	0.79	15.77	5.0
N10c	25.73	1.35	27.08	5.0
N10a	19.93	1.05	20.98	5.0
N10	9.47	0.50	9.97	5.0
N10.5	9.33	0.48	9.81	4.9
N11b	10.95	0.58	11.53	5.0
N11a	7.64	0.85	8.49	10.0
N11	7.07	0.79	7.86	10.1
N14	100.32	5.28	105.60	5.0
N13	27.24	1.43	28.67	5.0
N12c	18.64	0.98	19.62	5.0
N12b	28.00	1.47	29.47	5.0
N12a	22.70	1.19	23.89	5.0
N12	19.32	1.02	20.34	5.0
N15	67.39	7.49	74.88	10.0
Outlet	0.00	0.00	0.00	0.0

Post Development Conditions				
Node	**Pervious Area (ha)**	**Impervious Area (ha)**	**Total Area (ha)**	**% Impervious %**
N12c	18.64	0.98	19.62	5.0
N12b	28.00	1.47	29.47	5.0
N12a	22.70	1.19	23.89	5.0
N12	19.32	1.02	20.34	5.0
N11b	10.95	0.58	11.53	5.0
N11a	7.64	0.85	8.49	10.0
N9U	11.29	0.00	11.29	0.0
N9e	13.00	1.63	14.63	11.1
N9c	16.66	1.85	18.51	10.0
N9f	18.50	3.27	21.77	15.0
N9d	27.85	4.92	32.77	15.0
N9b	17.60	1.96	19.56	10.0
N9a	21.66	2.41	24.07	10.0
9.01	6.60	39.80	46.40	85.8
BH01A	7.60	29.40	37.00	79.5
10.01	4.00	26.50	30.50	86.9
10.02	10.90	36.00	46.90	76.8
BH01B	4.50	17.00	21.50	79.1
90.01	0.80	5.70	6.50	87.7
BH01C	4.90	1.60	6.50	24.6
92.01	1.90	14.30	16.20	88.3
91.01	0.50	3.30	3.80	86.8
9.04	4.40	0.20	4.60	4.3
8.01	5.60	35.40	41.00	86.3
BH02A	7.80	36.50	44.30	82.4
BH02B	2.90	0.20	3.10	6.5
80.01	2.10	15.10	17.20	87.8
BH04	15.00	11.70	26.70	43.8
8.03	2.90	0.20	3.10	6.5
8.04_d	0.00	0.00	0.00	0.0
8.05	3.80	0.20	4.00	5.0
82.01	1.50	11.10	12.60	88.1
8.06	2.30	0.10	2.40	4.2
23.01	4.70	27.30	32.00	85.3
11.01	24.70	8.80	33.50	26.3
11.02	7.70	3.00	10.70	28.0
22.01	1.50	11.00	12.50	88.0
22.02	0.70	5.40	6.10	88.5
BH03A	0.00	0.00	0.00	0.0
11.04	4.30	11.00	15.30	71.9
BH03B	7.00	0.80	7.80	10.3
8.07	0.00	0.00	0.00	0.0
86.01	1.50	10.90	12.40	87.9
8.08	5.90	0.30	6.20	4.8
18.01	2.20	16.50	18.70	88.2
81.01	2.20	14.80	17.00	87.1
83.01	0.60	4.50	5.10	88.2
84.01	1.50	1.60	3.10	51.6
84.01A	1.00	3.80	4.80	79.2

Post Development Conditions				
Node	Pervious Area (ha)	Impervious Area (ha)	Total Area (ha)	% Impervious %
BH05	4.20	1.10	5.30	20.8
2.01	46.10	0.00	46.10	0.0
3.01	44.00	1.80	45.80	3.9
2.02	68.50	2.50	71.00	3.5
4.01	7.43	2.48	9.91	25.0
2.03	38.00	4.20	42.20	10.0
4.01a	4.96	1.65	6.61	25.0
4.02	2.60	19.40	22.00	88.2
4.03	2.60	19.10	21.70	88.0
2.04	8.10	0.40	8.50	4.7
13.01	3.70	16.90	20.60	82.0
51.01	3.40	13.80	17.20	80.2
5.01	13.95	3.50	17.45	20.1
5.02	6.00	22.30	28.30	78.8
50.01	10.40	31.60	42.00	75.2
KC02A	3.40	10.70	14.10	75.9
D2	0.00	0.00	0.00	0.0
KC01A	17.50	5.40	22.90	23.6
14.01	3.30	1.10	4.40	25.0
14.02	1.20	8.40	9.60	87.5
KC01	6.00	0.30	6.30	4.8
15.01	4.10	13.40	17.50	76.6
16.01	2.50	8.40	10.90	77.1
KC02	8.70	0.50	9.20	5.4
6.01	16.30	2.40	18.70	12.8
6.02	4.60	17.30	21.90	79.0
17.01	5.30	5.70	11.00	51.8
2.07	3.80	0.20	4.00	5.0
7.01	28.10	3.00	31.10	9.6
7.02	3.10	11.60	14.70	78.9
2.08	4.80	0.60	5.40	11.1
12.01	3.30	1.00	4.30	23.3
12.02	3.20	14.70	17.90	82.1
2.09	7.10	0.40	7.50	5.3
2.1	0.00	0.00	0.00	0.0
19.01	1.90	13.10	15.00	87.3
1.03	6.80	0.40	7.20	5.6
N6a	101.27	17.87	119.14	15.0
N5b	11.06	5.95	17.01	35.0
N5a	23.84	12.83	36.67	35.0
N4b	15.57	6.67	22.24	30.0
N4a	18.13	7.77	25.90	30.0
N3a	28.90	9.63	38.53	25.0
N1c	42.23	18.10	60.33	30.0
N1b	20.32	8.71	29.03	30.0
N1d	21.92	9.40	31.32	30.0
N1a	12.07	5.17	17.24	30.0
N1	0.00	0.00	0.00	0.0
N2a	30.59	10.20	40.79	25.0
N2	18.75	6.25	25.00	25.0
N3	31.71	10.57	42.28	25.0

Post Development Conditions				
Node	**Pervious Area (ha)**	**Impervious Area (ha)**	**Total Area (ha)**	**% Impervious %**
N4	110.29	36.76	147.05	25.0
N5	129.57	69.77	199.34	35.0
N6	87.65	29.22	116.87	25.0
N7	64.00	20.00	84.00	23.8
1.02	9.50	0.50	10.00	5.0
20.01	0.80	5.20	6.00	86.7
20.02	5.00	7.30	12.30	59.3
21.01	0.70	5.90	6.60	89.4
1.04	5.90	0.30	6.20	4.8
N9	16.03	1.78	17.81	10.0
N10b	14.98	0.79	15.77	5.0
N10c	25.73	1.35	27.08	5.0
N10a	19.93	1.05	20.98	5.0
N10	9.47	0.50	9.97	5.0
N10.5	9.33	0.48	9.81	4.9
N11	7.07	0.79	7.86	10.1
N14	100.32	5.28	105.60	5.0
N13	27.24	1.43	28.67	5.0
N15	67.39	7.49	74.88	10.0
Outlet	0.00	0.00	0.00	0.0

APPENDIX C – FIGURES



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J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS
PO Box 4366 PENRITH WESTFIELD NSW 2750
P 02 4720 3300
F 02 4721 7638
W www.jwprince.com.au
E jwp@jwprince.com.au

LEGEND

Precinct Boundary

Floodway as determined in Post Exhibition report (June 2012)

Flood Fringe and Non-Flood Affected Areas (Public Exhibition report 2011)

HAZARD CATEGORISATION

LOW HAZARD

TRANSITION HAZARD

HIGH HAZARD

N S W E

Scale 1: 5,000 @ A3

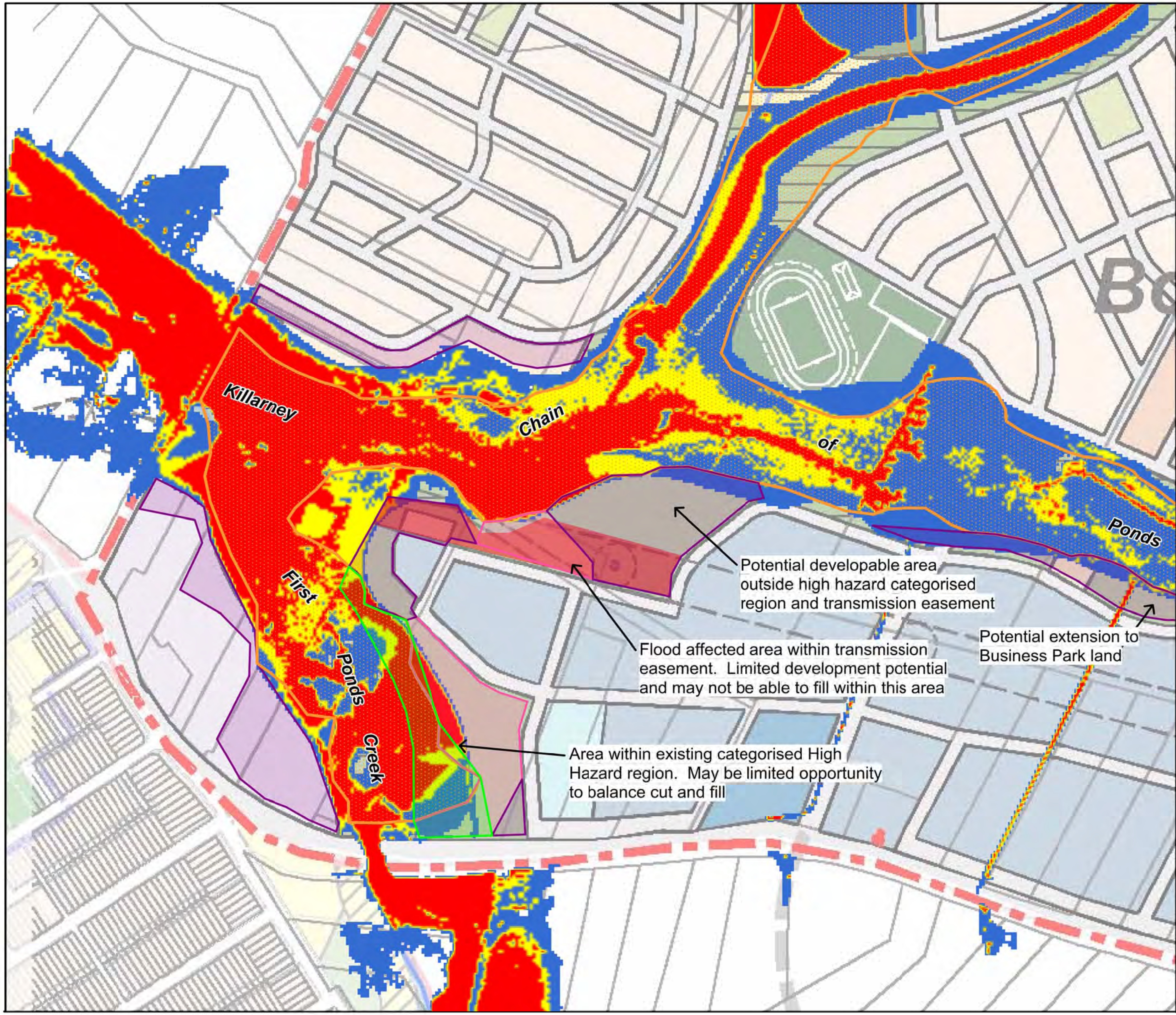
100 0 100 m

Figure 4.1
Box Hill/ Box Hill Industrial Precinct

Potential Developable Land and Flood Storage Areas

File Name:8979_2PE Fig4_1.wor

Date : 26/10/12 Issue : A



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PO Box 4366 PENRITH WESTFIELD NSW 2750
P 02 4720 3300
F 02 4721 7538
W www.jwprince.com.au
E jwp@jwprince.com.au

LEGEND

- Precinct Boundary
- Floodway as determined in Post Exhibition report (June 2012)
- Flood Fringe and Non-Flood Affected Areas (Public Exhibition report 2011)
- Flood Storage as determined in Public Exhibition report (2011)
- Area designated by submission to be cut for compensatory flood storage

HAZARD CATEGORISATION

- LOW HAZARD
- TRANSITION HAZARD
- HIGH HAZARD

N
W E
S

Scale 1: 5,000 @ A3

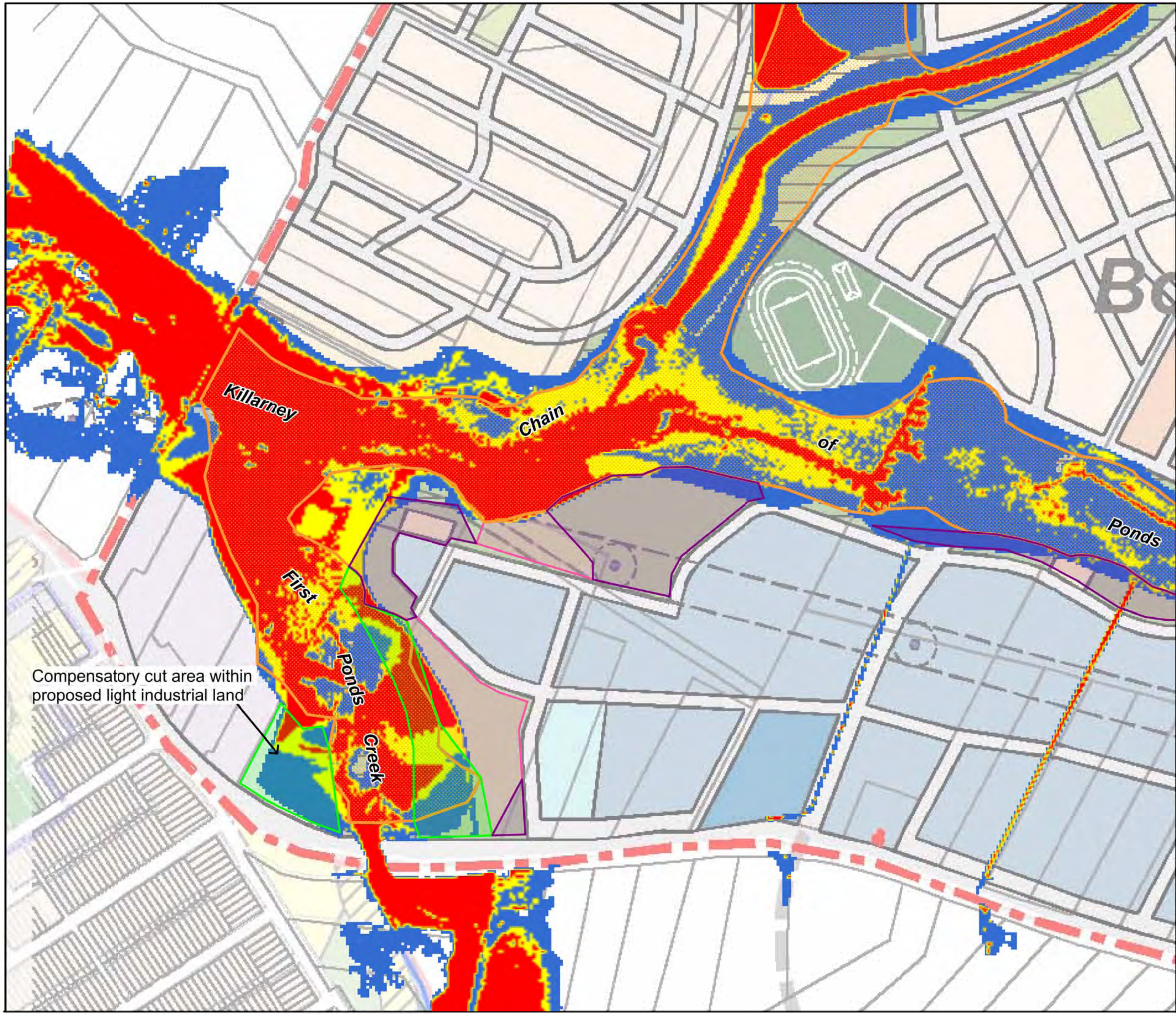
100 0 100 m

Figure 4.2
Box Hill/ Box Hill Industrial Precinct

Potential Developable Land and Flood Storage Areas Scenario 2

File Name: 8979_2PE Fig4.2.wor

Date : 26/10/12 Issue : A



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J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS
& PROJECT MANAGERS
PO Box 4366 PENRITH WESTFIELD NSW 2750
P 02 4720 3300
F 02 4721 7638
W www.jwprince.com.au
E jwp@jwprince.com.au

LEGEND

Precinct Boundary

Floodway as determined in Post Exhibition report (June 2012)

Flood Fringe and Non-Flood Affected Areas (Public Exhibition report 2011)

Flood Storage as determined in Public Exhibition report (2011)

Area designated by submission to be cut for compensatory flood storage

HAZARD CATEGORISATION

LOW HAZARD

TRANSITION HAZARD

HIGH HAZARD

N
W E
S

Scale 1: 5,000 @ A3

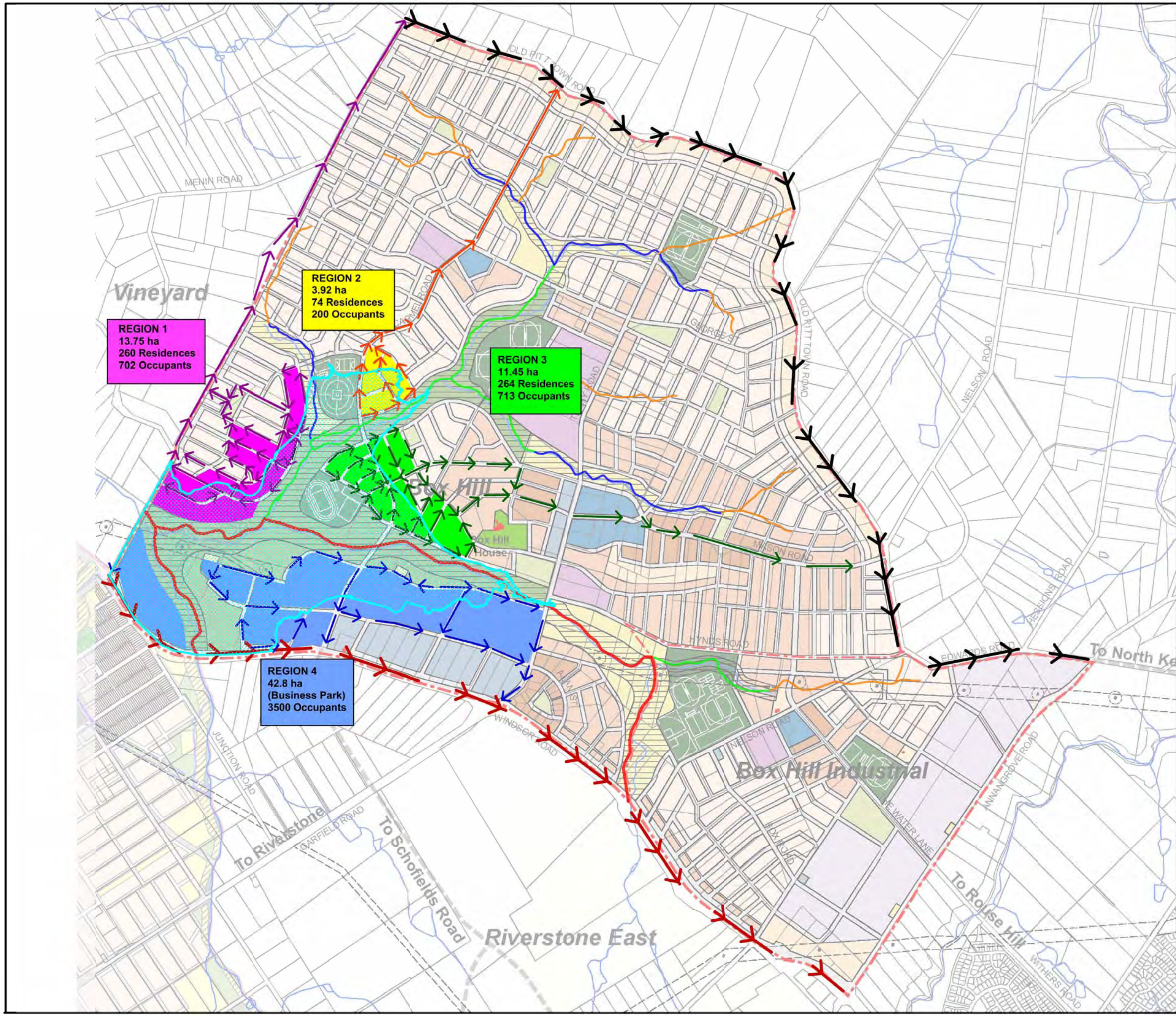
100 0 100 m

Figure 4.3
Box Hill/ Box Hill Industrial Precinct

Potential Developable Land and Flood Storage Areas Scenario 3

File Name:8979_2PE Fig4.3.wor

Date : 26/10/12 Issue : A



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J. WYNDHAM PRINCE

CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS

PO Box 4366 PENRITH WESTFIELD NSW 2750

P 02 4720 3300 W www.jwprince.com.au

F 02 4721 7638 E jwp@jwprince.com.au

LEGEND

REGIONAL FLOOD LEVEL - 26.4m

EVACUATION ZONE

- REGION 1
- REGION 2
- REGION 3
- REGION 4

EVACUATION ROUTES

- REGION 1
- REGION 2
- REGION 3
- REGION 4

REGIONAL MAIN EVACUATION ROUTES

- OLD PITT TOWN ROAD
- WINDSOR ROAD

NOTE:
NUMBERS RELATED TO FLOOD AFFECTED LOTS ONLY

N W E S

Scale 1: 17,000 @ A3

500 0 m

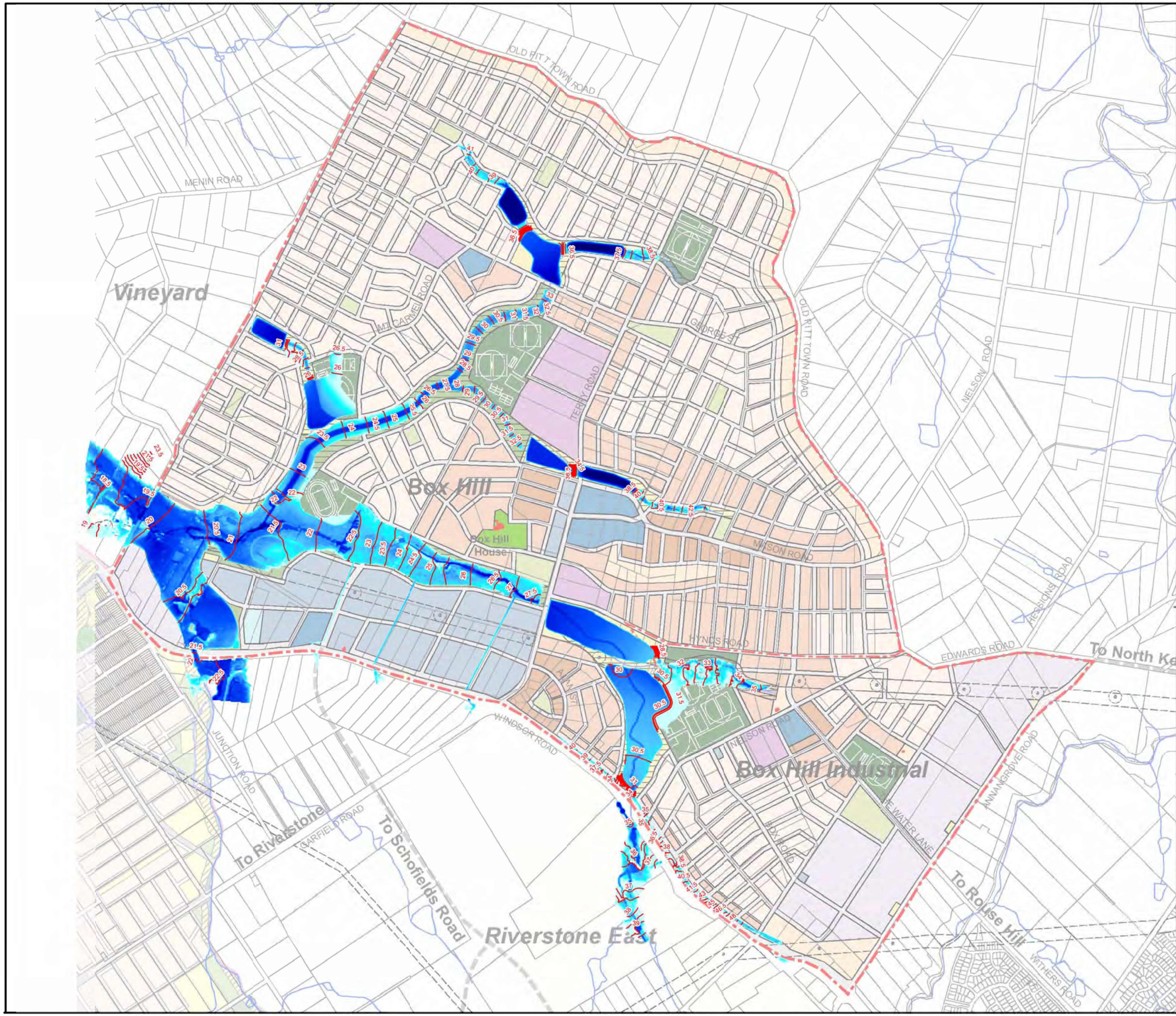
Figure 4.4

Box Hill/Box Hill Industrial Precinct

Evacuation Plan for Regional PMF Event

File Name: 8979_2PE_Evacuation_Plan

Date : 29/10/2012 Issue : A



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J. WYNDHAM PRINCE

CONSULTING CIVIL INFRASTRUCTURE ENGINEERS
& PROJECT MANAGERS
PO Box 4366 PENRITH WESTFIELD NSW 2750
P 02 4720 3300 W www.jwprince.com.au
F 02 4721 7638 E jwp@jwprince.com.au

LEGEND

Precinct Boundary

FLOOD DEPTH (m)

- 0.0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

FLOOD LEVEL CONTOURS (0.5m INTERVAL)

N W E S

Scale 1: 17,000 @ A3

500 0 m

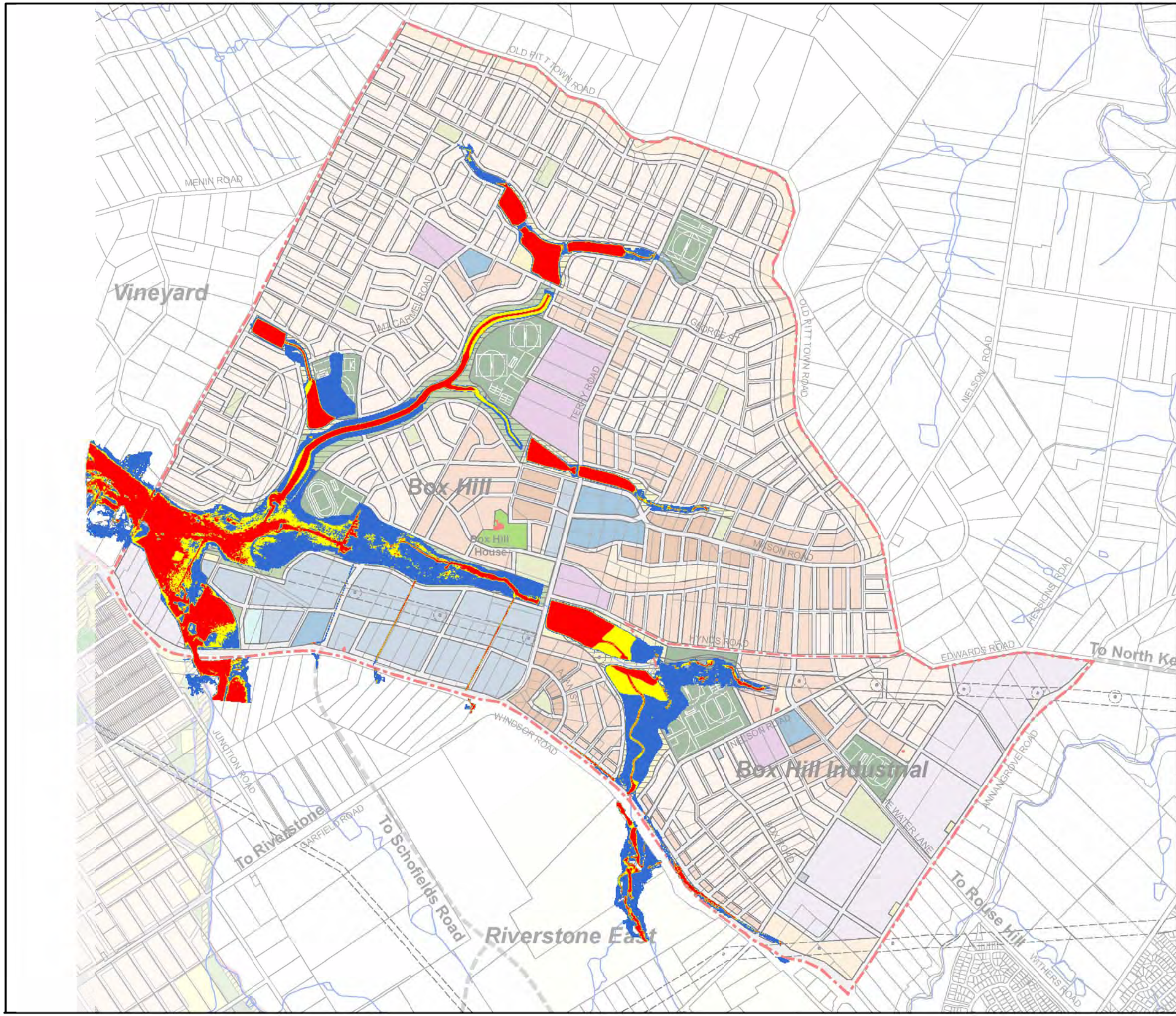
Figure 6.1

Box Hill/Box Hill Industrial Precinct

100 Year ARI Developed Condition Flood Depth and Level Profile

Scenario 1

File Name: 8979_Fig6.1_2PE_100y_FD
Date : 29/10/12 Issue A



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& PROJECT MANAGERS
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F 02 4721 7638
W www.jwprince.com.au
E jwp@jwprince.com.au

LEGEND

Precinct Boundary

HAZARD CATEGORISATION

LOW HAZARD

TRANSITION HAZARD

HIGH HAZARD

N W E S

Scale 1: 17,000 @ A3

500 0 m

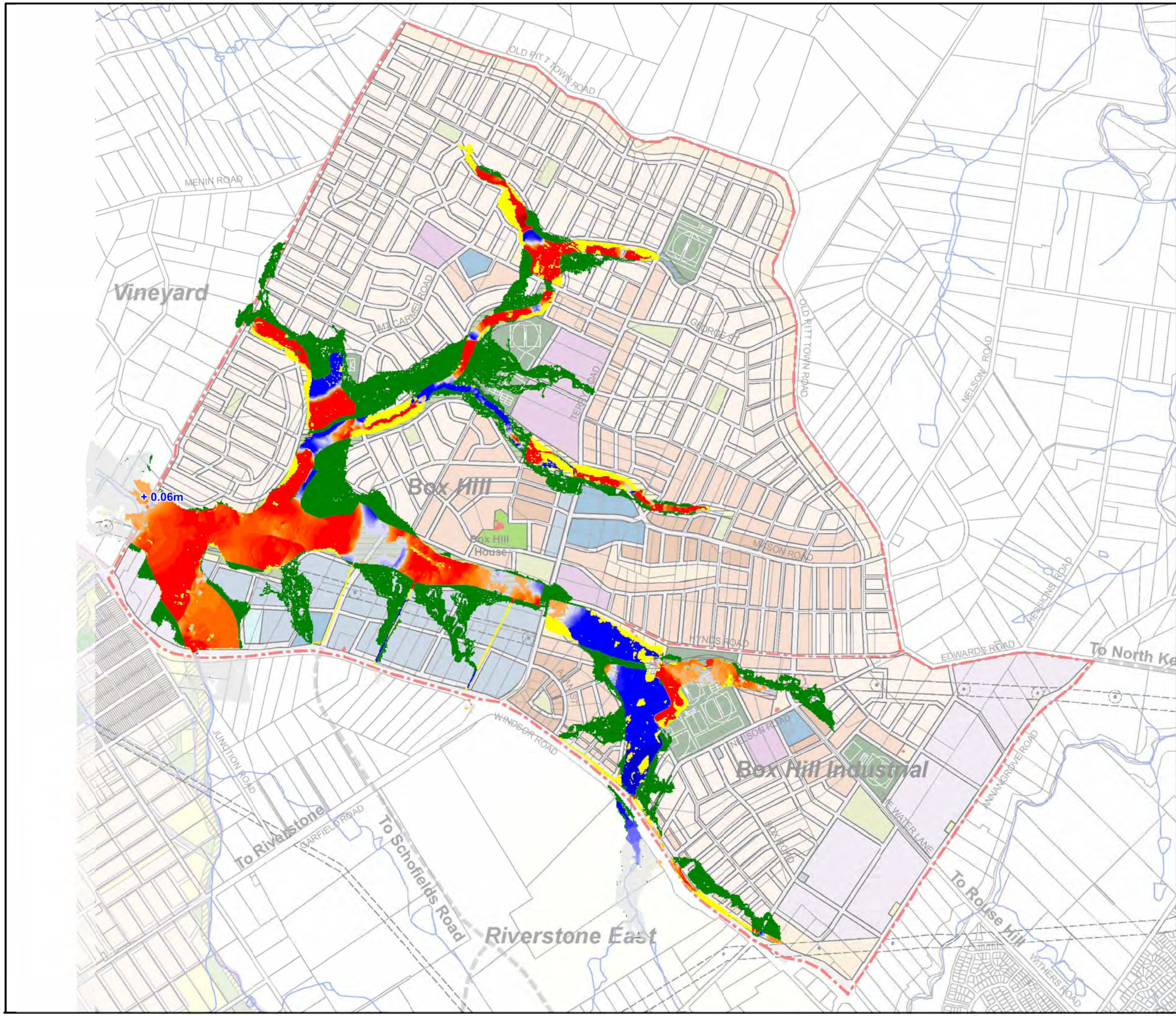
Figure 6.2

Box Hill/Box Hill Industrial Precinct

100 Year ARI Developed Conditions Hazard Profile

Scenario 1

File Name: 8979 Fig6.2_2PE 100y Z1
Date : 29/10/12 Issue A



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LEGEND

PRECINCT BOUNDARY

INCREASE IN FLOOD LEVELS (m)

-0.2+
-0.18
-0.16
-0.14
-0.12
-0.10
-0.08
-0.06
-0.04
-0.02
0
0.02
0.04
0.06
0.08
0.10
0.12
0.14
0.16
0.18
0.2+

AREAS NOW FLOOD FREE
AREAS NOW FLOOD AFFECTED

N W E S

Scale 1: 17,000 @ A3

500 0 m

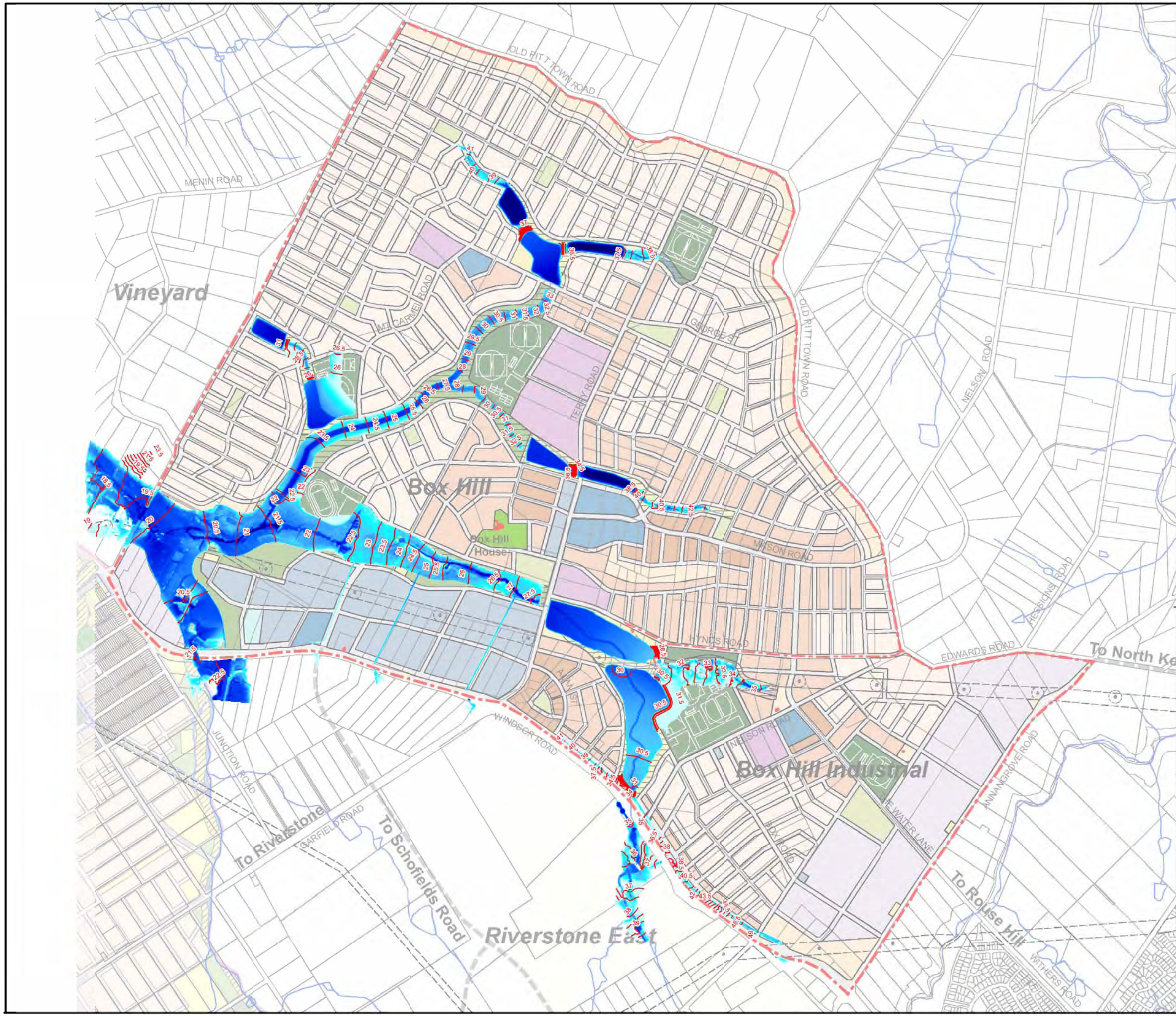
Figure 6.3

Box Hill/Box Hill Industrial Precinct

100 Year ARI Flood Difference Map Pre-Post Development

Scenario 1

File Name: 8979_Fig6.3_2PE_100y_FDiff
Date : 26/10/12 Issue A



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& PROJECT MANAGERS
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P 02 4720 3300 W www.jwprince.com.au
F 02 4721 7638 E jwp@jwprince.com.au

LEGEND

Precinct Boundary

FLOOD DEPTH (m)

- 0.0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

FLOOD LEVEL CONTOURS (0.5m INTERVAL)

N W E S

Scale 1: 17,000 @ A3

500 0 m

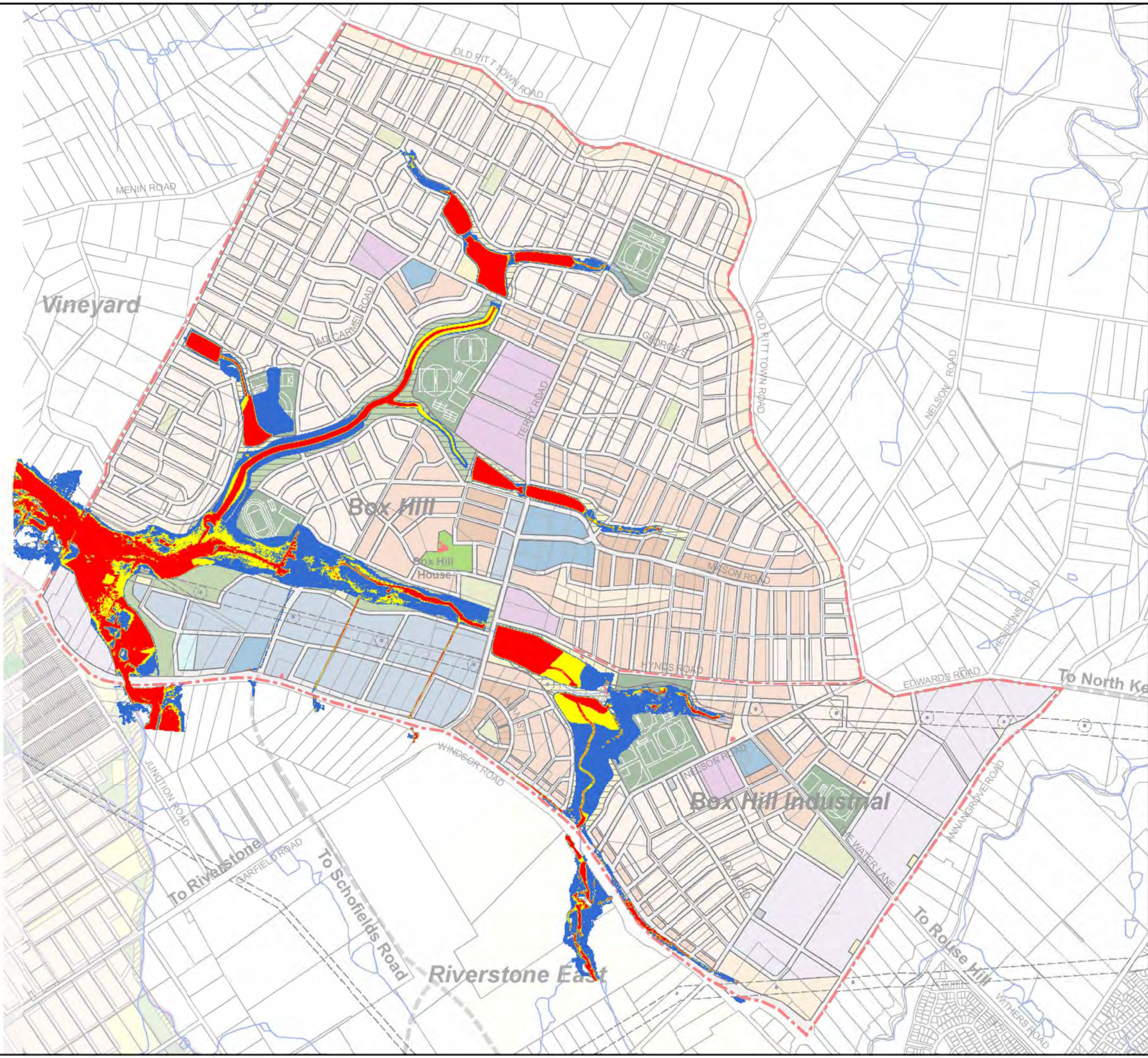
Figure 6.4

Box Hill/Box Hill Industrial Precinct

100 Year ARI Developed Condition Flood Depth and Level Profile

Scenario 2

File Name: 8979_Fig6.4_2PE_100y_FD
Date : 29/10/12 Issue : A



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LEGEND

Precinct Boundary

HAZARD CATEGORISATION

LOW HAZARD

TRANSITION HAZARD

HIGH HAZARD

N W E S

Scale 1: 17,000 @ A3

500 0 m

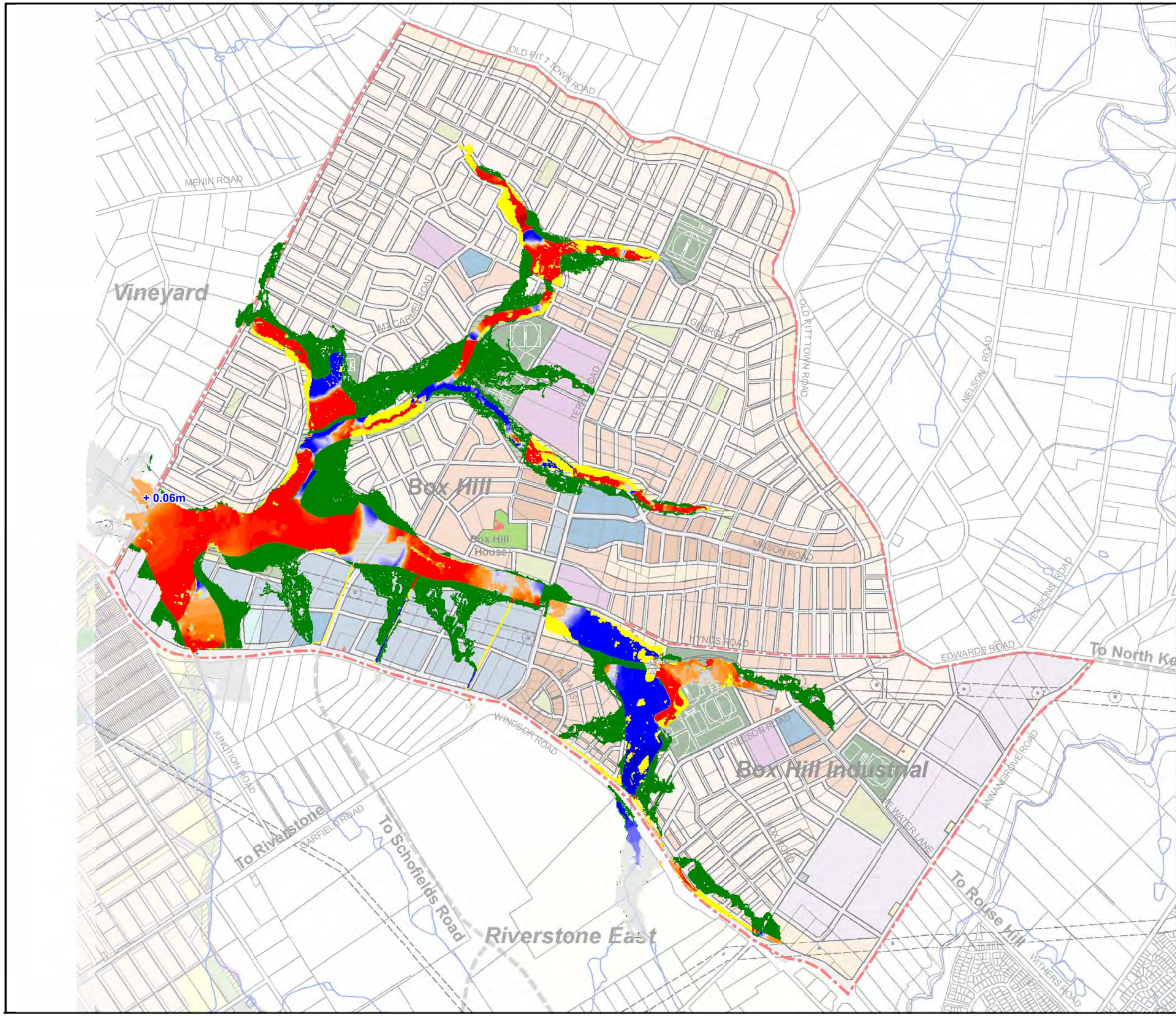
Figure 6.5

Box Hill/Box Hill Industrial Precinct

100 Year ARI Developed Conditions Hazard Profile

Scenario 2

File Name: 8979 Fig6.5_2PE 100y Z1
Date : 29/10/12 Issue A



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P 02 4720 3300
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LEGEND

PRECINCT BOUNDARY

INCREASE IN FLOOD LEVELS (m)

- -0.2+
- -0.18
- -0.16
- -0.14
- -0.12
- -0.10
- -0.08
- -0.06
- -0.04
- -0.02
- 0
- 0.02
- 0.04
- 0.06
- 0.08
- 0.10
- 0.12
- 0.14
- 0.16
- 0.18
- 0.2+

AREAS NOW FLOOD FREE

AREAS NOW FLOOD AFFECTED

N
W E
S

Scale 1: 17,000 @ A3

500 0 m

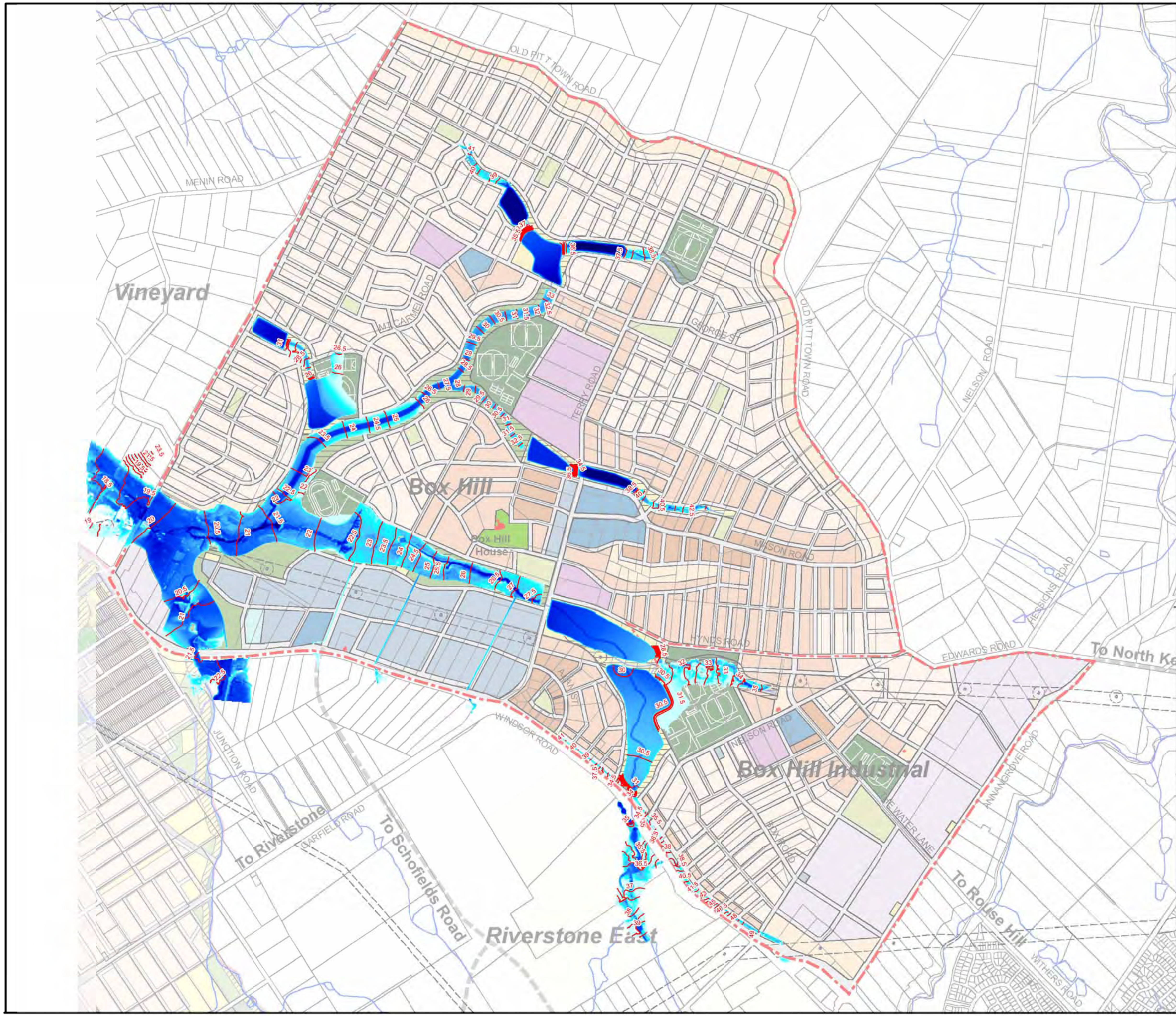
Figure 6.6

Box Hill/Box Hill Industrial Precinct

100 Year ARI
Flood Difference Map
Pre-Post Development

Scenario 2

File Name: 8979_Fig6.6_2PE_100y_FDiff
Date : 26/10/12 Issue A



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P 02 4720 3300
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E jwp@jwprince.com.au

LEGEND

Precinct Boundary

FLOOD DEPTH (m)

- 0.0 to 0.1
- 0.1 to 0.2
- 0.2 to 0.3
- 0.3 to 0.5
- 0.5 to 1.0
- 1.0 to 2.0
- 2.0 +

FLOOD LEVEL CONTOURS (0.5m INTERVAL)

N
W E
S

Scale 1: 17,000 @ A3

500 0 m

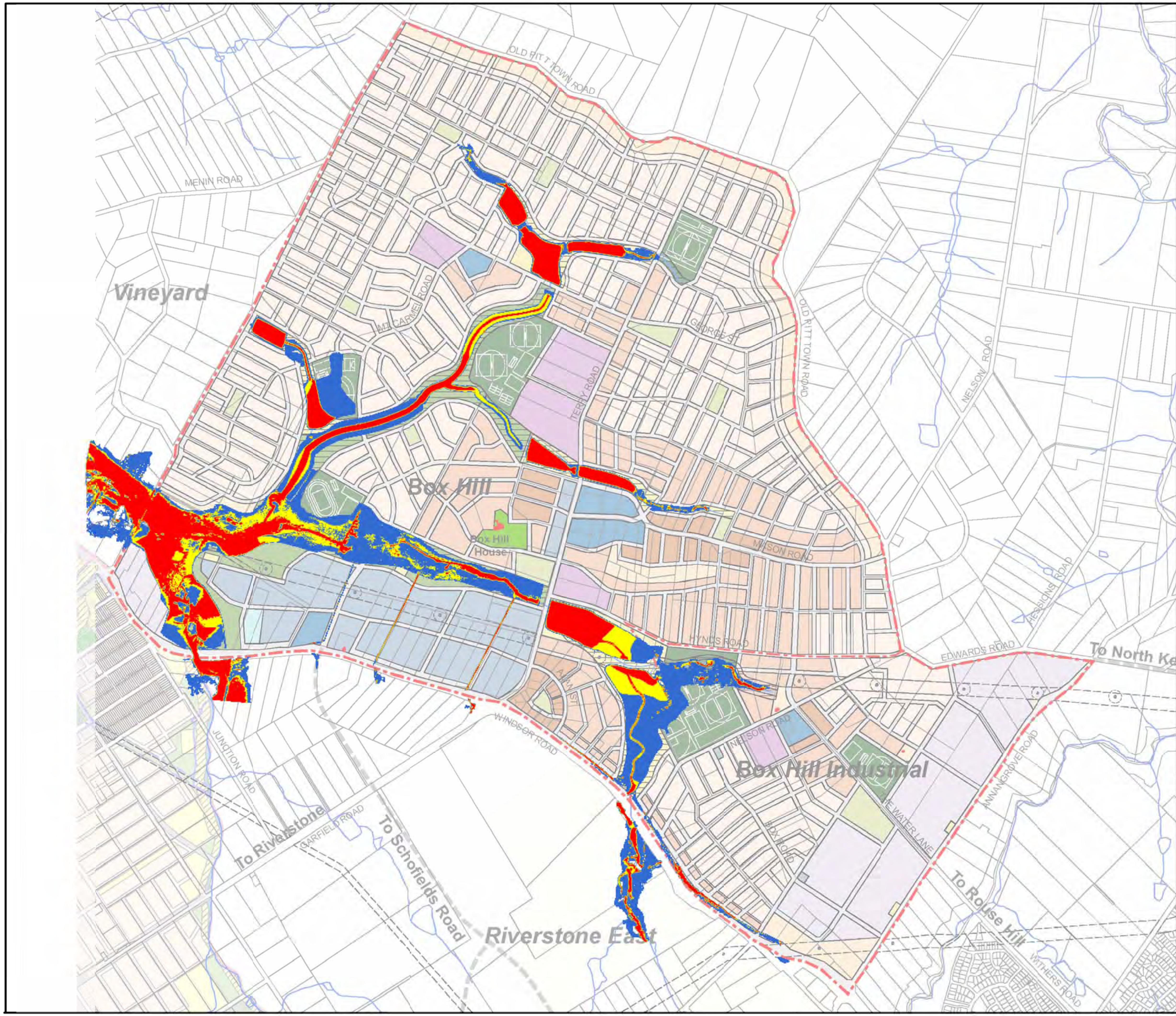
Figure 6.7

Box Hill/Box Hill Industrial Precinct

100 Year ARI
Developed Condition
Flood Depth and
Level Profile

Scenario 3

File Name: 8979_Fig6.7_2PE_100y_FD
Date : 29/10/12 Issue A



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LEGEND

Precinct Boundary

HAZARD CATEGORISATION

LOW HAZARD

TRANSITION HAZARD

HIGH HAZARD

N
W E
S

Scale 1: 17,000 @ A3

500 0 m

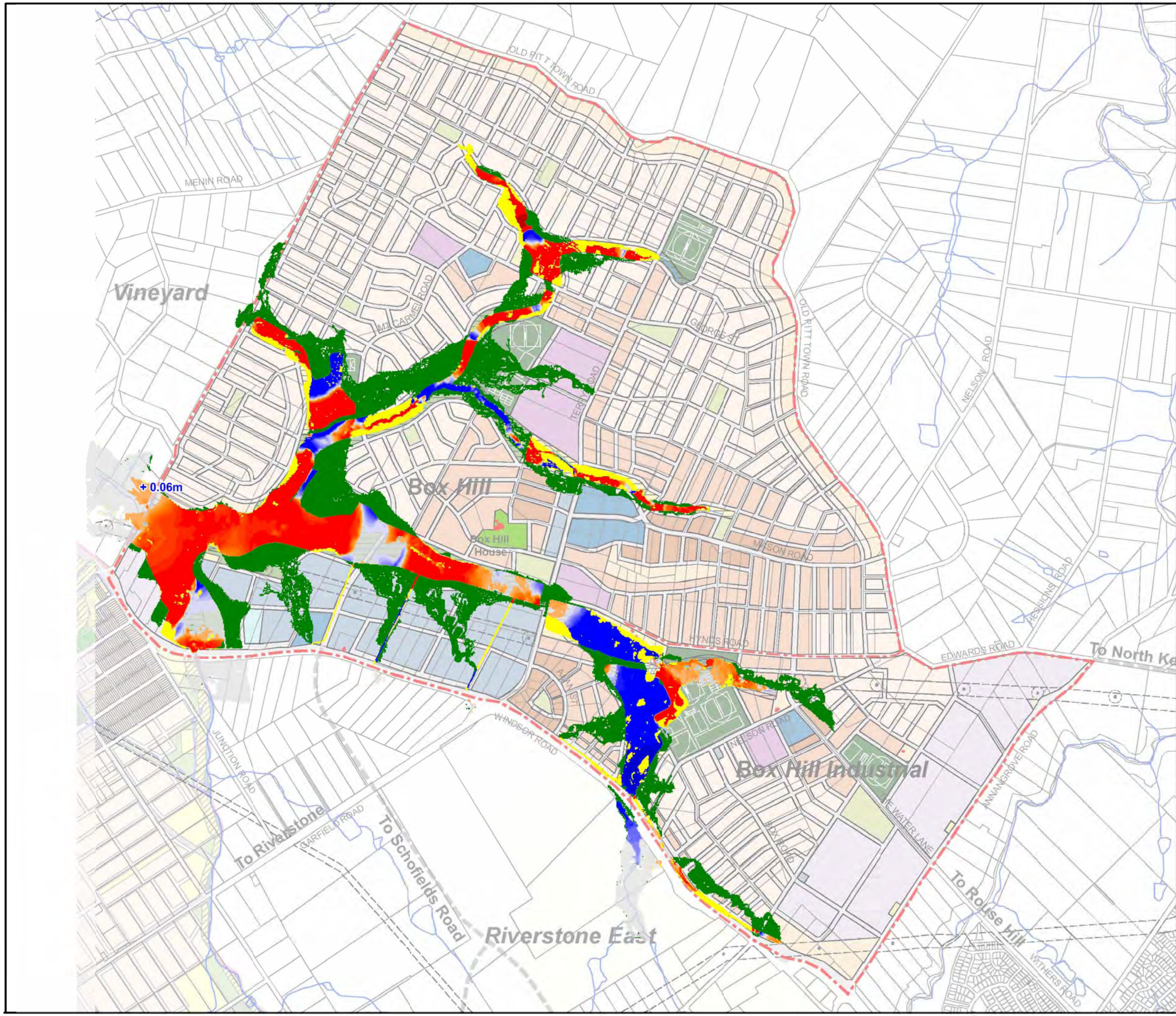
Figure 6.8

Box Hill/Box Hill Industrial Precinct

100 Year ARI Developed Conditions Hazard Profile

Scenario 3

File Name: 8979 Fig6.8_2PE 100y Z1
Date : 29/10/12 Issue A



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LEGEND

PRECINCT BOUNDARY

INCREASE IN FLOOD LEVELS (m)

- -0.2+
- -0.18
- -0.16
- -0.14
- -0.12
- -0.10
- -0.08
- -0.06
- -0.04
- -0.02
- 0
- 0.02
- 0.04
- 0.06
- 0.08
- 0.10
- 0.12
- 0.14
- 0.16
- 0.18
- 0.2+

AREAS NOW FLOOD FREE

AREAS NOW FLOOD AFFECTED

N W E S

Scale 1: 17,000 @ A3

500 0 m

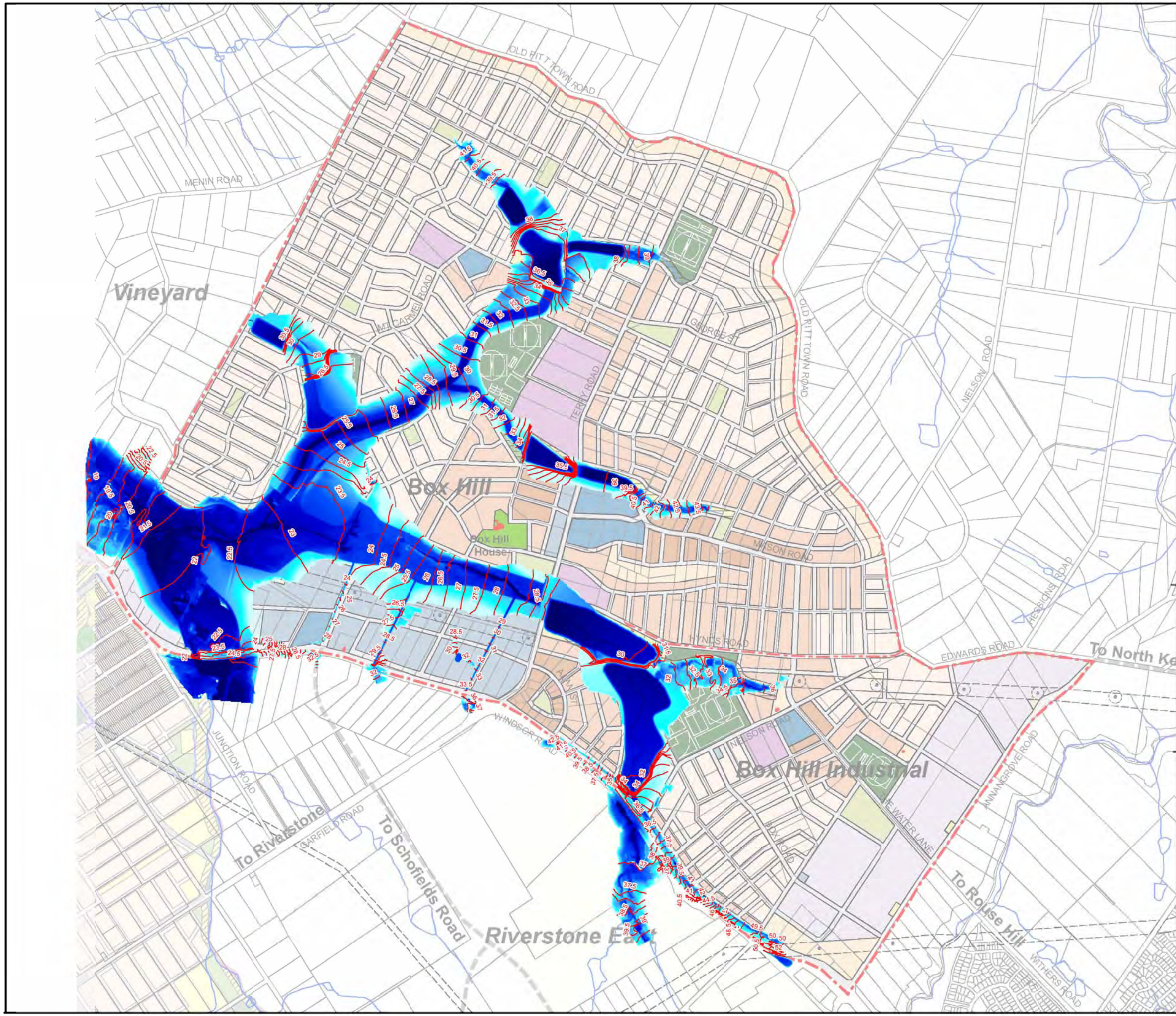
Figure 6.9

Box Hill/Box Hill Industrial Precinct

100 Year ARI Flood Difference Map Pre-Post Development

Scenario 3

File Name: 8979_Fig6.9_2PE_100y_FDiff
Date : 29/10/12 Issue A



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LEGEND

Precinct Boundary

FLOOD DEPTH (m)

0.0 to 0.1
0.1 to 0.2
0.2 to 0.3
0.3 to 0.5
0.5 to 1.0
1.0 to 2.0
2.0 +

FLOOD LEVEL CONTOURS (0.5m INTERVAL)

N W E S

Scale 1: 17,000 @ A3

500 0 m

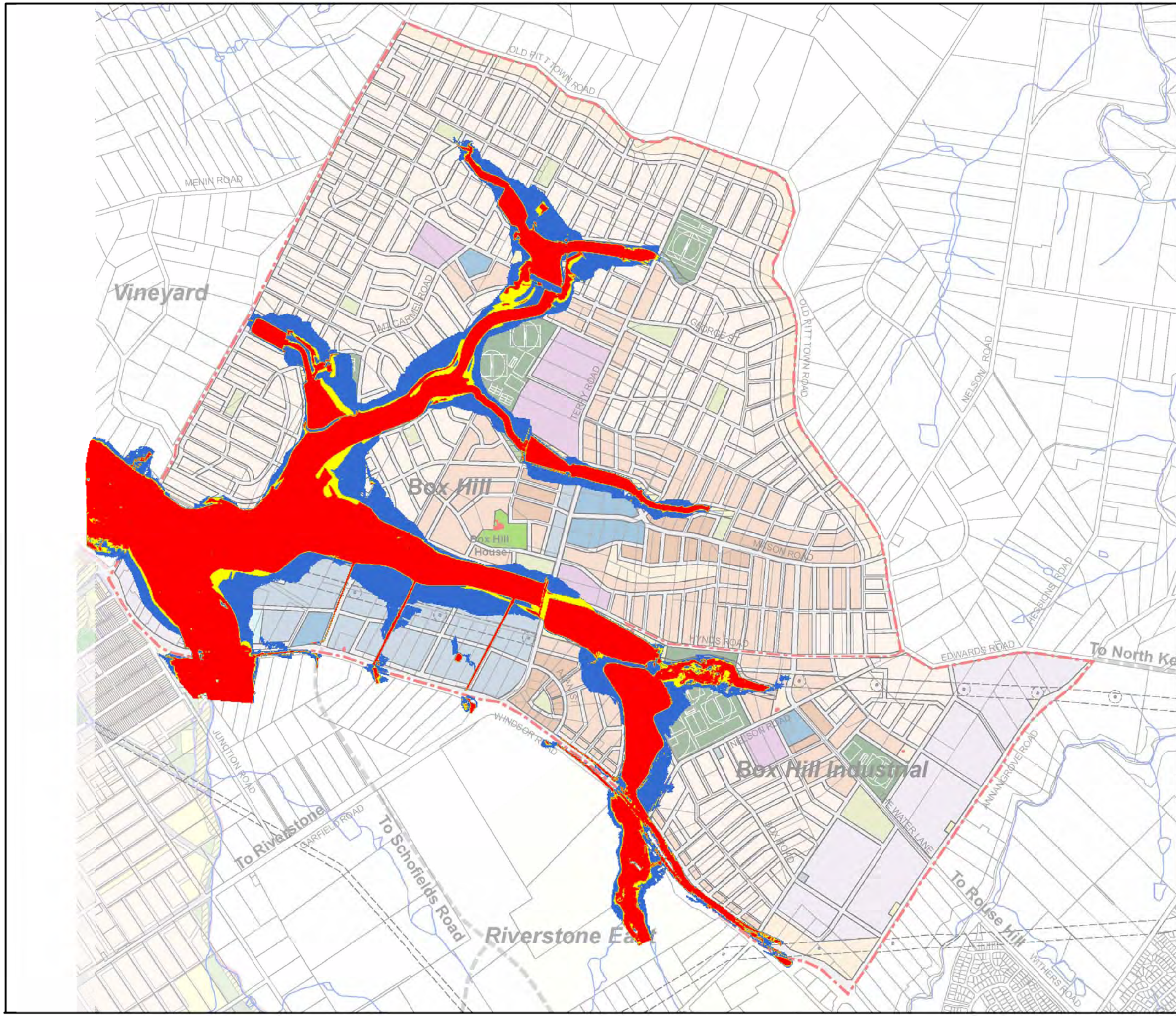
Figure 6.10

Box Hill/Box Hill Industrial Precinct

PMF
Developed Condition
Flood Depth and
Level Profile

Scenario 1

File Name: 8979_Fig6.10_2PE_PMF_FD
Date : 29/10/12 Issue A



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F 02 4721 7638 E jwp@jwprince.com.au

LEGEND

Precinct Boundary

HAZARD CATEGORISATION

LOW HAZARD

TRANSITION HAZARD

HIGH HAZARD

N S W E

Scale 1: 17,000 @ A3

500 0 m

Figure 6.11

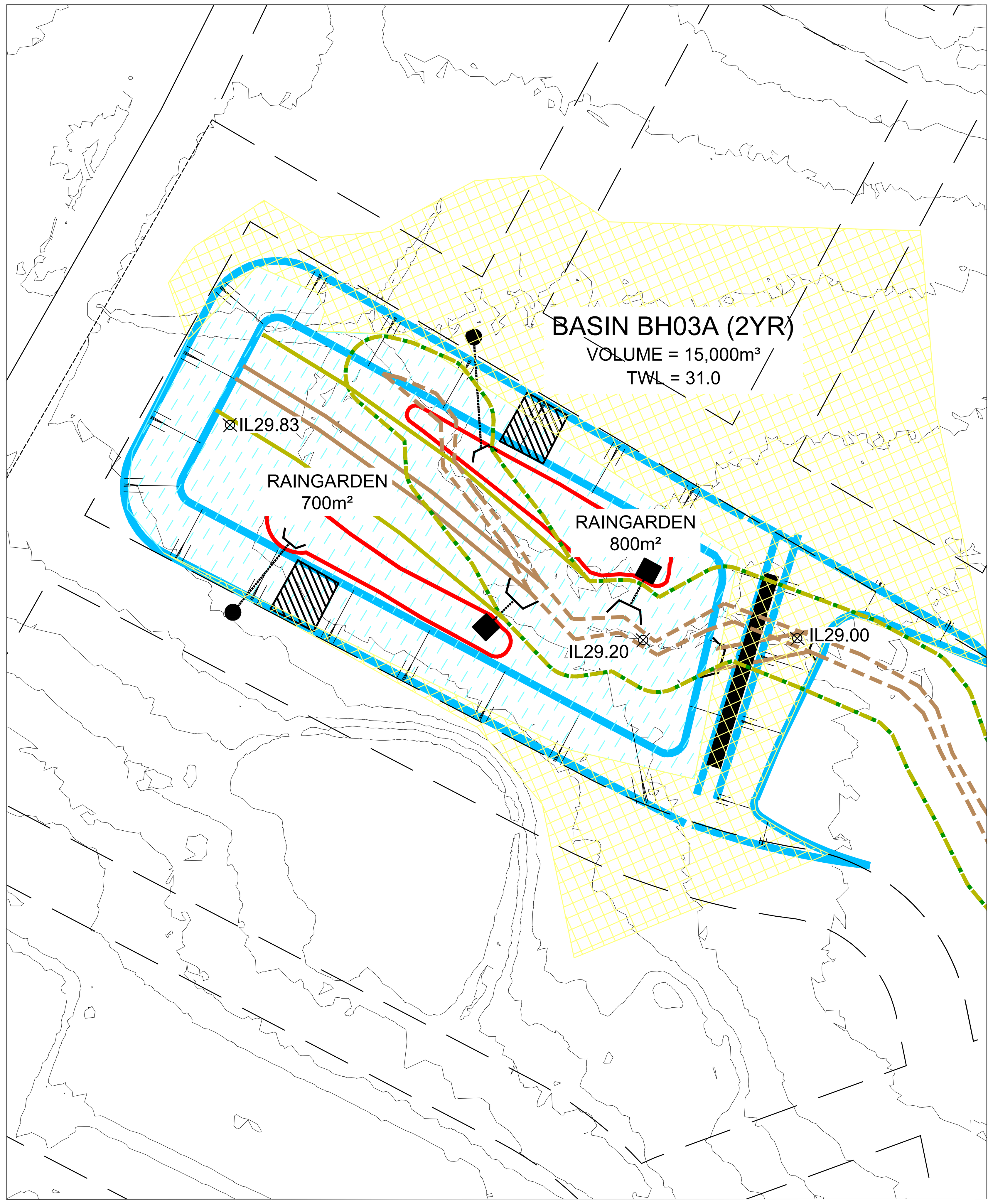
Box Hill/Box Hill Industrial Precinct

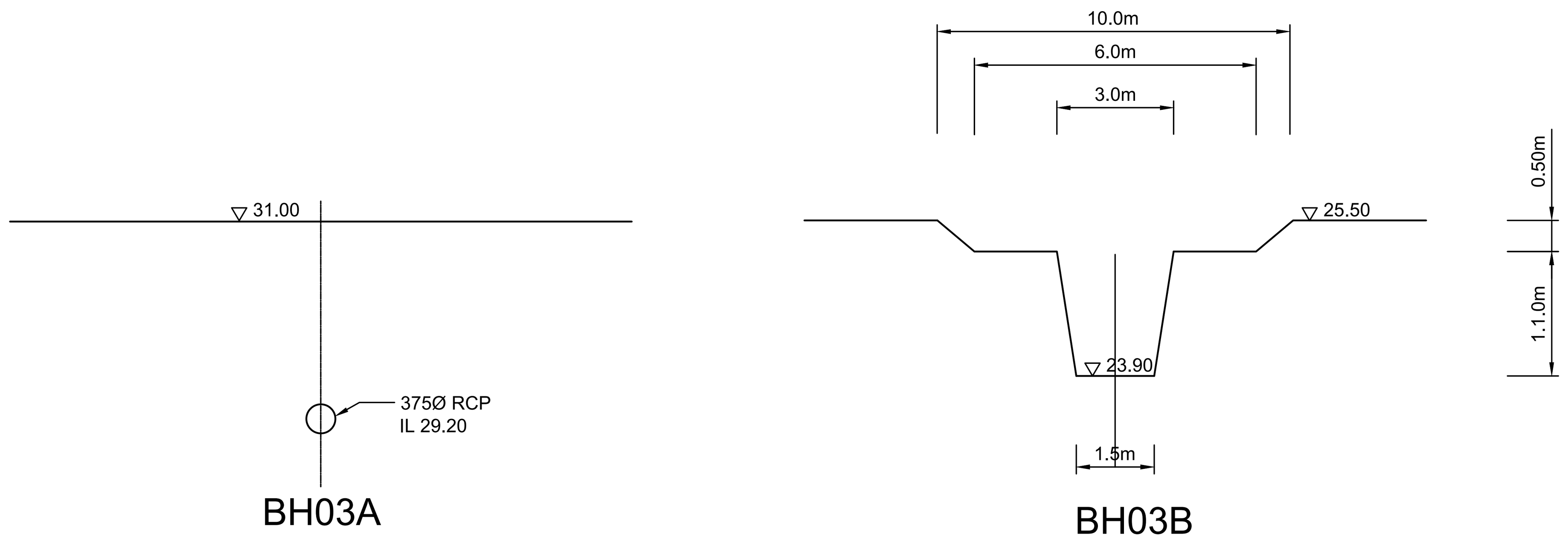
PMF
Developed Conditions
Hazard Profile

Scenario 1

File Name: 8979 Fig6.11 2PE PMF Z1
Date : 29/10/12 Issue A

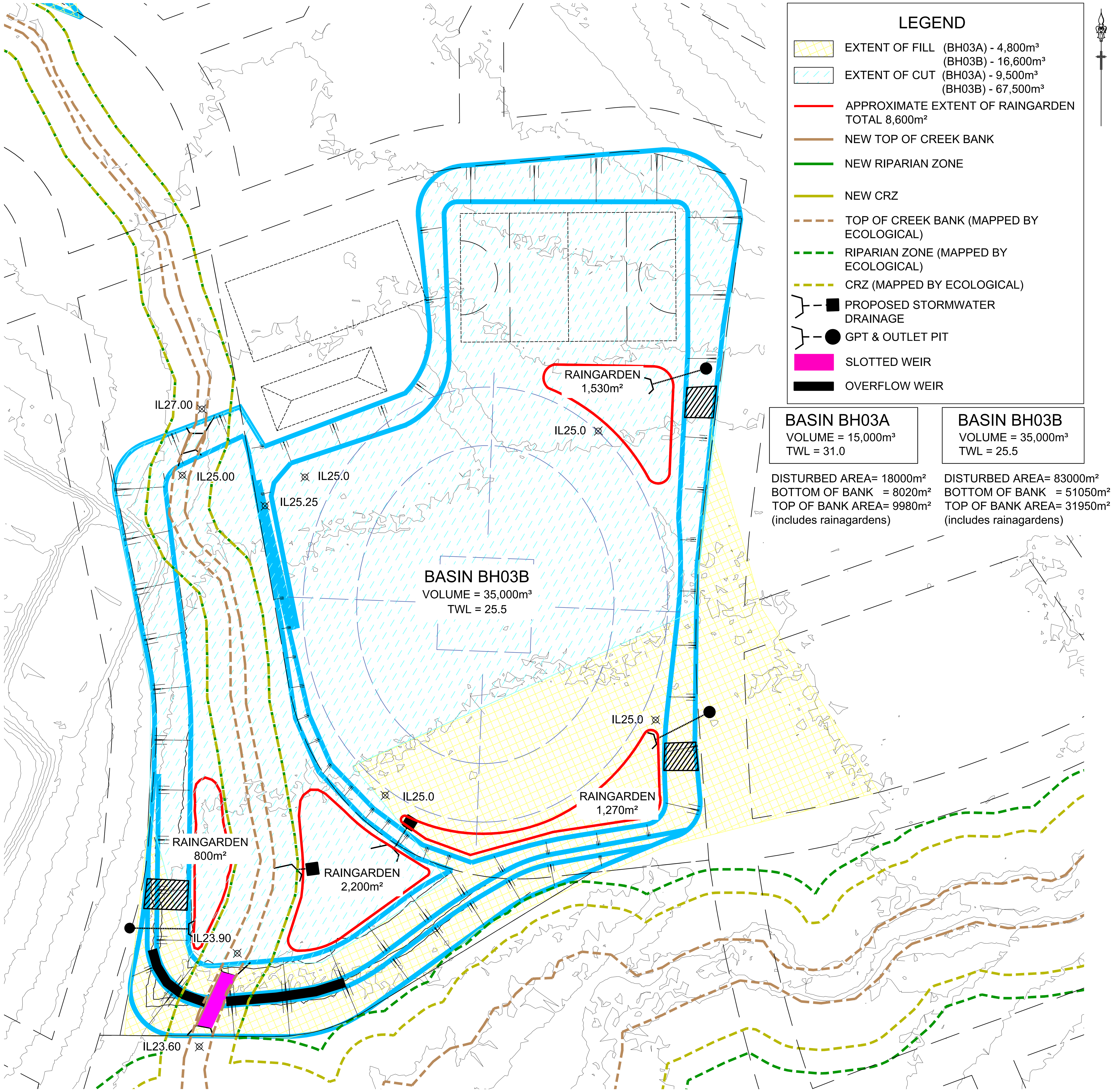
APPENDIX D – PRELIMINARY COST ESTIMATES





BASIN OUTLET ARRANGEMENTS

N.T.S.



LEGEND

- EXTENT OF FILL (BH03A) - 4,800m³ (BH03B) - 16,600m³
- EXTENT OF CUT (BH03A) - 9,500m³ (BH03B) - 67,500m³
- APPROXIMATE EXTENT OF RAINGARDEN TOTAL 8,600m²
- NEW TOP OF CREEK BANK
- NEW RIPARIAN ZONE
- NEW CRZ
- TOP OF CREEK BANK (MAPPED BY ECOLOGICAL)
- RIPARIAN ZONE (MAPPED BY ECOLOGICAL)
- CRZ (MAPPED BY ECOLOGICAL)
- PROPOSED STORMWATER DRAINAGE
- GPT & OUTLET PIT
- SLOTTED WEIR
- OVERFLOW WEIR

BASIN BH03A	BASIN BH03B
VOLUME = 15,000m³	VOLUME = 35,000m³
TWL = 31.0	TWL = 25.5

DISTURBED AREA= 18000m²	DISTURBED AREA= 83000m²
BOTTOM OF BANK = 8020m²	BOTTOM OF BANK = 51050m²
TOP OF BANK AREA= 9980m²	TOP OF BANK AREA= 31950m²
(includes rainagardens)	(includes rainagardens)

1:1000 (AT A1)

20 10 0 10 20 30 40 50 60 70 80 90 100

METRES

F	BASIN OUTLET DETAIL BH03B AMENDED, BASIN NOTE AMENDED	MS	MS			21/11/12
E	MASTER PLAN UPDATED DISTURBED AREAS ADDED CUT/FILL REVISED	MS	DP	MS		15/05/12
D	CARPARK SHOWN	MS	BT	DC		26/04/12
C	MINOR AMENDMENT	MS	MT	DC		14/02/11
B	FILL, ACCESS, BATTER, GPT AND ROAD AMENDED	MS	JT	DC		09/02/11
A	FIRST ISSUE	MS	AS			29/01/11
	AMENDMENT	DES	DRN	CKD	APR	DATE

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BOX HILL INDUSTRIAL PRECINCT

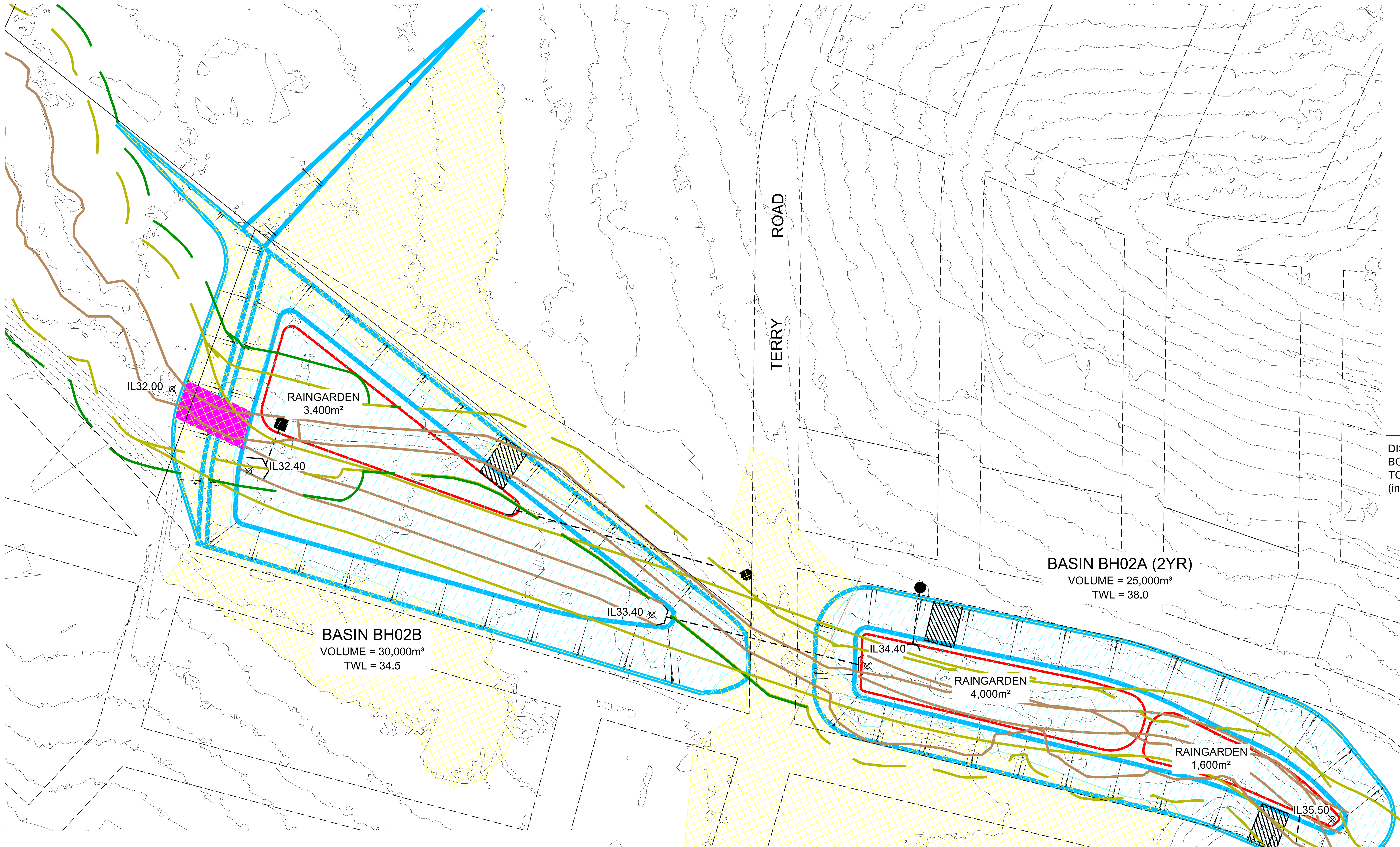
BASIN BH03A & BH03B

PLAN No: 8979/SK07 F

FILE No: 8979SK07

SHEET SIZE: A1 ORIGINAL

Plotted: 21 November , 2012 3:19:57 PM File Name: J:\8979D\SK - Concept Sketch Designs\8979SK07.dwg



LEGEND

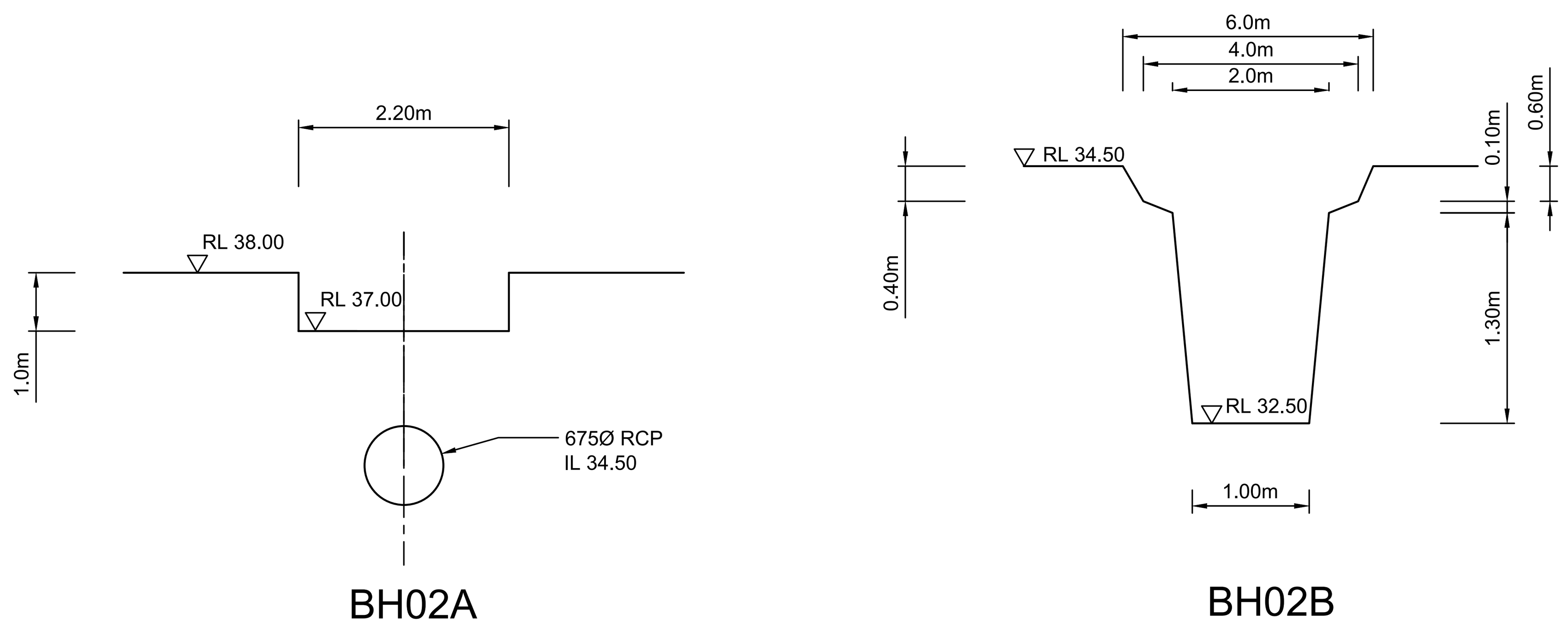
- EXTENT OF FILL (BH02A) - 31,300m³ (BH02B) - 31,600m³
- EXTENT OF CUT (BH02A) - 27,300m³ (BH02B) - 25,700m³
- APPROXIMATE EXTENT OF RAINGARDEN TOTAL 10,000m²
- NEW TOP OF CREEK BANK
- NEW RIPARIAN ZONE
- NEW CRZ
- TOP OF CREEK BANK (MAPPED BY ECOLOGICAL)
- RIPARIAN ZONE (MAPPED BY ECOLOGICAL)
- CRZ (MAPPED BY ECOLOGICAL)
- PROPOSED STORMWATER DRAINAGE
- GPT & OUTLET PIT
- SLOTTED WEIR

BASIN BH02A
VOLUME = 25,000m³
TWL = 38.0

DISTURBED AREA= 41700m²
BOTTOM OF BANK = 6645m²
TOP OF BANK AREA= 35055m²
(includes rainagardens)

BASIN BH02B
VOLUME = 30,000m³
TWL = 34.5

DISTURBED AREA= 44000m²
BOTTOM OF BANK = 11725m²
TOP OF BANK AREA= 32275m²
(includes rainagardens)



BASIN OUTLET ARRANGEMENTS
N.T.S.

1:1000 (AT A1) 20 10 0 10 20 30 40 50 60 70 80 90 100 METRES

	AMENDMENT	DES	DRN	CKD	APR	DATE
E	BASIN OUTLET DETAIL BH02B AMENDED, BASIN NOTE AMENDED	MS	MS			21/11/12
D	MASTER PLAN UPDATED DISTURBED AREAS ADDED CUT/FILL REVISED	MS	DP	MS		15/05/12
C	VOLUMES AMENDED	MS	BT	DC		26/04/12
B	FILL, ACCESS AND GPT AMENDED	MS	MS	DC		09/02/11
A	FIRST ISSUE	MS	AS			29/01/11

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CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS
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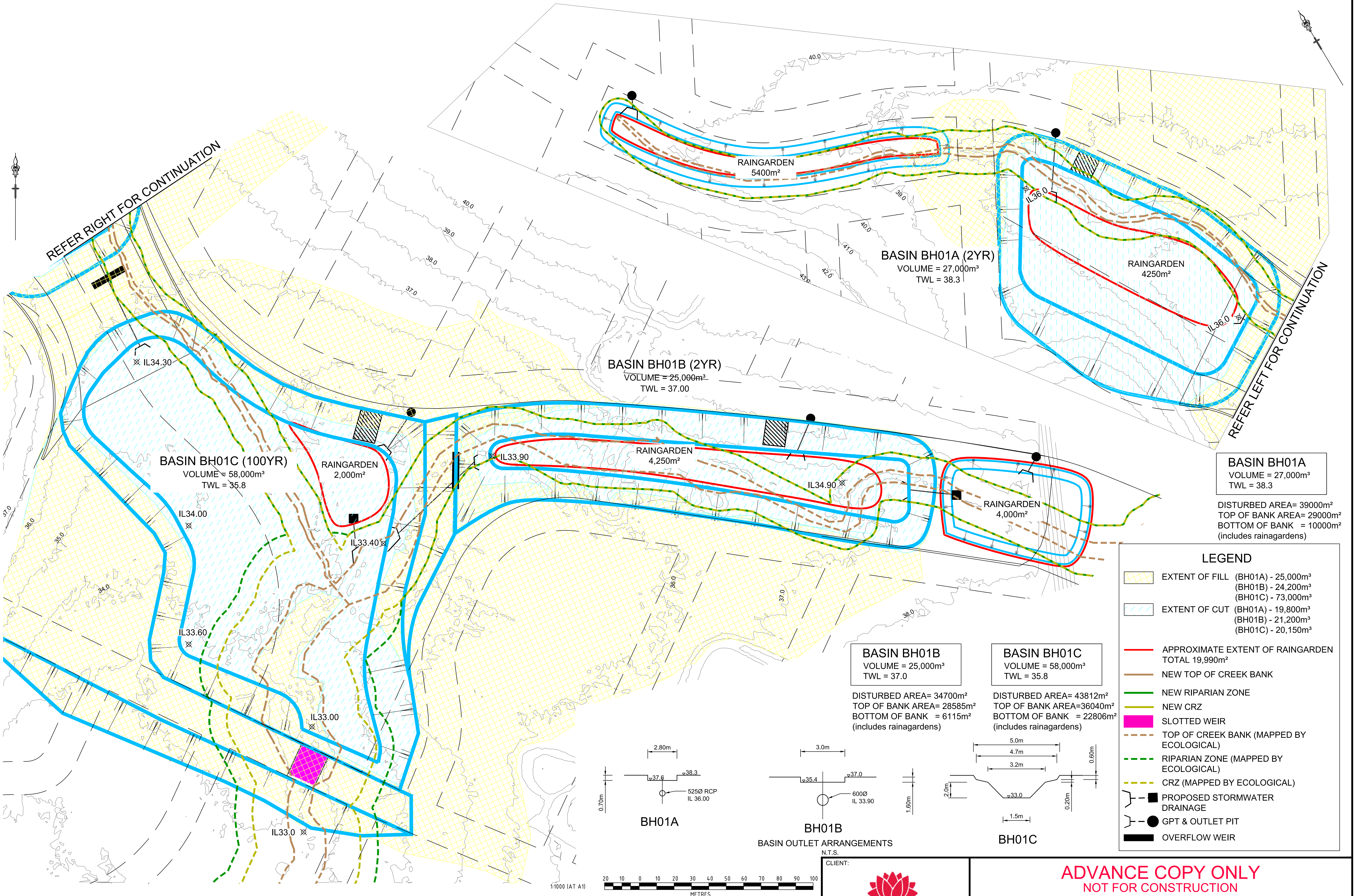
BOX HILL INDUSTRIAL PRECINCT
BASIN BH02A & BH02B

PLAN No: 8979/SK06 E
FILE No: 8979SK06
SHEET SIZE: A1 ORIGINAL

Plotted: 21 November , 2012 3:18:27 PM File Name: J:\8979D\SK - Concept Sketch Designs\8979SK06.dwg



BASIN BH01A
VOLUME = 27,000m³
TWL = 38.3

DISTURBED AREA= 39000m²
TOP OF BANK AREA= 29000m²
BOTTOM OF BANK = 10000m²
(includes rainagardens)

BASIN BH01B
VOLUME = 25,000m³
TWL = 37.0

DISTURBED AREA= 34700m²
TOP OF BANK AREA= 28585m²
BOTTOM OF BANK = 6115m²
(includes rainagardens)

BASIN BH01C
VOLUME = 58,000m³
TWL = 35.8

DISTURBED AREA= 43812m²
TOP OF BANK AREA=36040m²
BOTTOM OF BANK = 22806m²
(includes rainagardens)

LEGEND

- EXTENT OF FILL (BH01A) - 25,000m³, (BH01B) - 24,200m³, (BH01C) - 73,000m³
- EXTENT OF CUT (BH01A) - 19,800m³, (BH01B) - 21,200m³, (BH01C) - 20,150m³
- APPROXIMATE EXTENT OF RAINGARDEN TOTAL 19,990m²
- NEW TOP OF CREEK BANK
- NEW RIPARIAN ZONE
- NEW CRZ
- SLOTTED WEIR
- TOP OF CREEK BANK (MAPPED BY ECOLOGICAL)
- RIPARIAN ZONE (MAPPED BY ECOLOGICAL)
- CRZ (MAPPED BY ECOLOGICAL)
- PROPOSED STORMWATER DRAINAGE
- GPT & OUTLET PIT
- OVERFLOW WEIR

	AMENDMENT	DES	DRN	CKD	APR	DATE
F	BASIN BH01C FOOTPRINT AND VOLUME REDUCED	JC	VG	DC		13/10/12
E	MASTER PLAN UPDATED DISTURBED AREAS ADDED CUT/FILL REVISED	MS	DP	MS		15/05/12
D	BASIN STORAGE AMENDED	BT	BT	DC		26/04/12
C	MINOR AMENDMENT	MS	MT	DC		14/02/11
B	GENERAL AMENDMENTS	MS	MS	DC		09/02/11
A	FIRST ISSUE	MS	AS			29/01/11

J. WYNDHAM PRINCE
CONSULTING CIVIL INFRASTRUCTURE ENGINEERS & PROJECT MANAGERS
PO Box 4366 PENRITH WESTFIELD NSW 2750
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DATUM:
ORIGIN:

CLIENT:
NSW GOVERNMENT

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BOX HILL INDUSTRIAL PRECINCT
BASIN BH01A, BH01B & BH01C

PLAN No: 8979/SK05 F
FILE No: 8979SK05
SHEET SIZE: A1 ORIGINAL

Plotted: 1 November , 2012 10:20:21 AM File Name: J:\8979\DISK - Concept Sketch Designs\8979SK05.dwg

PRELIMINARY COST ESTIMATE

PROJECT: Box Hill Section 94 Basins

CLIENT: Department of Planning

JWP Plan Number/Version: 8979SK05 Rev F **BH01C**

NO.	ITEM	QTY.	UNIT	RATE Exc GST$	AMOUNT Exc GST$
1	**BASIN**				
	Establishment (5%)	1	item	$265,000.00	$265,000.00
	Clearing (Allowance Only)	1	item	$50,000.00	$50,000.00
	Strip & stockpile topsoil	37,900	sq.m.	$1.50	$56,850.00
	Respread topsoil	22,800	sq.m.	$2.50	$57,000.00
	Earthworks - Excavate and Dispose of Unsound Material	2,100	cu.m.	$200.00	$420,000.00
	Earthworks - Cut to Fill On Site	18,050	cu.m.	$5.00	$90,250.00
	Earthworks - Import material	54,950	cu.m.	$30.00	$1,648,500.00
	Earthworks - Cut, Dispose and Compact within 2 km		cu.m.	$10.00	
	Earthworks - Cut to Dispose off Site (incl. disposal fees)		cu.m.	$75.00	
	Trim and Compact	37,900	sq.m.	$1.00	$37,900.00
	Basin Lower Surface Turf	22,500	sq.m.	$15.00	$337,500.00
	Batter Surface Turf	13,300	sq.m.	$10.00	$133,000.00
	Core Riparian Planting Bush Regeneration (incl 2 yr maint)	15,200	sq.m.	$25.00	$380,000.00
	Planting (incl maintenance for 2 years)	20,320	sq.m.	$9.50	$193,040.00
	Soil & Water Management (Allowance Only)	1	item	$25,000.00	$25,000.00
				SUBTOTAL	**$3,694,040.00**
2	**BIO-RETENTION RAINGARDEN (RGBH07_8)**				
	Media Bed constructions (incl. Earthworks, filter bed & subsoil drainage)	2,000	sq.m.	$180.00	$360,000.00
	Raingarden Planting	2,000	sq.m.	$45.00	$90,000.00
	Construction of Maintenance Access	1	item	$7,000.00	$7,000.00
	GPT device and Associated Drainage Infrastructure	1	item	$173,750.00	$173,750.00
				SUBTOTAL	**$630,750.00**
3	**DRAINAGE / STRUCTURES**				
	Main Outlet Slotted Weir (Incl. Walling)	380	sq.m.	$500.00	$190,000.00
	Rock Erosion Protection / Energy Dissipator at Outlet	100	sq.m.	$250.00	$25,000.00
				SUBTOTAL	**$215,000.00**
				TOTAL FOR ITEMS 1, 2 & 3	**$4,539,790.00**
4	**PLANT & CONTINGENCIES**				
	15% Plant & Contingency		item		$681,000.00
				SUBTOTAL WITH 15% CONTINGENCY	**$5,220,790.00**
5	**ADMINISTRATION AND MANAGEMENT COSTS**				
	Consultancy and Project Management Fees (6%)		item		$314,000.00
	Government Agency Approvals (DSC, RTA, DECCW, etc - Allowance Only)		item		$10,000.00
	Council DA Fees and planFIRST Levy		item		$12,035.00
	PCA Fees (Allowance Only)		item		$10,000.00
				SUBTOTAL	**$347,000.00**
				TOTAL	**$5,567,790.00**