West Gables

Integrated Water Cycle Management and Flood Management Strategy

Prepared for Allam and Stockland

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Document Information

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Executive Summary

Allam Property Group and Stockland Corporation Limited have commissioned the preparation of an Integrated Water Cycle Management and Flood Strategy (**IWCMS**) to support the proposed West Gables Rezoning Development Area located within The Hills Shire Council Local Government Area. This strategy provides a delivery framework for the full development cycle and details of the likely infrastructure required to meet major stakeholder requirements for the project.

West Gables is located within the suburbs of Box Hill and Maraylya, adjacent to the Box Hill/Box Hill Industrial and The Gables development precincts. The development area encompasses approximately 78.1ha and is planned to deliver approximately 1,300 dwellings, roads and infrastructure, and parklands.

The proposed IWCMS for West Gables incorporates the following key elements and opportunities.

Regional Catchment Area:

- Utilise the downstream Town Centre Lake constructed as part of The Gables development to manage site discharge to the downstream Cataract Creek tributary floodplain.
- Utilise redundancies present in bio-retention basins within the downstream riparian corridor to treat developed flows generated within West Gables to avoid double treatment of flows and optimise the required bio-retention areas on site.

Sitewide:

- One (1) online storage infrastructure provided within the proposed riparian corridor.
- Five (5) offline detention basins
- Six (6) water quality basins
- Ten (10) gross pollutant traps

These measures are considered appropriate for achieving stormwater quantity and stormwater quality targets typically expected from modern development projects and comply with council requirements. The management strategy provided is intended to meet minimum requirements for the development with individual components to be refined at detailed design incorporating potential innovative solutions as deemed suitable for each application.

1 Introduction

Enspire Solutions (**Enspire**) has been engaged by Allam Property Group (**Allam**) and Stockland Corporation Limited (**Stockland**) to prepare an Integrated Water Cycle Management Strategy (**IWCMS**) to support the proposed West Gables Rezoning Development Area (**West Gables**), located in The Hills Shire Council (**THSC**) Local Government Area (**LGA**).

Enspire has prepared this IWCMS report in collaboration with Northrop Consulting Engineers (**Northrop**), who have undertaken the flood modelling for West Gables and provided a Flood Model Assessment to append this report.

Reference is made throughout this report to the Box Hill North Precinct (**The Gables**) located directly east of the West Gables site. Extensive flood modelling has been previously undertaken for The Gables by Northrop that encompasses a wider catchment that includes the West Gables. Flood models undertaken for The Gables have been amended to consider West Gables in the developed case and have informed this IWCMS.

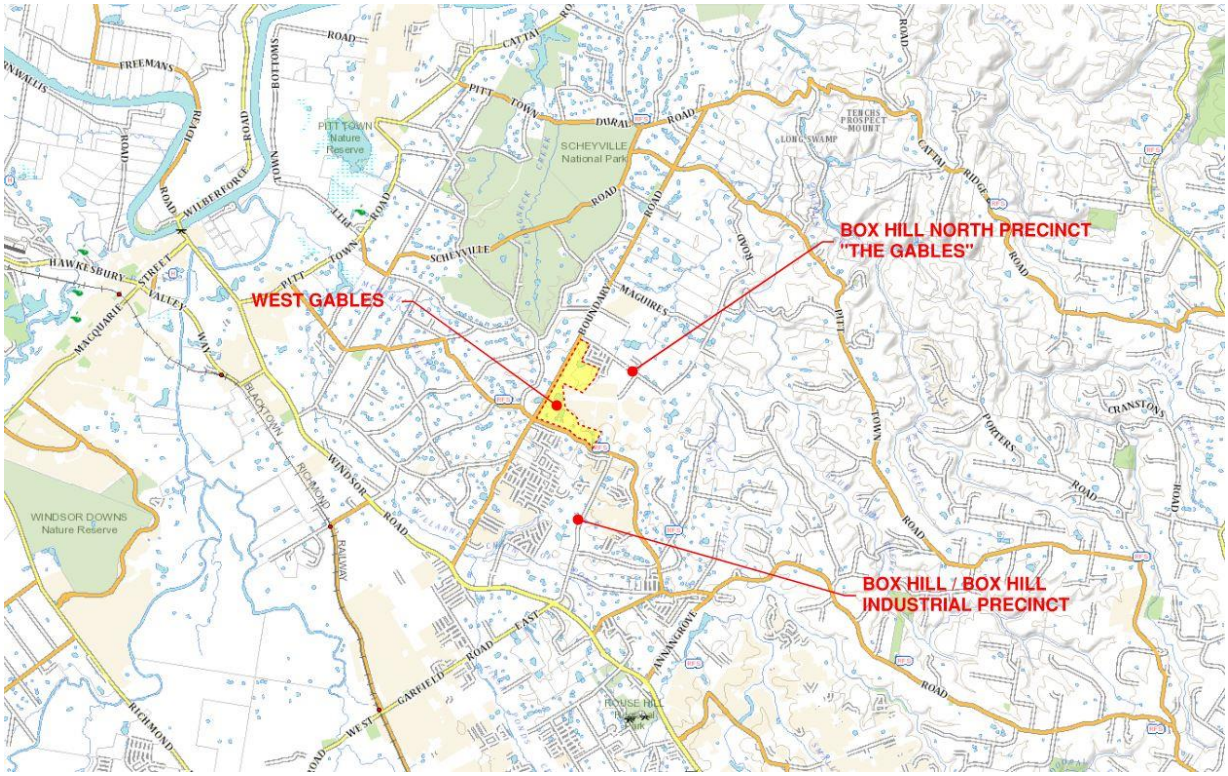

Figure 1 – West Gables Rezoning Locality plan

Background aerial source: SIX Maps June 2022.

West Gables is located within the suburbs of Box Hill and Maraylya, adjacent to the Box Hill/Box Hill Industrial and The Gables development precincts. The development area encompasses approximately 78.1ha and is bounded by Red Gables Road to the North, Boundary Road to the west, Old Pitt Town Road to the south and The Gables development to the east. West Gables is seperated into three (3) sites by Cataract Road and Valletta Drive.

This IWCMS report provides:

1. A summary of previous water cycle management studies and the key outcomes that have been carried forward in this strategy report.

2. Flooding, stormwater quantity, stormwater quality and environmental management details that form the core of this strategy report.
3. Concept infrastructure plans to help guide current and future stakeholders on stormwater management requirements for each sub catchment.

1.1 Existing Site Conditions

The West Gables Rezoning Development Area currently consists of rural land holdings in fragmented ownership, with parcel sizes ranging from 2ha to 15ha in area.

The West Gables landform consists of undulating land with slopes generally in a range of 3% to 6%. Within the northern portion of the precinct sits a hilltop surrounded by slopes of approximately 8% to 20%. The land has generally been cleared and consists of grassed fields, with the exception of one parcel of land which has maintained a significant portion of the existing trees.

An existing first order watercourse enters the precinct from the west and continues east into The Gables development and eventually north into the Cataract Creek tributary. This watercourse has been formalised downstream into riparian corridor as part of The Gables development.

There are five existing ridgelines that define the major catchments of the site which convey stormwater runoff to several large existing farm dams. These large farm dams are located both online and offline to the existing watercourse. There are also a number of smaller farm dams dispersed throughout the West Gables.

An electrical transmission line owned and operated by Transgrid crosses the north west corner of the site, with an 81.6m wide easement associated with the line accounting for approximately 1.75ha of land.

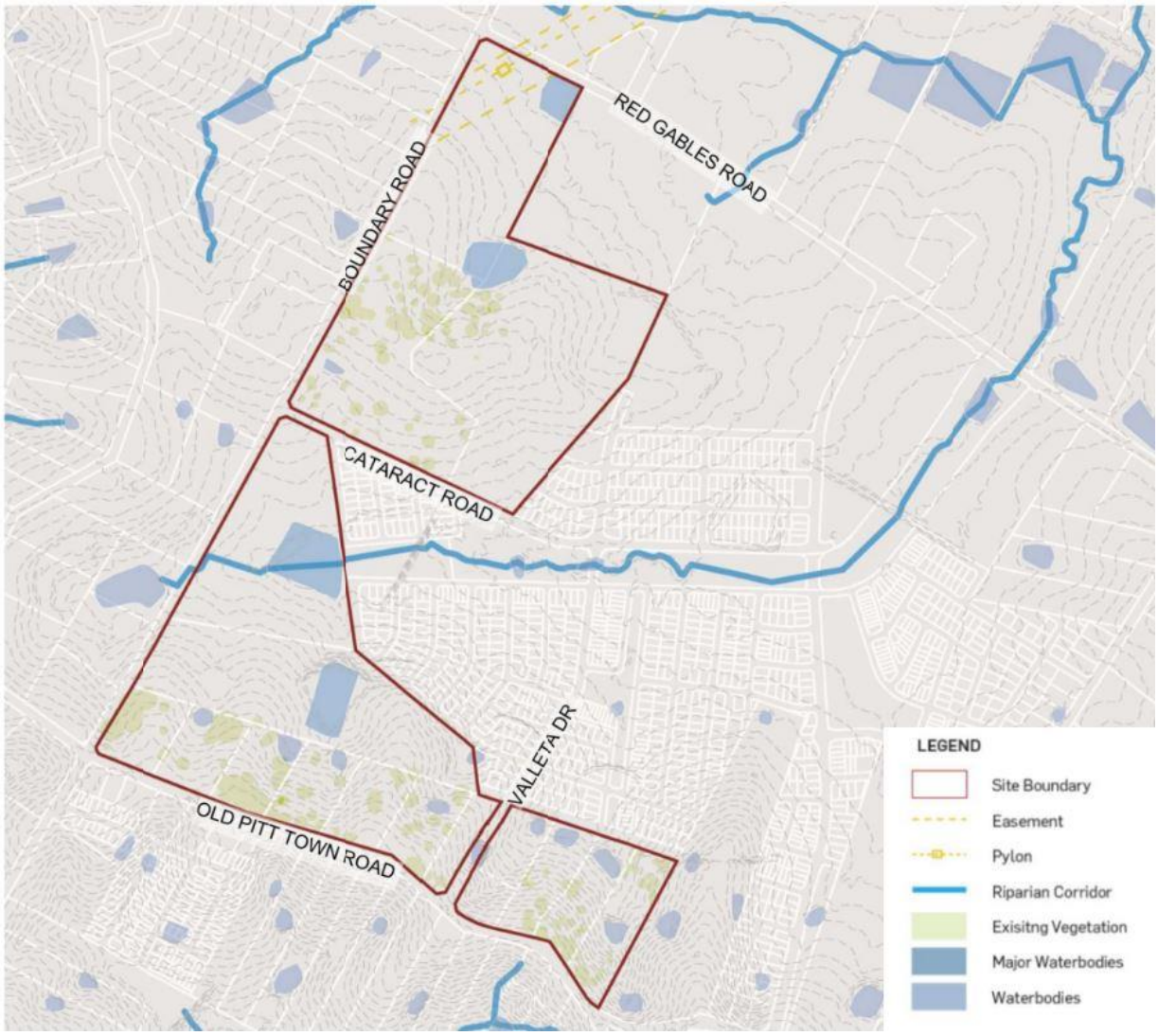

Figure 2 – Existing Site Conditions

Source: Urbis Technical Workshop Presentation March 2022

1.2 Proposed Development

West Gables is planned to deliver approximately 1,300 dwellings, roads and infrastructure, and parklands. The existing farm dams are to be removed and a riparian corridor re-established where existing online dams are located. Stormwater detention and water quality basins will be provided throughout the development to mitigate peak flows resulting from the development of the site and provide treatment to minimise environmental impacts.

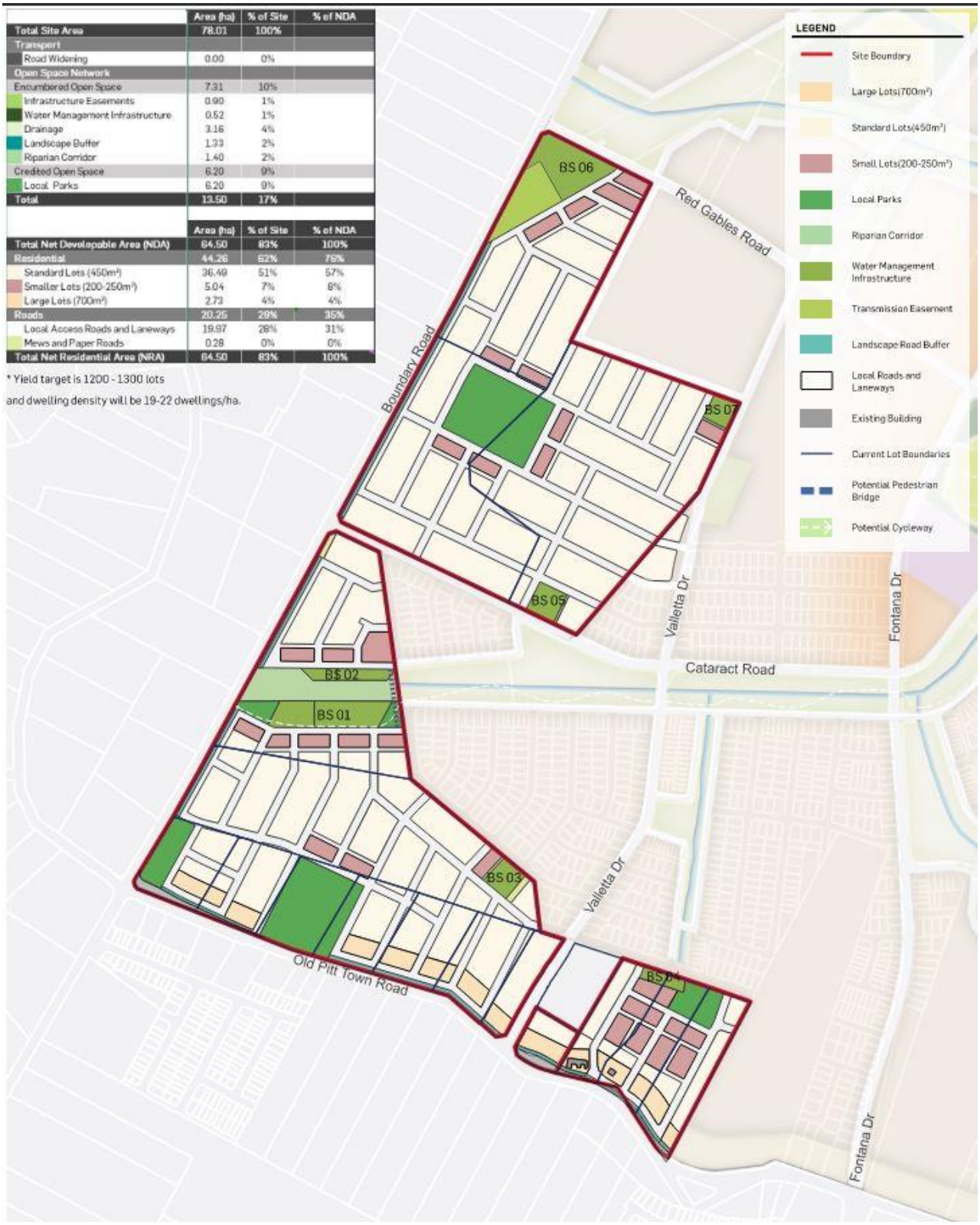

Figure 3 – West Gables Rezoning Masterplan

Source: West Gables Illustrative Concept Plan (Urbis 2022)

1.3 Previous Studies and Outcomes

1.3.1 Water Cycle and Flood Management Strategy Report (2013)

Stormwater management has been investigated for The Gables development adjacent to the West Gables Rezoning and a Water Cycle and Flood Management Strategy Report was prepared by J. Wyndham Prince (**JWP**) in 2013. This report informed the rezoning of the Box Hill North Precinct and provided a controlling document in The Hills Shire Council DCP Part D Section 17 – Box Hill North.

The strategy adopted a treatment train consisting of on lot treatment, street level treatment and subdivision/development treatment measures including:

- Proprietary GPT units at discharge points
- Twenty (20) bio-retention basins
- Six (6) detention basins, including two basins to manage 2 year ARI flows only.

As part of the strategy, a two-dimensional flood model was developed to test impacts of the development of the precinct on both local and regional flood levels. Flood modelling results showed urbanisation of the Box Hill North Precinct will result in minor increases in flood levels outside of the precinct boundary (<50mm) for the Cataract Creek tributary floodplain. These increases are limited to the riparian corridors and floodways and do not impact existing dwellings.

The strategy adopted for The Gables development, directly downstream of the West Gables Rezoning development area has been used to inform the strategy of this report.

1.3.2 Flood Modelling & Dam Break Assessment Report (2019)

A Flood Modelling and Dam Break Assessment was prepared by Northrop Consulting Engineers for The Gables development adjacent to the West Gables Rezoning. This report supported a DA resubmission for the Town Centre Lake and Detention Basin within The Gables. The Lake is located at the confluence of the two riparian corridors that run through The Gables site and consists of a permanent ponded volume and additional detention storage for flood mitigation. The centralised lake forms the major component of the site wide detention strategy for The Gables development.

The flood modelling was undertaken using the TUFLOW software and rainfall data from Australian Rainfall and Runoff (ARR) 1987. The flood modelling covered approximated nine (9) square kilometres (900ha) from the top of the catchment, upstream (south) of Old Pitt Town Road, to approximately 2km downstream of the lake location. The purpose of the detention storage provided is to attenuate flow in the 1% AEP event and cater for events up to the Acceptable Flood Capacity (AFC).

Flood model results were compared with previously approved results and found similar flood levels and impacts were similar and generally in accordance with approved strategy guidelines.

As the West Gables site ultimately discharges to the two riparian corridors that drain to the Town Centre Lake, this infrastructure has been considered in the Flood Modelling undertaken by Northrop and this assessment has been used to inform the strategy of this report.

2 Proposed Stormwater Management Strategy

The development of the West Gables will introduce a material increase in impervious surfaces contributing to an increase in post-development stormwater runoff and pollutant loading compared to pre-development conditions. The post-development case, with respect to the current masterplan (**Figure 3**), features seven major catchments with associated discharge locations throughout the site and these catchments are shown in **Figure 4**.

The proposed water management strategy for West Gables incorporates the following key elements and opportunities:

- Provide detention basins (online and offline) for each of the seven catchments to manage increased stormwater runoff in the post-development case.
- Provide water quality controls including bio-retention and proprietary devices for each of the seven catchments to manage increase in pollutant loads in the post-development case.
- Integrate both stormwater quantity and quality control measures throughout the development with existing stormwater management strategy for The Gables development downstream.
- Utilise redundancies in downstream control measures to reduce requirements for within the West Gables site and provide an optimised treatment train for the wider precinct. **Section 2.1** details specific opportunities and constraints arising from the West Gables' proximity to The Gables development.

The needs of development have been defined based on the following control documentation that outline key objectives to generally meet minimum statutory requirements:

- The Hills Shire Council Development Control Plan 2012 (Council DCP)
  - The Hills Shire Council Development Control Plan Appendix B – Water Sensitive Urban Design.
  - The Hills Shire Council Design Guidelines for Subdivisions and Developments.
- NSW MUSIC Modelling Guidelines, August 2015, BMT WBM

Key statutory outcomes from the above can be summarised as the need to:

- Maximise safety of public spaces during storm events up to the 1% AEP event.
- Maximise safe passage of Probable Maximum Flood (PMF) flows.
- Minimise the erosion of existing waterways.
- Minimise the discharge of pollutants from operation of development sites.
- Minimise maintenance of stormwater management systems.

The typical management system incorporates a water quality treatment train consisting gross pollutant traps and bio-retention basins, and water quantity control infrastructure consisting of dry detention basins.

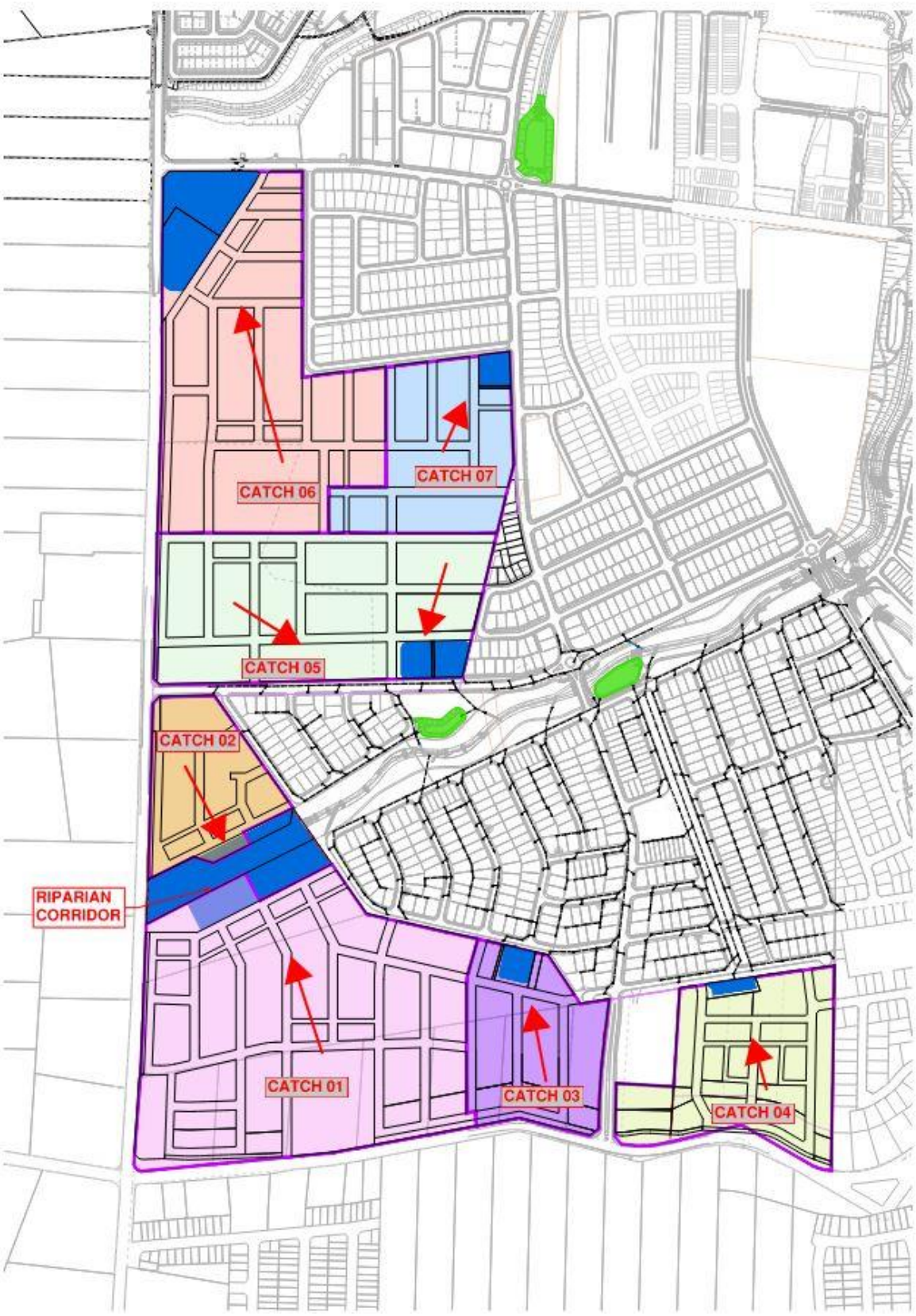

Figure 4 – West Gables Post Development Catchment Plan

2.1 Opportunities and Constraints

Due to the location of the West Gables Rezoning development area, there are a number of constraints to be managed within the site as well as opportunities that can be exploited to provide an improved outcome for the development.

As the development is bounded by a number of existing roads and an adjacent development (The Gables), there are a significant number of interfaces to existing infrastructure that need to be managed. These interface conditions, paired with the current masterplan road and lot layout, constrain the catchment breakdown and path of travel for runoff draining to each basin. As a result, stormwater infrastructure within adjacent roadways outside the development area will require upgrading to convey runoff from proposed catchments to their respective water quality basins.

A number of the basins within the West Gables development are proposed to discharge directly into the network of The Gables development directly east of the site. These discharge points sit upstream of the water quality infrastructure for The Gables, therefore an opportunity arises to consider catchment within West Gables as part of the wider catchment for the downstream treatment train within The Gables development. This Strategy will assess the downstream water quality infrastructure for any redundancy that can be utilised to reduce the required treatment within the West Gables. **Figure 5** identifies water quality infrastructure located directly downstream of West Gables basins and prior to discharge into the riparian corridor.

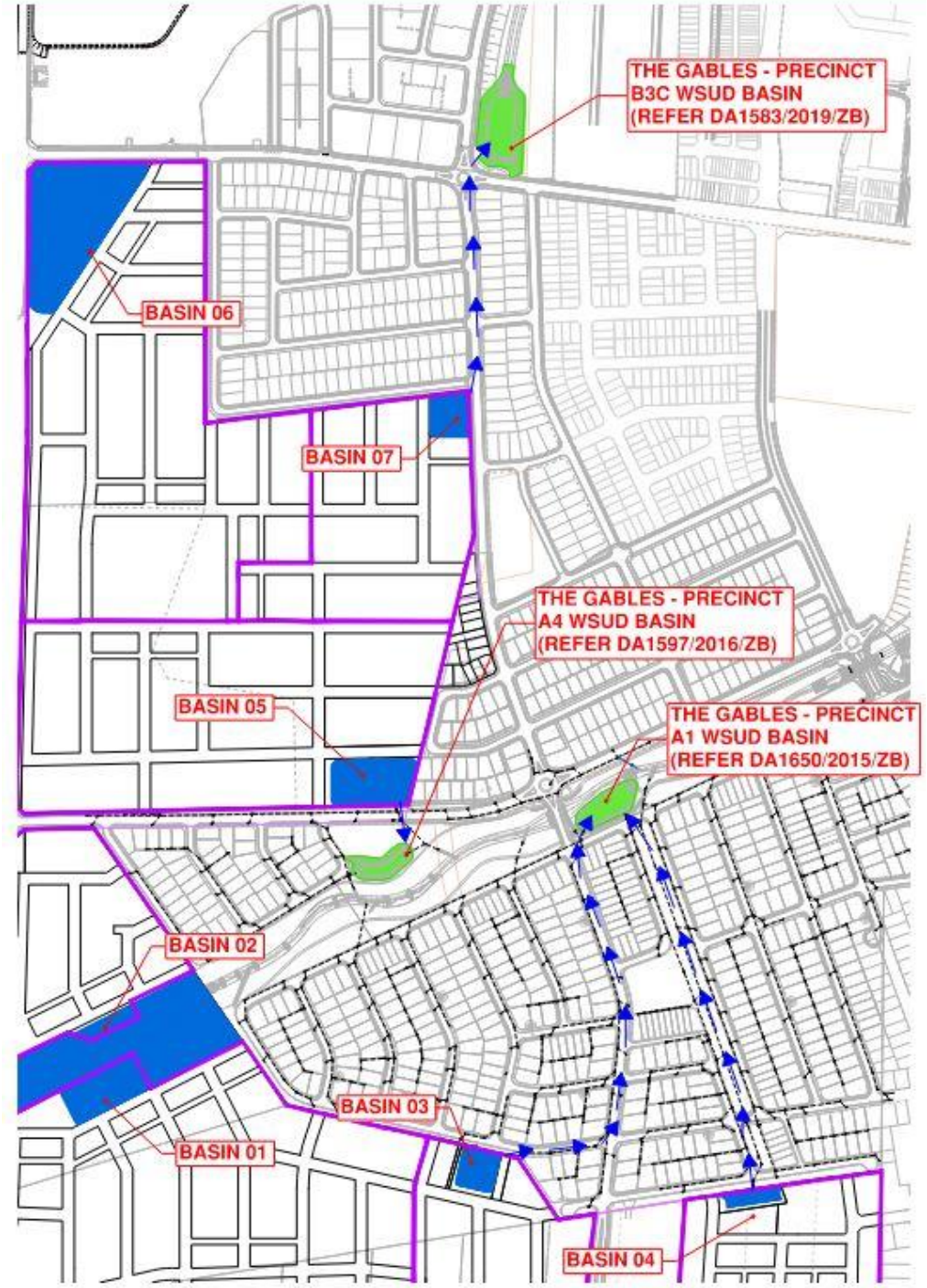

Figure 5 – Downstream Water Quality Basin Locality Plan

2.1.1 Basin 01 and Basin 02

Both Basin 01 and Basin 02 are located within or directly adjacent to the proposed extension of the downstream riparian corridor. This presents an opportunity to provide online stormwater detention for both catchments, rather than a separate detention basin. By providing online storage, only bio-retention basins are required, therefore reducing the footprint of the stormwater management infrastructure. It is proposed to construct a staged bund outlet on the eastern boundary of the riparian corridor within the West Gables site to control detention.

2.1.2 Basin 03 and Basin 04

Both Basin 03 and Basin 04 proposed for the West Gables development discharge into the stormwater network constructed as part of Precinct A Stage 1 of The Gables development. Both basins sit at the top of the catchment treated by the Precinct A1 WSUD basin prior to discharge into the riparian corridor. Whilst the design of this basin has considered catchment area with the West Gables site as undeveloped, the basin's performance is to be assessed to determine if redundancies included in the design can be utilised to treat developed flows from West Gables, therefore reducing the required bio-retention filter area required for Basin 03 and Basin 04.

Whilst the location of Basin 03 and Basin 04 with respect to The Gables Precinct A1 provides an opportunity to optimise the water quality outcomes, it also provides constraints on the design of each basin's outlet. As both basins discharge into the Precinct A1 network, the outlet configurations are restricted by the invert levels of the connecting network, and the as constructed levels of the adjacent local roads. This constraint limits the basin storage depth, restricting the basins OSD storage capacity and therefore impacting the basin footprint.

2.1.3 Basin 05

Basin 05 proposed for the West Gables development discharges into the stormwater network constructed as part of Precinct A Stage 4 of The Gables development. The basin is located near to the Precinct A4 WSUD basin, with part of Basin 05's contributing catchment draining to this basin. West Gables catchment area included in the Precinct A4 basin has been considered as undeveloped. There is an opportunity to assess if there is enough redundancy within the existing basin to treat the part of Basin 05's catchment currently draining to this outlet.

The location of Basin 05 constrains the design of the basin's outlet as the basin discharges into the Precinct A4 network within Cataract Road. The Basin 05 outlet configuration is restricted by the inverts of the existing pit and pipe and the as constructed road levels. This restricts the basin storage depth, therefore impacting the total basin footprint.

2.1.4 Basin 06

The location of Basin 06 takes advantage of a vacant Transgrid easement crossing the northwest corner of the West Gables site. This easement is associated with an overhead electrical transmission line and can be utilised as a drainage reserve provided approval is received from Transgrid. No ground level infrastructure is present within the West Gables extents as the stauchen supporting the overhead line is located north of Red Gables Road. This means services clashes are limited and impact on the easement can be restricted to accessibility requirements for Transgrid vehicles. The large area covered by the easement provides sufficient room for a combined OSD and WSUD basin to be constructed to service a large catchment of the development.

Basin 06 is proposed to discharge directly into the riparian corridor to the north of West Gables. An existing headwall outlet is to be utilised, therefore limiting the basin invert to levels that tie into the existing headwall and avoid clashes with adjacent stormwater infrastructure within Red Gables Road. The basin bank levels are also restricted by the adjacent Boundary Road and Red Gables Road levels.

2.1.5 Basin 07

Basin 07 proposed for the West Gables development discharges into the stormwater network constructed as part of Precinct B Stage 3C of The Gables development. The basin sits at the top of the catchment treated by the Precinct B3C WSUD basin prior to discharge into the riparian corridor. Whilst the design of this basin has considered catchment area with the West Gables site as undeveloped, the basin's performance is to be assessed to determine if redundancies included in the design can be utilised to treat developed flows from West Gables, therefore reducing or removing the required bio-retention filter area required for Basin 07.

Whilst the location of Basin 07 with respect to The Gables Precinct B3C provides an opportunity to optimise the water quality outcomes, it also provides constraints on the design of the basin's outlet. As the basin discharges into the Precinct B3C network, the outlet configuration is restricted by the invert levels of the connecting network, and the as constructed levels of the adjacent local road. This constraint limits the basin storage depth, restricting the basins OSD storage capacity and therefore impacting the basin footprint.

2.1.6 Existing Network Upgrades

The masterplan layout for West Gables combined with existing topography results in a catchment configuration where portions of the site drain towards the adjacent Gables development prior to the proposed basins. This has resulted in a requirement in various locations for existing stormwater networks to be upgraded to cater for developed flows from contributing catchments or stormwater lines to be constructed in existing adjacent roadways to direct runoff to proposed basins within the West Gables development.

Figure 6 below identifies locations where these upgrade works are required.

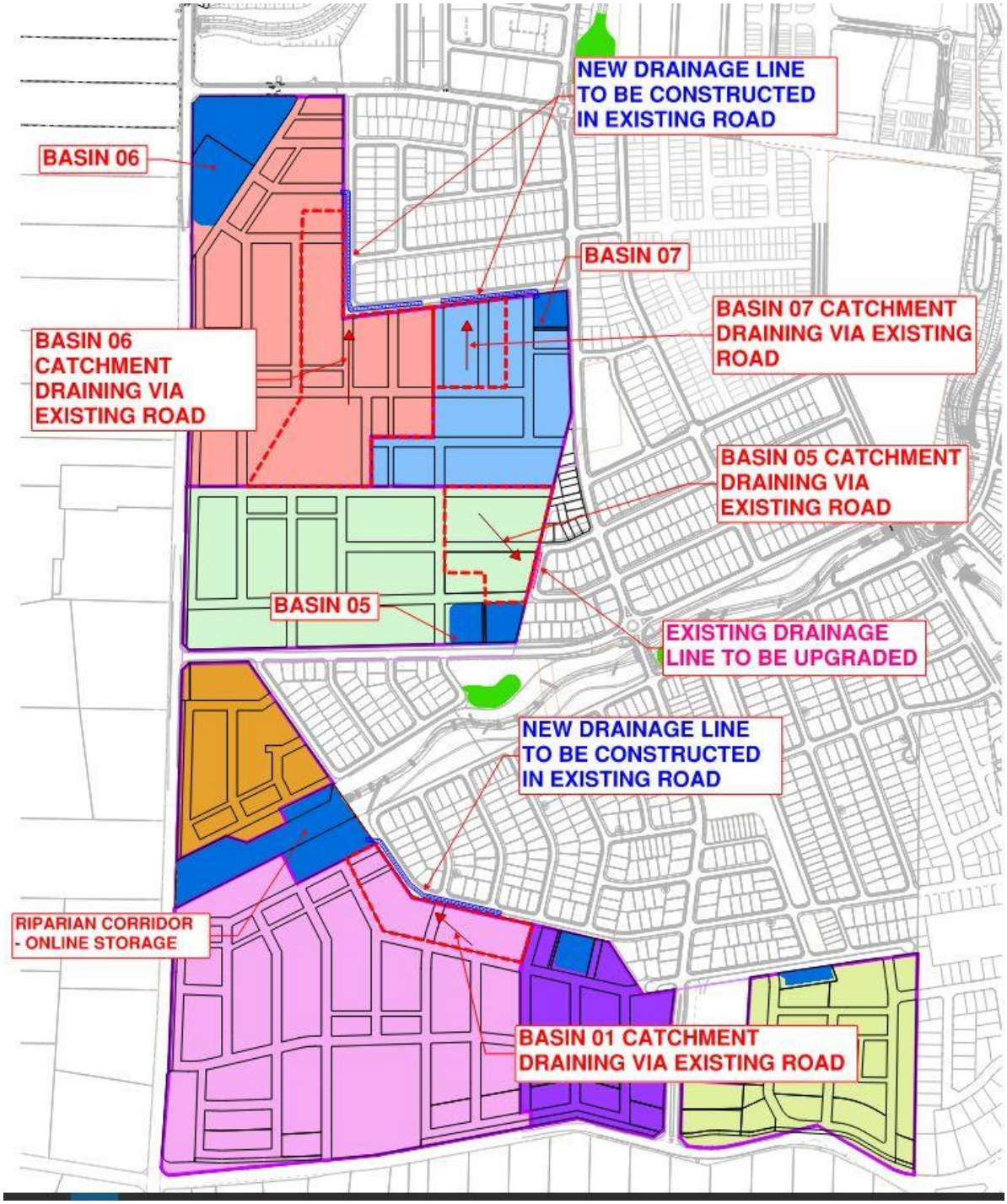

Figure 6 – Required Stormwater Upgrades

3 Flooding

3.1 Assessment Scope

Due to the location of the West Gables site upstream of The Gables development, flood conditions for the pre-development and post development case's have been assessed on a precinct wide scale to capture the impact of the West Gables development on the downstream flood levels.

A flood assessment has been undertaken by Northrop with details provided in **Appendix A**.

4 Stormwater Quantity Controls

4.1 Performance Criteria'

The stormwater quantity management strategy has been developed to meet the following objectives at discharge points into existing waterways:

- Post-development discharge flow rates are to be controlled to not exceed pre-development discharge rates for typical storm events up to and including 1% Annual Exceedance Probability (AEP).
- Maximise safe passage of Probably Maximum Flood (PMF) flows
- Minimise erosion of existing waterways

As the West Gables development discharges directly into the riparian corridors developed as part of The Gables development, discharge is ultimately controlled by the Town Centre Lake. The Lake has been assessed with consideration of West Gables in the developed case to determine storage requirements for West Gables.

An assessment has been undertaken by Northrop with input from Enspire to determine the on site storage requirements for each catchment of West Gables. Reference is made to the Northrop documentation in **Appendix A** for methodology and results.

4.2 Stormwater Quantity Management Strategy

The stormwater quantity management strategy adopts detention basins as the primary control of post-development discharge. Basin outlet configurations are assumed to consist of piped discharge control for very frequent storm to infrequent storm events.

This strategy should not preclude the investigation and/or adoption of alternative management techniques as part of future development that may better serve the needs of the project as defined in **Section 2**.

This infrastructure is proposed to be located within land identified for urban development and within the Transgrid easement present on site.

4.3 Results and Discussion

Estimated storage requirements are summarised in **Table 1** below and are based on the modelling undertaken by Northrop as detailed in **Appendix A**. Basins have been modelled with typically 1.0m to 2.0m depth of storage to account for effects of water level on outflow rates and to allow for appropriate interfaces to adjacent levels and connection to existing stormwater networks.

Concept Stormwater Basin Sketches provided in **Appendix B** demonstrate the required storage volumes specified in **Table 1** below are achievable.

Table 1 – Basin Storage Requirements and Characteristics

Basin	Required Storage (m^3)	Available Storage (m^3)	Basin Invert (m)	Basin Top Water Level (m)
1 & 2 (Online)	13200	24252	41.5	44.04
3	1224	1261	49.15	50.33
4	1012	1012	44.85	46.15
5	984	1881	41.9	42.66
6	3512	3551	37.8	38.82
7	498	1107	40.3	40.98

5 Stormwater Quality Controls

The West Gables Water Sensitive Urban Design development strategy guiding principle is to reduce the impact of urban stormwater runoff quality and quantity discharging into waterways both within and downstream of West Gables.

5.1 Performance Criteria

The stormwater quality management strategy has been developed to meet The Hills Shire Council Design Guidelines as a minimum. The fundamental objective is to safeguard the environment by improving the quality of stormwater run-off entering receiving waters with achievement of this objective measured through the following performance criteria:

- 90% reduction in average annual gross pollutant (GP) loads
- 85% reduction in average annual suspended solids (TSS) loads
- 65% reduction in average annual total phosphorus (TP) loads
- 45% reduction in average annual total nitrogen (TN) loads

5.2 Stormwater Quality Management Strategy

The adopted stormwater quality management strategy focuses treatment at the downstream end of five catchments that drain to the central 1st order riparian corridor to the east and two catchments that drain to the 1st order riparian corridor to the north. The treatment train for each of these catchments comprises a Gross Pollutant Trap (GPT) and bio-filtration basin. Additional water elements that contribute to improvement of stormwater quality leaving West Gables are present in the development scenario, such as the bio-retention basins downstream, prior to the riparian corridor within The Gables precinct. The contribution of these elements has been included in the water quality management assessment.

The following infrastructure for stormwater quality management has been included in the water quality management strategy to meet the minimum pollutant reduction targets:

- Up to ten (10) GPT units: the model of these GPT units has not been defined to date, however these treatment devices will remove gross pollutants such as litter, and larger organic material. The units have not been modelled to remove TSS, TP or TN noting that numerous proprietary devices can achieve partial removal of these finer particles. This is to be refined as part of detailed design where GPT device properties are known.
- Up to six (6) bio-filtration basins: the bio-filtration basins have typically been co-located within the site's detention basins. Where possible, such as in the case of catchment Basin 01 and Basin 02, the bio-filtration basin has been located independently of the catchment's stormwater detention basin. The maximum depth of ponding above the bio-filtration basins is estimated to be 1.5m above extended detention level in the 1% AEP event.
- No rainwater tanks have been included in the model due to the intended adoption of reticulated recycled water for West Gables.

The locations of the proposed water quality improvement infrastructure are shown in **Figure 7** and a summary of the catchments and their respective bio-filtration basin footprints is provided in **Table 2.** Bio-filtration basins have been adopted as a base case as they are a functional and economical means of achieving water quality improvement targets.

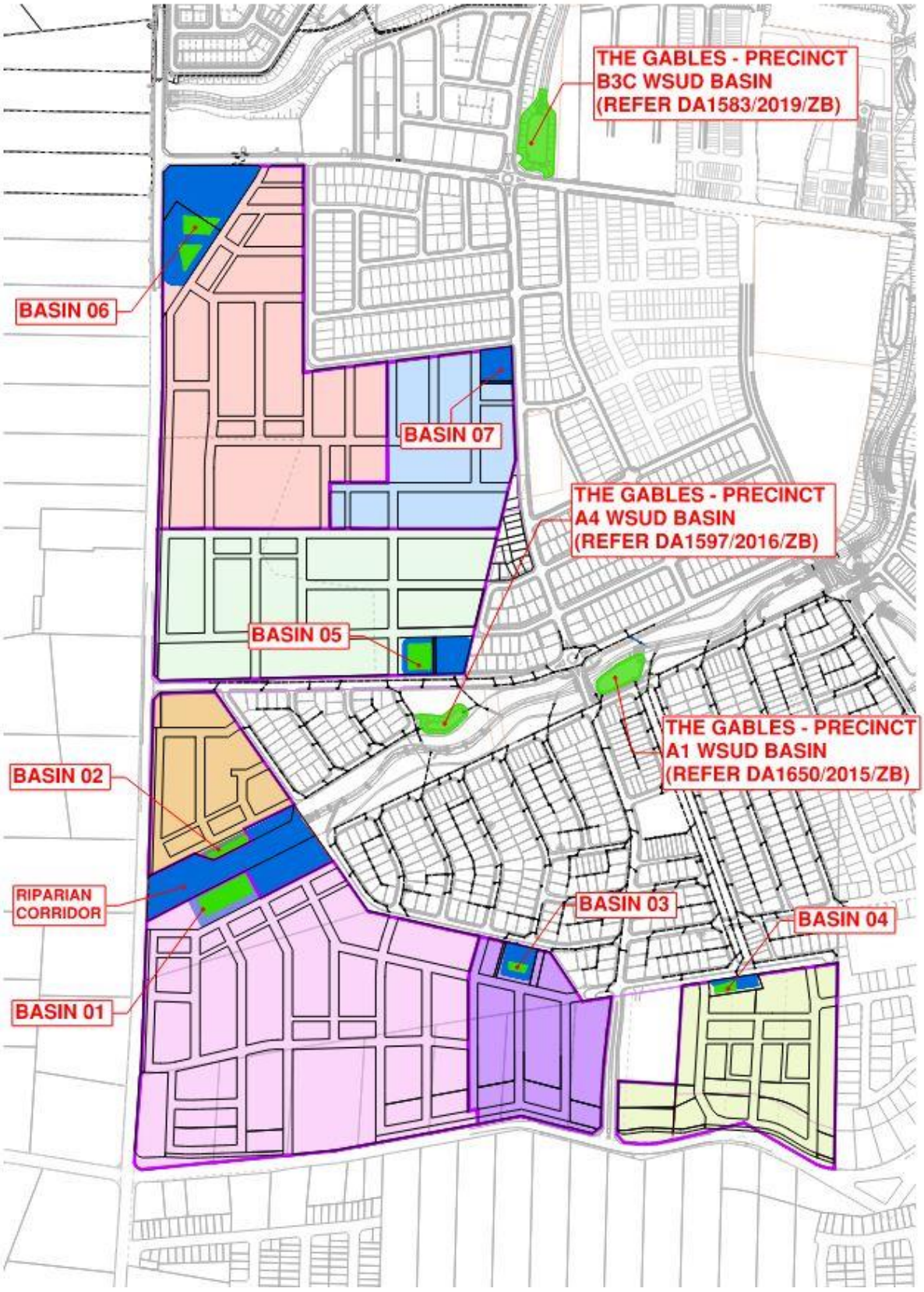

Figure 7 – Water Quality Basin Locality Plan

Table 2 – Water Quality Basin Summary

Basin ID	Contributing Catchment Area (ha)	Bio-Retention Area (m^2)	Total Basin Footprint (m^2)
Basin 01	21.90	2500	29842
Basin 02	4.58	500	
Basin 03	5.82	300	3228
Basin 04	7.86	400	2000
Basin 05	12.79	1400	6846
Basin 06	16.45	2000	19974
Basin 07	6.40	0	2923
Gables B3C Basin	26.53 (Not incl. West Gables)	2350	6260
Gables A4 Basin	4.3 (Not incl. West Gables)	733	2290
Gables A1 Basin	15.8 (Not incl. West Gables)	2021	2755

5.3 Modelling Methodology

The stormwater quality management strategy has been assessed using the MUSIC v6.3 software package which is the industry standard software for modelling water quality and water sensitive urban design outcomes.

Post-development catchment boundaries adopted for modelling are like those that have been adopted for stormwater quantity modelling but have been further broken down into land use categories to appropriately model pollutant quantities and the proposed treatment train.

Catchment hydrology, pollutant generation and treatment device parameters adopted are detailed in the following sections and have been developed based on:

- The Hills Shire Council Design Guidelines.
- NSW MUSIC Modelling Guidelines
- Third party data where applicable

5.3.1 Catchment Hydrology

Rainfall data across numerous weather stations has been assessed with the rainfall data detailed in **Table 3** and monthly Potential Evapotranspiration (PET) data in **Table 4** adopted for modelling purposes. These rainfall parameters have been assessed based on:

- Proximity to the subject site (the closer the more relevant).
- Completeness of data (minimal to no data gaps)
- Period of data collection (ideally 40 years or more)
- Period appropriate for modelling typical climate conditions (generally a 10-year period with no extreme dry or wet conditions)
- Appropriate timestep for modelling evaporation and infiltration effects accurately (industry standard for water quality modelling is 6-minute).

Table 3 – MUSIC Model Rainfall Data

Variable	Adopted Value
Weather Station	Richmond (67033)
Rainfall Period	1980-1990
Timestep	6 minute

Table 4 – MUSIC Model Monthly PET

Month	Protect PET (mm)
January	183
February	151
March	140
April	105
May	65
June	51
July	65
August	93
September	120
October	146
November	171
December	205

Table 5 – MUSIC Catchment Rainfall-Runoff Parameters

Parameter	Adopted Value
Impervious Areas	
Rainfall Threshold	1.0mm
Pervious Areas	
Soil Storage Capacity (mm)	120
Initial Storage (% of capacity)	25
Field Capacity (mm)	80
Infiltration Capacity Coefficient – a	200
Infiltration Capacity Coefficient – b	1.0
Groundwater	
Initial Depth (mm)	10
Daily Recharge Rate (%)	25
Daily Baseflow Rate (%)	5
Daily Deep Seepage Rate (%)	0

5.3.2 Catchment Representation

Post development catchments have been defined by the following general urban typologies:

- Roads
- Residential
  - Roof (60% of Lot Area)
  - Other Impervious (20% of Lot Area)
  - Other Pervious (20% of Lot Area)
- Open Space
- External

It is recognised that there is the potential for other land uses to be dispersed throughout the site, however the location of such land uses may be subject to change and will not vary significantly in impervious area compared to the above typologies modelled in this strategy to meaningfully affect feasibility of the strategy. Further, such land uses may adopt on lot stormwater

management which will be an improvement on this strategy. It is envisaged that naturalised open space will retain vegetation and existing soils with minimal construction works and, in most cases, will passively provide water quality improvement through the removal of existing agriculture as a land use.

Table 6 details a typical development land use breakdown adopted to generate nodes suitable for MUSIC modelling. The proportions of each land use per basin catchment have been based on an initial development masterplan reflective of a typical residential development. While there may be changes in land use proportions and areas in future, such changes are unlikely to be significant to meaningfully impact This Strategy, especially where an Urban Development zoning is adopted.

Table 6 – MUSIC Nodes Details Summary

Land Use	Sub-Catchment	Adopted Impervious	Comments
Roads	N/A	90%	
Residential	Roof	100%	60% of land use area assumed to be roof
	Other Impervious	100%	20% of land use area assumed to be other impervious surfaces
	Other Pervious	0%	20% of land use area assumed to be pervious surfaces
Open Space	N/A	20%	

5.3.3 Catchment Pollutant Generation

Table 7 – MUSIC Catchment Pollutant Generation Parameters

		Total Suspended Solids (mg/L-log10)		Total Phosphorus (mg/L-log10)		Total Nitrogen (mg/L-log10)	
Land Use	**Mean / Standard Deviation**	**Base Flow**	**Storm Flow**	**Base Flow**	**Storm Flow**	**Base Flow**	**Storm Flow**
Road	Mean	1.2	2.43	-0.85	-0.3	0.11	0.35
	Standard Deviation	1.7	0.32	0.00	0.25	0.12	0.19
Residential	Mean	1.2	2.15	-0.85	-0.6	0.11	0.3
	Standard Deviation	0.17	0.32	0.19	0.25	0.12	0.19
Roof	Mean	1.1	1.3	-0.82	-0.89	0.32	0.3
	Standard Deviation	0.17	0.32	0.00	0.25	0.12	0.19
Open Space	Mean	1.2	2.15	-0.85	-0.6	0.11	0.3
	Standard Deviation	0.17	0.32	0.19	0.25	0.12	0.19
Rural	Mean						
	Standard Deviation						

5.3.4 Treatment Node Properties

5.3.4.1 Gross Pollutant Traps

Vortex type gross pollutant traps have been assumed to be adopted allowing for treatment up to the 3-month storm event. Large storm events are assumed to bypass via splitter pots and be directed to detention basins. Given the range of proprietary products available this strategy has adopted the following treatment effectiveness for gross pollutant traps which is typical for industry leading units available in the market.

- 98% GP removal
- 70% TSS removal for inflow concentrations greater than 75mg/L
- 30% TP removal for inflow concentrations greater than 0.5mg/L
- 0% TN removal

While not a performance target, it is part of this strategy that oil pillows will be installed in GPTs to capture hydrocarbon pollutants.

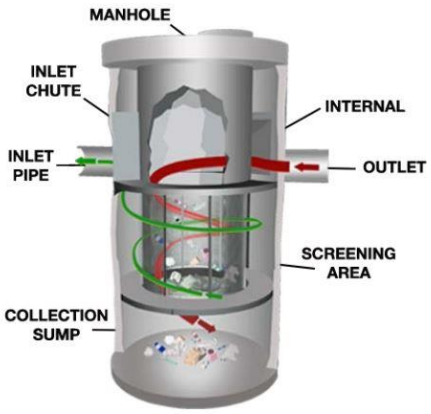

Figure 8 – Typical Vortex Type GPT Concept

5.3.4.2 Bio-Retention Basins

The predominant means of suspended solids and nutrient removal is to be through the construction of bio-retention basins. Bio-retention basins are to incorporate an engineered filtration media that promotes nutrient removal when appropriately vegetated. Bio-retention basins have been modelled in MUSIC adopting the parameters detailed in **Table 8**. A typical bio-retention basin arrangement is presented in **Figure 9**.

Table 8 – Bio-Retention Basin Parameters

Parameter	Adopted Value
High Flow Bypass	3-month flow rate
Extended Detention Depth	300mm
Saturated Hydraulic Conductivity	100mm/hr
Filter Depth	500mm
TN Content of Filter Media	800mg/kg
Orthophosphate Content	40mg/kg
Exfiltration Rate	0mm/hr
Base liner	Yes
Vegetation	Effective nutrient removing plants assumed

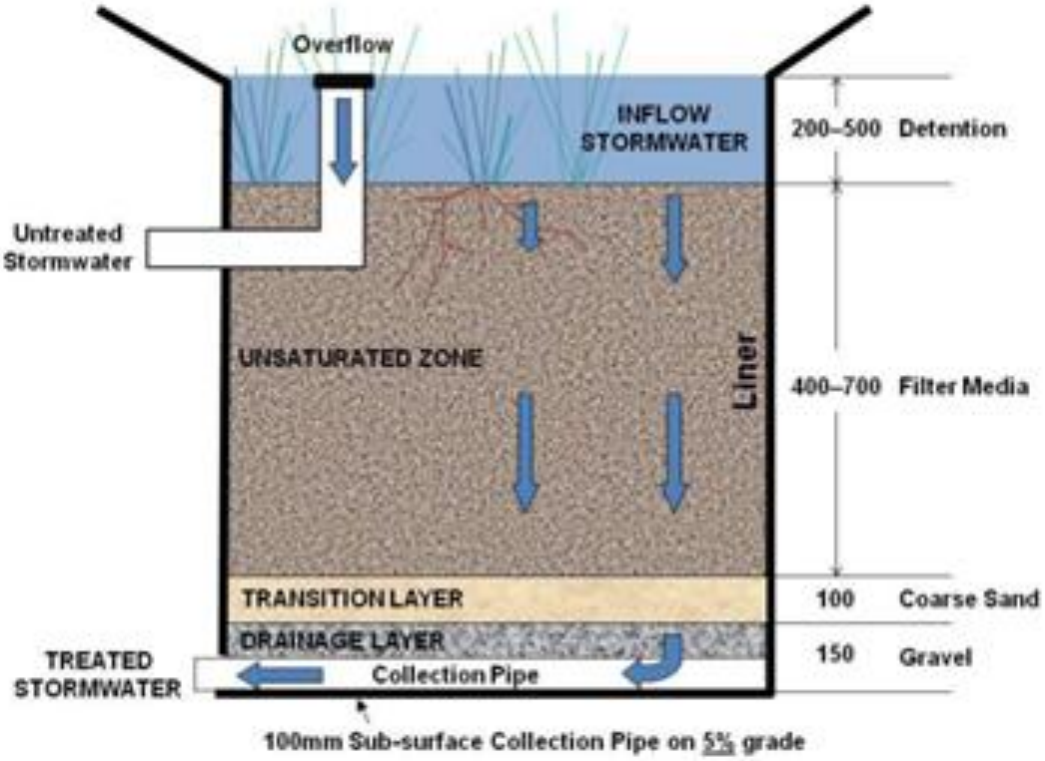

Figure 9 – Typical Bio-Retention Basin Arrangement

Source: Biofilters and Wetlands for Stormwater Treatment and Harvesting (CRC, 2014)

5.4 'Results and Discussion

Estimated post-development pollutant reductions and estimated bio-retention basin filter area requirement are summarised in **Table 9** and **Table 10** based on the modelling methodology described in the preceding Sections.

As demonstrated, the proposed stormwater quality management strategy is capable of achieving performance criteria for the development and with refinement as part of future detailed design has potential to create high amenity infrastructure connecting development and adjacent natural vegetation.

Table 9 – MUSIC Modelling Results – At Basin Outlet

Control Node	GP Removal (%)	TSS Removal (%)	TP Removal (%)	TN Removal (%)	Bio-Retention System Filter Area (m^2)
Performance Target	**90%**	**85%**	**65%**	**45%**	
Basin 1	100	90.7	73.9	58	2500
Basin 2	100	94.3	73.8	55.3	500
Basin 3	100	89.5	63.5	39.2	300
Basin 4	100	88.7	63.8	40	400
Basin 5	100	92.6	72.6	54.9	1400
Basin 6	100	93.2	75	61	2000
Basin 7	100	68.4	29.4	0	0

Table 10 – MUSIC Modelling Results – At Outlet to Riparian

Basin ID	Target Node	GP Removal (%)	TSS Removal (%)	TP Removal (%)	TN Removal (%)
Performance Target		**90%**	**85%**	**65%**	**45%**
Basin 1	Basin 1 Outlet	100	90.7	73.9	58
Basin 2	Basin 2 Outlet	100	94.3	73.8	55.3
Basin 3	Gables A1 Basin Outlet	100	87	66.2	51.2
Basin 4	Gables A1 Basin Outlet	100	87	66.2	51.2
Basin 5	Basin 5 Outlet	100	92.6	72.6	54.9
Basin 6	Basin 6 Outlet	100	93.2	75	61
Basin 7	Gables B3C Basin Outlet	100	90.2	66.7	49.2

6 Conclusions and Recommendations

Allam Property Group and Stockland Corporation Limited have commissioned the preparation of an Integrated Water Cycle Management and Flood Strategy to support the proposed West Gables Rezoning Development Area located within The Hills Shire Council Local Government Area. This strategy provides a delivery framework for the full development cycle and details of the likely infrastructure required to meet major stakeholder requirements for the project.

The proposed IWCMS for West Gables incorporates the following key elements and opportunities.

Regional Catchment Area:

- Utilise the downstream Town Centre Lake constructed as part of The Gables development to manage site discharge to the downstream Cataract Creek tributary floodplain.
- Utilise redundancies present in bio-retention basins within the downstream riparian corridor to treat developed flows generated within West Gables to avoid double treatment of flows and optimise the required bio-retention areas on site.

Sitewide:

- One (1) online storage infrastructure provided within the proposed riparian corridor.
- Five (5) offline detention basins
- Six (6) water quality basins
- Ten (10) gross pollutant traps

These measures are considered appropriate for achieving stormwater quantity and stormwater quality targets typically expected from modern development projects. The management strategy provided is intended to meet minimum requirements for the development with individual components to be refined at detailed design incorporating potential innovative solutions as deemed suitable for each application.

Appendix A Flood Modelling Assessment

Prepared by Northrop Consulting Engineers

Flood Modelling Assessment

for

Gables West

for Enspire Solutions Pty Ltd

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Acronyms

ABCB	Australian Building Codes Board
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ALS	Airborne Laser Survey (LiDAR)
ARI	Average Recurrence Interval
B_{des}	Design blockage per The Gables Blockage Strategy
B_{severe}	High blockage per The Gables Blockage Strategy (typically 80% at outlet structures)
BoM	Bureau of Meteorology
CC	Construction Certificate
DA	Development Application
DEM	Digital Elevation Model (A grid of terrain elevations usually obtained from ALS)
DV	Product of Depth and Velocity
EY	Exceedances Per Year
FSL	Full Supply Level
ha	Measure of area (hectares or 10,000 square metres)
LGA	Local Government Authority
LiDAR	Light Detection and Ranging (also see ALS)
m	Measure of length / height / distance (metres)
m AHD	Meters above Australian High Datum
ML	Measure of volume (megalitres or 1,000 cubic metres)
m/s	Measure of velocity (metres per second)
m^3/s	Measure of flow rate (cubic metres per second)
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PMPDF	Probable Maximum Precipitation Design Flood

THSC	The Hills Shire Council
TUFLOW	A 1D and 2D hydraulic modelling software

Introduction and Background

Northrop Consulting Engineers Pty Ltd (Northrop) have been engaged by Enspire Solutions Pty Ltd (Enspire) to prepare a flood modelling assessment for West Gables development.

Gables is a master planned suburb approximately 380 hectares in size and designed to accommodate over 4,100 dwellings, a retail and mixed-use centre, school and public open space areas. At the centre of this development is a constructed lake and detention basin, providing visual amenity, water quality treatment and flood mitigation functions.

A Flood Impact Assessment for the overall Gables precinct development was previously prepared by J. Wyndham Prince (April 2015), that was further refined for the proposed lake and basin site in their report Box Hill North Main Detention Basins and Lake Stormwater Management Strategy and Flood Assessment Report (October 2016).

A joint venture between Stockland and Allam Group aims to rezone and develop land on the perimeter of the original masterplan community. This will cater for additional dwellings and incorporate local parks and associated water quality and quantity management infrastructure.

The purpose of this correspondence is to present the flood modelling assessment for this additional development and consider the impact to both pre-Gables conditions and the existing approved layout and lake structures.

Included herein is a list of related and supporting documentation, description of the study area, methodology used to undertake the assessment, outline of the modelling undertaken, presentation of the results of the modelling and assessment, and discussion around the implications of the results.

Related Reports and Documents

This report is to be read in conjunction with the following reports and documents:

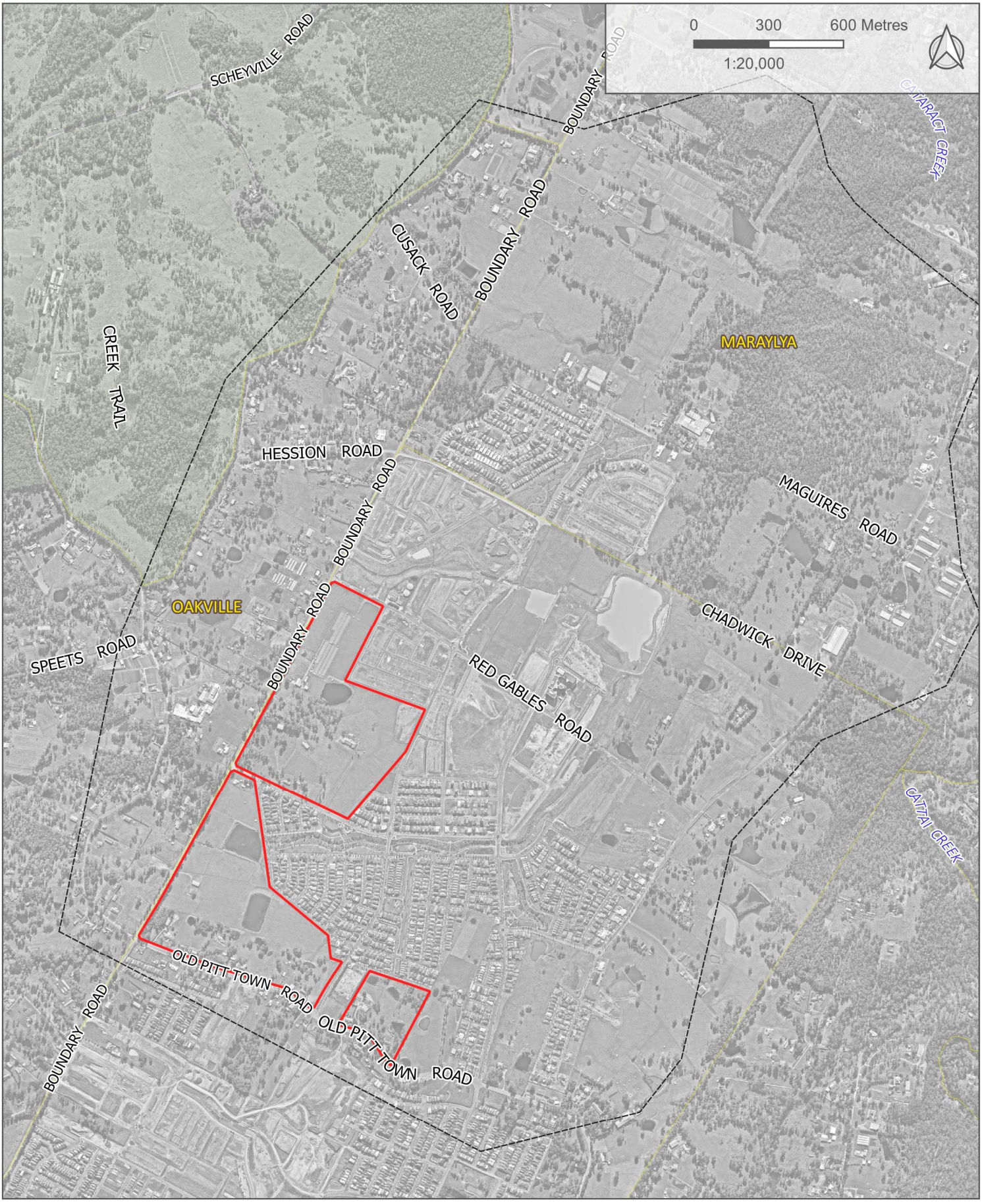
1. Civil Engineering Drawings prepared by Enspire Solutions
2. The Gables Lake CC TUFLOW Modelling Preliminary Submission prepared by Northrop Engineers, dated 11 February 2019
3. The Gables Lake CC Review emails prepared by The Hills Shire Council, dated various 3 May 2019 through 30 May 2019
4. The Gables Precinct Town Centre Main Detention Basins and Lake Civil Engineering Assessment Report – Revision 6 prepared by Northrop Consulting Engineers, May 2019
5. The Gables Precinct Town Centre Main Detention Basins and Lake Dam Break Assessment Civil Engineering Report – Revision 5 prepared by Northrop Consulting Engineers, May 2019
6. The Gables Blockage Strategy prepared by Northrop Consulting Engineers dated 3 May 2019
7. Response to Council Comments and Sensitivity Analysis for The Gables Town Centre Lake prepared by Northrop Consulting Engineers dated 8 May 2019
8. The Gables TUFLOW Submission Requirements prepared by Northrop Consulting Engineers dated 3 May 2019
9. Letter to Dams Safety Committee from J Wyndham Prince dated 9 September 2016 regarding Consequence Categories
10. Letter to Dams Safety Committee from J Wyndham Prince dated 19 October 2016 regarding Consequence Categories
11. Letter from Dams Safety Committee to J Wyndam Prince dated 4 November 2016 requesting further information
12. Letter to Dams Safety Committee from J Wyndham Prince dated 8 December 2016 responding to RFI regarding impact on Maguires Road
13. Letter from Dams Safety Committee to J Wyndam Prince dated 21 February 2017 outlining Flood Consequence Category and Sunny Day Consequence Category for the dam
14. Box Hill and Box Hill Industrial Precincts – Water Cycle Management Strategy Report prepared by J. Wyndham Prince, July 2013
15. Box Hill North Flood Impact Assessment prepared by J. Wyndham Prince, April 2015
16. Box Hill North Main Detention Basins and Lake Stormwater Management Strategy and Flood Assessment Report prepared by J. Wyndham Prince, October 2016
17. Letter to Hills Shire Council regarding TUFLOW Model for the Gables Urban Release Area, Box Hill prepared by Northrop Consulting Engineers dated 3 November 2017
18. Letters received from Dams Safety Committee Re: The Gables Basin dated 28 March 2018.
19. Peer Review for The Gables Dam prepared by Hunter H_2O dated 19 April 2018
20. Peer Review for The Gables Dam prepared by Hunter H_2O dated 20 September 2018

Study Area

The subject site is located adjacent to an unnamed tributary of Cataract Creek. The area is currently rural and is characterised by open pastures, and farm dams.

The area immediately downstream of development consists of the Gables development.

An aerial photo showing the locality is presented in Figure 1 overleaf.



Legend

Project Area Flood Model Extent

Figure 1

Locality

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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Methodology

The flood modelling was undertaken using the following steps;

- Review of existing modelling and consents, and proposed design layout and surfaces.
- Amend TUFLOW model to accommodate design changes.
- Run and assess models with respect to previous documentation.
- Prepare figures to graphically represent results.

Outcomes have been detailed in this correspondence.

Flood Model Setup

Model Approach

A computational flood model has been prepared for the development design and assessment in conjunction with The Hills Shire Council. It covers approximately nine square kilometres (900 ha) from the top of catchment upstream of Old Pitt Town Road, to approximately two kilometres downstream of the basin and lake.

The model was developed using the TUFLOW software and a rainfall on grid hydrology approach.

Hydrology

Rainfall depths and temporal patterns from Australian Rainfall and Runoff (ARR) 1987 have been adopted. Probable Maximum Precipitation (PMP) has been estimated using the Generalised Short Duration Method (GSDM) and interpolation of these two sources has been undertaken for events between the reasonable limit of ARR procedures and the PMP.

Roughness and Losses

Roughness values and associated losses are presented in Table 1 below. Spatial distribution for the existing and ultimate developed cases is presented overleaf in Figure 2 and Figure 3.

Table 1 - Manning's Roughness

ID	Landuse	Manning's n	Initial Loss (mm)	Continuing Loss (mm/hr)
1	Floodplain High Grass	0.035	15	2.5
2	Roads	0.015	1	0
3	Light Vegetation	0.04	15	2.5
4	Medium Vegetation	0.05	15	2.5
5	Dense Vegetation	0.10	15	2.5
6	Dams	0.025	0	0
7	Buildings Within the Floodplain	0.30	0	0
8	Buildings Outside the Floodplain	0.025	0	0
9	Waterway with Minimal Vegetation	0.03	15	2.5
10	Waterway with Medium Vegetation and Raingardens	0.05	15	2.5
11	Waterway with Dense Vegetation	0.08	15	2.5
12	Residential Lots Combined	0.30	1	0
13	Open Space and Sports Fields	0.025	5	1
14	Drainage Channel	0.07	15	2.5
15	Dense Vegetation Sensitivity	0.15	15	2.5
16	Rock Armouring	0.04	15	2.5

Existing Farm Dams

Existing farm dams have been modelled as full to their lowest spill crest using a 2d_iwl layer. Spatial distribution is presented overleaf in Figure 4 and Figure 5.

Basin Outlets and Configuration

Basin configurations are presented in Table 2 below and the civil drawings are presented in Appendix A.

Table 2 – Basin configuration

	Basin 1 + 2	Basin 3	Basin 4	Basin 5	Basin 6	Basin 7
Invert (m AHD)	41.40	48.85	44.88	41.93	37.80	40.35
Outlet Type	RCBC	RCP	RCP	RCP	RCP	RCP
Outlet Dimensions (mm)	1200 x 900	450	900	750	600	750
Outlet Pipe Invert (m AHD)	41.40	48.85	43.60	40.95	37.80	38.75

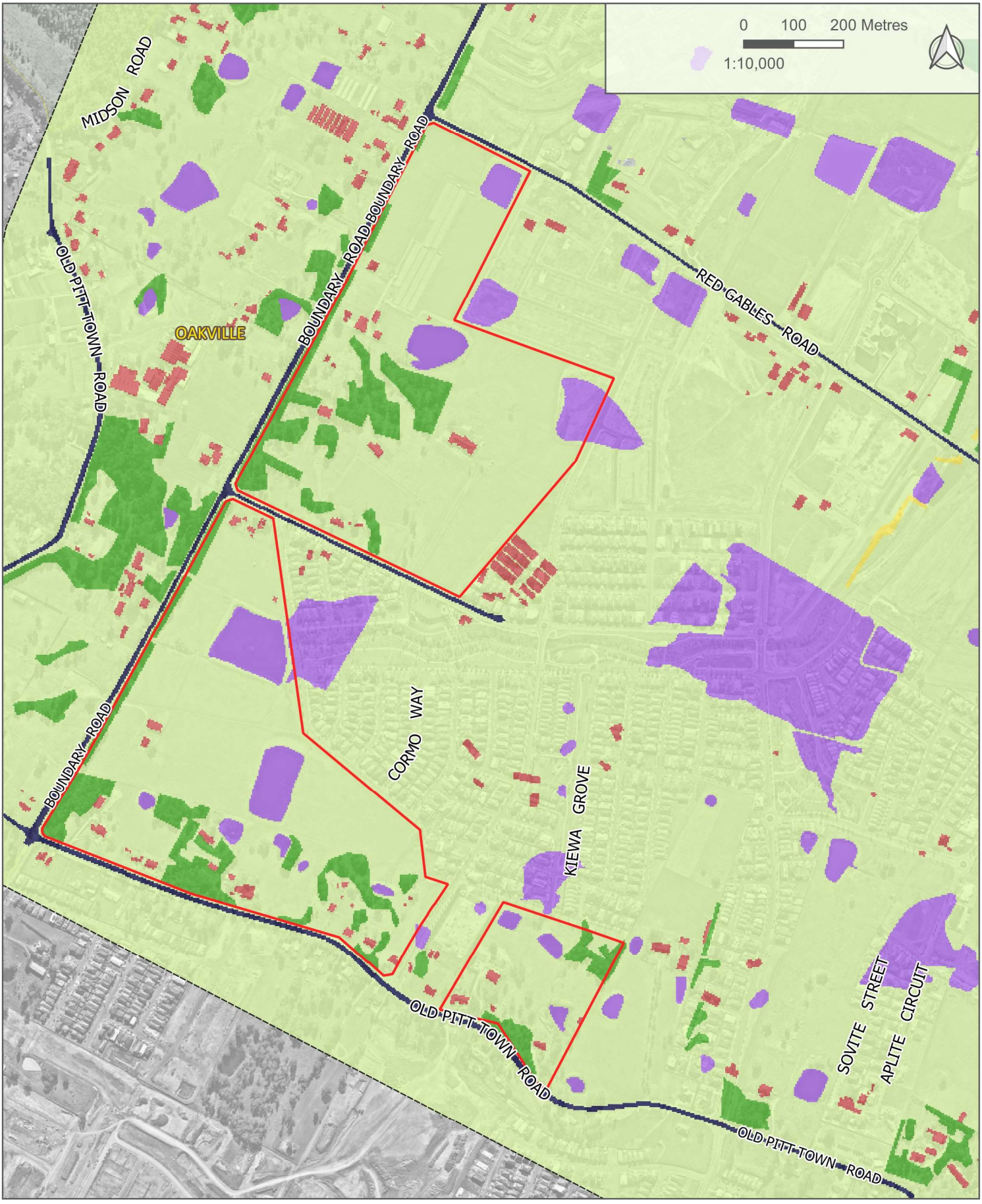
Topography

Existing and developed topography are presented overleaf in Figure 6 and Figure 7.

Scenarios

The adopted scenarios in this submission are EXIST_04 for the existing case, and WestGables_004 for the developed case. Comparisons are made between these two scenarios and the previous adopted lake CC model (with minor amendments) UltDev_014.

This considers comparisons in flood behaviour if The Gables never went ahead, and a comparison with the current approved development.



Legend

- Project Area
- Flood Model Extent

Roughness

- n = 0.035
- n = 0.015
- n = 0.04
- n = 0.10
- n = 0.025
- n = 0.025
- n = 0.05
- n = 0.08
- n = 0.30
- n = 0.07
- n = 0.04

Figure 2

Existing Case Roughness

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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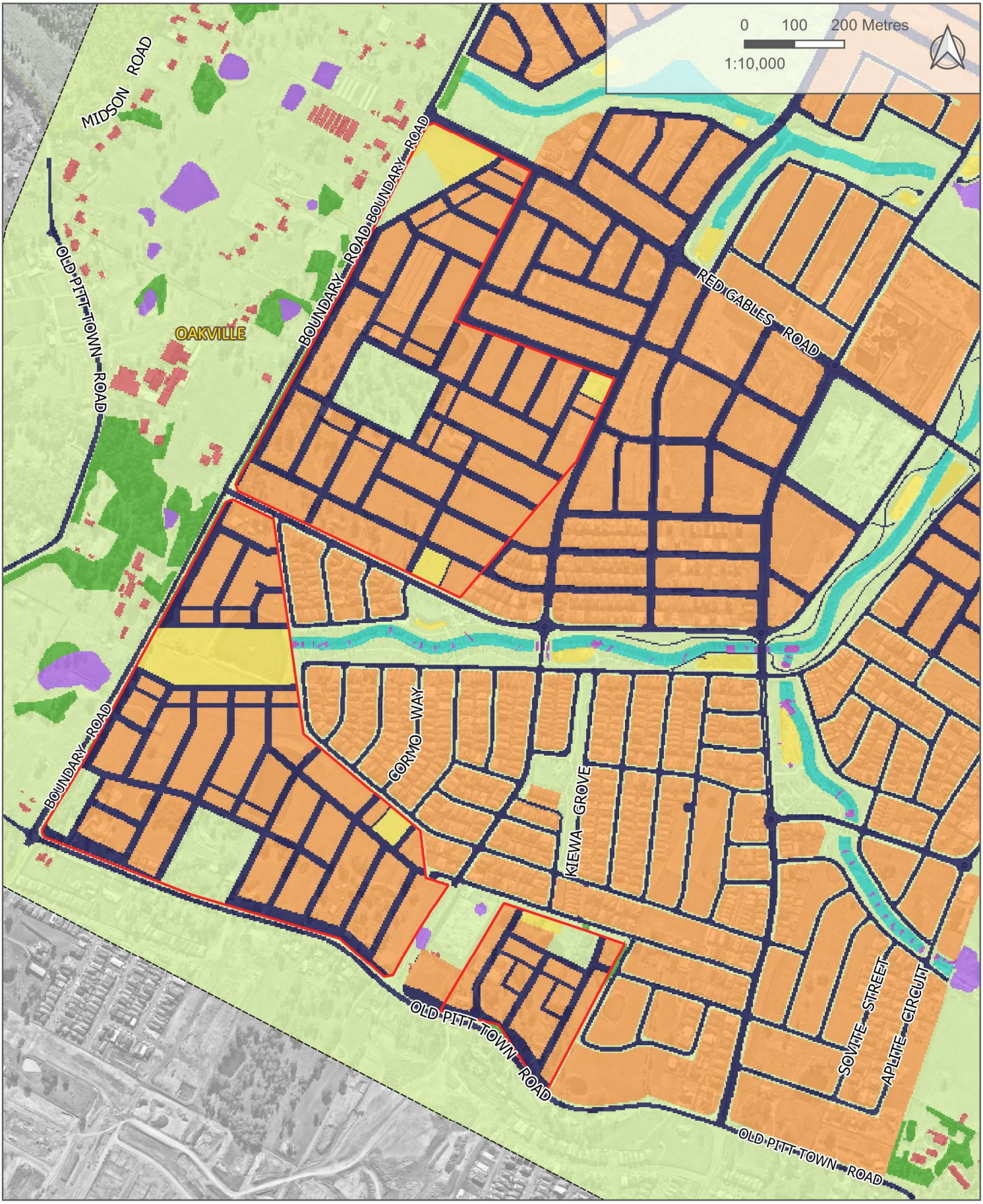

Legend

- Project Area
- Flood Model Extent

Roughness

- n = 0.035
- n = 0.015
- n = 0.04
- n = 0.10
- n = 0.025
- n = 0.025
- n = 0.05
- n = 0.08
- n = 0.30
- n = 0.07
- n = 0.04

Figure 3

Developed Case Roughness

West Gables

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Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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Legend

- Project Area
- Flood Model Extent
- 2D Initial Water Levels

Figure 4

Existing Initial Water Levels

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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Legend

- Project Area
- Flood Model Extent
- 2D Initial Water Levels

Figure 5

Developed Initial Water Levels

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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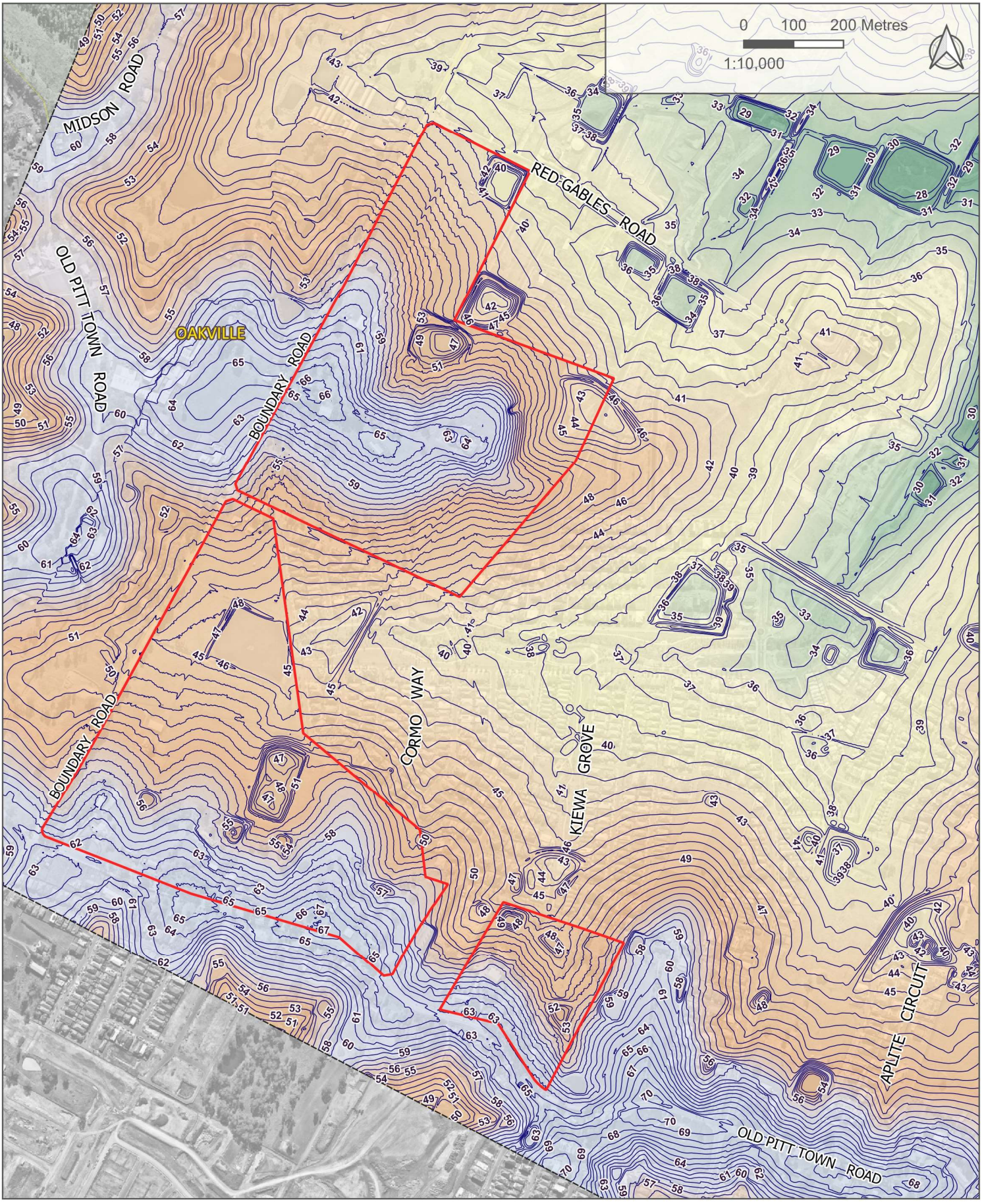

Legend

- Project Area
- Flood Model Extent
- Elevation (m AHD)
  - 70
  - 30
- 1m Contour

Figure 6

Existing Topography

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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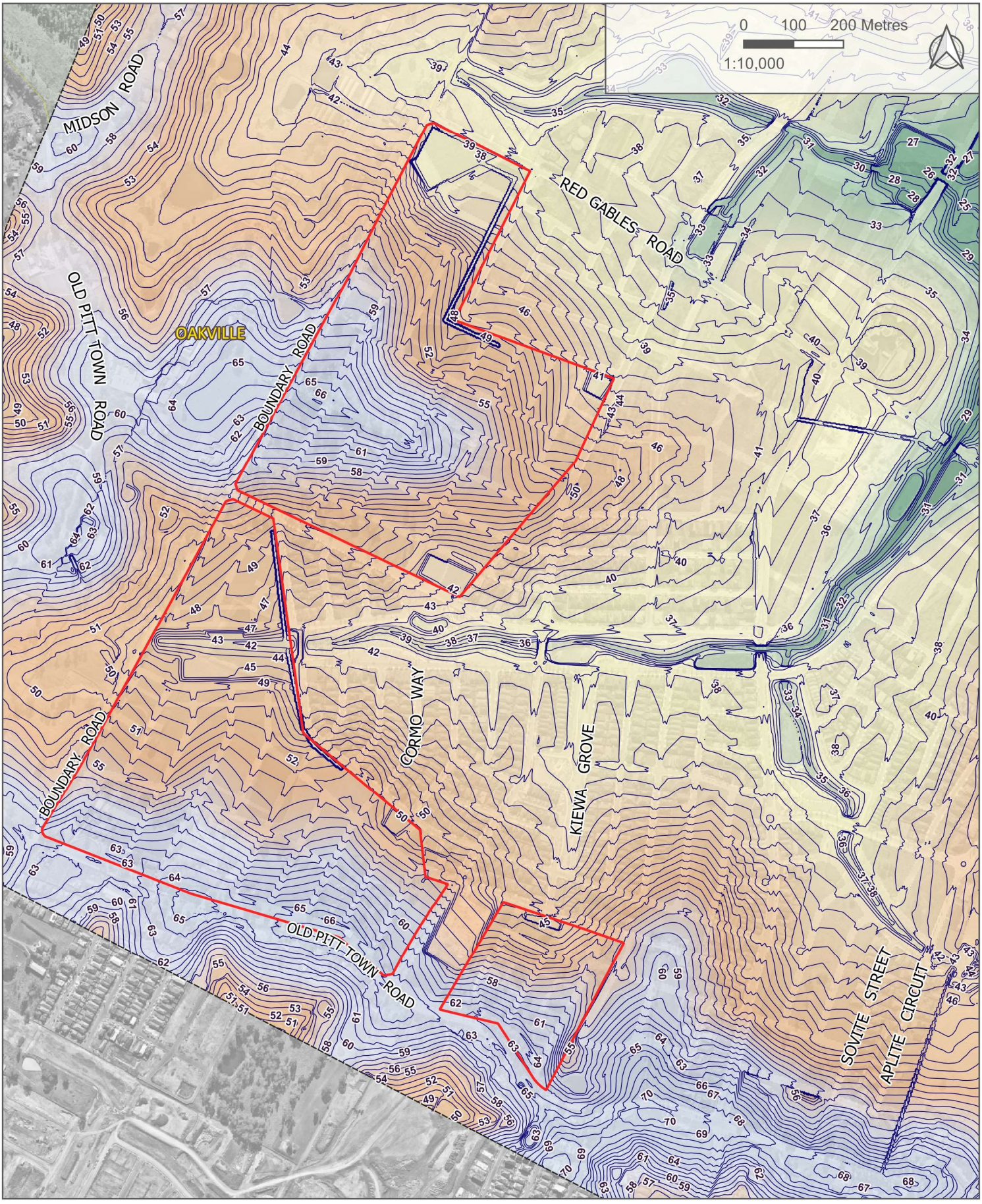

Legend

- Project Area
- Flood Model Extent
- Elevation (m AHD): 70 / 30
- 1m Contour

Figure 7

Developed Topography

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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Flood Modelling Results

Flood Levels and Peak Flows

Flood reporting locations are presented overleaf in Figure 8.

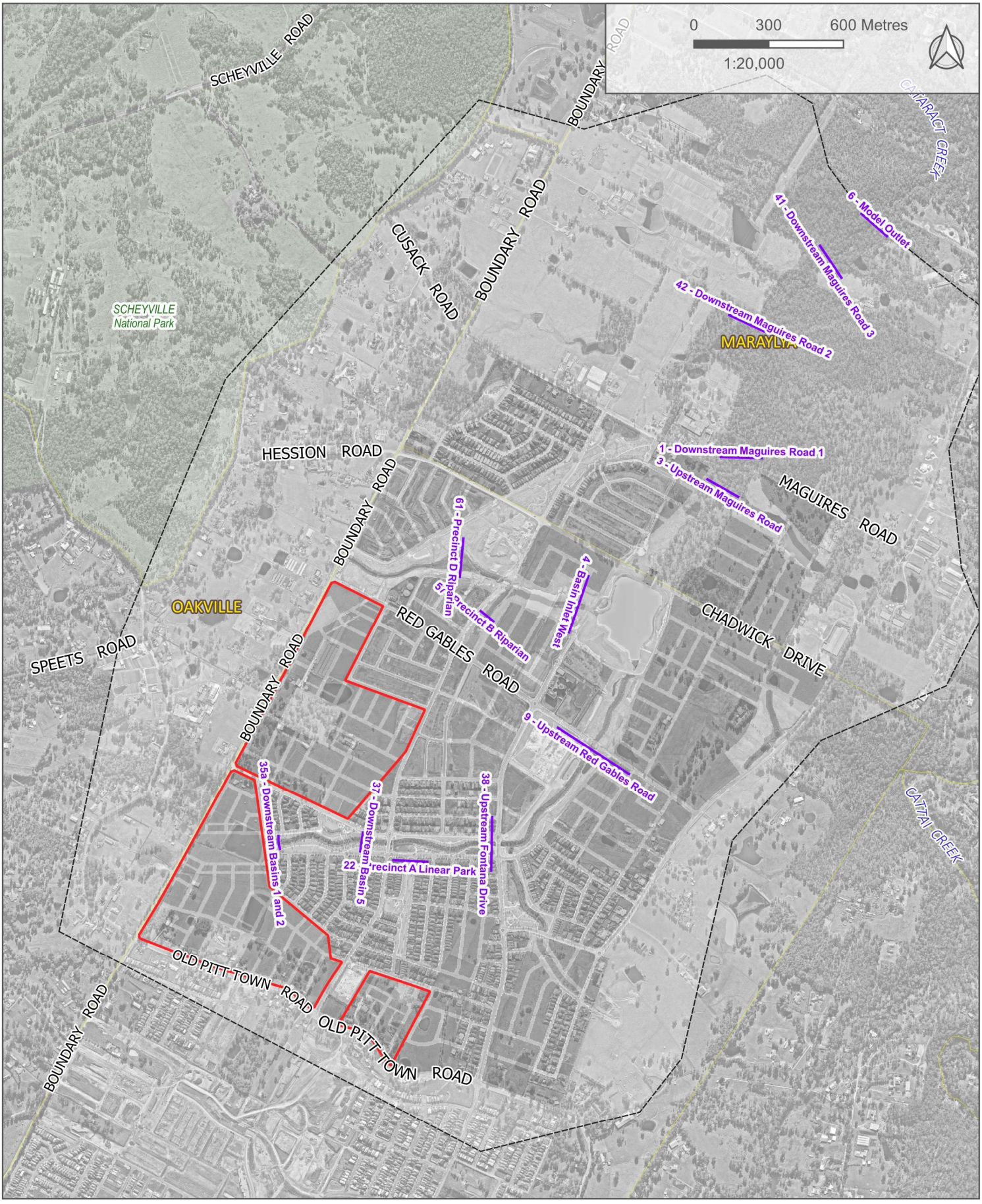
The basin levels calculated in this analysis are presented below in Table 3. Table 4 demonstrates a comparison of the downstream riparian flow rates.

Table 3 - Flood modelling results – peak flows

	Basin 1 + 2	Basin 3	Basin 4	Basin 5	Basin 6	Basin 7
39.35% AEP	42.80	49.65	44.90	42.33	38.57	40.57
10% AEP	43.33	49.95	44.92	42.43	38.74	40.72
1%AEP (Bdes)	44.03	50.33	44.98	42.67	39.05	40.98
PMF	45.44	50.69	46.33	43.46	40.02	41.85

Table 4 – 1% AEP peak flow results

Location	EXIST_04 (m^3/s)	UltDev_014 (m^3/s)	WestGables_004 (m^3/s)
6 – Model Outlet	69.4	73.5	74.2
41 – Downstream Maguires Road 3	68.1	70.9	71.7
42 – Downstream Maguires Road 2	64.2	63.2	64.2
1 – Downstream Maguires Road 1	48.9	40.4	40.0
3 – Upstream Maguires Road	45.7	36.9	35.4
4 – Basin Inlet West	N/A	25.4	24.0
61 – Precinct D Riparian	N/A	16.2	16.9
57 – Precinct B Riparian	N/A	9.4	7.3
9 – Upstream Red Gables Road	N/A	50.3	49.4
38 – Upstream Fontana Drive	N/A	22.6	20.9
22 – Precinct A Linear Park	N/A	1.0	0.6
37 – Downstream Basin 5	N/A	9.4	8.3
35a – Downstream Basin 1 and 2	N/A	6.3	4.3



Legend

- Project Area
- Flood Model Extent

Flow Reporting Points

Figure 8

Flow Reporting Locations

West Gables

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Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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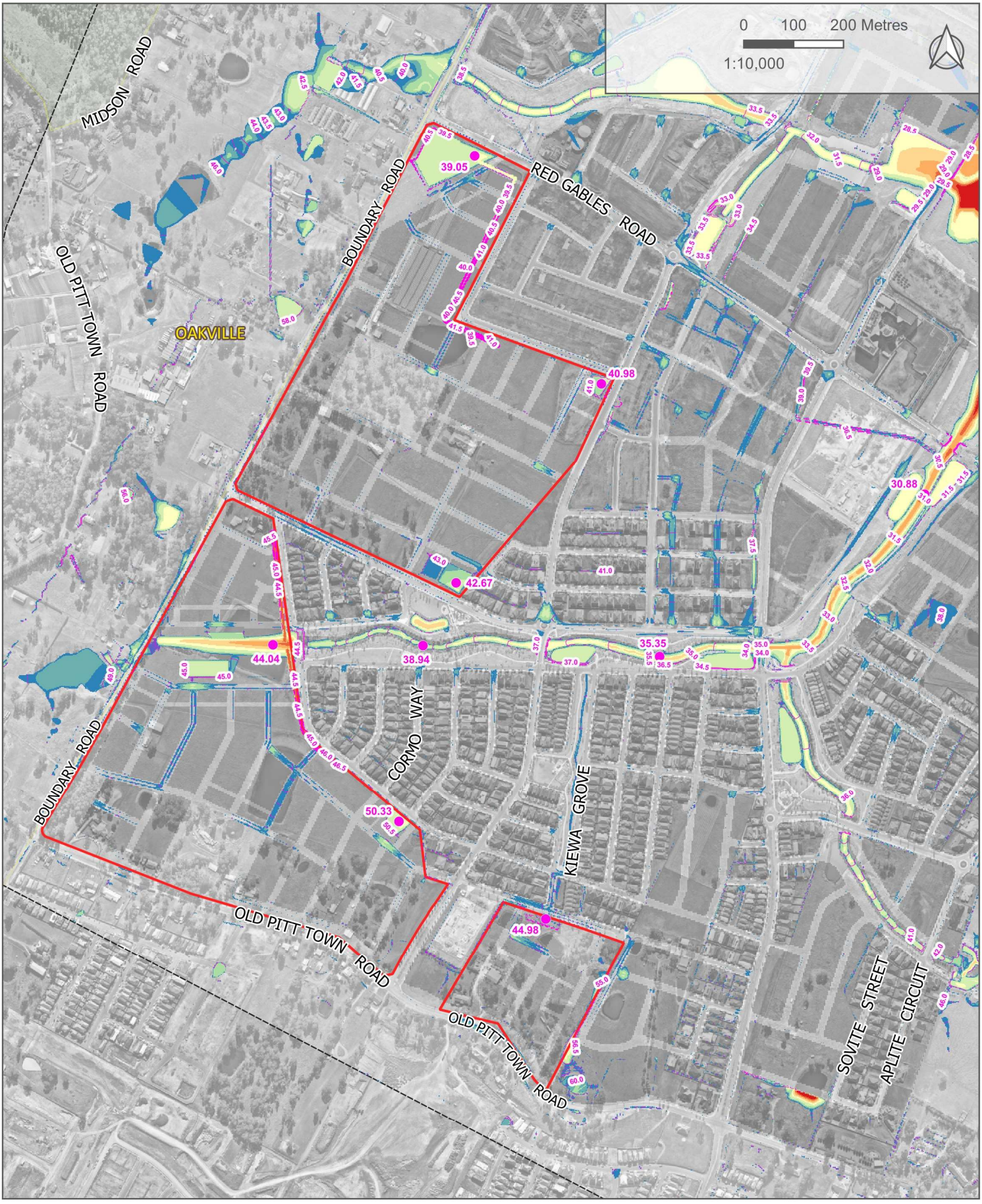

Legend

- Project Area
- Flood Model Extent
- Reporting Point
- 500mm WSL

Depth (m)

- <= 0.1000
- 0.1000 - 0.2000
- 0.2000 - 0.3000
- 0.3000 - 0.5000
- 0.5000 - 1.0000
- 1.0000 - 1.5000
- 1.5000 - 2.0000
- 2.0000 - 2.5000
- 2.5000 - 3.0000
- > 3.0000

Figure D1

1% AEP Depth and Elevation

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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Legend

- Project Area
- Flood Model Extent

Velocity (m/s)

- <= 0.5000
- 0.5000 - 1.0000
- 1.0000 - 1.5000
- 1.5000 - 2.0000
- > 2.0000

Figure D2

1% AEP
Velocity

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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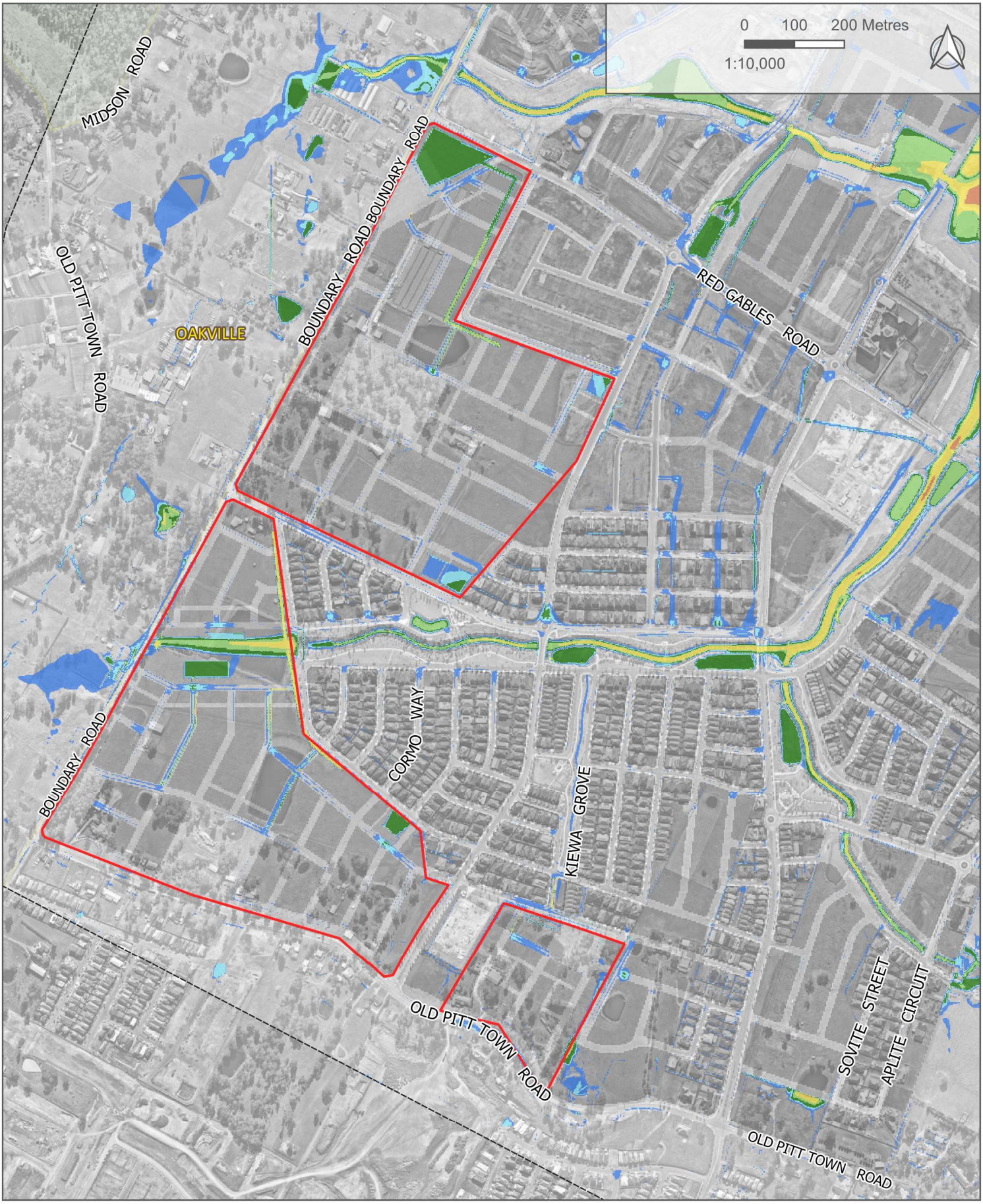

Legend

- Project Area
- Flood Model Extent

Hazard Categories

- H1
- H2
- H3
- H4
- H5
- H6

Figure D3

1% AEP
AEMI Hazard

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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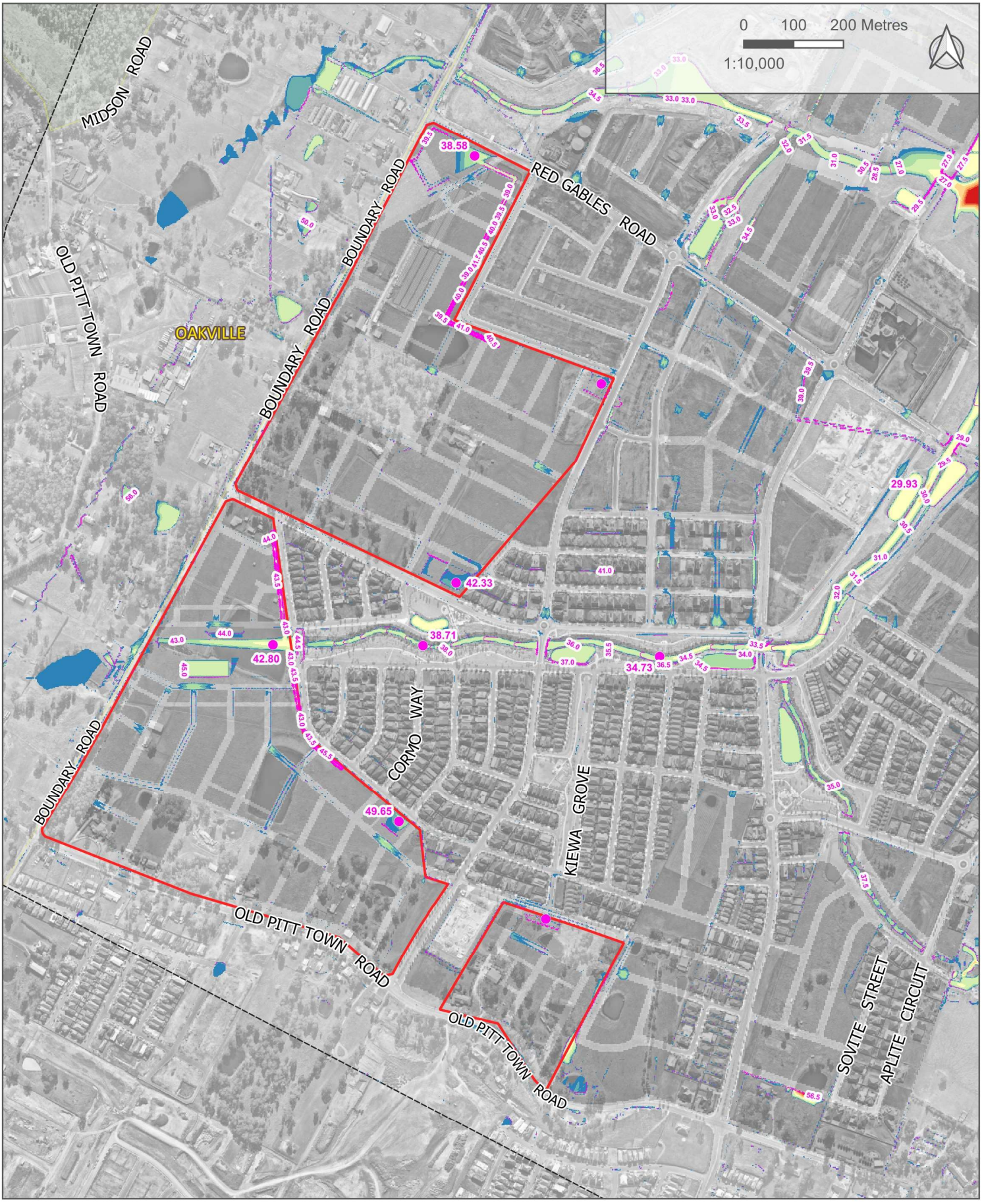

Legend

- Project Area
- Flood Model Extent
- Reporting Point
- 500mm WSL

Depth (m)

- <= 0.1000
- 0.1000 - 0.2000
- 0.2000 - 0.3000
- 0.3000 - 0.5000
- 0.5000 - 1.0000
- 1.0000 - 1.5000
- 1.5000 - 2.0000
- 2.0000 - 2.5000
- 2.5000 - 3.0000
- > 3.0000

Figure D4

39.35% AEP Depth and Elevation

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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Legend

- Project Area
- Flood Model Extent

Velocity (m/s)

- <= 0.5000
- 0.5000 - 1.0000
- 1.0000 - 1.5000
- 1.5000 - 2.0000
- > 2.0000

Figure D5

39.35% AEP
Velocity

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
5/12/2022 X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\west figures_v2.qgz

Legend

- Project Area
- Flood Model Extent

Hazard Categories

- H1
- H2
- H3
- H4
- H5
- H6

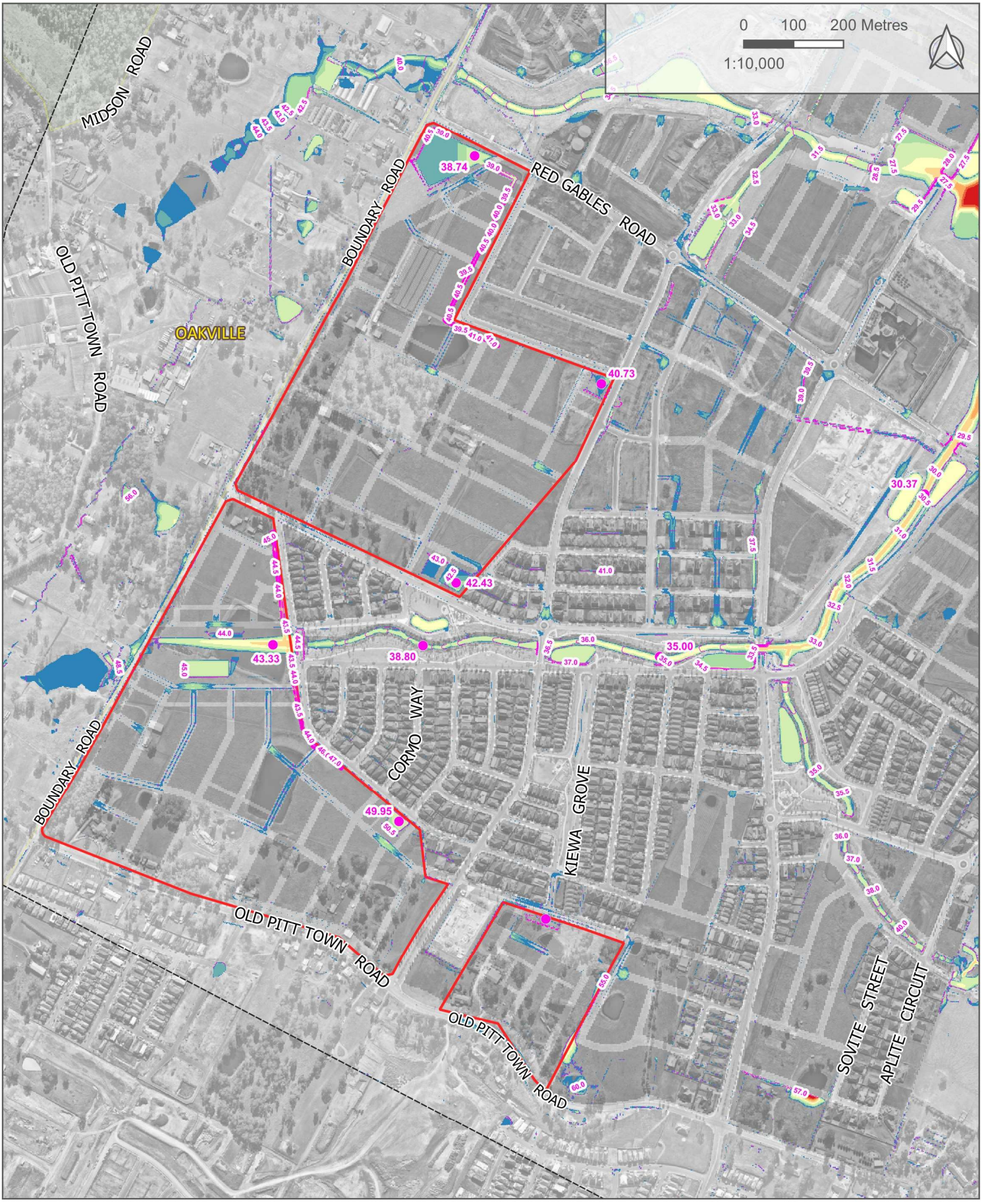
Figure D6

39.35% AEP
AEMI Hazard

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
5/12/2022 X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\west figures_v2.qgz



Legend

- Project Area
- Flood Model Extent
- Reporting Point
- 500mm WSL

Depth (m)

- <= 0.1000
- 0.1000 - 0.2000
- 0.2000 - 0.3000
- 0.3000 - 0.5000
- 0.5000 - 1.0000
- 1.0000 - 1.5000
- 1.5000 - 2.0000
- 2.0000 - 2.5000
- 2.5000 - 3.0000
- > 3.0000

Figure D7

10% AEP Depth and Elevation

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
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Legend

- Project Area
- Flood Model Extent

Velocity (m/s)

- <= 0.5000
- 0.5000 - 1.0000
- 1.0000 - 1.5000
- 1.5000 - 2.0000
- > 2.0000

Figure D8

10% AEP
Velocity

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
5/12/2022 X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\west figures_v2.qgz

Legend

- Project Area
- Flood Model Extent

Hazard Categories

- H1
- H2
- H3
- H4
- H5
- H6

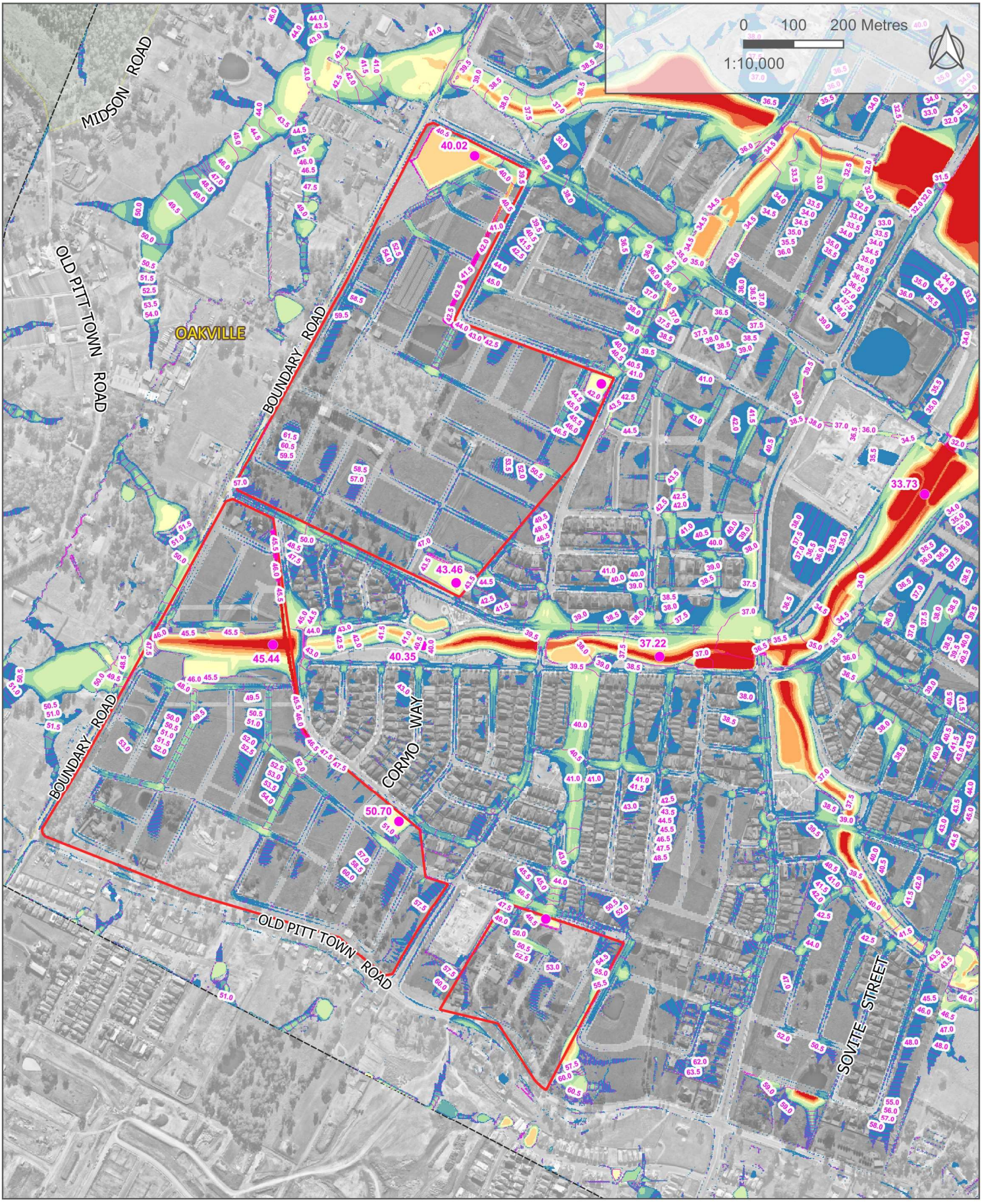
Figure D9

10% AEP
AEMI Hazard

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
5/12/2022 X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\west figures_v2.qgz



Legend

- Project Area
- Flood Model Extent
- Reporting Point
- 500mm WSL

Depth (m)

- <= 0.1000
- 0.1000 - 0.2000
- 0.2000 - 0.3000
- 0.3000 - 0.5000
- 0.5000 - 1.0000
- 1.0000 - 1.5000
- 1.5000 - 2.0000
- 2.0000 - 2.5000
- 2.5000 - 3.0000
- > 3.0000

Figure D10

PMF Depth and Elevation

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
5/12/2022 X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\west figures_v2.qgz

Legend

- Project Area
- Flood Model Extent

Velocity (m/s)

- <= 0.5000
- 0.5000 - 1.0000
- 1.0000 - 1.5000
- 1.5000 - 2.0000
- > 2.0000

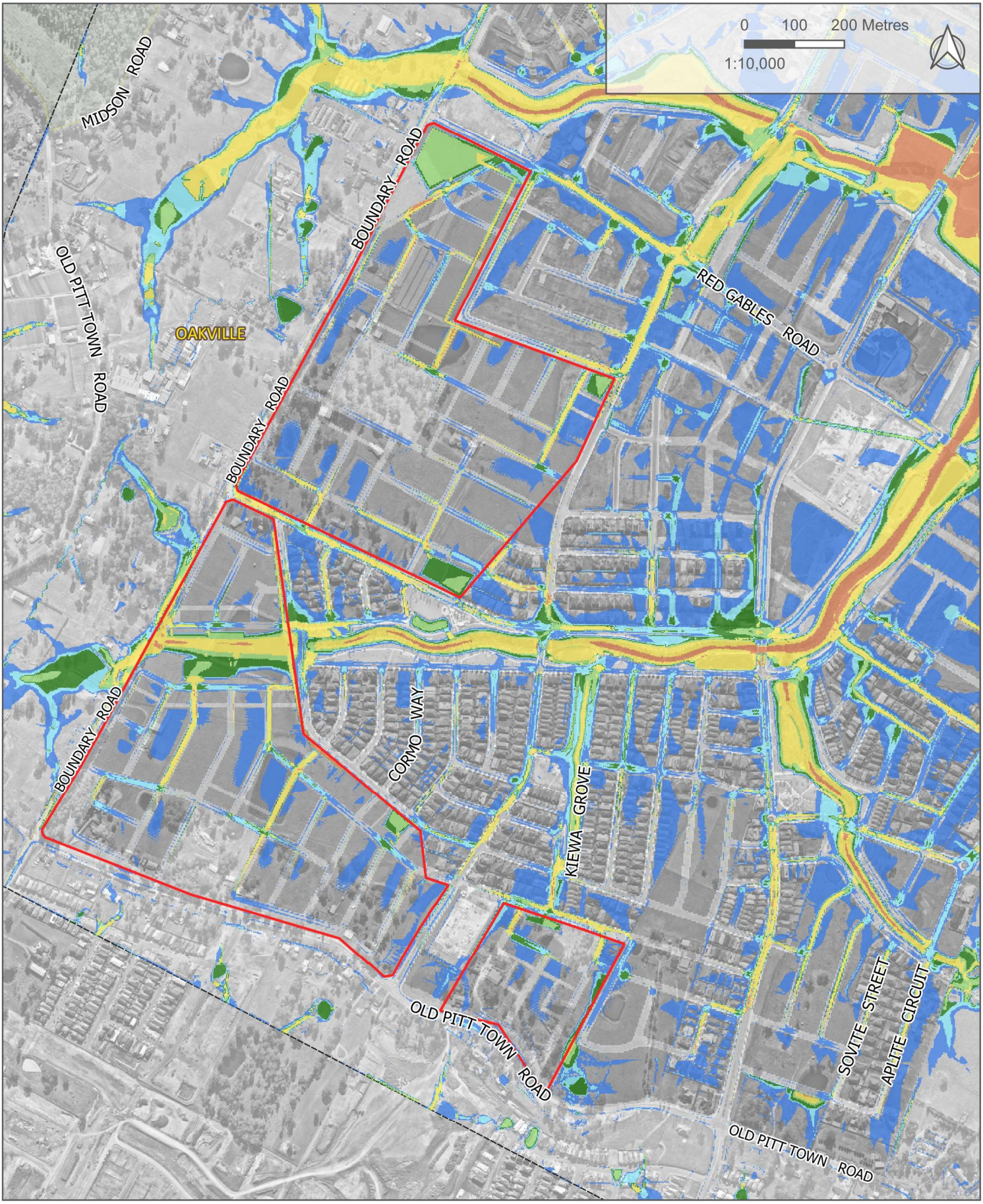
Figure D11

PMF
Velocity

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
5/12/2022 X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\west figures_v2.qgz



Legend

- Project Area
- Flood Model Extent

Hazard Categories

- H1
- H2
- H3
- H4
- H5
- H6

Figure D12

PMF
AEMI Hazard

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
5/12/2022 X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\west figures_v2.qgz

Discussion

Flood Extents and Velocity Mapping

Whilst the modelling reports flood behaviour at every grid cell, it has previously been assumed (and agreed with The Hills Shire Council) that any flow under 100mm depth is classified as sheet flow and not reported in the figures.

It is noted that in some areas, flow depth greater than 100mm is present on lots or within roadways. This is due to the pit and pipe network not being included in these areas of the model. Detailed one dimensional analysis of the road stormwater network will be undertaken for each subdivision stage to ensure flood extents are minimised and safe depths, velocities and velocity depth products maintained, and no residential lots are classified as “Flood Controlled”.

Flood Elevation Comparison

A flood elevation comparison in the 1% AEP is presented in Figure C1 and C2 overleaf.

A 65mm increase is calculated in the Bdes 1% AEP developed to existing comparison at the model outlet. This is generally consistent with the previous Lake CC reporting.

In the comparison with the existing developed case, there is a reduction through much of the main riparian corridor, and an approximately 100mm reduction in the main lake.

There is an isolated increase in the Precinct D riparian corridor of approximately 30mm and an increase downstream of Maguires Road (west) culverts due to a change in configuration since the previous submission. Levels near the model outlet are +/-3mm from this previous package.

This demonstrates the detention concept for West Gables in most areas improves the flood conditions through the Gables proper and to adjacent properties downstream.

Velocity Comparison

A flood velocity comparison in the 39.35% AEP with the existing case is presented overleaf in Figure C3.

This demonstrates most of the velocity increases are limited to 0.5m/s and velocities are generally lower than the erosive threshold for grass at 1.5m/s.

Changes Since Gables Modelling Submission

The following changes have been made in the existing case.

- Removal of farm dam upstream of Boundary Road outside of the project area.
- Inclusion of detailed survey.
- Amendment of basin initial water levels based on detailed survey.

Changes to the developed case include.

- Amendment of the Manning’s roughness layer
- Amendment of topography.
- Dam outlets represented in the 1D domain.
- Terrain adjustment to funnel water into Basins 1 and 2, and Basin 6. This represents the future trunk drainage arrangement.

Blockage

The Gables subdivision is subject to a blockage guideline. In the absence of a guideline for the Gables West project area, basins were modelled as zero blockage.

This demonstrates a conservative assumption that maximum flow is released downstream into the catchment. The design blockage scenario was applied through the rest of the Gables development.

We believe measures to mitigate blockage can be incorporated through detailed design of the outlet structures, including amended sizing to reflect a design blockage percentage, or debris control structures over the outlets of the smaller basins.

Response to Ministerial Directions Flooding

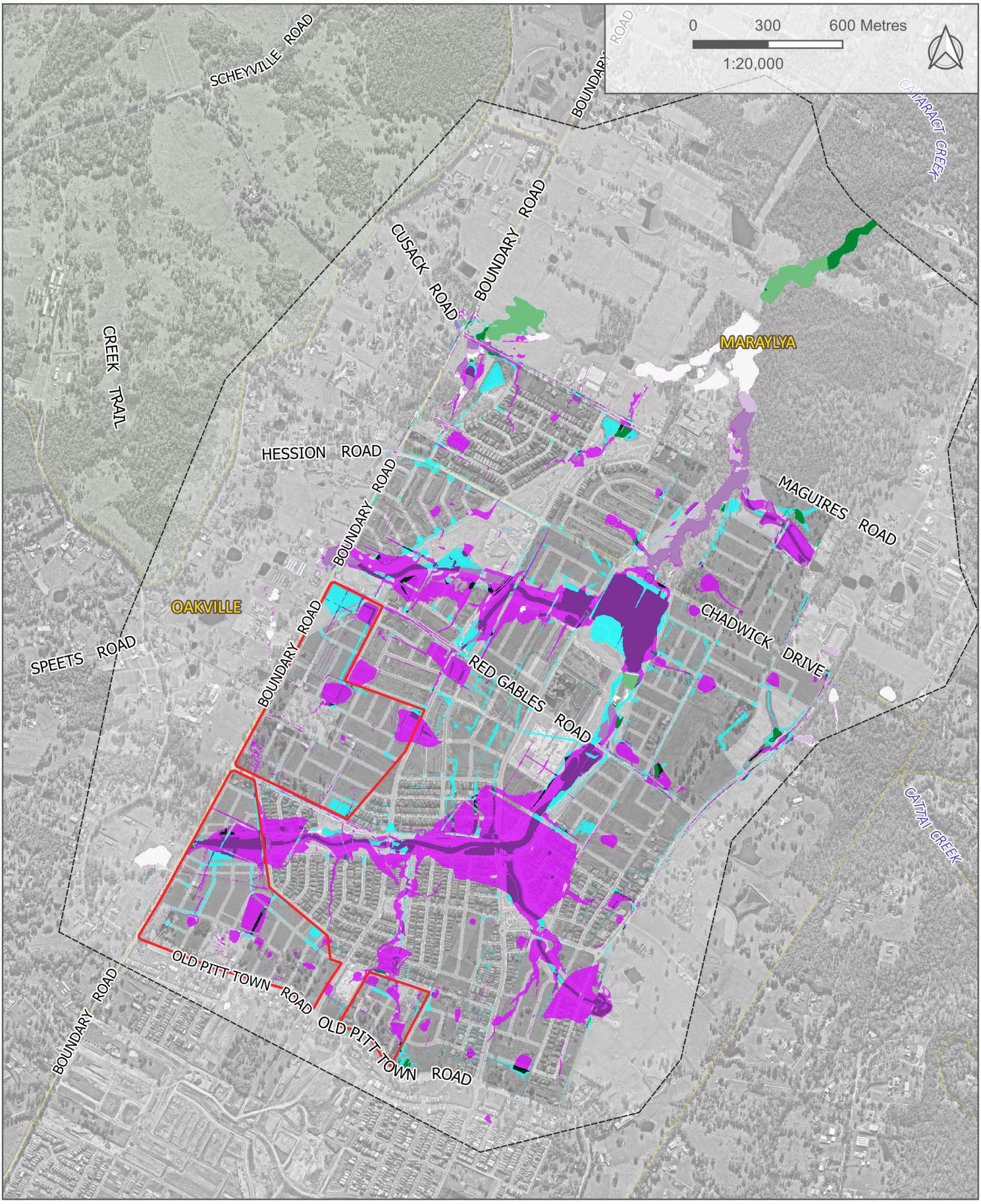
A response to the ministerial direction is presented below in Table 5.

Table 5 - Response to Ministerial Directions

Requirement	Response
4.1.1 A planning proposal must include provisions that give effect to and are consistent with:	
a) The NSW Flood Prone Land Policy.	The subject site is located within the Flood Planning Area and as such, the provisions of the NSW Flood Prone Land Policy and Floodplain Development Manual are applicable. The principles of the NSW Flood Prone Land Policy are expected to be satisfied through adoption of appropriate flood mitigation and development controls.
b) The principles of the Floodplain Development Manual 2005.	The principles of the Floodplain Development Manual (2005) are expected to be achievable through the implementation of development controls. Where storage has been removed from the floodplain, basins have been provided in an attempt to replicate existing conditions. This report assesses the potential impacts of the development on adjacent properties. These engineering basin concepts are expected to be further reviewed at Development Application Phase.
c) The considering Flooding in land use planning guideline 2021, and	The recommendations contained within this guideline are included under the The Hills LEP 2019. Key flood constraints outlined in this guideline are summarised as; • Flood Function • Flood Hazard • Flood Extent and Behaviour; and • Risk to Life

Requirement	Response
	These elements have all been discussed in this assessment.
d) Any adopted flood study and/or floodplain risk management plan prepared in accordance with the principles of the Floodplain Development Manual 2005 and adopted by the relevant council.	This assessment has considered the previous Box Hill North planning proposal, and Gables flood study as developed for the adjoining development.
4.1.2 A planning proposal must not rezone land within the flood planning area from Recreation, Rural, Special Purpose or Conservation Zones to a Residential, Business, Industrial or Special Purpose Zones.	**The planning proposal does not propose to rezone Recreation, Rural, Special Purpose or Conservation Zones to a Residential, Business, Industrial or Special Purpose Zones.**
4.1.3 A planning proposal must not contain provisions that apply to the flood planning area which:	
a) Permit development in floodway areas,	The topography has been modified to located development outside the floodway in line with the wider Gables development.
b) Permit development that will result in significant flood impacts to other properties,	Detention has been incorporated which generally results in a reduction in flood levels from the currently approved condition. Areas of minor increase have been discussed in the sections preceding.
c) Permit development for the purpose of residential accommodation in high hazard areas,	The topography has been amended to lower the hazard of the developed area in line with the wider Gables development. Flood hazard is generally H1 across future residential lots.
d) Permit a significant increase in the development and/or dwelling density of that land.	Topography has modified the flood behaviour to prevent densification of development within the flood planning area. This is consistent with the wider Gables development.
e) Permit development for the purpose of centre-based childcare facilities, hostels, boarding houses, group homes, hospitals, residential care facilities, respite day care centres and senior housing, in areas where the occupants of the development cannot effectively evacuate,	Not applicable.

Requirement	Response
f) permit development to be carried out without development consent except for the purposes of exempt development or agriculture. Dams, drainage canals, levees, still require development consent,	Not applicable.
g) are likely to result in a significantly increased requirement for government spending on emergency management services, flood mitigation and emergency response measures, which can include but are not limited to the provision of road infrastructure, flood mitigation infrastructure and utilities, or	This development adds to the existing development of this catchment. We believe it is unlikely to significantly contribute to additional government spending.
h) permit hazardous industries or hazardous storage establishments where hazardous materials cannot be effectively contained during the occurrence of a flood event.	Not applicable.
4.1.5 For the purposes of preparing a planning proposal, the flood planning area must be consistent with the principles of the Floodplain Development Manual 2005 or as otherwise determined by a Floodplain Risk Management Study or Plan adopted by the relevant council.	**The definition of Flood Planning Area in The Hills LEP (2019) is consistent with the NSW Floodplain Development Manual (2005). As such, the Flood Planning Area for the subject site is expected the be defined as the 1% AEP + 500mm.**



Legend

- Project Area
- Flood Model Extent
- Wet Dry
- Was Wet Now Dry
- Was Dry Now Wet

Difference (m)

- <= -0.5000
- -0.5000 - -0.1000
- -0.1000 - -0.0500
- -0.0500 - -0.0100
- -0.0100 - 0.0100
- 0.0100 - 0.0500
- 0.0500 - 0.5000
- > 0.5000

Figure C1

1% AEP Comparison Elevation
WestGables_004 minus EXIST_04

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
5/12/2022 X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\west figures_v2.qgz

Legend

- Project Area
- Flood Model Extent
- Wet Dry
- Was Wet Now Dry
- Was Dry Now Wet

Difference (m)

- <= -0.5000
- -0.5000 - -0.1000
- -0.1000 - -0.0500
- -0.0500 - -0.0100
- -0.0100 - 0.0100
- 0.0100 - 0.0500
- 0.0500 - 0.5000
- > 0.5000

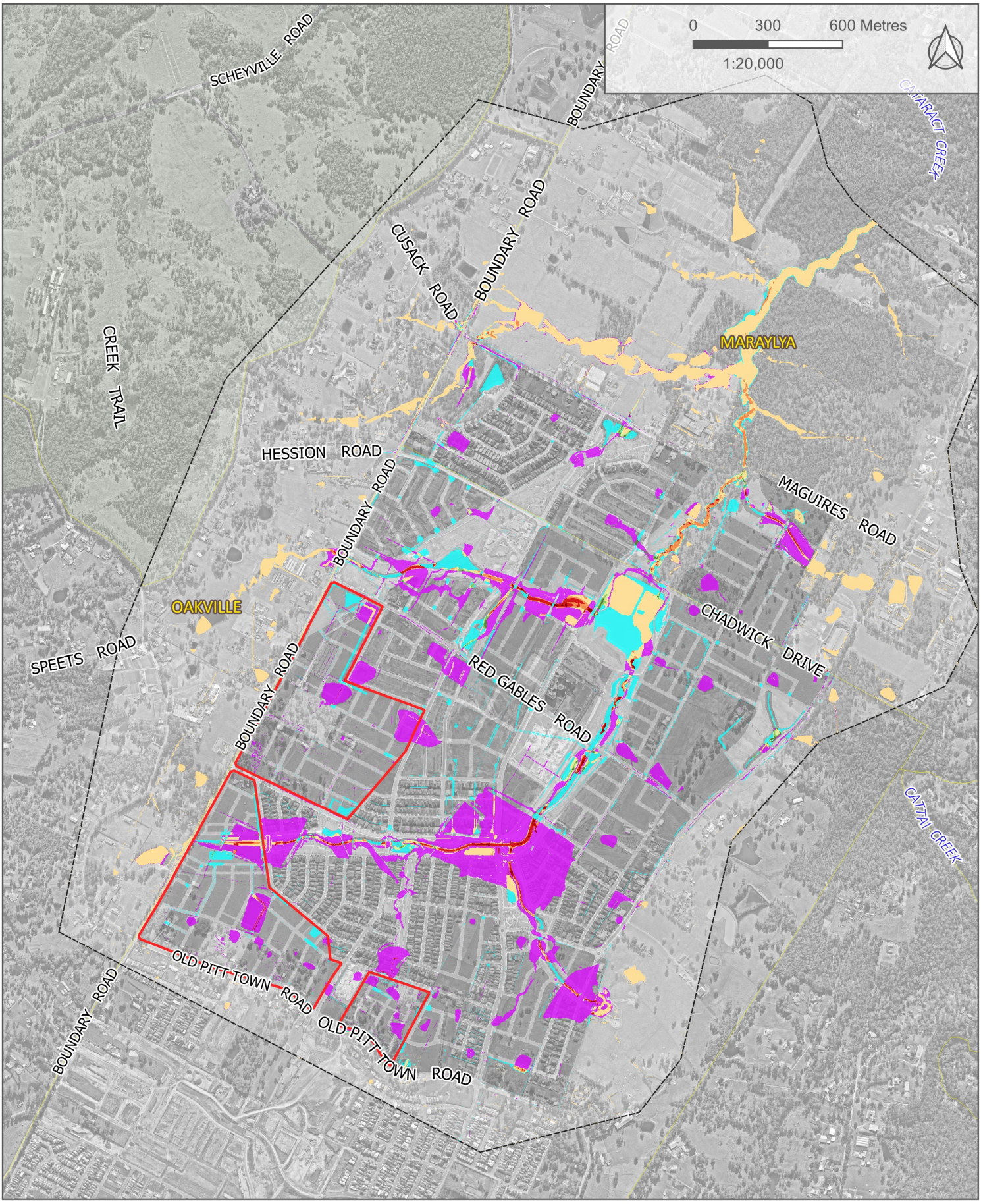
Figure C2

1% AEP Comparison Elevation
WestGables_004 minus UltDev_014

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
5/12/2022 X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\west figures_v2.qgz



Legend

- Project Area
- Flood Model Extent
- Wet Dry
- Was Wet Now Dry
- Was Dry Now Wet

Difference (m/s)

- <= -1.0000
- -1.0000 - -0.5000
- -0.5000 - -0.2000
- -0.2000 - 0.2000
- 0.2000 - 0.5000
- 0.5000 - 1.0000
- 1.0000 - 2.0000

Figure C3

39.35% AEP Comparison Velocity
WestGables_004 minus EXIST_04

West Gables

NORTHROP

Data Source: Aerial (SIX Maps), Cadastre (NSW LPI)
5/12/2022 X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\west figures_v2.qgz

Conclusions

Northrop Consulting Engineers have been engaged by Enspire Solutions to complete flood modelling for the proposed Gables West development. This has been undertaken using the catchment wide TUFLOW model to assess the impacts relative to the pre-Gables development case, and currently approved masterplan layout.

The following preliminary conclusions have been drawn from the assessment.

- We believe it is feasible to incorporate detention within the development to mitigate impacts on the Gables Lake and downstream properties, when compared to previous approvals.
- We believe it is feasible to contain the 1% AEP within the riparian corridors through the development which is similar to the previously approved masterplan development.

We submit our findings for consideration.

Limitation statement

Northrop Consulting Engineers Pty Ltd (Northrop) has been retained to prepare this report based on specific instructions, scope of work and purpose pursuant to a contract with its client. It has been prepared in accordance with the usual care and thoroughness of the consulting profession for the use by Enspire Solutions Pty Ltd. The report is based on generally accepted practices and standards applicable to the scope of work at the time it was prepared. No other warranty, express or implied, is made as to the professional advice included in this report.

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Document Register

Rev	Status	Prepared	Approved	Date
1	Draft	GB	GB	6 July 2022
2	Approval	GB	GB	5 December 2022

Appendix A – Civil Engineering Drawings

LEGEND

- SITE BOUNDARY
- 100.00 CONTOUR
- CONTOUR
- OVERLAND FLOW

RIPARIAN EXTENSION

BOUNDARY ROAD

OLD PITT TOWN ROAD

CATARCT ROAD

RED GABLES ROAD

BASIN 01

BASIN 02

BASIN 03

BASIN 04

BASIN 05

BASIN 06

BASIN 07

CATCHMENT 01

CATCHMENT 02

CATCHMENT 03

CATCHMENT 04

CATCHMENT 05

CATCHMENT 06

CATCHMENT 07

CATCHMENTS	
CATCHMENT	AREA (ha)
01	21.90
02	4.58
03	5.82
04	7.86
05	12.79
06	16.45
07	6.40

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland it's your place; THE GABLES BOX HILL

Scale: 0 50 100 200 300m — SCALE 1:3000 @A1

North

enspire
Enspire Solutions Pty Ltd
Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Scale: 1:3000

Date: 6/07/2022

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Title: CONCEPT STORMWATER DRAINAGE CATCHMENT PLAN

Size: A1

Datum: GDA94

Project Number/Drawing Number: 220012-SK-0001

Revision: 2

DATE PLOTTED: 5 December 2022 5:34 PM BY - HAYDEN DAVENPORT

CAD File: P:\220012 GablesRezoning\D-Civil\00-SiteWide\Drawings\4-Sketches-Formal\220012-SK-0001-SK-0007-WEST GABLES BASIN CONCEPTS.dwg

LEGEND

- SITE BOUNDARY
- 100.00 — CONTOUR
- BATTER
- RW — RETAINING WALL
- ● F 100.00 — FINISHED LEVEL
- ● IL 100.00 — INVERT LEVEL
- CHANNEL
- STORMWATER DRAINAGE LINE / FLOW DIRECTION
- KERB INLET PIT
- SURFACE INLET PIT/JUNCTION PIT
- HEADWALL

HIGH FLOW BYPASS.

SPLITTER PIT.

GROSS POLLUTANT TRAP

BASIN ACCESS ALLOWANCE

BIO AREA = 2500m²
MEDIA BASE RL44.35

1 IN 6

15.0m

3.0m

GROSS POLLUTANT TRAP

SPLITTER PIT.

HIGH FLOW BYPASS.

BASIN ACCESS ALLOWANCE

BIO AREA = 500m²
MEDIAN BASE RL43.25

7.5m

ONLINE STORAGE
OSD VOLUME = 24,252m³ (915.9m³/ha)
TOTAL FOOTPRINT = 29842m²
(RIPARIAN)
1% AEP TWL = 44.04m

2.0% FALL

1 IN 5

37.0m

26.0m

MULTI-STAGE OUTLET FOR ONLINE STORAGE.

IL 41.40

IL 41.50

EMBANKMENT LEVEL = 45.20m

F 44.50

e 44.00

e 43.50

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland — it's your place; THE GABLES BOX HILL

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

North

enspire
Enspire Solutions Pty Ltd
Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Scale: 1:500

Date: 6/07/2022

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Title: CONCEPT STORMWATER BIO-RETENTION / OSD BASINS 01&02

Size: A1

Datum: GDA94

Project Number/Drawing Number: 220012-SK-0002

Revision: 2

DATE PLOTTED: 5 December 2022 5:34 PM BY: HAYDEN DAVENPORT

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LEGEND

- SITE BOUNDARY
- 100.00 — CONTOUR
- BATTER
- RW — RETAINING WALL
- F 100.00 — FINISHED LEVEL
- IL 100.00 — INVERT LEVEL
- CHANNEL
- STORMWATER DRAINAGE LINE / FLOW DIRECTION
- KERB INLET PIT
- SURFACE INLET PIT/JUNCTION PIT
- HEADWALL

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland — it's your place; THE GABLES BOX HILL

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

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Enspire Solutions Pty Ltd
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ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Title: CONCEPT STORMWATER BIO-RETENTION / OSD BASINS 03

Scale: 1:500

Date: 6/07/2022

Size: A1

Datum: GDA94

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 220012-SK-0003

Revision: 2

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LEGEND

- SITE BOUNDARY
- 100.00 — CONTOUR
- BATTER
- RW — RETAINING WALL
- F 100.00 — FINISHED LEVEL
- IL 100.00 — INVERT LEVEL
- CHANNEL
- STORMWATER DRAINAGE LINE / FLOW DIRECTION
- KERB INLET PIT
- SURFACE INLET PIT/JUNCTION PIT
- HEADWALL

GROSS POLLUTANT TRAP

SPLITTER PIT.

6.0m

BASIN ACCESS ALLOWANCE

HIGH FLOW BYPASS.

BIO AREA = 400m^2
MEDIA BASE RL44.85

BASIN 04
OSD VOLUME = 1012m^3 (128.8m^3/ha)
BASIN FOOTPRINT = 2000m^2
1% AEP TWL = 44.98m

TOP OF WALL = 46.65m

MAINTAIN EXISTING STORMWATER PIPE

GL.45.90m
IL.43.50m

GL.44.85m
IL.43.60m

GL.45.25m
IL.43.04m
Ø900 DS PIPE

900

1.0% FALL

5.00m

F 45.25

TOW 48.25

e 47.1

e 46.15

e 45.50

e 47.3

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland — it's your place; THE GABLES BOX HILL

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

North

Enspire Solutions Pty Ltd
Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Title: CONCEPT STORMWATER BIO-RETENTION / OSD BASINS 04

Scale: 1:500

Date: 6/07/2022

Size: A1

Datum: GDA94

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 220012-SK-0004

Revision: 2

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LEGEND

- SITE BOUNDARY
- 100.00 — CONTOUR
- BATTER
- RW — RETAINING WALL
- ● F 100.00 — FINISHED LEVEL
- ● IL 100.00 — INVERT LEVEL
- CHANNEL
- STORMWATER DRAINAGE LINE / FLOW DIRECTION
- KERB INLET PIT
- SURFACE INLET PIT/JUNCTION PIT
- HEADWALL

EXISTING SPLITTER PIT. TO BE MODIFIED

GROSS POLLUTANT TRAP

BIO AREA = 1400m^2
MEDIA BASE RL42.30

BASIN ACCESS ALLOWANCE

GROSS POLLUTANT TRAP

SPLITTER PIT.

HIGH FLOW BYPASS.

EXISTING HIGH FLOW BYPASS.

BASIN 05
OSD VOLUME = 1881m^3 (147.1m^3/ha)
BASIN FOOTPRINT = 6846m^2
1% AEP TWL = 42.66m

GL.41.93m
IL.40.95m

GL.42.82m
IL.40.80m
Ø750 DS PIPE

TOP OF WALL = 43.38m

UPGRADE EXISTING STORMWATER LINE

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland — it's your place; THE GABLES BOX HILL

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

North

enspire
Enspire Solutions Pty Ltd
Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Title: CONCEPT STORMWATER BIO-RETENTION / OSD BASINS 05

Scale: 1:500

Date: 6/07/2022

Size: A1

Datum: GDA94

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Project Number/Drawing Number: 220012-SK-0005

Revision: 2

DATE PLOTTED: 5 December 2022 5:35 PM BY : HAYDEN DAVENPORT

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LEGEND

- SITE BOUNDARY
- 100.00 — CONTOUR
- BATTER
- RW — RETAINING WALL
- F 100.00 — FINISHED LEVEL
- IL 100.00 — INVERT LEVEL
- CHANNEL
- STORMWATER DRAINAGE LINE / FLOW DIRECTION
- KERB INLET PIT
- SURFACE INLET PIT/JUNCTION PIT
- HEADWALL

BIO AREA = 740m^2
MEDIA BASE RL42.70

BIO AREA = 1260m^2
MEDIA BASE RL38.65

GL.42.70m
IL.40.56m

GL.39.40m
IL.38.06m

GL.38.65m
IL.37.80m

GL.39.5m
IL.37.26m

GL.39.5m
IL.36.83m

IL.37.80m

BASIN 06
OSD VOLUME = 3551m^3 (215.9m^3/ha)
BASIN FOOTPRINT = 2.0ha
1% AEP = 38.82

TOP OF BERM = 39.32m

GROSS POLLUTANT TRAP

SPLITTER PIT.

HIGH FLOW BYPASS.

BASIN ACCESS ALLOWANCE

GROSS POLLUTANT TRAP

SPLITTER PIT.

HIGH FLOW BYPASS

BIO-BASIN BYPASS.

SPLITTER PIT.

GROSS POLLUTANT TRAP

BASIN TO OUTLET TO EXISTING HEADWALL.
IL. 36.38

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland — it's your place; THE GABLES BOX HILL

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

North

enspire
Enspire Solutions Pty Ltd
Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Title: CONCEPT STORMWATER BIO-RETENTION / OSD BASINS 06

Scale: 1:500

Date: 6/07/2022

Size: A1

Datum: GDA94

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 220012-SK-0006

Revision: 2

DATE PLOTTED: 5 December 2022 5:35 PM BY : HAYDEN DAVENPORT

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LEGEND

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- RW — RETAINING WALL
- F 100.00 — FINISHED LEVEL
- IL 100.00 — INVERT LEVEL
- CHANNEL
- STORMWATER DRAINAGE LINE / FLOW DIRECTION
- KERB INLET PIT
- SURFACE INLET PIT/JUNCTION PIT
- HEADWALL

SPLITTER PIT.

GROSS POLLUTANT TRAP

CONSTRUCT STORMWATER LINE IN EXISTING ADJACENT ROAD TO DIRECT CATCHMENTS FLOWS TO BASIN

BASIN ACCESS ALLOWANCE

HIGH FLOW BYPASS.

BASIN 07
OSD VOLUME = 1107m^3 (173.0m^3/ha)
BASIN FOOTPRINT = 2923m^2
1% AEP TWL = 40.95

GL.40.30m
IL.38.75m

T.W.L

CATCHMENT WATER QUALITY TREATMENT TO OCCUR AT DOWNSTREAM WSUD BASIN B3C LOCATED WITHIN THE GABLES. REFER DA1583/2019/ZB

UPGRADE EXISTING NETWORK TO Ø750 TO MATCH BASIN OUTLET

TOP OF WALL = 41.64m

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland — it's your place; THE GABLES BOX HILL

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

North

Enspire Solutions Pty Ltd
Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Title: CONCEPT STORMWATER BIO-RETENTION / OSD BASIN 07

Scale: 1:500

Date: 6/07/2022

Size: A1

Datum: GDA94

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 220012-SK-0007

Revision: 2

DATE PLOTTED: 5 December 2022 5:35 PM BY : HAYDEN DAVENPORT

CAD File: P:\220012 GablesRezoning\D-Civil\00-SiteWide\Drawings\4-Sketches-Formal\220012-SK-0001-SK-0007-WEST GABLES BASIN CONCEPTS.dwg

Appendix B – Existing Flooding Scenario Submission

NORTHROP
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ABN 81 094 433 100

27 July 2022

SY171804

The Hills Shire Council
Anisul Huq
3 Columbia Court
Baulkham Hills NSW 2153

Dear Anisul,

Re: West Gables Development – Pre-Development Flood Model

Northrop Consulting Engineers have been engaged by Enspire Solutions to provide flood modelling services to support the West Gables Development area on behalf of Stockland and Allam Group. As part of this process we have reviewed the existing case flood model (EXIST_03) used for The Gables Development (model originally developed by JWP and amended by Northrop 2017-2022), identified parameters for modification, run the updated existing case, and compared to previous submissions.

A meeting was held with Council on the 14th July 2022 where it was requested to undertake a sensitivity analysis with the basin upstream of Boundary Road that has been removed, included back into the model.

The purpose of this correspondence is to summarise the updated model parameters and present a comparison of the existing flood levels for the EXIST_05 and EXIST_04 scenarios, to the previously submitted EXIST_03.

TUFLOW Version

The EXIST_04 and EXIST_05 models have been assessed using TUFLOW Classic, Version 2016-03-AE double precision solver.

Model Parameters

The following changes to the EXIST_03 model is included in the EXIST_04 scenario.

- A new surface was included in the model to reflect the existing ground conditions of the Gables West project area.
- The existing basin in the Gables West project area and the basin adjacent to Precinct B were clipped out from the new survey as the survey is not representing the existing conditions of the basins correctly.
- Two lots in Valletta Drive (Lot 1 DP1213569 and Lot 2 DP1213569) immediately south of the Gables development were clipped out the new surface as there has been significant development within these lots as a result of the Gables development.
- The Manning's roughness for the EXIST_04 is presented in Attachment 1 - Figure A1. This included the removal of a basin upstream of Boundary Road.

- Initial water level (IWL) of farm dams in the development area were updated based on the survey provided. Attachment 1 – Figure A2 presents the adopted initial water levels and any change in IWL compared with the EXIST_03 model. Initial water levels were adopted at the lowest spillway level per previous model approach.

No changes have been made to the existing hydraulic controls and blockage factors.

The following changes were made to the EXIST_04 model to represent the EXIST_05 scenario.

- The Manning's roughness for the EXIST_05 scenario is the same as EXIST_03.
- The initial water level for the basin upstream of Boundary Road was reinstated.
- The detailed survey was clipped out of the basin upstream of Boundary Road to represent the EXIST_03 condition in this area.

Figure 1 - Nearmap aerial, September 2013

Figure 2 - Nearmap aerial, June 2022

Results and Discussion

The flood elevation difference between EXIST_04 and EXIST_03 for the 39.35% AEP and 1% AEP events are presented in Attachment 1 – Figure A3 and Figure A4.

A summary of the results and a discussion are presented herein.

- A decrease of approximately 448mm in flood level was observed immediately upstream of Boundary Road during the 39.95% AEP event. The main reason is the removal of the basin outside the Gables and Gables West project area and the location is shown in Attachment 1 - Figure A1. As a result, this basin is not included in the new Gables West survey and hence, in the EXIST_04 model. A similar decrease of approximately 384mm was observed during the 1% AEP event.
- The removal of the basin has also resulted in increases in flood level through the upper reaches of the site approximately of up to 30mm and 21mm during the 1% AEP and 39.35% AEP events respectively. However, the change in the existing flood level in downstream areas of the Gables and Gables West project is less than 10mm.
- Increases of up to 504mm and 376mm are shown in two basins in the Gables West project area (one basin near Red Gables Road and the other is adjacent to the Sundowner Parkway) and this increase can be attributed to the increased initial water levels of the basins based on the new survey.
- The same assumption was made for initial water level in basins (i.e. basins are full to their lowest spillway crest). This was considered reasonable as it matches with the previous assumptions for the existing case model, basins are unlikely to be completely empty at the start of rainfall burst. Pre burst rainfall is likely, with a 10% to 90% pre-burst rainfall depth range of 0mm to 113mm in the 2-hour event.

The flood elevation difference between sensitivity model, EXIST_05 and EXIST_03 for the 39.35% AEP and 1% AEP events are presented in Attachment 1 – Figure A5 and Figure A6.

This demonstrates a reduction in flood level of approximately up to 8mm downstream of the west Gables project area during the 39.35% AEP event. During the 1% AEP event, change in the existing flood level in downstream areas of the Gables and Gables West project is less than 5mm. Overall, the results from the sensitivity analysis confirm that the increases shown through the upper reaches of the site in the previous EXIST_04 run are mostly due to the removal of the basin.

Conclusion

It was determined that both scenarios considered.

- Represents a “predeveloped” condition for the Gables and Gables West Project areas.
- Does not produce any significant increases in flood levels over the properties upstream or downstream in the 1% AEP and 39.35% AEP events.
- Is producing expected results compared to previous submissions.

The sensitivity analysis undertaken using the EXIST_05 model shows that the increases shown through the upper reaches of the site in the EXIST_04 run are mostly due to the removal of the basin.

Either model can be used as a base model for the proposed Gables West Development project, and we request Council to confirm which scenario is preferred.

Prepared by

Nadeeka Parana Manage
Environmental Engineer
BEng (Environmental)(Hons)
PhD (Environmental Eng.)

Reviewed by

Angus Brien
Principal | Group Manager | Civil Engineer
BEng (Civil)(Hons)

Limitation statement

Northrop Consulting Engineers Pty Ltd (Northrop) has been retained to prepare this report based on specific instructions, scope of work and purpose pursuant to a contract with its client. It has been prepared in accordance with the usual care and thoroughness of the consulting profession for the use by The Hills Shire Council. The report is based on generally accepted practices and standards applicable to the scope of work at the time it was prepared. No other warranty, express or implied, is made as to the professional advice included in this report.

Except where expressly permitted in writing or required by law, no third party may use or rely on this report unless otherwise agreed in writing by Northrop.

Where this report indicates that information has been provided to Northrop by third parties, Northrop has made no independent verification of this information except as expressly stated in the report. Northrop is not liable for any inaccuracies in or omissions to that information.

The report was prepared on the dates shown and is based on the conditions and information received at the time of preparation.

This report should be read in full, with reference made to all sources. No responsibility is accepted for use of any part of this report in any other context or for any other purpose. Northrop does not purport to give legal advice or financial advice. Appropriate specialist advice should be obtained where required.

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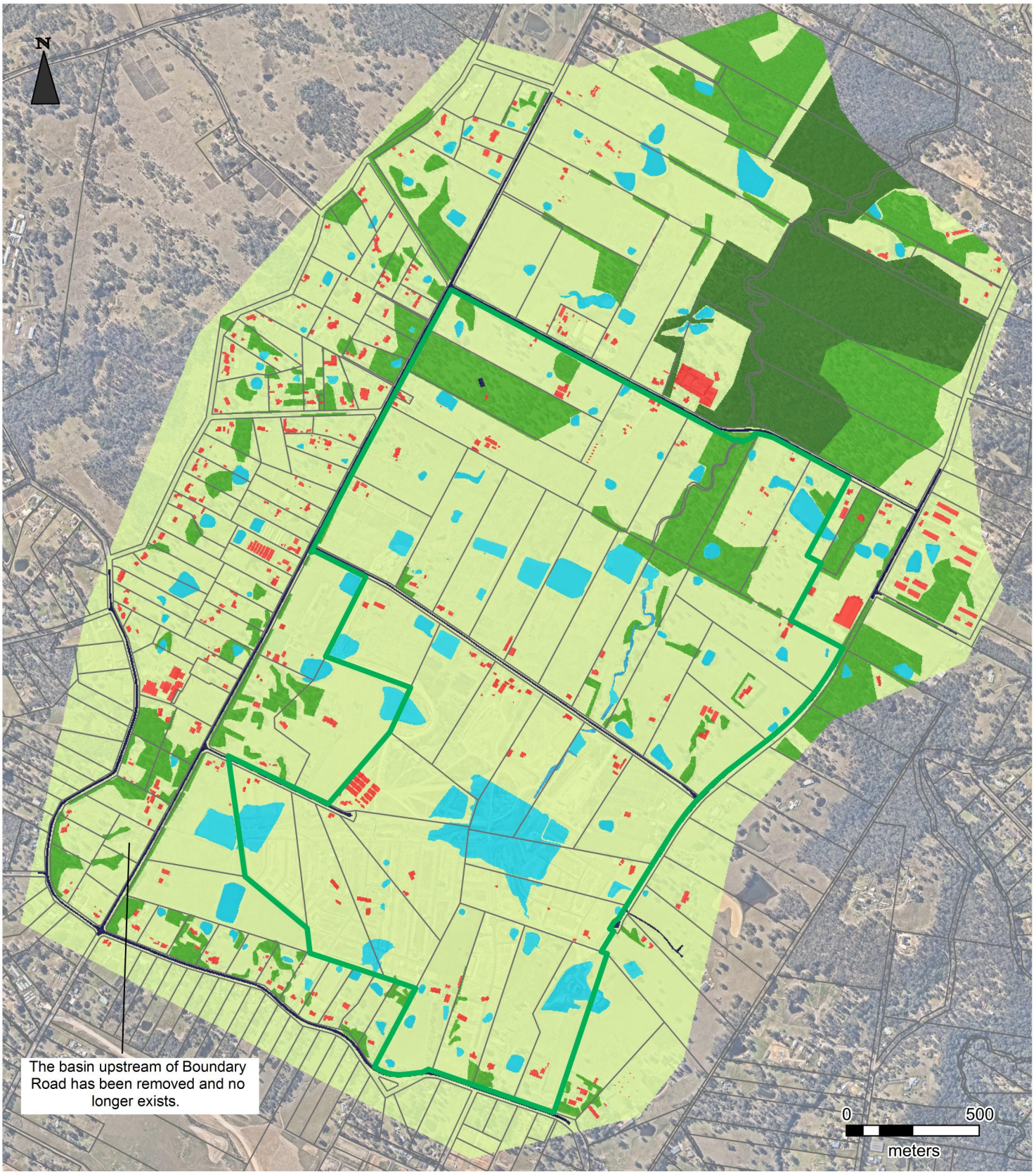
Document Register

Rev	Status	Prepared	Approved	Date
A	Approval	N Parana Manage	A Brien	27 June 2022
B	Approval	A Brien	A Brien	28 June 2022
C	Approval	N Parana Manage	A Brien	27 July 2022

Attachment 1 – Result Figures



Legend

Gables Development

Lot

Manning's Roughness
Value

n = 0.012	n = 0.30	n = 0.025
n = 0.02	n = 0.08	n = 0.10
n = 0.04	n = 0.05	n = 0.05
n = 0.15	n = 0.03	n = 0.04
n = 0.07	n = 0.025	n = 0.015
n = 0.025	n = 0.30	n = 0.035

THE GABLES
BOX HILL

EXIST_04

Manning's Roughness

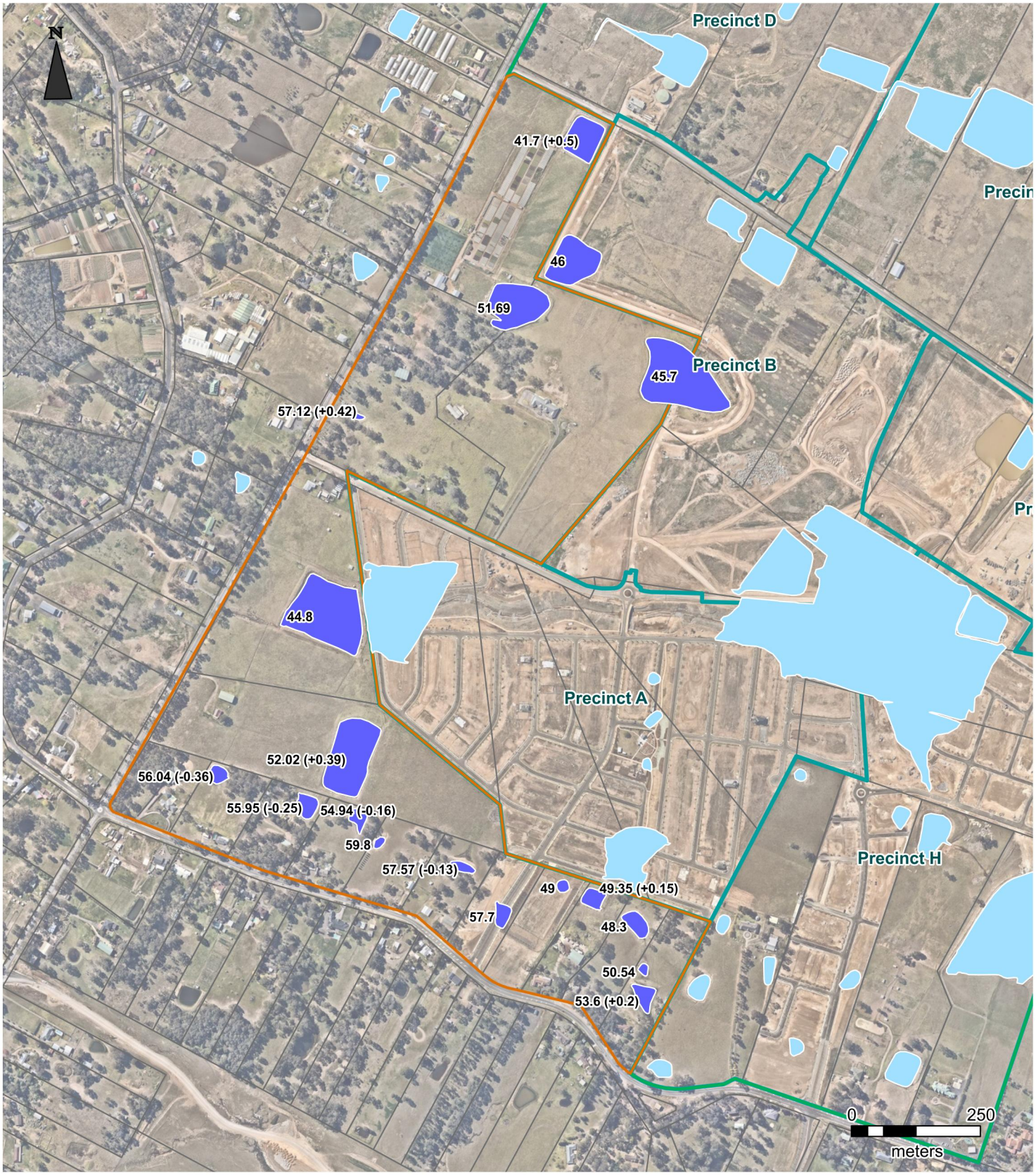
NORTHROP

Stockland
it's your place

Figure A1

27-06-2022

X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\FIGURES\EXIST_04_Comparisons\Figures\Packaged_workspaces\Fig_A1\Fig_A1_EXIST_04_Manning's_Roughness.WOR



Legend

- Gables Development
- Precincts
- Gables West Development
- Basins Gables West

THE GABLES
BOX HILL

EXIST_04

Initial Water Level

NORTHROP

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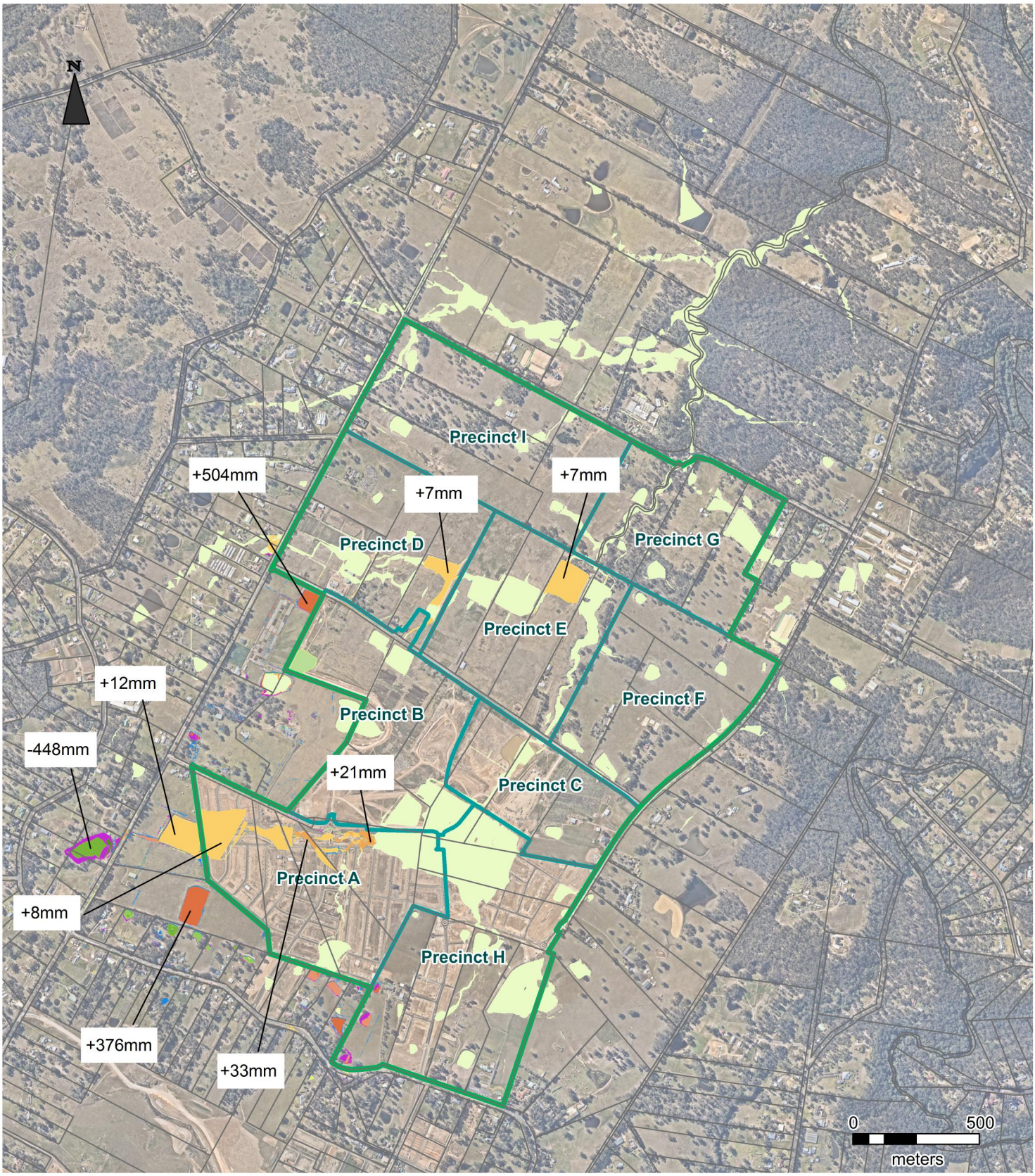
Figure A2

27-06-2022

X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\FIGURES\EXIST_04_Comparisons\Figures\Packaged_workspaces\Fig_A2
\Fig_A2_SY171804_IWL.WOR



Legend

Gables Development

Precincts

Wet / Dry
Value

Was Dry Now Wet

Was Wet Now Dry

Elevation Difference (m)
Value

Plus greater than 2

2 to 0.5

0.5 to 0.2

0.2 to 0.05

0.05 to 0.02

0.02 to 0.005

0.005 to -0.005

-0.02 to -0.005

-0.05 to -0.02

-0.2 to -0.05

-0.5 to -0.2

-2 to -0.5

Minus greater than 2

THE GABLES
BOX HILL

EXIST_04 Minus EXIST_03

39.35% AEP
120m and 540m Envelope
Bdes Elevation Difference

Figure A3

27-06-2022

NORTHROP

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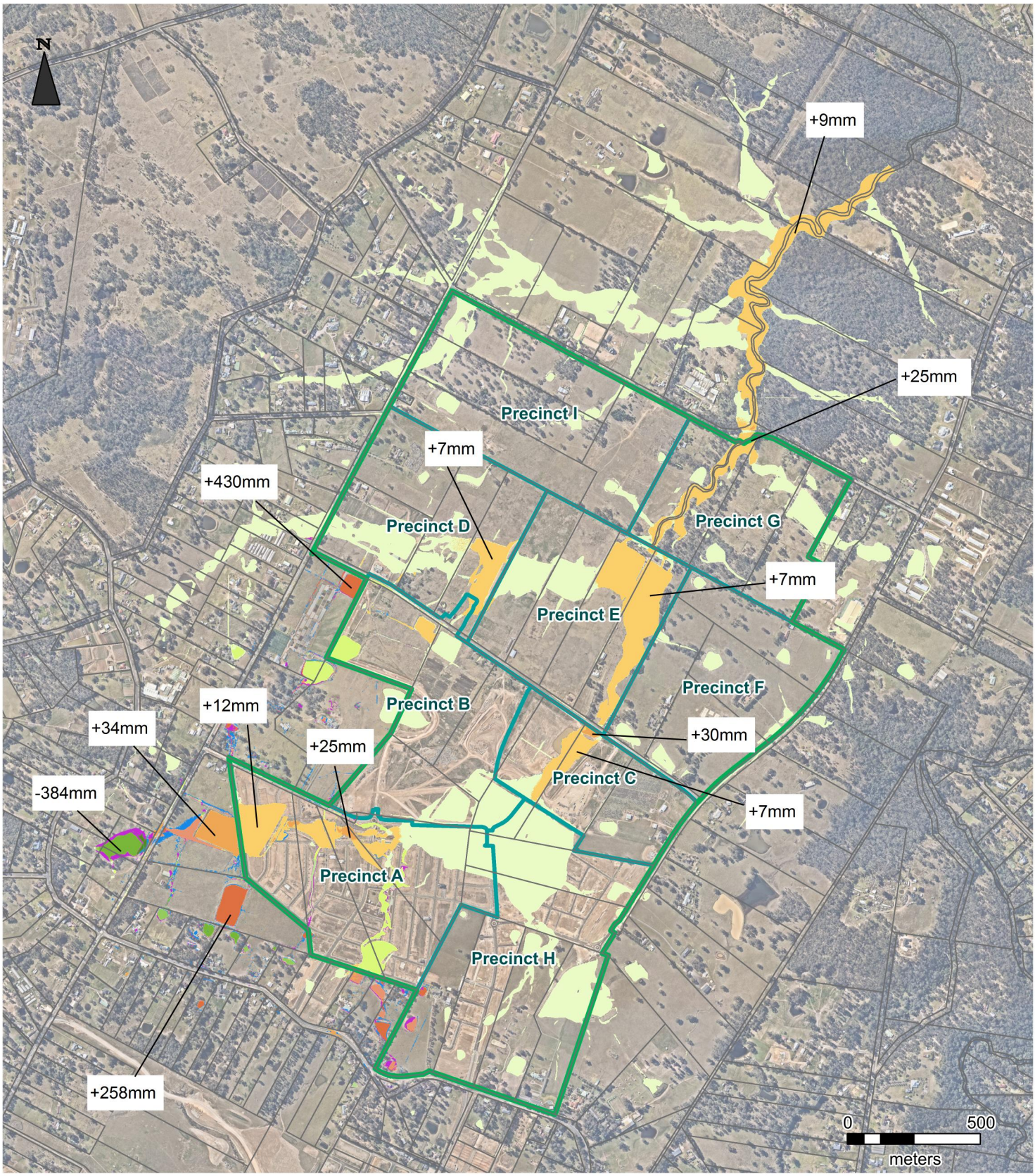
X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\FIGURES\EXIST_04_Comparisons\Figures\Packaged_workspaces\Fig_A3\Fig_A3_2y_EXIST04_minus_EXIST03.WOR



Legend

Gables Development

Precincts

Wet / Dry
Value

Was Dry Now Wet

Was Wet Now Dry

Elevation Difference (m)
Value

Plus greater than 2	0.02 to 0.005	-0.5 to -0.2
2 to 0.5	0.005 to -0.005	-2 to -0.5
0.5 to 0.2	-0.02 to -0.005	Minus greater than 2
0.2 to 0.05	-0.05 to -0.02	
0.05 to 0.02	-0.2 to -0.05	

THE GABLES
BOX HILL

EXIST_04 Minus EXIST_03

1% AEP
120m and 540m Envelope
Bdes Elevation Difference

Figure A4

27-06-2022

NORTHROP

Stockland
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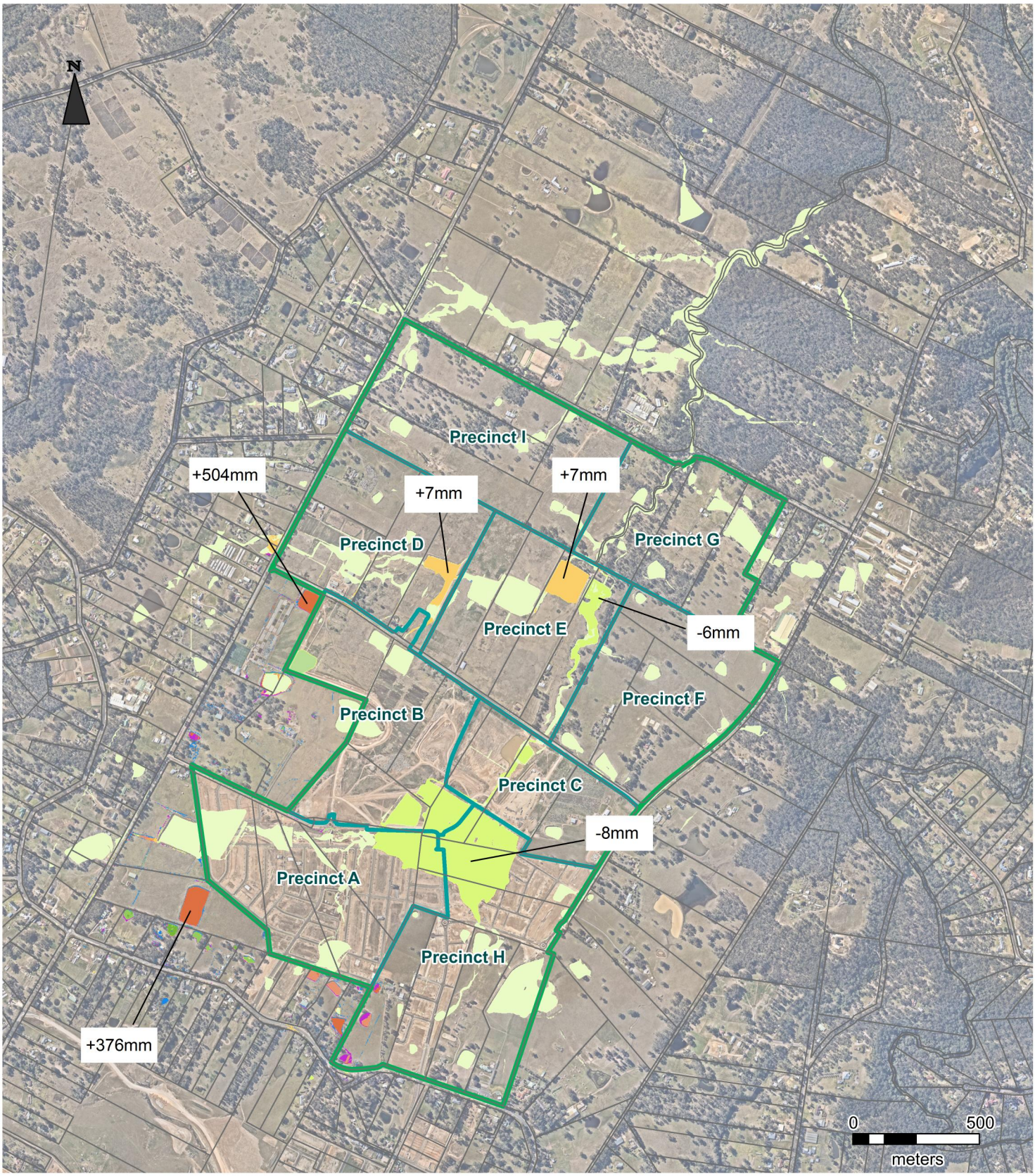
X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\FIGURES\EXIST_04_Comparisons\Figures\Packaged_workspaces\Fig_A4\Fig_A4_100y_EXIST04_minus_EXIST03.WOR



Legend

- Gables Development
- Precincts

Wet / Dry
Value

- Was Dry Now Wet
- Was Wet Now Dry

Elevation Difference (m)
Value

- Plus greater than 2
- 2 to 0.5
- 0.5 to 0.2
- 0.2 to 0.05
- 0.05 to 0.02
- 0.02 to 0.005
- 0.005 to -0.005
- -0.02 to -0.005
- -0.05 to -0.02
- -0.2 to -0.05
- -0.5 to -0.2
- -2 to -0.5
- Minus greater than 2

THE GABLES
BOX HILL

EXIST_05 Minus EXIST_03

39.35% AEP
120m and 540m Envelope
Bdes Elevation Difference

Figure A5

22-07-2022

NORTHROP

Stockland
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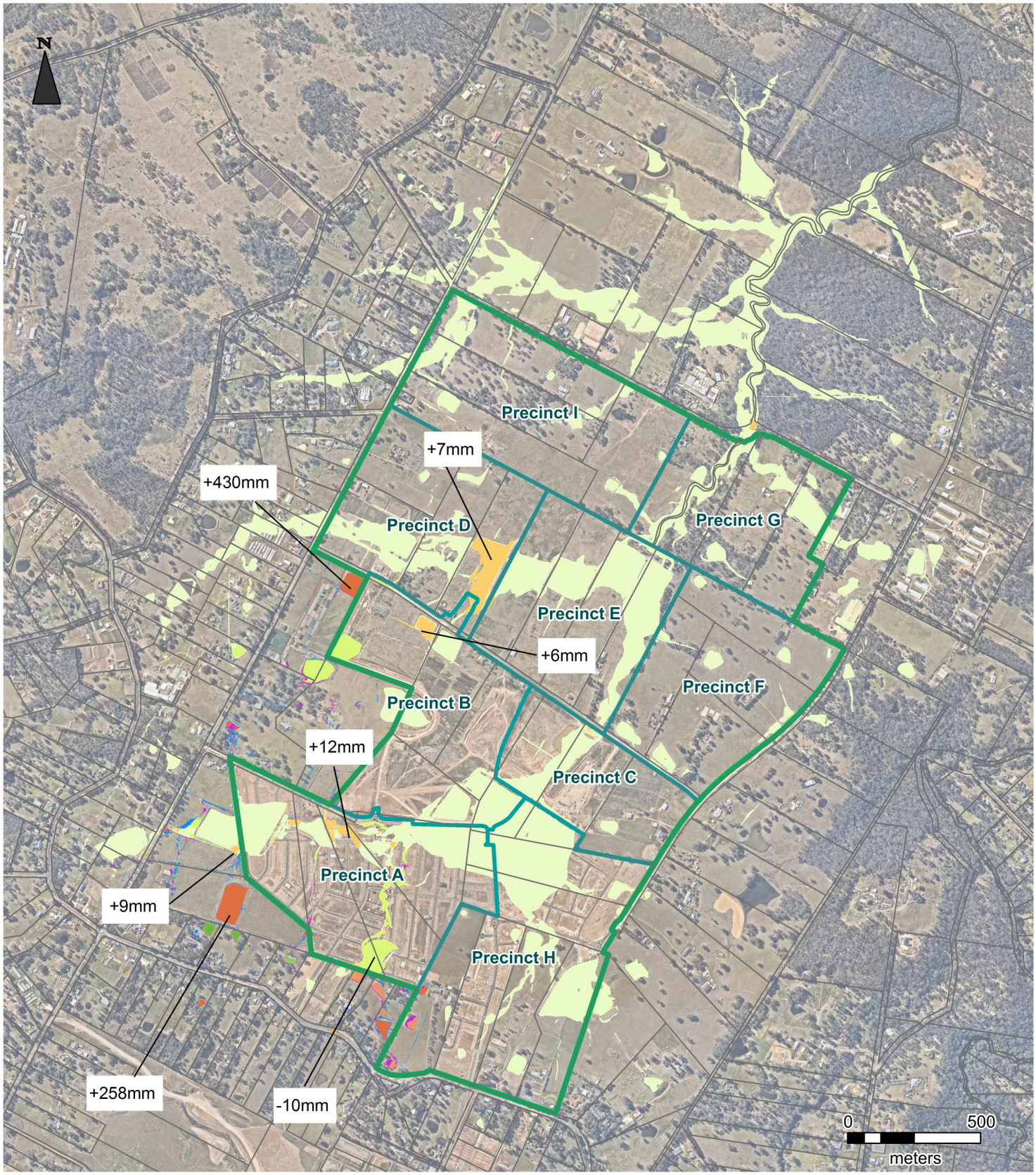
X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\FIGURES\EXIST_05_Comparisons\Packaged workspaces\Fig_A5\Fig_A5_2y_EXIST05_minus_EXIST03.WOR



Legend

Gables Development

Precincts

Wet / Dry
Value

Was Dry Now Wet

Was Wet Now Dry

Elevation Difference (m)
Value

Plus greater than 2

2 to 0.5

0.5 to 0.2

0.2 to 0.05

0.05 to 0.02

0.02 to 0.005

0.005 to -0.005

-0.02 to -0.005

-0.05 to -0.02

-0.2 to -0.05

-0.5 to -0.2

-2 to -0.5

Minus greater than 2

THE GABLES
BOX HILL

EXIST_05 Minus EXIST_03

1% AEP
120m and 540m Envelope
Bdes Elevation Difference

Figure A6

22-07-2022

NORTHROP

Stockland
it's your place

X:\PROJECTS\SYDNEY\2017 Jobs\SY171804 - The Gables\West - CONFIDENTIAL\FIGURES\EXIST_05_Comparisons\Packaged workspaces\Fig_A6\
Fig_A6_100y_EXIST05_minus_EXIST03.WOR

Attachment 2 – Submission Checklist

Item Number	Submitted	Meeting	Approved	TUFLOW Submission Checklist (Items to be added as required)	Comments
0	☑	☐	☐	Readme files identifying; • Purpose of submission; • Changes since previous version; and • Folder structure.	Readme file submitted in root folder.
1	☑	☐	☐	Model control files (*.tcf, *.tgc, *.tbc, *.tef) simplified with scenario for assessment. Files to include a comment header describing generally; • The purpose of the run; • The version the model has been based on; and • Changes made since last iteration (preliminary submission) of this model. All commands to have a comment describing their purpose.	Model control files have been submitted in **1 - Model Control Files**
2	☑	☐	☐	Model input files provided for all events and durations considered using “copyall” function. This produces a *.zip file with all GIS files and DEMs called in running the model.	Copy all zip files have been submitted in **2 - Model Input Files** Events and durations considered are summarised overleaf.
3	☑	☐	☐	Modelling log (*.xls) replicating comments in control files.	Updated modelling log has been submitted in **3 - Modelling Log**
4	☑	☐	☐	Figures showing model setup and results.	Model figures *.pdf submitted in **4 - Model Setup and Results Figures.**
5	☑	☐	☐	MapInfo workspaces. To generally include; • Figure workspaces used for Item 4; • Inputs used in creating the TUFLOW scenarios; and • Filtered results grids.	Packaged MapInfo workspaces have been included in **5 - Mapinfo Workspaces.**
6	☑	☐	☐	Check files for all event and duration runs.	Check files included in **6 - Model Check Files**

Item Number	Submitted	Meeting	Approved	TUFLOW Submission Checklist (Items to be added as required)	Comments
7	☑	☐	☐	Results files for all event and duration runs.	Result files included in **7 - Model Results Files**
8	☐	☐	☐	Civil drawings used in support of the submission.	No drawings for this submission.
9	☑	☐	☐	Updated correspondence and reports (as required).	Supporting memo provided in **9 – Reports and Correspondence.**
10	☐	☐	☐	Additional items if required for submission (F10, F11 etc).	No additional items submitted.

2 – Events and Durations Considered

EXIST_04 Runs

AEP / min	10	15	25	30	45	60	90	120	150	180	270	360	540	720
39.35% B_{des}								C					C	
18.13% B_{des}														
10% B_{des}														
5% B_{des}														
1% B_{des}								C					C	
1% Zero														

EXIST_05 Runs

AEP / min	10	15	25	30	45	60	90	120	150	180	270	360	540	720
39.35% B_{des}								C					C	
18.13% B_{des}														
10% B_{des}														
5% B_{des}														
1% B_{des}								C					C	
1% Zero														

Appendix B Concept Stormwater Basin Sketches

Prepared by Enspire Solutions

LEGEND

- SITE BOUNDARY
- 100.00 CONTOUR
- CONTOUR
- OVERLAND FLOW

RIPARIAN EXTENSION

BOUNDARY ROAD

OLD PITT TOWN ROAD

CATARCT ROAD

RED GABLES ROAD

BASIN 01

BASIN 02

BASIN 03

BASIN 04

BASIN 05

BASIN 06

BASIN 07

CATCHMENT 01

CATCHMENT 02

CATCHMENT 03

CATCHMENT 04

CATCHMENT 05

CATCHMENT 06

CATCHMENT 07

CATCHMENTS	
CATCHMENT	AREA (ha)
01	21.90
02	4.58
03	5.82
04	7.86
05	12.79
06	16.45
07	6.40

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland it's your place; THE GABLES BOX HILL

Scale: 0 50 100 200 300m — SCALE 1:3000 @A1

North

enspire
Enspire Solutions Pty Ltd
Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Scale: 1:3000

Date: 6/07/2022

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Title: CONCEPT STORMWATER DRAINAGE CATCHMENT PLAN

Size: A1

Datum: GDA94

Project Number/Drawing Number: 220012-SK-0001

Revision: 2

DATE PLOTTED: 5 December 2022 5:34 PM BY - HAYDEN DAVENPORT

CAD File: P:\220012 GablesRezoning\D-Civil\00-SiteWide\Drawings\4-Sketches-Formal\220012-SK-0001-SK-0007-WEST GABLES BASIN CONCEPTS.dwg

LEGEND

- SITE BOUNDARY
- 100.00 — CONTOUR
- BATTER
- RW — RETAINING WALL
- ● F 100.00 — FINISHED LEVEL
- ● IL 100.00 — INVERT LEVEL
- CHANNEL
- STORMWATER DRAINAGE LINE / FLOW DIRECTION
- KERB INLET PIT
- SURFACE INLET PIT/JUNCTION PIT
- HEADWALL

HIGH FLOW BYPASS.

SPLITTER PIT.

GROSS POLLUTANT TRAP

BASIN ACCESS ALLOWANCE

BIO AREA = 2500m²
MEDIA BASE RL44.35

1 IN 6

15.0m

3.0m

GROSS POLLUTANT TRAP

SPLITTER PIT.

HIGH FLOW BYPASS.

BASIN ACCESS ALLOWANCE

BIO AREA = 500m²
MEDIAN BASE RL43.25

7.5m

ONLINE STORAGE
OSD VOLUME = 24,252m³ (915.9m³/ha)
TOTAL FOOTPRINT = 29842m²
(RIPARIAN)
1% AEP TWL = 44.04m

2.0% FALL

1 IN 5

37.0m

26.0m

MULTI-STAGE OUTLET FOR ONLINE STORAGE.

IL 41.40

IL 41.50

EMBANKMENT LEVEL = 45.20m

F 44.50

e 44.00

e 43.50

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland — it's your place; THE GABLES BOX HILL

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

North

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Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Scale: 1:500

Date: 6/07/2022

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Title: CONCEPT STORMWATER BIO-RETENTION / OSD BASINS 01&02

Size: A1

Datum: GDA94

Project Number/Drawing Number: 220012-SK-0002

Revision: 2

DATE PLOTTED: 5 December 2022 5:34 PM BY: HAYDEN DAVENPORT

CAD File: P:\220012 GablesRezoning\D-Civil\00-SiteWide\Drawings\4-Sketches-Formal\220012-SK-0001-SK-0007-WEST GABLES BASIN CONCEPTS.dwg

LEGEND

- SITE BOUNDARY
- 100.00 — CONTOUR
- BATTER
- RW — RETAINING WALL
- F 100.00 — FINISHED LEVEL
- IL 100.00 — INVERT LEVEL
- CHANNEL
- STORMWATER DRAINAGE LINE / FLOW DIRECTION
- KERB INLET PIT
- SURFACE INLET PIT/JUNCTION PIT
- HEADWALL

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland — it's your place; THE GABLES BOX HILL

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

North

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Enspire Solutions Pty Ltd
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ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Title: CONCEPT STORMWATER BIO-RETENTION / OSD BASINS 03

Scale: 1:500

Date: 6/07/2022

Size: A1

Datum: GDA94

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 220012-SK-0003

Revision: 2

DATE PLOTTED: 5 December 2022 5:34 PM BY : HAYDEN DAVENPORT

CAD File: P:\220012 GablesRezoning\D-Civil\00-SiteWide\Drawings\4-Sketches-Formal\220012-SK-0001-SK-0007-WEST GABLES BASIN CONCEPTS.dwg

LEGEND

- SITE BOUNDARY
- 100.00 — CONTOUR
- BATTER
- RW — RETAINING WALL
- F 100.00 — FINISHED LEVEL
- IL 100.00 — INVERT LEVEL
- CHANNEL
- STORMWATER DRAINAGE LINE / FLOW DIRECTION
- KERB INLET PIT
- SURFACE INLET PIT/JUNCTION PIT
- HEADWALL

GROSS POLLUTANT TRAP

SPLITTER PIT.

6.0m

BASIN ACCESS ALLOWANCE

HIGH FLOW BYPASS.

BIO AREA = 400m^2
MEDIA BASE RL44.85

BASIN 04
OSD VOLUME = 1012m^3 (128.8m^3/ha)
BASIN FOOTPRINT = 2000m^2
1% AEP TWL = 44.98m

TOP OF WALL = 46.65m

MAINTAIN EXISTING STORMWATER PIPE

GL.45.90m
IL.43.50m

GL.44.85m
IL.43.60m

GL.45.25m
IL.43.04m
Ø900 DS PIPE

900

1.0% FALL

5.00m

F 45.25

TOW 48.25

e 47.1

e 46.15

e 45.50

e 47.3

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland — it's your place; THE GABLES BOX HILL

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

North

Enspire Solutions Pty Ltd
Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Title: CONCEPT STORMWATER BIO-RETENTION / OSD BASINS 04

Scale: 1:500

Date: 6/07/2022

Size: A1

Datum: GDA94

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 220012-SK-0004

Revision: 2

DATE PLOTTED: 5 December 2022 5:34 PM BY : HAYDEN DAVENPORT

CAD File: P:\220012 GablesRezoning\D-Civil\00-SiteWide\Drawings\4-Sketches-Format\220012-SK-0001-SK-0007-WEST GABLES BASIN CONCEPTS.dwg

LEGEND

- SITE BOUNDARY
- 100.00 — CONTOUR
- BATTER
- RW — RETAINING WALL
- ● F 100.00 — FINISHED LEVEL
- ● IL 100.00 — INVERT LEVEL
- CHANNEL
- STORMWATER DRAINAGE LINE / FLOW DIRECTION
- KERB INLET PIT
- SURFACE INLET PIT/JUNCTION PIT
- HEADWALL

EXISTING SPLITTER PIT. TO BE MODIFIED

GROSS POLLUTANT TRAP

BIO AREA = 1400m^2
MEDIA BASE RL42.30

BASIN ACCESS ALLOWANCE

GROSS POLLUTANT TRAP

SPLITTER PIT.

HIGH FLOW BYPASS.

EXISTING HIGH FLOW BYPASS.

BASIN 05
OSD VOLUME = 1881m^3 (147.1m^3/ha)
BASIN FOOTPRINT = 6846m^2
1% AEP TWL = 42.66m

GL.41.93m
IL.40.95m

GL.42.82m
IL.40.80m
Ø750 DS PIPE

TOP OF WALL = 43.38m

UPGRADE EXISTING STORMWATER LINE

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland — it's your place; THE GABLES BOX HILL

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

North

enspire
Enspire Solutions Pty Ltd
Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Title: CONCEPT STORMWATER BIO-RETENTION / OSD BASINS 05

Scale: 1:500

Date: 6/07/2022

Size: A1

Datum: GDA94

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 220012-SK-0005

Revision: 2

DATE PLOTTED: 5 December 2022 5:35 PM BY : HAYDEN DAVENPORT

CAD File: P:\220012 GablesRezoning\D-Civil\00-SiteWide\Drawings\4-Sketches-Formal\220012-SK-0001-SK-0007-WEST GABLES BASIN CONCEPTS.dwg

LEGEND

- SITE BOUNDARY
- 100.00 — CONTOUR
- BATTER
- RW — RETAINING WALL
- F 100.00 — FINISHED LEVEL
- IL 100.00 — INVERT LEVEL
- CHANNEL
- STORMWATER DRAINAGE LINE / FLOW DIRECTION
- KERB INLET PIT
- SURFACE INLET PIT/JUNCTION PIT
- HEADWALL

BIO AREA = 740m^2
MEDIA BASE RL42.70

BIO AREA = 1260m^2
MEDIA BASE RL38.65

GL.42.70m
IL.40.56m

GL.39.40m
IL.38.06m

GL.38.65m
IL.37.80m

GL.39.5m
IL.37.26m

GL.39.5m
IL.36.83m

IL.37.80m

BASIN 06
OSD VOLUME = 3551m^3 (215.9m^3/ha)
BASIN FOOTPRINT = 2.0ha
1% AEP = 38.82

TOP OF BERM = 39.32m

GROSS POLLUTANT TRAP

SPLITTER PIT.

HIGH FLOW BYPASS.

BASIN ACCESS ALLOWANCE

GROSS POLLUTANT TRAP

SPLITTER PIT.

HIGH FLOW BYPASS

BIO-BASIN BYPASS.

SPLITTER PIT.

GROSS POLLUTANT TRAP

BASIN TO OUTLET TO EXISTING HEADWALL.
IL. 36.38

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland — it's your place; THE GABLES BOX HILL

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

North

enspire
Enspire Solutions Pty Ltd
Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Title: CONCEPT STORMWATER BIO-RETENTION / OSD BASINS 06

Scale: 1:500

Date: 6/07/2022

Size: A1

Datum: GDA94

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 220012-SK-0006

Revision: 2

DATE PLOTTED: 5 December 2022 5:35 PM BY : HAYDEN DAVENPORT

CAD File: P:\220012 GablesRezoning\D-Civil\00-SiteWide\Drawings\4-Sketches-Formal\220012-SK-0001-SK-0007-WEST GABLES BASIN CONCEPTS.dwg

LEGEND

- SITE BOUNDARY
- 100.00 — CONTOUR
- BATTER
- RW — RETAINING WALL
- F 100.00 — FINISHED LEVEL
- IL 100.00 — INVERT LEVEL
- CHANNEL
- STORMWATER DRAINAGE LINE / FLOW DIRECTION
- KERB INLET PIT
- SURFACE INLET PIT/JUNCTION PIT
- HEADWALL

SPLITTER PIT.

GROSS POLLUTANT TRAP

CONSTRUCT STORMWATER LINE IN EXISTING ADJACENT ROAD TO DIRECT CATCHMENTS FLOWS TO BASIN

BASIN ACCESS ALLOWANCE

HIGH FLOW BYPASS.

BASIN 07
OSD VOLUME = 1107m^3 (173.0m^3/ha)
BASIN FOOTPRINT = 2923m^2
1% AEP TWL = 40.95

GL.40.30m
IL.38.75m

T.W.L

CATCHMENT WATER QUALITY TREATMENT TO OCCUR AT DOWNSTREAM WSUD BASIN B3C LOCATED WITHIN THE GABLES. REFER DA1583/2019/ZB

UPGRADE EXISTING NETWORK TO Ø750 TO MATCH BASIN OUTLET

TOP OF WALL = 41.64m

REV.	DATE	DESCRIPTION	DRN.	DES.	VERIF.	APPD.
2	5/12/2022	ISSUED FOR INFORMATION	HD	HD	-	RH
1	6/07/2022	ISSUED FOR INFORMATION	CWH	HD	-	RH

Client: Stockland — it's your place; THE GABLES BOX HILL

Scale: 0 10 20 30 40 50m — SCALE 1:500 @A1

North

Enspire Solutions Pty Ltd
Level 4, 153 Walker Street, North Sydney NSW 2060
ABN: 71 624 801 690
Phone: 02 9922 6135

Project: WEST GABLES REZONING

Title: CONCEPT STORMWATER BIO-RETENTION / OSD BASIN 07

Scale: 1:500

Date: 6/07/2022

Size: A1

Datum: GDA94

Status: FOR INFORMATION ONLY — NOT TO BE USED FOR CONSTRUCTION

Project Number/Drawing Number: 220012-SK-0007

Revision: 2

DATE PLOTTED: 5 December 2022 5:35 PM BY : HAYDEN DAVENPORT

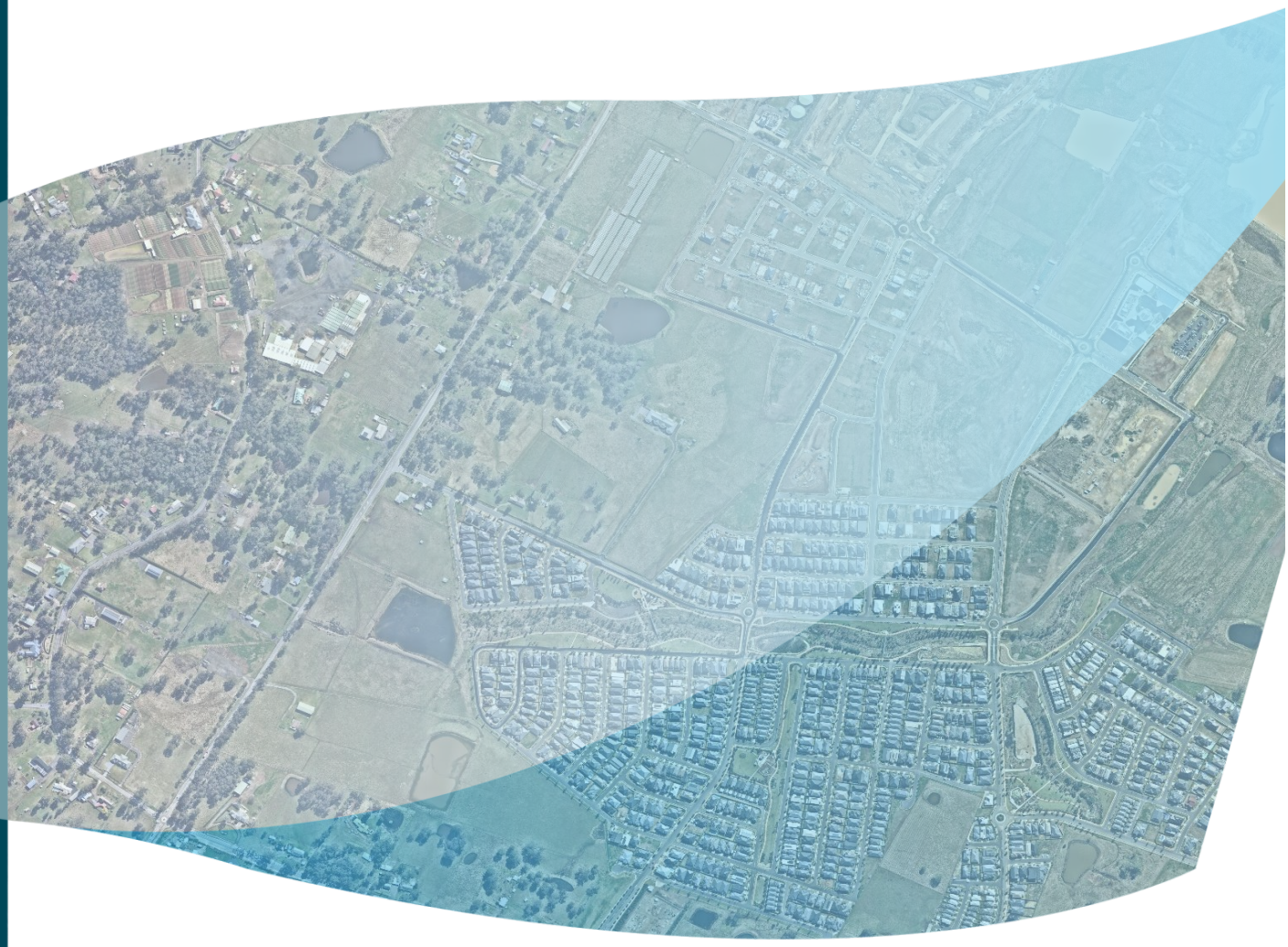
CAD File: P:\220012 GablesRezoning\D-Civil\00-SiteWide\Drawings\4-Sketches-Formal\220012-SK-0001-SK-0007-WEST GABLES BASIN CONCEPTS.dwg

Appendix C Opinion of Probable Costs

Prepared by Enspire Solutions

West Gables

Opinion of Probable Cost - Basin and Drainage Infrastructure



Prepared for Stockland and Allam
Monday, 5 December 2022
Revision 2

Revision Register

Revision	Date	Who	Description
1	25/11/2022	CVA	Initial Estimate
2	5/12/2022	CVA	Issued For Review

Notes and Assumptions

Item	Notes/Assumptions
1	This Opinion of Probable Cost (OPC) is based upon the masterplan prepared by Urbis and is to be submitted as part of the West Gables Rezoning.
2	This OPC is completed based off present day costs.
3	Stripping is excluded as part of the earthworks calculations.
4	It is assumed that trench spoil from utilities and drainage excavation will be re-used to backfill.
5	Bio-Retention planting includes planting within the filter media footprint and is not inclusive of any endemic planting along the remainder of the allocated drainage space.
6	Basin and associated drainage infrastructure works are based off concept drawings only and are subject to change.
7	It is assumed that any embellishment works that are associated with the Water Management Infrastructure areas are excluded as part of this OPC.
8	Embellishment has been excluded as part of these drainage associated infrastructure works.
9	Road boxing is not included as part of the overall earthworks strategy for this rezoning proposal.
10	Gross Pollutant Traps (GPT) costs are assumed to include provisions for supply and installation of the device.
11	Maintenance and establishment of planting is not included as part of this estimate.

Drawings

Drawing #	Revision	Date	Name
220012-SK-0001	1	5/12/2022	CONCEPT STORMWATER DRAINAGE CATCHMENT PLAN
220012-SK-0002	1	5/12/2022	CONCEPT STORMWATER BIO-RETETION / OSD BASINS 01&02
220012-SK-0003	1	5/12/2022	CONCEPT STORMWATER BIO-RETETION / OSD BASINS 03
220012-SK-0004	1	5/12/2022	CONCEPT STORMWATER BIO-RETETION / OSD BASINS 04
220012-SK-0005	1	5/12/2022	CONCEPT STORMWATER BIO-RETETION / OSD BASINS 05
220012-SK-0006	1	5/12/2022	CONCEPT STORMWATER BIO-RETETION / OSD BASINS 06

Summary

Basin and Drainage Infrastructure Works - Construction

#	Item		Current Estimate	Comments
1	Basin 1 + 2	$	3,211,072	Review of rates and provisions for Stacked Rock Walls
2	Drainage Upgrade Basin 1+2	$	542,783	Updates for road reinstatement and preliminaries.
3	Basin 3	$	791,281	Review of rates and provisions for permanent fencing.
4	Basin 4	$	712,542	Review of rates and provisions for permanent fencing.
5	Basin 5	$	1,613,379	Review of rates and provisions for permanent fencing.
6	Drainage Upgrade Basin 5	$	304,171	Updates for road reinstatement and preliminaries.
7	Basin 6	$	4,145,762	Review of rates and provisions for permanent fencing.
8	Drainage Upgrade Basin 6	$	504,430	Updates for road reinstatement and preliminaries.
9	Basin 7	$	427,912	Review of rates and provisions for permanent fencing.
10	Drainage Upgrade Basin 7	$	379,475	Updates for road reinstatement and preliminaries.
	Sub Total (excl GST)	**$**	**12,632,805**	
	Contingency (2.5%)	$	315,820	
	Total (excl GST)	**$**	**12,948,626**	

Basin and Drainage Infrastructure Works - Administration and Management

#	Item		Current Estimate	Comments
A	Consultancy and Project Management	$	1,553,835	12% of Construction cost applied.
B	Government Agenct Approvals (Allowance Only)	$	10,000.00	Allowance Only
C	Council DA Fees and Levys	$	32,371.56	0.025% of Construction cost applied.
D	PCA Fees (Allowance Only)	$	10,000.00	Allowance Only
	Total (excl GST)	**$**	**1,606,207**	

Basin and Drainage Infrastructure Works - Total

#	Item		Current Estimate	Comments
	Construction	$	12,948,626	
	Administration and Management	$	1,606,207	
	Total (excl GST)	**$**	**14,554,832**	
	Total (incl GST)	**$**	**16,010,315**	

Basin 1 + 2

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
1	**Preliminaries**				
1.1	**Basin Preliminaries**				
1.1.1	Establishment	1	item	$ 90,000.00	$ 90,000.00
1.1.2	Temporary ATF Fencing	811	L.m	$ 15.00	$ 12,165.00
1.1.3	Sediment and Erosion Control	1	item	$ 20,000.00	$ 20,000.00
1.1.4	Weed eradication prior to site commencement	1	item	$ 15,000.00	$ 15,000.00
				Preliminaries Subtotal	***$ 137,165.00***
2	**Earthworks**				
2.1	**Bulk Earthworks**				
2.1.1	Topsoil Stripping to Stockpile	28731	sqm	$ 5.81	$ 166,927.11
2.1.2	Topsoil Stockpile to Placement	28731	sqm	$ 5.81	$ 166,927.11
2.1.3	Cut to Fill and compact	14887	cum	$ 5.95	$ 88,577.65
2.1.4	Cut and remove from site	10700	cum	$ 25.00	$ 267,500.00
				Earthworks Subtotal	***$ 689,931.87***
3	**Gross Pollutant Traps**				
3.1	GPT	2	each	$ 100,000.00	$ 200,000.00
				Gross Pollutant Traps Subtotal	***$ 200,000.00***
4	**Headwalls/Riprap and Scour Protection**				
4.1	450dia Headwall	2	each	$ 280.00	$ 560.00
4.2	600dia Headwall	3	each	$ 320.00	$ 960.00
4.3	1350dia Headwall	1	each	$ 3,600.00	$ 3,600.00
4.4	Riprap Head Wall	620	sqm	$ 130.00	$ 80,600.00
				Headwalls/Riprap and Scour Protection Subtotal	***$ 85,720.00***
5	**Maintenance Access**				
5.1	**Concrete Maintenance Access Track (CBR 4%)**				
5.1.1	125mm Concrete (SL72 mesh - 40 cover) on 100mm DGB20 on 50mm Granular Bedding	500	sqm	$ 130.00	$ 65,000.00
				Maintenance Access Subtotal	***$ 65,000.00***
6	**Landscaping**				
6.1	**WSUD Basin Landscaping**				
6.1.1	Riparian Planting	4525	sqm	$ 80.00	$ 362,000.00
6.1.2	Bio-Retention Planting	3000	sqm	$ 60.00	$ 180,000.00
				Landscaping Subtotal	***$ 542,000.00***
7	**Water Quality Basin**				
7.1	**Bio-retention Basin**				
7.1.1	HDPE Liner	4525	sqm	$ 40.00	$ 181,000.00
7.1.2	Bioretention Media - Drainage Layer (200mm)	3000	sqm	$ 60.00	$ 180,000.00
7.1.3	Bioretention Media - Transition Layer (50mm)	3000	sqm	$ 50.00	$ 150,000.00
7.1.4	Bioretention Media - Filter Layer (400mm)	3000	sqm	$ 100.00	$ 300,000.00
7.1.5	Subsoil Drainage - 100dia PVC (slotted pipe)	1250	L.m	$ 40.00	$ 50,000.00
7.1.6	Flushing points - 100dia	43	each	$ 60.00	$ 2,580.00
				Water Quality Basin Subtotal	***$ 863,580.00***
8	**Stormwater Drainage**				
8.1	**Excavate for drainage trenches in all classes of material**				
8.1.1	Excavation in OTR - Road Drainage	426	cum	$ 20.00	$ 8,520.00
8.2	**Supply all materials, bed, lay, and joint stormwater drainage pipes**				
8.2.1	**Drainage Pipes**				
8.2.1.1	450mm dia RCP CLASS 2	25	m	$ 200.00	$ 5,000.00
8.2.1.2	600mm dia RCP CLASS 2	24	m	$ 270.00	$ 6,480.00
8.2.1.3	1350mm dia RCP CLASS 2	154	m	$ 630.00	$ 97,020.00
8.2.1.4	1200 x 1500mm dia RCBC	20	m	$ 1,860.00	$ 37,200.00
8.2.1.5	CCTV Inspections	54	m	$ 5.00	$ 270.00
8.3	**Excavate for and construct drainage structures, including backfill, covers and grates and all necessary connections:**				
8.3.1	**Up to 900x900mm Chamber and <2000mm deep**				
8.3.1.1	900 x 900 CLASS B GRATED SURFACE INLET PIT	2	each	$ 3,300.00	$ 6,600.00
8.3.2	**900 < X or Y < 2100mm Chamber and <3000mm deep**				
8.3.2.1	900 x 900 CLASS C JUNCTION PIT (CONCRETE INFILL)	3	each	$ 5,000.00	$ 15,000.00
8.3.3	**Special Pits**				$ -
8.3.3.1	Splitter Pits	2	each	$ 15,000.00	$ 30,000.00
8.3.4	**Structual Certification**				$ -
8.3.4.1	Structural inspection and certification of special pits	2	item	$ 850.00	$ 1,700.00
				Stormwater Drainage Subtotal	***$ 207,790.00***

Basin 1 + 2

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
9	**Retaining Walls**				
9.1	Stacked Sandstone Rock Wall	660	sqm	$ 599.22	$ 395,485.20
				Retaining Walls Subtotal	***$ 395,485.20***
9	**Roadworks Ancillaries**				
9.1	**Basin Access**				
9.1.1	Bollards	6	each	$ 150.00	$ 900.00
9.2	**Basin Signage**				
9.2.1	Basin Signage to Hill Shire Specifications	5	each	$ 500.00	$ 2,500.00
				Roadworks Ancillaries Subtotal	***$ 3,400.00***
10	**Maintenance**				
10.1	**Maintenance of Landscaping and Drainage**				
10.1.1	Maintenance (initial 3 months)	12	wks	$ 250.00	$ 3,000.00
10.1.2	Maintenance (9 months)	36	wks	$ 500.00	$ 18,000.00
				Maintenance Subtotal	***$ 21,000.00***
				Total	**$ 3,211,072.07**

Drainage Upgrade Basin 1+2

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
1	**Preliminaries**				
1.1	**Preliminaries**				
1.1.1	Establishment	1	each	$ 5,000.00	$ 5,000.00
1.1.2	Traffic Management incl preparation of S. 138 certificate and gaining approval thereto	1	item	$ 50,000.00	$ 50,000.00
1.1.3	Temporary ATF Fencing	522	L.m	$ 15.00	$ 7,830.00
1.1.4	Sediment and Erosion Control	1	each	$ 3,000.00	$ 3,000.00
1.1.5	Demolish existing kerb and gutter and dispose of offsite	234	m	$ 50.00	$ 11,700.00
1.1.6	Demolition of existing asphalt pavement and dispose of offsite	211	sqm	$ 20.00	$ 4,220.00
				Preliminaries Subtotal	***$ 81,750.00***
2	**Headwalls/Riprap and Scour Protection**				
2.1	750dia Headwall	1	each	$ 860.00	$ 860.00
2.2	Riprap Head Wall	100	sqm	$ 130.00	$ 13,000.00
				Headwalls/Riprap and Scour Protection Subtotal	***$ 13,860.00***
3	**Roadworks Ancillaries**				
3.1	**Local Road (CBR 4%)**				
3.1.1	Local Rd Reinstatement	211	sqm	$ 180.00	$ 37,908.00
3.1.2	150mm Kerb and Gutter (K&G)	235	L.m	$ 160.00	$ 37,600.00
				Roadworks Ancillaries Subtotal	***$ 75,508.00***
4	**Stormwater Drainage**				
4.1	**Excavate for drainage trenches in all classes of material**				
4.1.1	Excavation in OTR - Road Drainage	314	cum	$ 20.00	$ 6,280.00
4.2	**Supply all materials, bed, lay, and joint stormwater drainage pipes**				
4.2.1	**Drainage Pipes**				
4.2.1.1	375mm dia RCP CLASS 2	28	m	$ 510.00	$ 14,280.00
4.2.1.2	450mm dia RCP CLASS 2	58	m	$ 600.00	$ 34,800.00
4.2.1.3	525mm dia RCP CLASS 2	58	m	$ 690.00	$ 40,020.00
4.2.1.4	600mm dia RCP CLASS 2	56	m	$ 810.00	$ 45,360.00
4.2.1.5	750mm dia RCP CLASS 2	61	m	$ 1,020.00	$ 62,220.00
4.2.1.6	CCTV Inspections	261	m	$ 5.00	$ 1,305.00
4.3	**Excavate for and construct drainage structures, including backfill, covers and grates and all necessary connections:**				
4.3.1	**Up to 900x900mm Chamber and <2000mm deep**				
4.3.2	1.8m LINTEL	6	each	$ 7,500.00	$ 45,000.00
4.3.3	**900 < X or Y < 2100mm Chamber and <3000mm deep**				
4.3.4	1.8m LINTEL	3	each	$ 10,000.00	$ 30,000.00
				Stormwater Drainage Subtotal	***$ 279,265.00***
5	**Landscaping**				
5.1	**Install Road Verge Turf and all associated works**				
5.1.1	Local Road	1,900	sqm	$ 30.00	$ 57,000.00
5.2	**Install Road Street Trees and all associated works**				
5.2.1	Local Road	20	each	$ 720.00	$ 14,400.00
				Landscaping Subtotal	***$ 71,400.00***
6	**Maintenance**				
6.1	**Maintenance of Landscaping and Drainage**				
6.1.1	Maintenance (initial 3 months)	12	wks	$ 250.00	$ 3,000.00
6.1.2	Maintenance (9 months)	36	wks	$ 500.00	$ 18,000.00
				Maintenance Subtotal	***$ 21,000.00***
				Total	**$ 542,783.00**

Basin 3

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
1	**Preliminaries**				
1.1	**Basin Preliminaries**				
1.1.1	Establishment	1	item	$ 26,000.00	$ 26,000.00
1.1.2	Temporary ATF Fencing	196	L.m	$ 15.00	$ 2,940.00
1.1.3	Sediment and Erosion Control	1	item	$ 20,000.00	$ 20,000.00
1.1.4	Weed eradication prior to site commencement	1	item	$ 5,000.00	$ 5,000.00
				Preliminaries Subtotal	***$ 53,940.00***
2	**Earthworks**				
2.1	**Bulk Earthworks**				
2.1.1	Topsoil Stripping to Stockpile	2498	sqm	$ 5.81	$ 14,513.38
2.1.2	Topsoil Stockpile to Placement	2498	sqm	$ 5.81	$ 14,513.38
2.1.3	Cut to Fill and compact	104	cum	$ 5.95	$ 618.80
2.1.4	Cut and remove from site	7733	cum	$ 25.00	$ 193,325.00
				Earthworks Subtotal	***$ 222,970.56***
3	**Gross Pollutant Traps**				
3.1	GPT	1	each	$ 100,000.00	$ 100,000.00
				Gross Pollutant Traps Subtotal	***$ 100,000.00***
4	**Headwalls/Riprap and Scour Protection**				
4.1	600dia Headwall	1	each	$ 320.00	$ 320.00
4.2	1350dia Headwall	1	each	$ 3,600.00	$ 3,600.00
4.3	Riprap Head Wall	200	sqm	$ 130.00	$ 26,000.00
				Headwalls/Riprap and Scour Protection Subtotal	***$ 29,920.00***
5	**Maintenance Access**				
5.1	**Concrete Maintenance Access Track (CBR 4%)**				
5.1.1	125mm Concrete (SL72 mesh - 40 cover) on 100mm DGB20 on 50mm Granular Bedding	500	sqm	$ 130.00	$ 65,000.00
				Maintenance Access Subtotal	***$ 65,000.00***
6	**Landscaping**				
6.1	**WSUD Basin Landscaping**				
6.1.1	Bio-Retention Planting	303	sqm	$ 55.00	$ 16,665.00
6.2	**Permanent Fencing**				
6.2.1	Fencing	196	L.m	$ 120.00	$ 23,520.00
6.2.2	Access Gate with lock	1	each	$ 2,000.00	$ 2,000.00
				Landscaping Subtotal	***$ 42,185.00***
7	**Water Quality Basin**				
7.1	**Bio-retention Basin**				
7.1.1	HDPE Liner	2498	sqm	$ 40.00	$ 99,920.00
7.1.2	Bioretention Media - Drainage Layer (200mm)	303	sqm	$ 60.00	$ 18,180.00
7.1.3	Bioretention Media - Transition Layer (50mm)	303	sqm	$ 50.00	$ 15,150.00
7.1.4	Bioretention Media - Filter Layer (400mm)	303	sqm	$ 100.00	$ 30,300.00
7.1.5	Subsoil Drainage - 100dia PVC (slotted pipe)	165	L.m	$ 40.00	$ 6,600.00
7.1.6	Flushing points - 100dia	15	each	$ 60.00	$ 900.00
				Water Quality Basin Subtotal	***$ 171,050.00***

Basin 3

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
8	**Stormwater Drainage**				
8.1	**Excavate for drainage trenches in all classes of material**				
8.1.1	Excavation in OTR - Road Drainage	206	cum	$ 20.00	$ 4,120.00
8.1	**Supply all materials, bed, lay, and joint stormwater drainage pipes**				
8.1.1	**Drainage Pipes**				
8.1.1.1	450mm dia RCP CLASS 2	53	m	$ 200.00	$ 10,600.00
8.1.1.2	600mm dia RCP CLASS 2	12	m	$ 270.00	$ 3,240.00
8.1.1.3	1350mm dia RCP CLASS 2	38	m	$ 630.00	$ 23,940.00
8.1.1.4	CCTV Inspections	103	m	$ 5.00	$ 515.00
8.2	**Excavate for and construct drainage structures, including backfill, covers and grates and all necessary connections:**				
8.2.1	**Up to 900x900mm Chamber and <2000mm deep**				
8.2.1.1	900 x 900 CLASS B GRATED SURFACE INLET PIT	3	each	$ 3,300.00	$ 9,900.00
8.2.2	**900 < X or Y < 2100mm Chamber and <3000mm deep**				
8.2.2.1	900 x 900 CLASS C JUNCTION PIT (CONCRETE INFILL)	1	each	$ 5,000.00	$ 5,000.00
8.2.3	**Special Pits**				
8.2.3.1	Splitter Pits	1	each	$ 15,000.00	$ 15,000.00
8.2.4	**Structual Certification**				$ -
8.2.4.1	Structural inspection and certification of special pits	1	item	$ 850.00	$ 850.00
				Stormwater Drainage Subtotal	***$ 73,165.00***
9	**Retaining Walls**				
9.1	Blockwork retaining wall	106	sqm	$ 100.00	$ 10,600.00
				Retaining Walls Subtotal	***$ 10,600.00***
10	**Roadworks Ancillaries**				
10.1	**Basin Access**				
10.1.1	Bollards	3	each	$ 150.00	$ 450.00
10.2	**Basin Signage**				
10.2.1	Basin Signage to Hill Shire Specifications	2	each	$ 500.00	$ 1,000.00
				Roadworks Ancillaries Subtotal	***$ 1,450.00***
11	**Maintenance**				
11.1	**Maintenance of Landscaping and Drainage**				
11.1.1	Maintenance (initial 3 months)	12	wks	$ 250.00	$ 3,000.00
11.1.2	Maintenance (9 months)	36	wks	$ 500.00	$ 18,000.00
				Maintenance Subtotal	***$ 21,000.00***
				Total	**$ 791,280.56**

Basin 4

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
1	**Preliminaries**				
1.1	**Basin Preliminaries**				
1.1.1	Establishment	1	item	$ 30,000.00	$ 30,000.00
1.1.2	Traffic Management incl preparation of S. 138 certificate and gaining approval thereto	1	item	$ 20,000.00	$ 20,000.00
1.1.2	Temporary ATF Fencing	220	L.m	$ 15.00	$ 3,300.00
1.1.3	Sediment and Erosion Control	1	item	$ 3,000.00	$ 3,000.00
1.1.4	Weed eradication prior to site commencement	1	item	$ 4,000.00	$ 4,000.00
1.1.5	Demolish existing kerb and gutter and dispose of offsite	20	m	$ 50.00	$ 1,000.00
1.1.6	Demolition of existing asphalt pavement and dispose of offsite	50	sqm	$ 20.00	$ 1,000.00
				Preliminaries Subtotal	***$ 62,300.00***
2	**Earthworks**				
2.1	**Bulk Earthworks**				
2.1.1	Topsoil Stripping to Stockpile	2103	sqm	$ 5.81	$ 12,218.43
2.1.2	Topsoil Stockpile to Placement	2103	sqm	$ 5.81	$ 12,218.43
2.1.3	Cut to Fill and compact	179	cum	$ 5.95	$ 1,065.05
2.1.4	Cut and remove from site	2394	cum	$ 25.00	$ 59,850.00
				Earthworks Subtotal	***$ 85,351.91***
3	**Gross Pollutant Traps**				
3.1	GPT	1	each	$ 80,000.00	$ 80,000.00
				Gross Pollutant Traps Subtotal	***$ 80,000.00***
4	**Headwalls/Riprap and Scour Protection**				
4.1	450dia Headwall	1	each	$ 320.00	$ 320.00
4.2	900dia Headwall	1	each	$ 1,410.00	$ 1,410.00
4.3	Riprap Head Wall	200	sqm	$ 130.00	$ 26,000.00
				Headwalls/Riprap and Scour Protection Subtotal	***$ 27,730.00***
5	**Maintenance Access**				
5.1	**Concrete Maintenance Access Track (CBR 4%)**				
5.1.1	125mm Concrete (SL72 mesh - 40 cover) on 100mm DGB20 on 50mm Granular Bedding	200	sqm	$ 130.00	$ 26,000.00
				Maintenance Access Subtotal	***$ 26,000.00***
6	**Landscaping**				
6.1	**WSUD Basin Landscaping**				
6.1.1	Bio-Retention Planting	400	sqm	$ 55.00	$ 22,000.00
6.2	**Permanent Fencing**				
6.2.1	Fencing	220	L.m	$ 120.00	$ 26,400.00
6.2.2	Access Gate with lock	1	each	$ 2,000.00	$ 2,000.00
				Landscaping Subtotal	***$ 50,400.00***
7	**Water Quality Basin**				
7.1	**Bio-retention Basin**				
7.1.1	HDPE Liner	2103	sqm	$ 40.00	$ 84,120.00
7.1.2	Bioretention Media - Drainage Layer (200mm)	400	sqm	$ 60.00	$ 24,000.00
7.1.3	Bioretention Media - Transition Layer (50mm)	400	sqm	$ 50.00	$ 20,000.00
7.1.4	Bioretention Media - Filter Layer (400mm)	400	sqm	$ 100.00	$ 40,000.00
7.1.5	Subsoil Drainage - 100dia PVC (slotted pipe)	238	L.m	$ 40.00	$ 9,520.00
7.1.6	Flushing points - 100dia	17	each	$ 60.00	$ 1,020.00
				Water Quality Basin Subtotal	***$ 178,660.00***

Basin 4

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
8	**Stormwater Drainage**				
8.1	**Excavate for drainage trenches in all classes of material**				
8.1.1	Excavation in OTR - Road Drainage	200	cum	$ 20.00	$ 4,000.00
8.1	**Supply all materials, bed, lay, and joint stormwater drainage pipes**				
8.1.1	**Drainage Pipes**				
8.1.1.1	450mm dia RCP CLASS 2	16	m	$ 200.00	$ 3,200.00
8.1.1.2	900mm dia RCP CLASS 2	84	m	$ 1,300.00	$ 109,200.00
8.1.1.3	CCTV Inspections	100	m	$ 5.00	$ 500.00
8.2	**Excavate for and construct drainage structures, including backfill, covers and grates and all necessary connections:**				
8.2.1	**Up to 900x900mm Chamber and <2000mm deep**				
8.2.1.1	900 x 900 CLASS B GRATED SURFACE INLET PIT	1	each	$ 9,000.00	$ 9,000.00
8.2.2	**900 < X or Y < 2100mm Chamber and <3000mm deep**				
8.2.2.1	900 x 900 CLASS C JUNCTION PIT (CONCRETE INFILL)	2	each	$ 5,000.00	$ 10,000.00
8.2.3	**Special Pits**				$ -
8.2.3.1	Splitter Pits	1	each	$ 15,000.00	$ 15,000.00
8.2.4	**Structual Certification**				$ -
8.2.4.1	Structural inspection and certification of special pits	1	item	$ 850.00	$ 850.00
				Stormwater Drainage Subtotal	***$ 151,750.00***
9	**Retaining Walls**				
9.1	Blockwork retaining wall	279	sqm	$ 100.00	$ 27,900.00
				Retaining Walls Subtotal	***$ 27,900.00***
10	**Roadworks Ancillaries**				
10.1	**Basin Access**				
10.1.1	Bollards	3	each	$ 150.00	$ 450.00
10.2	**Basin Signage**				
10.2.1	Basin Signage to Hill Shire Specifications	2	each	$ 500.00	$ 1,000.00
				Roadworks Ancillaries Subtotal	***$ 1,450.00***
11	**Maintenance**				
11.1	**Maintenance of Landscaping and Drainage**				
11.1.1	Maintenance (initial 3 months)	12	wks	$ 250.00	$ 3,000.00
11.1.2	Maintenance (9 months)	36	wks	$ 500.00	$ 18,000.00
				Maintenance Subtotal	***$ 21,000.00***
				Total	**$ 712,541.91**

Basin 5

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
1	**Preliminaries**				
1.1	**Basin Preliminaries**				
1.1.1	Establishment	1	item	$ 56,000.00	$ 56,000.00
1.1.2	Temporary ATF Fencing	316	L.m	$ 15.00	$ 4,740.00
1.1.3	Sediment and Erosion Control	1	item	$ 3,000.00	$ 3,000.00
1.1.4	Weed eradication prior to site commencement	1	item	$ 5,000.00	$ 5,000.00
				Preliminaries Subtotal	***$ 68,740.00***
2	**Earthworks**				
2.1	**Bulk Earthworks**				
2.1.1	Topsoil Stripping to Stockpile	6290	sqm	$ 5.81	$ 36,544.90
2.1.2	Topsoil Stockpile to Placement	6290	sqm	$ 5.81	$ 36,544.90
2.1.3	Cut to Fill and compact	25	cum	$ 5.95	$ 148.75
2.1.4	Cut and remove from site	15156	cum	$ 25.00	$ 378,900.00
				Earthworks Subtotal	***$ 452,138.55***
3	**Gross Pollutant Traps**				
3.1	GPT	1	each	$ 100,000.00	$ 100,000.00
				Gross Pollutant Traps Subtotal	***$ 100,000.00***
4	**Headwalls/Riprap and Scour Protection**				
4.1	600dia Headwall	2	each	$ 320.00	$ 640.00
4.2	1350dia Headwall	1	each	$ 3,600.00	$ 3,600.00
4.3	Riprap Head Wall	300	sqm	$ 130.00	$ 39,000.00
				Headwalls/Riprap and Scour Protection Subtotal	***$ 43,240.00***
5	**Maintenance Access**				
5.1	**Concrete Maintenance Access Track (CBR 4%)**				
5.1.1	125mm Concrete (SL72 mesh - 40 cover) on 100mm DGB20 on 50mm Granular Bedding	500	sqm	$ 130.00	$ 65,000.00
				Maintenance Access Subtotal	***$ 65,000.00***
6	**Landscaping**				
6.1	**WSUD Basin Landscaping**				
6.1.1	Bio-Retention Planting	1400	sqm	$ 60.00	$ 84,000.00
6.2	**Permanent Fencing**				
6.2.1	Fencing	316	L.m	$ 120.00	$ 37,920.00
6.2.2	Access Gate with lock	1	each	$ 2,000.00	$ 2,000.00
				Landscaping Subtotal	***$ 123,920.00***
7	**Water Quality Basin**				
7.1	**Bio-retention Basin**				
7.1.1	HDPE Liner	6290	sqm	$ 40.00	$ 251,600.00
7.1.2	Bioretention Media - Drainage Layer (200mm)	1400	sqm	$ 60.00	$ 84,000.00
7.1.3	Bioretention Media - Transition Layer (50mm)	1400	sqm	$ 50.00	$ 70,000.00
7.1.4	Bioretention Media - Filter Layer (400mm)	1400	sqm	$ 100.00	$ 140,000.00
7.1.5	Subsoil Drainage - 100dia PVC (slotted pipe)	700	L.m	$ 40.00	$ 28,000.00
7.1.6	Flushing points - 100dia	20	each	$ 60.00	$ 1,200.00
				Water Quality Basin Subtotal	***$ 574,800.00***

Basin 5

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
8	**Stormwater Drainage**				
8.1	**Excavate for drainage trenches in all classes of material**				
8.1.1	Excavation in OTR - Road Drainage	248	cum	$ 20.00	$ 4,960.00
8.1	**Supply all materials, bed, lay, and joint stormwater drainage pipes**				
8.1.1	**Drainage Pipes**				
8.1.1.1	450mm dia RCP CLASS 2	44	m	$ 200.00	$ 8,800.00
8.1.1.2	600mm dia RCP CLASS 2	50	m	$ 270.00	$ 13,500.00
8.1.1.3	1200mm dia RCP CLASS 2	19	m	$ 570.00	$ 10,830.00
8.1.1.4	1350mm dia RCP CLASS 2	11	m	$ 630.00	$ 6,930.00
8.1.1.5	CCTV Inspections	124	m	$ 5.00	$ 620.00
8.2	**Excavate for and construct drainage structures, including backfill, covers and grates and all necessary connections:**				
8.2.1	**Up to 900x900mm Chamber and <2000mm deep**				
8.2.1.1	900 x 900 CLASS B GRATED SURFACE INLET PIT	2	each	$ 3,300.00	$ 6,600.00
8.2.2	**Special Pits**				$ -
8.2.2.1	Splitter Pits	1	each	$ 15,000.00	$ 15,000.00
8.2.3	**Structual Certification**				$ -
8.2.3.1	Structural inspection and certification of special pits	1	item	$ 850.00	$ 850.00
8.2.3	**Modification of existing pit**				$ -
8.2.3.1	Modify existing junction pit for new 900dia connection	1	each	$ 70,000.00	$ 70,000.00
				Stormwater Drainage Subtotal	***$ 138,090.00***
9	**Retaining Walls**				
9.1	Blockwork retaining wall	25	sqm	$ 1,000.00	$ 25,000.00
				Retaining Walls Subtotal	***$ 25,000.00***
10	**Roadworks Ancillaries**				
10.1	**Basin Access**				
10.1.1	Bollards	3	each	$ 150.00	$ 450.00
10.2	**Basin Signage**				
10.2.1	Basin Signage to Hill Shire Specifications	2	each	$ 500.00	$ 1,000.00
				Roadworks Ancillaries Subtotal	***$ 1,450.00***
11	**Maintenance**				
11.1	**Maintenance of Landscaping and Drainage**				
11.1.1	Maintenance (initial 3 months)	12	wks	$ 250.00	$ 3,000.00
11.1.2	Maintenance (9 months)	36	wks	$ 500.00	$ 18,000.00
				Maintenance Subtotal	***$ 21,000.00***
				Total	**$ 1,613,378.55**

Drainage Upgrade Basin 5

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
1	**Preliminaries**				
1.1	**Preliminaries**				
1.1.1	Establishment	1	item	$ 15,000.00	$ 15,000.00
1.1.2	Traffic Management incl preparation of S. 138 certificate and gaining approval thereto	1	item	$ 50,000.00	$ 50,000.00
1.1.2	Temporary ATF Fencing	166	L.m	$ 15.00	$ 2,490.00
1.1.3	Sediment and Erosion Control	1	item	$ 3,000.00	$ 3,000.00
1.1.4	Demolish existing kerb and gutter and dispose of offsite	55	m	$ 50.00	$ 2,750.00
1.1.5	Demolition of existing asphalt pavement and dispose of offsite	50	sqm	$ 20.00	$ 1,000.00
1.1.6	Demolish existing RCP and dispose of offsite	55	m	$ 105.92	$ 5,825.60
				Preliminaries Subtotal	***$ 80,065.60***
2	**Headwalls/Riprap and Scour Protection**				
2.1	750dia Headwall	1	each	$ 860.00	$ 860.00
2.2	Riprap Head Wall	100	sqm	$ 130.00	$ 13,000.00
				Headwalls/Riprap and Scour Protection Subtotal	***$ 13,860.00***
3	**Roadworks Ancillaries**				
3.1	**Collector Road (CBR 4%)**				
3.1.1	Collector Rd Reinstatement	135	sqm	$ 200.00	$ 27,000.00
3.1.2	150mm Kerb and Gutter (K&G)	140	L.m	$ 160.00	$ 22,400.00
				Roadworks Ancillaries Subtotal	***$ 49,400.00***
4	**Stormwater Drainage**				
4.1	**Excavate for drainage trenches in all classes of material**				
4.1.1	Excavation in OTR - Road Drainage	166	cum	$ 20.00	$ 3,320.00
4.1	**Supply all materials, bed, lay, and joint stormwater drainage pipes**				
4.1.1	**Drainage Pipes**				
4.1.1.1	600mm dia RCP CLASS 2	55	m	$ 810.00	$ 44,550.00
4.1.1.2	750mm dia RCP CLASS 2	28	m	$ 1,020.00	$ 28,560.00
4.1.1.3	CCTV Inspections	83	m	$ 5.00	$ 415.00
4.2	**Excavate for and construct drainage structures, including backfill, covers and grates and all necessary connections:**				
4.2.1	**900 < X or Y < 2100mm Chamber and <3000mm deep**				
4.2.1.1	900 x 900 CLASS B GRATED SURFACE INLET PIT	1	each	$ 9,000.00	$ 9,000.00
4.2.1.2	1.8m LINTEL	3	each	$ 10,000.00	$ 30,000.00
				Stormwater Drainage Subtotal	***$ 115,845.00***
5	**Landscaping**				
5.1	**Install Road Verge Turf and all associated works**				
5.1.1	Collector Road	600	sqm	$ 30.00	$ 18,000.00
5.2	**Install Road Street Trees and all associated works**				
5.2.1	Collector Road	4	each	$ 1,500.00	$ 6,000.00
				Landscaping Subtotal	***$ 24,000.00***
6	**Maintenance**				
6.1	**Maintenance of Landscaping and Drainage**				
6.1.1	Maintenance (initial 3 months)	12	wks	$ 250.00	$ 3,000.00
6.1.2	Maintenance (9 months)	36	wks	$ 500.00	$ 18,000.00
				Maintenance Subtotal	***$ 21,000.00***
				Total	**$ 304,170.60**

Basin 6

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
1	**Preliminaries**				
1.1	**Basin Preliminaries**				
1.1.1	Establishment	1	item	$ 160,000.00	$ 160,000.00
1.1.2	Traffic Management incl preparation of S. 138 certificate and gaining approval thereto	1	item	$ 30,000.00	$ 30,000.00
1.1.3	Temporary ATF Fencing	592	L.m	$ 15.00	$ 8,880.00
1.1.4	Sediment and Erosion Control	1	item	$ 3,000.00	$ 3,000.00
1.1.5	Weed eradication prior to site commencement	1	item	$ 10,000.00	$ 10,000.00
1.1.6	Demolish existing kerb and gutter and dispose of offsite	20	m	$ 50.00	$ 1,000.00
1.1.7	Demolition of existing asphalt pavement and dispose of offsite	50	sqm	$ 20.00	$ 1,000.00
				Preliminaries Subtotal	***$ 211,880.00***
2	**Earthworks**				
2.1	**Bulk Earthworks**				
2.1.1	Topsoil Stripping to Stockpile	19974	sqm	$ 5.81	$ 116,048.94
2.1.2	Topsoil Stockpile to Placement	19974	sqm	$ 5.81	$ 116,048.94
2.1.3	Cut to Fill and compact	78	cum	$ 5.95	$ 464.10
2.1.4	Cut and remove from site	67347	cum	$ 25.00	$ 1,683,675.00
				Earthworks Subtotal	***$ 1,916,236.98***
3	**Gross Pollutant Traps**				
3.1	GPT	2	each	$ 100,000.00	$ 200,000.00
				Gross Pollutant Traps Subtotal	***$ 200,000.00***
4	**Headwalls/Riprap and Scour Protection**				
4.1	375dia Headwall	3	each	$ 240.00	$ 720.00
4.2	450dia Headwall	3	each	$ 320.00	$ 960.00
4.3	900dia Headwall	1	each	$ 1,410.00	$ 1,410.00
4.4	Riprap Head Wall	620	sqm	$ 130.00	$ 80,600.00
				Headwalls/Riprap and Scour Protection Subtotal	***$ 83,690.00***
5	**Maintenance Access**				
5.1	**Concrete Maintenance Access Track (CBR 4%)**				
5.1.1	125mm Concrete (SL72 mesh - 40 cover) on 100mm DGB20 on 50mm Granular Bedding	750	sqm	$ 130.00	$ 97,500.00
				Maintenance Access Subtotal	***$ 97,500.00***
6	**Landscaping**				
6.1	**WSUD Basin Landscaping**				
6.1.1	Bio-Retention Planting	2000	sqm	$ 55.00	$ 110,000.00
6.2	**Permanent Fencing**				
6.2.1	Fencing	592	L.m	$ 120.00	$ 71,040.00
6.2.2	Access Gate with lock	1	each	$ 2,000.00	$ 2,000.00
				Landscaping Subtotal	***$ 183,040.00***
7	**Water Quality Basin**				
7.1	**Bio-retention Basin**				
7.1.1	HDPE Liner	18596	sqm	$ 40.00	$ 743,840.00
7.1.2	Bioretention Media - Drainage Layer (200mm)	2000	sqm	$ 60.00	$ 120,000.00
7.1.3	Bioretention Media - Transition Layer (50mm)	2000	sqm	$ 50.00	$ 100,000.00
7.1.4	Bioretention Media - Filter Layer (400mm)	2000	sqm	$ 100.00	$ 200,000.00
7.1.5	Subsoil Drainage - 100dia PVC (slotted pipe)	1025	L.m	$ 40.00	$ 41,000.00
7.1.6	Flushing points - 100dia	45	each	$ 60.00	$ 2,700.00
				Water Quality Basin Subtotal	***$ 1,207,540.00***

Basin 6

8	**Stormwater Drainage**					
8.1	**Excavate for drainage trenches in all classes of material**					
8.1.1	Excavation in OTR - Road Drainage	770	cum	$ 20.00	$ 15,400.00	
8.2	**Supply all materials, bed, lay, and joint stormwater drainage pipes**					
8.2.1	**Drainage Pipes**					
8.2.1.1	450mm dia RCP CLASS 2	207	m	$ 200.00	$ 41,400.00	
8.2.1.2	600mm dia RCP CLASS 2	25	m	$ 270.00	$ 6,750.00	
8.2.1.3	900mm dia RCP CLASS 2	67	m	$ 450.00	$ 30,150.00	
8.2.1.4	1200mm dia RCP CLASS 2	106	m	$ 570.00	$ 60,420.00	
8.2.1.5	CCTV Inspections	385	m	$ 5.00	$ 1,925.00	
8.3	**Excavate for and construct drainage structures, including backfill, covers and grates and all necessary connections:**					
8.3.1	**Up to 900x900mm Chamber and <2000mm deep**					
8.3.1.1	900 x 900 CLASS B GRATED SURFACE INLET PIT	5	each	$ 3,300.00	$ 16,500.00	
8.3.1.2	900 x 900 CLASS C JUNCTION PIT (CONCRETE INFILL)	1	each	$ 3,000.00	$ 3,000.00	
8.3.2	**900 < X or Y < 2100mm Chamber and <3000mm deep**					
8.3.2.1	900 x 900 CLASS B GRATED SURFACE INLET PIT	1	each	$ 5,300.00	$ 5,300.00	
8.3.2.2	900 x 900 CLASS C JUNCTION PIT (CONCRETE INFILL)	2	each	$ 4,940.00	$ 9,880.00	
8.3.3	**Special Pits**				$ -	
8.3.3.1	Splitter Pits	2	each	$ 15,000.00	$ 30,000.00	
8.3.4	**Structual Certification**				$ -	
8.3.4.1	Structural inspection and certification of special pits	2	item	$ 850.00	$ 1,700.00	
				Stormwater Drainage Subtotal	***$ 222,425.00***	
9	**Roadworks Ancillaries**					
9.1	**Basin Access**					
9.1.1	Bollards	3	each	$ 150.00	$ 450.00	
9.2	**Basin Signage**					
9.2.1	Basin Signage to Hill Shire Specifications	2	each	$ 500.00	$ 1,000.00	
				Roadworks Ancillaries Subtotal	***$ 1,450.00***	
10	**Maintenance**					
10.1	**Maintenance of Landscaping and Drainage**					
10.1.1	Maintenance (initial 3 months)	12	wks	$ 250.00	$ 3,000.00	
10.1.2	Maintenance (9 months)	36	wks	$ 500.00	$ 18,000.00	
				Maintenance Subtotal	***$ 21,000.00***	
				Total	**$ 4,145,761.98**	

Drainage Upgrade Basin 6

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
1	**Preliminaries**				
1.1	**Basin Preliminaries**				
1.1.1	Establishment	1	item	$ 15,000.00	$ 15,000.00
1.1.2	Traffic Management incl preparation of S. 138 certificate and gaining approval thereto	1	item	$ 30,000.00	$ 30,000.00
1.1.3	Temporary ATF Fencing	250	L.m	$ 15.00	$ 3,750.00
1.1.4	Sediment and Erosion Control	1	item	$ 3,000.00	$ 3,000.00
1.1.5	Demolish existing kerb and gutter and dispose of offsite	250	m	$ 50.00	$ 12,500.00
1.1.6	Demolition of existing asphalt pavement and dispose of offsite	225	sqm	$ 20.00	$ 4,500.00
				Preliminaries Subtotal	***$ 68,750.00***
2	**Roadworks Ancillaries**				
2.1	**Local Road (CBR 4%)**				
2.1.1	Local Rd Reinstatement	135	sqm	$ 180.00	$ 24,300.00
2.1.2	150mm Kerb and Gutter (K&G)	127	L.m	$ 160.00	$ 20,320.00
				Roadworks Ancillaries Subtotal	***$ 44,620.00***
3	**Stormwater Drainage**				
3.1	**Excavation**				
3.1.1	Excavation in OTR	504.0	cum	$ 20.00	$ 10,080.00
3.2	**Supply all materials, bed, lay, and joint stormwater drainage pipes**				
3.2.1	**Drainage Pipes**				
3.2.1.1	450mm dia RCP CLASS 2	74	m	$ 600.00	$ 44,400.00
3.2.1.2	525mm dia RCP CLASS 2	24	m	$ 690.00	$ 16,560.00
3.2.1.3	825mm dia RCP CLASS 2	64	m	$ 1,140.00	$ 72,960.00
3.2.1.4	900mm dia RCP CLASS 2	79	m	$ 1,350.00	$ 106,650.00
3.2.1.5	1050mm dia RCP CLASS 2	11	m	$ 1,530.00	$ 16,830.00
3.2.1.6	CCTV Inspections	252	m	$ 5.00	$ 1,260.00
3.3	**Excavate for and construct drainage structures, including backfill, covers and grates and all necessary connections:**				
3.3.1	**Up to 900x900mm Chamber and <2000mm deep**				
3.3.2	900 x 900 CLASS B GRATED SURFACE INLET PIT	1	each	$ 9,000.00	$ 9,000.00
3.3.3	1.8m LINTEL	3	each	$ 10,000.00	$ 30,000.00
3.3.4	**900 < X or Y < 2100mm Chamber and <3000mm deep**				
3.3.5	1.8m LINTEL	1	each	$ 10,000.00	$ 10,000.00
				Stormwater Drainage Subtotal	***$ 317,740.00***
4	**Landscaping**				
4.1	**Install Road Verge Turf and all associated works**				
4.1.1	Local Road	1,360	sqm	$ 30.00	$ 40,800.00
4.2	**Install Road Street Trees and all associated works**				
4.2.1	Local Road	16	each	$ 720.00	$ 11,520.00
				Landscaping Subtotal	***$ 52,320.00***
5	**Maintenance**				
5.1	**Maintenance of Landscaping and Drainage**				
5.1.1	Maintenance (initial 3 months)	12	wks	$ 250.00	$ 3,000.00
5.1.2	Maintenance (9 months)	36	wks	$ 500.00	$ 18,000.00
				Maintenance Subtotal	***$ 21,000.00***
				Total	**$ 504,430.00**

Basin 7

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
1	**Preliminaries**				
1.1	**Basin Preliminaries**				
1.1.1	Establishment	1	item	$ 17,000.00	$ 17,000.00
1.1.2	Temporary ATF Fencing	200	L.m	$ 15.00	$ 3,000.00
1.1.3	Sediment and Erosion Control	1	item	$ 3,000.00	$ 3,000.00
1.1.4	Weed eradication prior to site commencement	1	item	$ 4,000.00	$ 4,000.00
				Preliminaries Subtotal	***$ 27,000.00***
2	**Earthworks**				
2.1	**Bulk Earthworks**				
2.1.1	Topsoil Stripping to Stockpile	2689	sqm	$ 5.81	$ 15,623.09
2.1.2	Topsoil Stockpile to Placement	2689	sqm	$ 5.81	$ 15,623.09
2.1.3	Cut to Fill and compact	522	cum	$ 5.95	$ 3,105.90
2.1.4	Cut and remove from site	5311	cum	$ 25.00	$ 132,775.00
				Earthworks Subtotal	***$ 167,127.08***
3	**Gross Pollutant Traps**				
3.1	GPT	1	each	$ 100,000.00	$ 100,000.00
				Gross Pollutant Traps Subtotal	***$ 100,000.00***
4	**Headwalls/Riprap and Scour Protection**				
4.1	1200dia Headwall	1	each	$ 2,500.00	$ 2,500.00
4.2	Riprap Head Wall	100	sqm	$ 130.00	$ 13,000.00
				Headwalls/Riprap and Scour Protection Subtotal	***$ 15,500.00***
5	**Maintenance Access**				
5.1	**Concrete Maintenance Access Track (CBR 4%)**				
5.1.1	125mm Concrete (SL72 mesh - 40 cover) on 100mm DGB20 on 50mm Granular Bedding	400	sqm	$ 130.00	$ 52,000.00
				Maintenance Access Subtotal	***$ 52,000.00***
6	**Stormwater Drainage**				
6.1	**Excavate for drainage trenches in all classes of material**				
6.1.1	Excavation in OTR - Road Drainage	34	cum	$ 17.64	$ 599.67
6.1	**Supply all materials, bed, lay, and joint stormwater drainage pipes**				
6.1.1	**Drainage Pipes**				
6.1.1.1	750mm dia RCP CLASS 2	6	m	$ 340.00	$ 2,040.00
6.1.1.2	1200mm dia RCP CLASS 2	11	m	$ 570.00	$ 6,270.00
6.1.1.3	CCTV Inspections	17	m	$ 5.00	$ 85.00
6.2	**Excavate for and construct drainage structures, including backfill, covers and grates and all necessary connections:**				
6.2.1	**900 < X or Y < 2100mm Chamber and <3000mm deep**				
6.2.1.1	900 x 900 CLASS B GRATED SURFACE INLET PIT	1	each	$ 5,300.00	$ 5,300.00
6.2.1.2	900 x 900 CLASS C JUNCTION PIT (CONCRETE INFILL)	1	each	$ 4,940.00	$ 4,940.00
				Stormwater Drainage Subtotal	***$ 19,234.67***
7	**Retaining Walls**				
7.1	Blockwork retaining wall	41	sqm	$ 600.00	$ 24,600.00
				Retaining Walls Subtotal	***$ 24,600.00***
8	**Roadworks Ancillaries**				
8.1	**Basin Access**				
8.1.1	Bollards	3	each	$ 150.00	$ 450.00
8.2	**Basin Signage**				
8.2.1	Basin Signage to Hill Shire Specifications	2	each	$ 500.00	$ 1,000.00
				Roadworks Ancillaries Subtotal	***$ 1,450.00***
9	**Maintenance**				
9.1	**Maintenance of Landscaping and Drainage**				
9.1.1	Maintenance (initial 3 months)	12	wks	$ 250.00	$ 3,000.00
9.1.2	Maintenance (9 months)	36	wks	$ 500.00	$ 18,000.00
				Maintenance Subtotal	***$ 21,000.00***
				Total	**$ 427,911.75**

Drainage Upgrade Basin 7

Revision: 2
Completed: C.Van Antwerpen
Checked: A.Nhan

Deferred Works = D
Maintenance Works = M

Item No.	Description of Work	Quantity	Unit	Unit Cost	Cost
1	**Preliminaries**				
1.1	**Preliminaries**				
1.1.1	Establishment	1	item	$ 15,000.00	$ 15,000.00
1.1.2	Traffic Management incl preparation of S. 138 certificate and gaining approval thereto	1	item	$ 30,000.00	$ 30,000.00
1.1.3	Temporary ATF Fencing	138	L.m	$ 15.00	$ 2,070.00
1.1.4	Sediment and Erosion Control	1	item	$ 3,000.00	$ 3,000.00
1.1.5	Weed eradication prior to site commencement	1	item	$ 3,000.00	$ 3,000.00
1.1.6	Demolish existing kerb and gutter and dispose of offsite	138	m	$ 50.00	$ 6,900.00
1.1.7	Demolition of existing asphalt pavement and dispose of offsite	124	sqm	$ 20.00	$ 2,480.00
1.1.8	Demolish existing stormwater pit and dispose of offsite	1	item	$ 250.00	$ 250.00
				Preliminaries Subtotal	***$ 62,700.00***
2	**Headwalls/Riprap and Scour Protection**				
2.1	600dia Headwall	1	each	$ 320.00	$ 320.00
2.2	Riprap Head Wall	100	sqm	$ 130.00	$ 13,000.00
				Headwalls/Riprap and Scour Protection Subtotal	***$ 13,320.00***
3	**Roadworks Ancillaries**				
3.1	**Local Road (CBR 4%)**				
3.1.1	Local Rd Reinstatement	230	sqm	$ 180.00	$ 41,400.00
3.1.2	150mm Kerb and Gutter (K&G)	239	L.m	$ 160.00	$ 38,240.00
				Roadworks Ancillaries Subtotal	***$ 79,640.00***
4	**Landscaping**				
4.1	**Permanent Fencing**				
4.1.1	Fencing	140	L.m	$ 120.00	$ 16,800.00
4.1.2	Access Gate with lock	1	each	$ 2,000.00	$ 2,000.00
				Landscaping Subtotal	***$ 18,800.00***
5	**Stormwater Drainage**				
5.1	**Excavate for drainage trenches in all classes of material**				
5.1.1	Excavation in OTR - Road Drainage	278	cum	$ 20.00	$ 5,560.00
5.2	**Supply all materials, bed, lay, and joint stormwater drainage pipes**				
5.2.1	**Drainage Pipes**				
5.2.1.1	450mm dia RCP CLASS 2	25	m	$ 600.00	$ 15,000.00
5.2.1.2	525mm dia RCP CLASS 2	57	m	$ 690.00	$ 39,330.00
5.2.1.3	600mm dia RCP CLASS 2	57	m	$ 810.00	$ 46,170.00
5.2.1.4	CCTV Inspections	139	m	$ 5.00	$ 695.00
5.3	**Excavate for and construct drainage structures, including backfill, covers and grates and all necessary connections:**				
5.3.1	**Up to 900x900mm Chamber and <2000mm deep**				
5.3.1.1	1.8m LINTEL	3	each	$ 7,500.00	$ 22,500.00
5.3.2	**900 < X or Y < 2100mm Chamber and <3000mm deep**				
5.3.2.1	1.8m LINTEL	1	each	$ 10,000.00	$ 10,000.00
				Stormwater Drainage Subtotal	***$ 139,255.00***
6	**Landscaping**				
6.1	**Install Road Verge Turf and all associated works**				
6.1.1	Local Road	1,300	sqm	$ 30.00	$ 39,000.00
6.2	**Install Road Street Trees and all associated works**				
6.2.1	Local Road	8	each	$ 720.00	$ 5,760.00
				Landscaping Subtotal	***$ 44,760.00***
7	**Maintenance**				
7.1	**Maintenance of Landscaping and Drainage**				
7.1.1	Maintenance (initial 3 months)	12	wks	$ 250.00	$ 3,000.00
7.1.2	Maintenance (9 months)	36	wks	$ 500.00	$ 18,000.00
				Maintenance Subtotal	***$ 21,000.00***
				Total	**$ 379,475.00**