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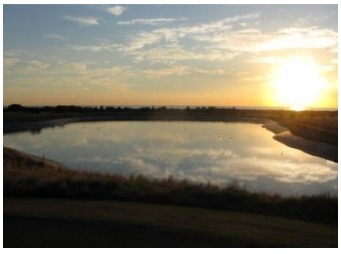

STORMWATER MANAGEMENT STRATEGY

1350 POUND ROAD, CLYDE NORTH

6 SEPTEMBER 2013

BW REF: 1200683

DOCUMENT CONTROL DATA

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		Synopsis	*Stormwater discharge strategy for the proposed residential development of 1350 Pound Road, Clyde North*

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Glossary of terms

Alphabetical list of terms and abbreviations used in report

ARI	Average Recurrence Interval - *The average, or expected, value of the periods between exceedances of a given rainfall total accumulated over a given duration.*[1]
Authorities	Organisations responsible for supply and management of sewer, water, gas, electricity and telecommunications, roads and transport
Client	Parkworth Pty Ltd
CMA	Melbourne Water
Council	City of Casey
GAA	Growth Areas Authority
WSUD	Water Sensitive Urban Design

1 STORMWATER MANAGEMENT STRATEGY

1.1 Introduction

Beveridge Williams has been commissioned by Parkworth Pty Ltd (the Developer) to prepare a Stormwater Management Strategy (SWMS) for a proposed Residential Estate located at 1350 Pound Road, Clyde North.

This SWMS is intended to provide sufficient evidence that the proposed Residential Development can meet Stormwater Best Practice Environmental Management Guidelines (BPEMG) and provide supporting evidence that the stormwater discharges from the proposed subdivision shall be to the satisfaction of Melbourne Water Corporation (MWC).

The site, 1350 Pound Road, Clyde North, is bounded by Pound Road (north-east), Thompsons Road (north), farm land to the south and west (currently proposed for further development into residential housing). There is a 150m Powerline Easement along the entire length of the southern boundary within the site. The site has a road frontage of approximately 1100m on Pound Road, and 30m on Thompsons Road. The site is irregularly shaped, and occupies an area of approximately 41.4ha. The location of the site is shown on Figure 1 below.

1.2 Site constraints

The site lies within the proposed 1053 Precinct Structure Plan area, and at the time of writing this report, the land is designated for future residential development (Zoned UGZ – Urban Growth Zone).

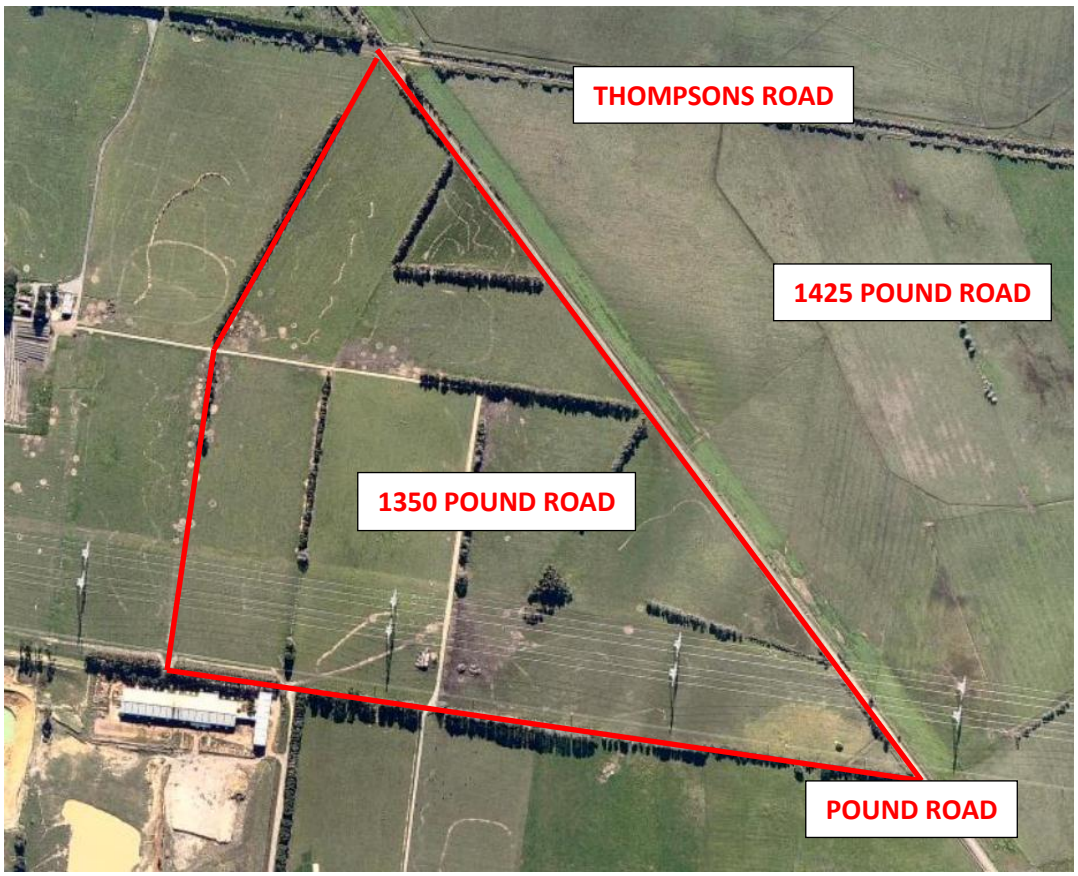

Figure 1: Aerial Location Plan
Source: NearMap
Not to scale

It is proposed to subdivide the land to form approximately 376 standard and medium density residential lots.

The land currently contains some farm sheds that are located towards the south of the. An Electricity Transmission Easement approx. 150m wide and associated power lines traverse the site from east to

west at the southern end of the site. The land is almost entirely cleared of large trees, although there are a few rows of trees on the property. The desalination pipeline runs along the north-east side of Pound Road within a pipeline easement 20m wide.

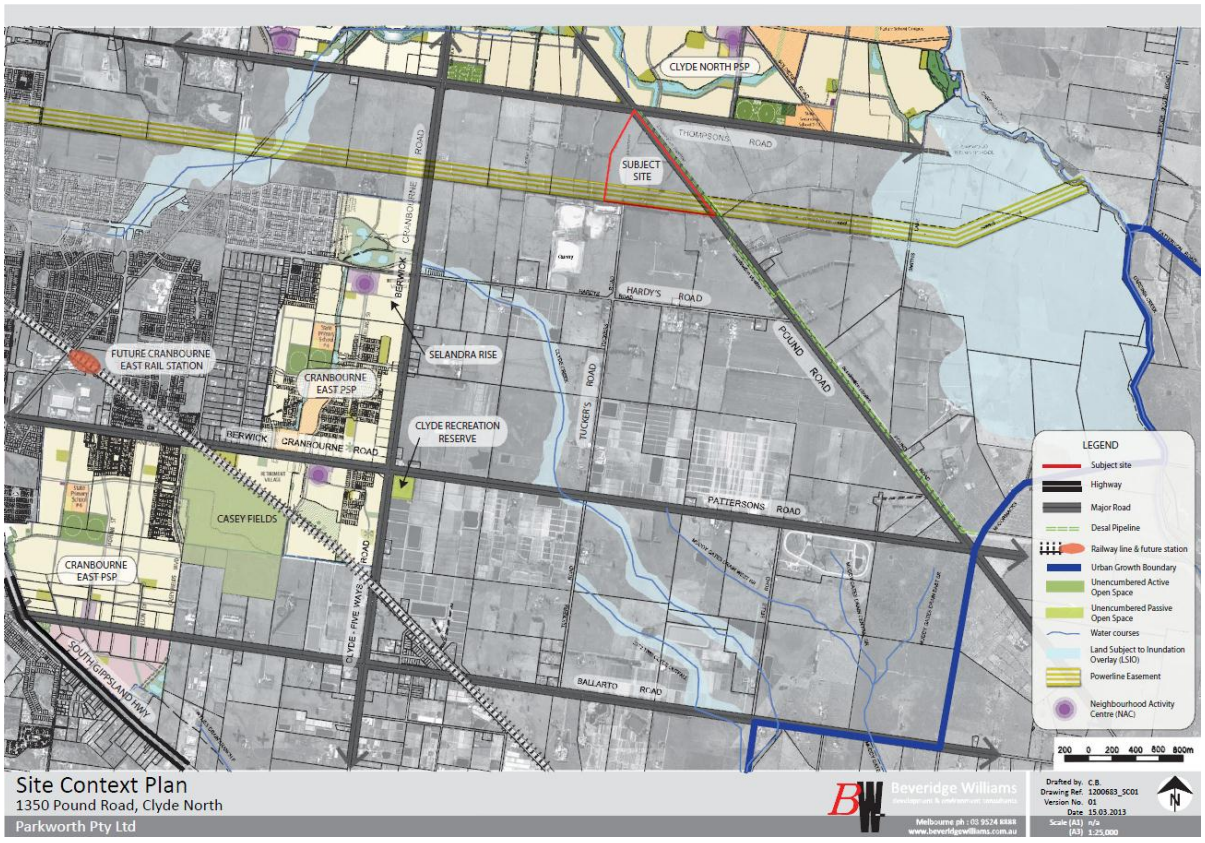

Figure 2: Site Context
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1.3 Design Intent

It is proposed to base the Site Stormwater Management Strategy on the Regional Stormwater Management Strategy (SWMS) prepared by Neil Craigie for the Casey Growth Areas known as PSP 1053 and PSP 1054 – refer to Appendix A.

The strategy being prepared by Neil Craigie proposes a Sediment Basin/Retarding Basin (SBRB) located in the north of the site discharging to the neighbouring property to the East (1425 Pound Road). Within the Neil Craigie SWMS there is a WLRB proposed in the neighbouring site, which also caters for the nutrient treatment for the subject site.

It will be a requirement for the development to provide stormwater quality mitigation measures for the overall site, as well as provide retardation back to pre-developed flow rates.

The location of treatments has been chosen to best suit the existing topography and to minimise loss of developable land.

This SBRB is proposed to maintain peak discharges to existing rural conditions in the 100 year ARI event and also remove any sediment.

The plan over the page (Figure 3) identifies the proposed SB within the site and the WLRBs in the neighbouring site as indicated in Neil Craigie's report.

Figure 3: Sediment Basins & Wetland/Retarding Basins for western catchment
Source: Neil M Craigie Pty Ltd (Report)
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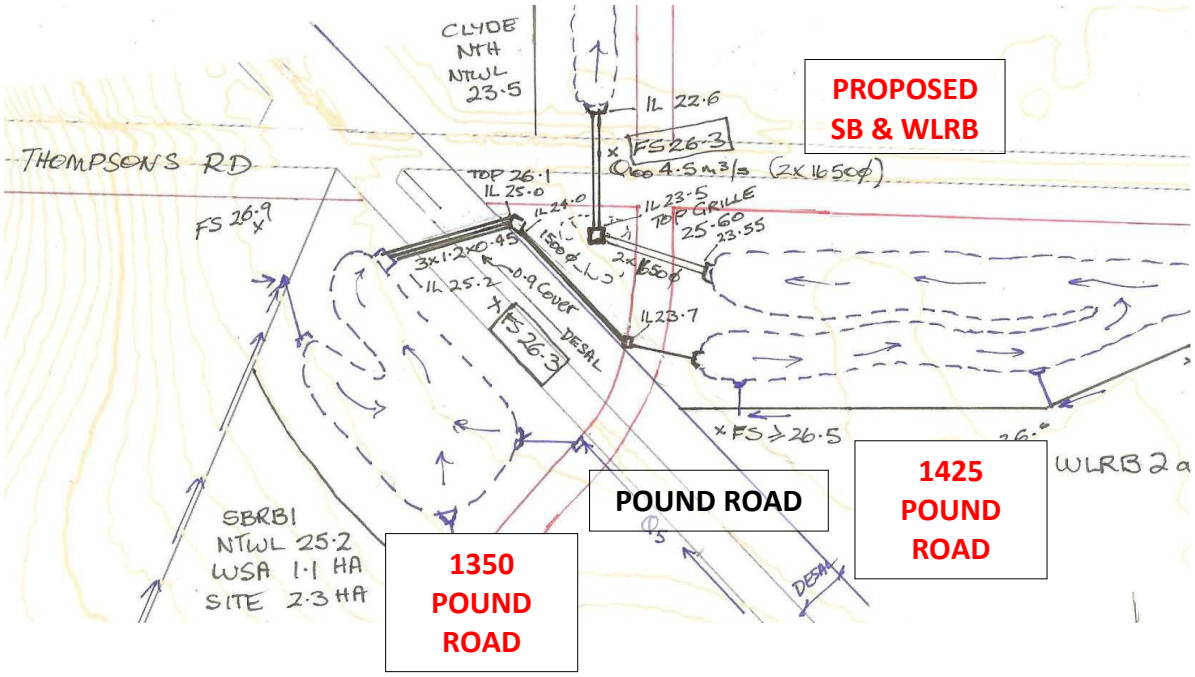

It is a requirement of the City of Casey Planning Scheme that both the Quantity and Quality of stormwater runoff from the proposed development meet the Urban Stormwater Best Practice Environmental Management Guidelines (BPEMG) and these objectives will be met as per the Neil Craigie SWMS and by the developer in providing the required water quantity and sediment removal facilities within the site, while nutrient treatment will be undertaken on the neighbouring property to the east (1425 Pound Road, Clyde North).

Melbourne Water has declared this area to be a drainage scheme (interim) - Ti-Tree Creek Drainage Scheme 0619.

1.4 Catchment Plan

The site of 41.4ha is within the PSP 1053. It has two sub-catchments, the western area discharges to the proposed SBRB located at the northern end of the site; see Figure 4 & 5 over the page on the Catchment Plan, which then flows under Thompsons Road via 1425 Pound Road. The second catchment to the east discharges into the neighbouring property, 1425 Pound Road, which will also flow under Thompsons Road to the north. It may be feasible for this second catchment to also discharge to the proposed SBRB; however, this will be subject to detailed design. Preliminary catchment areas were shown in the report prepared by Neil M Craigie Pty Ltd dated 3 November 2012 (Draft) which are shown overleaf in Figure 4. Figure 5 is also shown in Appendix B.

Figure 4: Site Catchment Areas
Source: Neil M Craigie Pty Ltd (Report)
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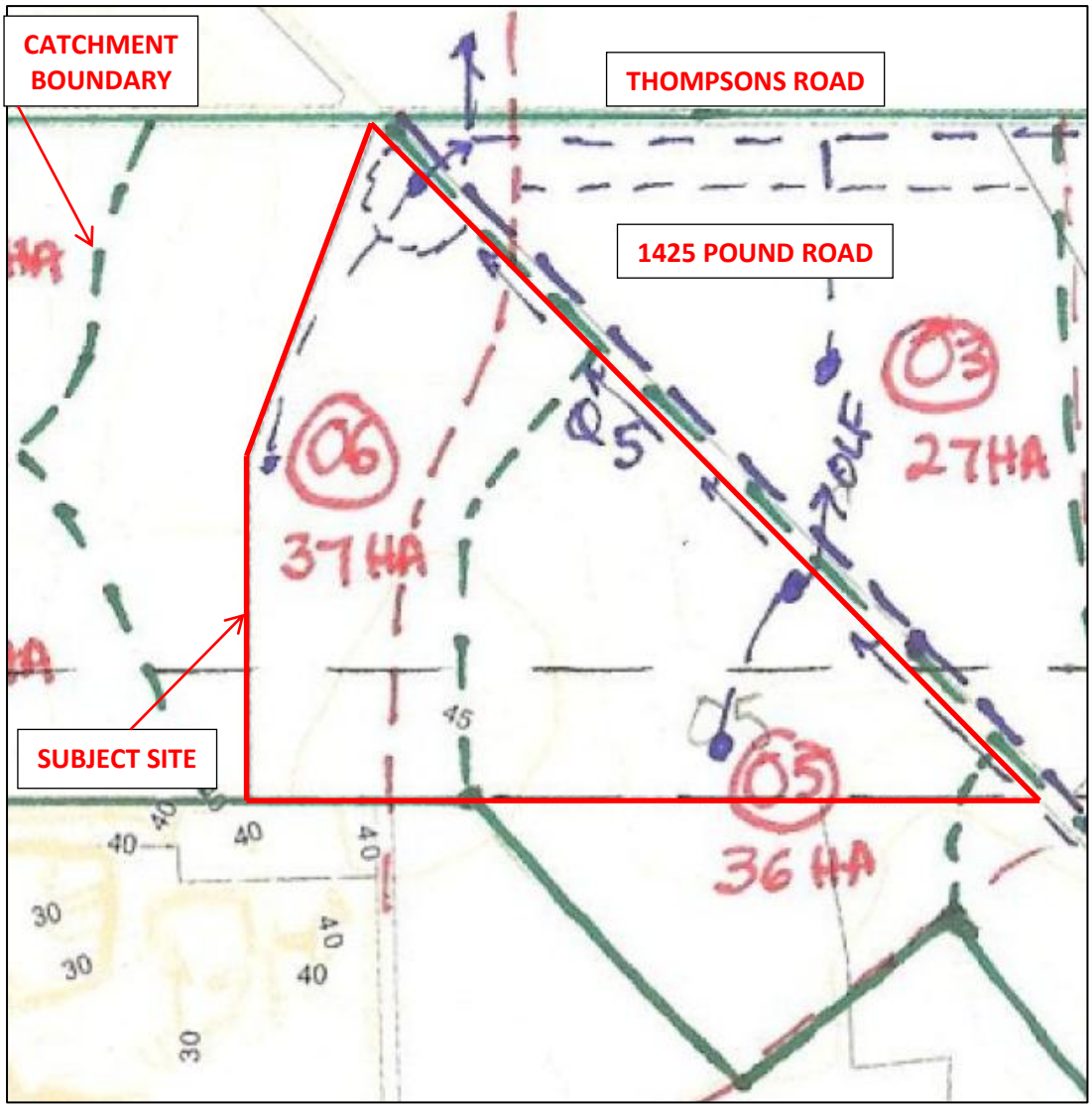

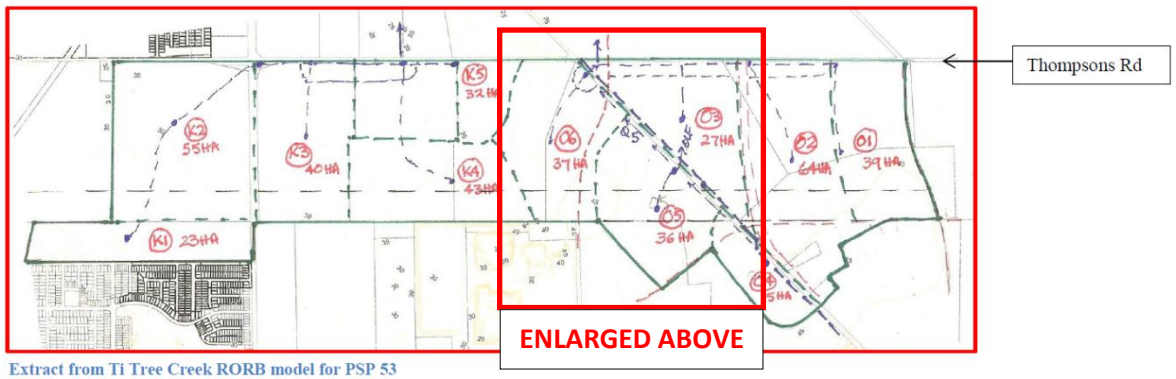

Extract from Ti Tree Creek RORB model for PSP 53

Figure 5: Drainage Catchment Areas
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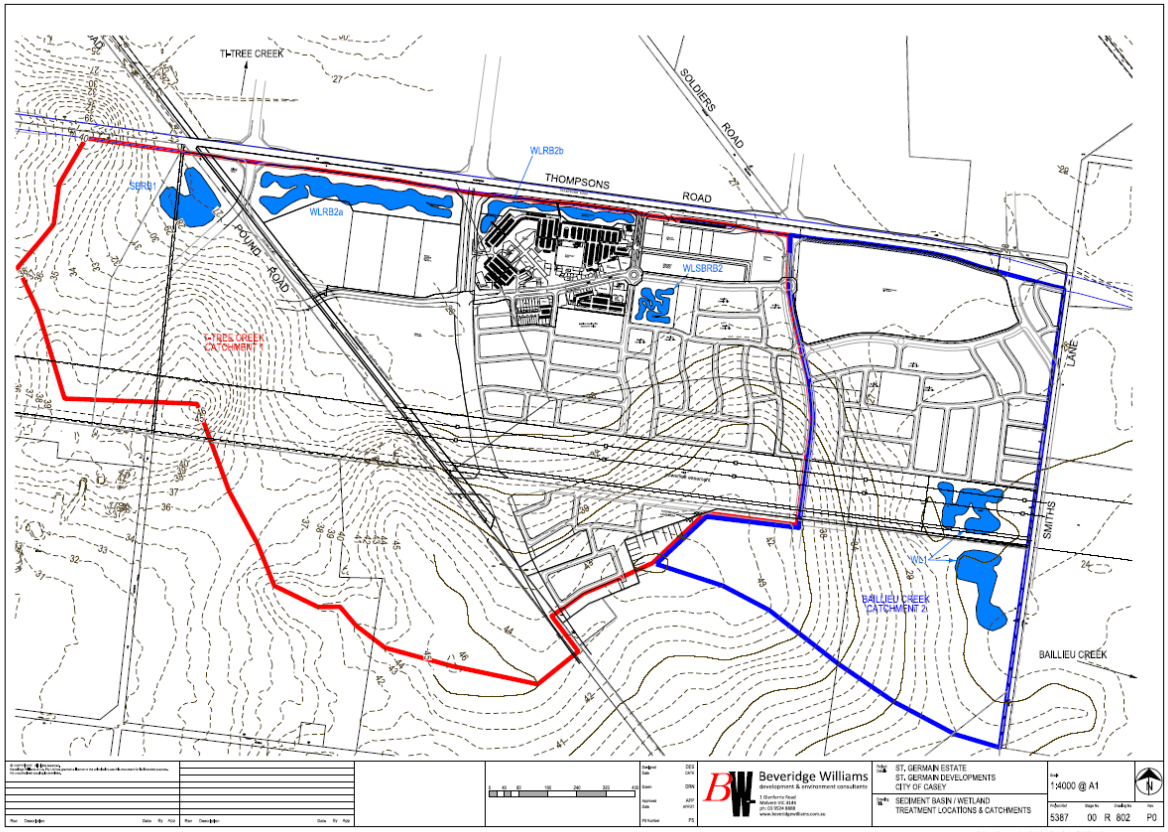

2 EXISTING CONDITIONS

2.1 Topography

The site has a high point towards the south and generally falls in a northerly direction towards Thompsons Road and Pound Road. The western side generally slopes more from the south to the north of the site towards Thompsons Road, and the eastern end slopes more to the north east towards Pound Road. The high point on the site is located in the south within the electricity transmission easement (approximately 46m AHD). The low point is approximately where Thompsons Road meets Pound Road at approximately 26.5m AHD.

The Indicative Development Plan shows contours and is shown in Figure 6 overleaf and in Appendix C.

2.2 Surface Water and Drainage

The closest surface water feature for the site is Ti-Tree Creek to the north of the site, located about 1.2km away. Currently, surface water runoff discharges from the site through private property at 1275 Pound Road. In the event of storms, water sheet flows across the paddocks in a north-west direction through 1275 Pound Road and to the wetland built at Berwick Waters Estate near Grices Road.

There is some external catchment entering the site from the west and from the south as is shown in the catchment plans – see figures 4 & 5.

2.3 Development Proposal

The site is proposed to be developed as standard and medium density residential with a drainage reserve to the north 2.3ha, a 1.1ha reserve to the north and a 0.61ha (0.34ha within the site) reserve to the east. An electrical transmission easement 150m wide traverses the site from east to west along the southern boundary.

The proposed subdivision as shown in the Indicative Development Plan (Figure 6 overleaf – also in Appendix C) is to form 376 conventional density and medium density residential lots, with an average lot size of 429m².

There are requirements within the Proposed 1053 PSP for part of Pound Road to be converted to a Connector Street and part of it to be closed. A Connector Street is also proposed to traverse the western boundary from the southern corner heading north to approximately half way along the site, where it will connect to another Connector Street running east-west from the western boundary to Pound Road.

A Melbourne Water drainage reserve has been set aside along Pound Road where it intersects Thompsons Road, with a total area of 2.34ha to develop the proposed Sediment Basin / Retarding Basin.

The internal road layout provides a series of roads designed in accordance with their function. The cross sections are of sufficient width to facilitate the provision of on street parking, pedestrian paths, bicycle paths and public transport. The street network ensures safe movement and ease of access both internally and with surrounding uses.

Figure 6: Indicative Development Plan
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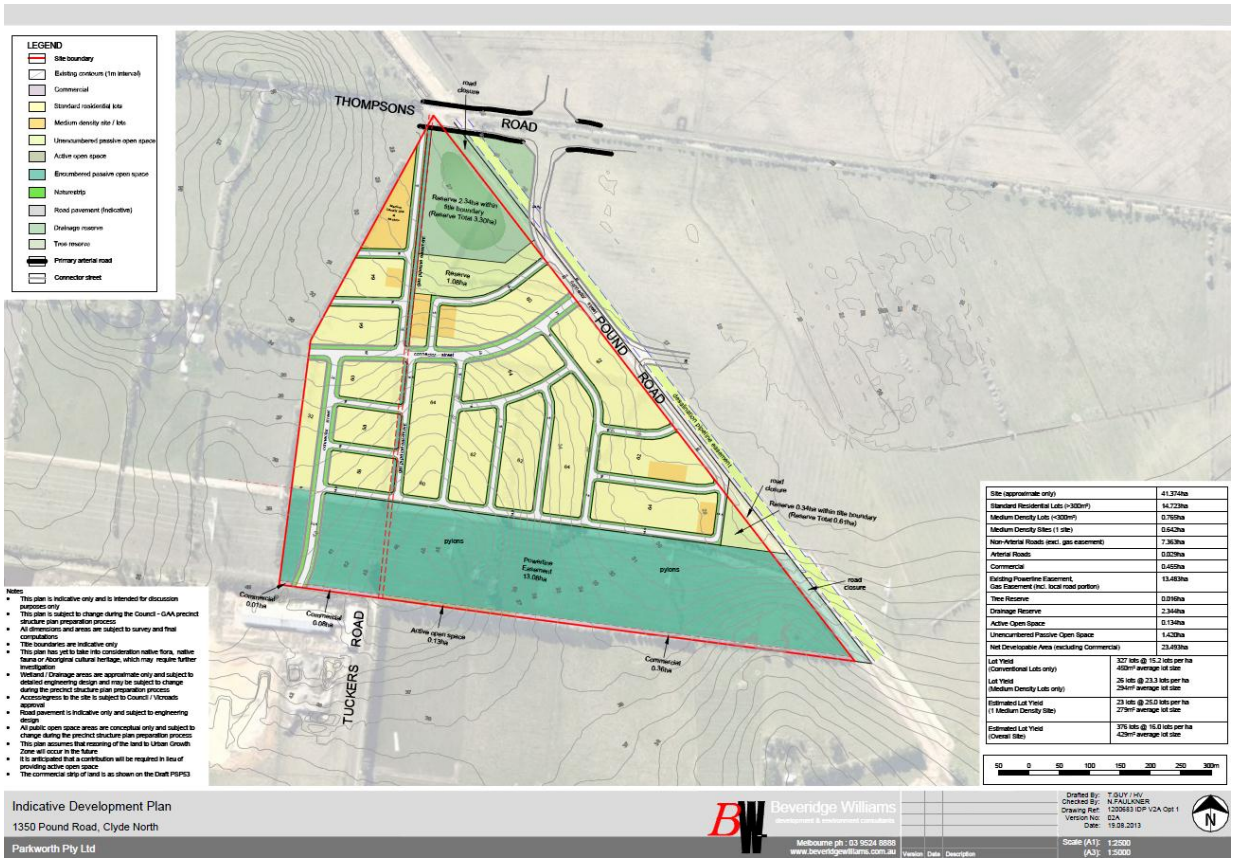

The indicative development plan shows that the site development will comprise the following:

16.13 ha allocated to Residential Allotments;
0.03 ha to Arterial Roads;
7.36 ha to Non Arterial Roads;
0.46 ha to Commercial;
13.48 ha to Powerline Easement;
2.34 ha to Drainage Reserves;
0.02 ha to Tree Reserve;
0.13 ha to Active Open Space;
1.42 ha of Unencumbered Passive Open Space.

23.49 ha Net Developable Area.
41.37 ha Total Area.

The Indicative Development Plan is provided in Appendix C.

3 HYDROLOGY

3.1 Catchment Assessment

There is currently a report being carried out for the 1054 and 1053 PSP area by Neil M Craigie Pty Ltd, for the GAA and City of Casey. Although the report has not been finalised or adopted the draft report has been used as the basis for the preparation of stormwater infrastructure layouts, locations and sizing throughout the 1053 PSP.

For the catchment assessment relating to 1350 Pound Road, Clyde North, we refer to the draft report prepared by Neil M Craigie Pty Ltd for the 1053 PSP.

A copy of the draft report prepared by "Neil M Craigie Pty Ltd, Casey Growth Area – Thompsons Road PSP 53 and Clyde Creek PSP 54 Stormwater Management Strategy (SWMS) DRAFT version 2, dated 3 November 2012" and prepared for GAA and City of Casey, is attached as Appendix A.

This report proposes a Sediment Basin/Retarding Basin (SBRB) be constructed in the northern corner of the site, within the 2.34ha Drainage Reserve. The SBRB will also service some land to the west of the subject site.

The Peak flow estimates for Existing Conditions were provided in Table 2 of the Neil Craigie report and are shown below:

Table 1: (Taken from Neil M Craigie Report) "TABLE 2: Peak Discharges for 100 years ARI (m^3/s) (Critical durations in parentheses)"

Location	Peak 100 Year ARI discharge
Thompsons Road (east outfall)	6.1 (9 hr)

Water Surface Area and Site area, taken from Neil Craigie's report, were calculated based on a MUSIC model. Normal Top Water Levels (NTWL) were selected from LIDAR data having regard to various constraints such as planning layout, protection of habitat areas, likely pipe gradings and sizes, and desirable open waterway grades. They are summarised below:

Table 2: (Taken from Neil M Craigie Report) "TABLE 4: Proposed Main SWMS Assets in the CGA"

Waterway / Location	Water Surface Area (ha)	NTWL (m)	Approximate Site Area (ha)
Ti Tree Creek at Thompsons Road SBRB1 (external to subject site)	1.85	25.00	3.30
Ti Tree Creek at Thompsons Road WLRB2 (incl SBRB2)	2.80	23.50	5.00

The Neil Craigie report includes the RORB hydrologic model developed for the 1053 PSP. The results of RORB modeling for the 1, 10 and 100 year ARI events were shown in Table 5 of the report, an extract is shown below for this site:

Table 3: (Taken from Neil M Craigie Report) "TABLE 5: RORB Model Results for fully developed conditions Waterway and storage layout as shown on Figure 4 (Critical Durations in parentheses)"

ARI (years)	Asset	Peak Inflow (m^3/s)	Peak Outflow (m^3/s)	Water Level (m)	Storage Volume (m^3)
1	Ti Tree Creek SBRB1 (desal Crossing)	3.4 (2)	1.2 (9)	25.66	5,280
10	Ti Tree Creek SBRB1	7.2 (2)	2.1 (9)	25.93	9,100
100	Ti Tree Creek SBRB1	11.4 (15)	3.9 (2)	26.28	14,200
1	Ti Tree Creek WLRB2 (Thompsons Road)	6.4 (2)	1.2 (48)	24.72	39,300
10	Ti Tree Creek WLRB2	12.5 (2)	2.3 (12)	25.11	56,900
100	Ti Tree Creek WLRB2	23.9 (15)	4.7 (12)	25.66	83,200

Note: WLRB2 is located on the neighbouring property 1425 Pound Road.

- The Peak flows for the 100 Year ARI are significantly reduced compared with pre-developed conditions, 6.1 m^3/s down to 4.7 m^3/s;
- Storage volumes can be retained within the drainage reserve area;
- Based on Existing surface levels for the site, freeboard above the 100 year flood level can be achieved.

The proposed SBRB on site and the WLRB located on the neighbouring property will therefore provide all required retardation for the designated catchment including 1350 Pound Road, Clyde North, and no additional detention capacity will be required within the western part of the development.

The internal catchments and proposed fraction impervious adopted will be as per the Neil Craigie Report.

4 STORMWATER MANAGEMENT AND TREATMENT

The subject site is located within the 1053 PSP. It will be necessary for the development to provide stormwater quality mitigation measures within the overall site, as well as provide infrastructure with capacity up to a 1 in 100 year ARI within and through the site.

It is a Victorian Government requirement that both the Quantity and Quality of stormwater runoff from the proposed development meet the Urban Stormwater Best Practice Environmental Management Guidelines (BPEMG). These objectives will be met in accordance with the Neil M Craigie Pty Ltd report.

4.1 Sub-surface Drainage

There are two catchments for the site however, both will be directed to the WLRB on the neighbouring development and from there will discharge to the Ti Tree Creek wetlands near Grices Road using a temporary pipe system to convey flows through private property at 1275 Pound Road. For storm events up to the 100 year ARI, storage will be required on-site within the constructed sediment basin / retarding basin. As the free flowing outlet pipe will have limited capacity of 0.6m³/s, temporary storage for excess volumes will also be stored within the proposed SBRB and on the neighbouring site at 1425 Pound Road, until the downstream wetland/waterway is constructed within the property at 1275 Pound Road.

It is anticipated that the temporary outfall will be constructed by the development at 1425 Pound Road as they will be developing in advance of the subject site.

The subsurface drainage network for the development will convey all pipe flows to the above mentioned waterways, via the water quality treatment facilities located in the drainage reserves on the two sites, which will enable the treatment of flows.

The Pipe network will be adequately sized to convey the 5 year flows through the network for Residential development. Easement drainage will convey lot drainage only (i.e. no road runoff).

The SBRB works proposed in the Neil Craigie report are located wholly within the site, although there will be a WLRB located in the neighbouring development on the eastern side of Pound Road in the neighbouring site, which will provide detention for the eastern catchment of the site and provide treatment for the entire development. Effectively this means that 1350 Pound Road is reliant upon 1425 Pound Road constructing their WLRB works to enable water quality and quantity requirements to be fully met. As it is likely that 1425 Pound Road will proceed ahead of the subject site, this is not anticipated to be an issue. It may also be a requirement to reach an agreement to construct the relevant parts of the neighbouring wetland to enable treatment to occur, as the neighbour may not fully develop their wetlands initially due to cost implications.

Clyde North PSP (excerpt shown over the page in Figure 7 & 8) shows that a waterway / wetland system is to be constructed through 1275 Pound Road from the inlet point at Thompsons Road (the outlet point for 1425 Pound Road – neighbouring site) to the constructed Wetland on the north side of the proposed Connector Road as shown at the top left hand corner of Figure 7. As this property is not being developed at this time, and an open drainage system would constrain the development of the land, the alternative is to provide a temporary subsurface pipe system along the Pound Road frontage. As the western catchment area ultimately requires a fully developed discharge limited to 1.2 m³/s in the one-year ARI event, a 900mm dia pipe can cater for flows of 0.6 m³/s. Once onsite storage detention is exceeded by the development discharge, further downstream works will have to be carried out which could include the construction of the proposed waterway/wetland within the 1275 Pound Road property. It is anticipated that the temporary pipe works will be undertaken by the developer of 1425 Pound Road as they require it in order to provide a free draining outlet from their site and they are expected to progress their works earlier than the developer of the subject site.

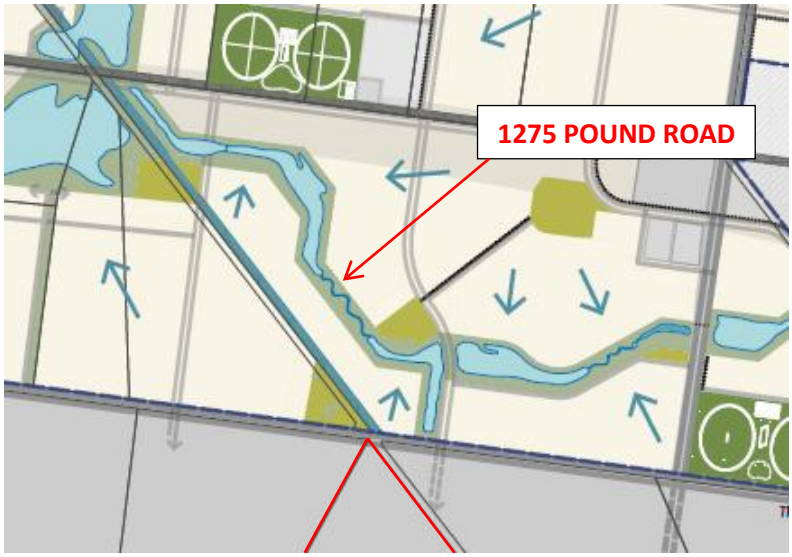

Figure 7: Excerpt from Clyde North PSP
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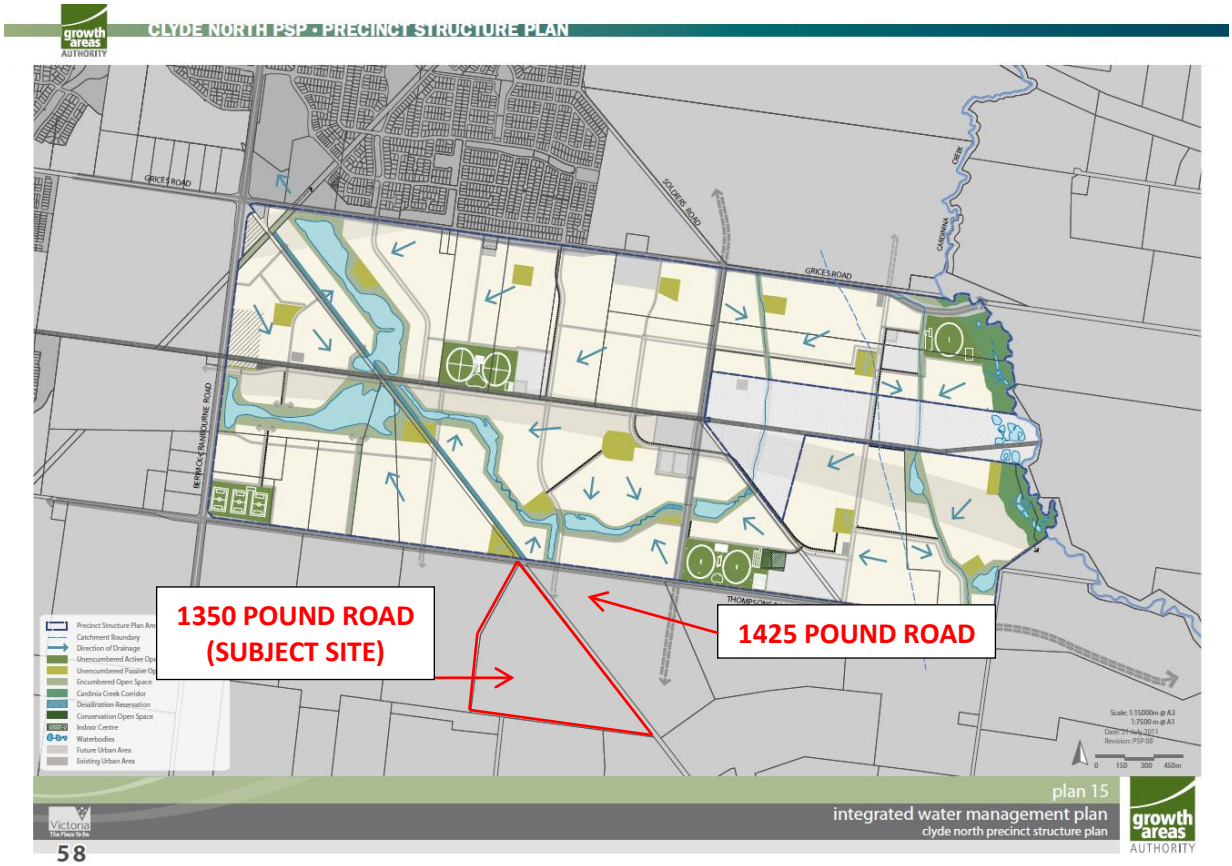

Figure 8: Clyde North PSP
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4.2 Subject Site Overland Flow

Overland flows from the site will be directed via the road network as shown in figure 9; a full size plan is located in Appendix D.

Figure 9: Overland Flowpaths
Not to scale

Figure 10 overleaf shows the preliminary arrangement of the sediment basin / retarding basin area and connecting pipe to the neighbouring wetland taken from Neil Craigie's report.

Total Water Surface area of the proposed sediment basin / retarding basin is 1.1 ha in Neil Craigie's report. The required storage volume in the SBRB is 14,200 m³. No additional detention capacity is required within this part of the development. It should be noted that these volumes apply to the situation where the downstream waterway is constructed. Further detention volumes may be required depending upon development rates of the site.

Figure 10 Indicative Sediment Basin / Retarding Basin
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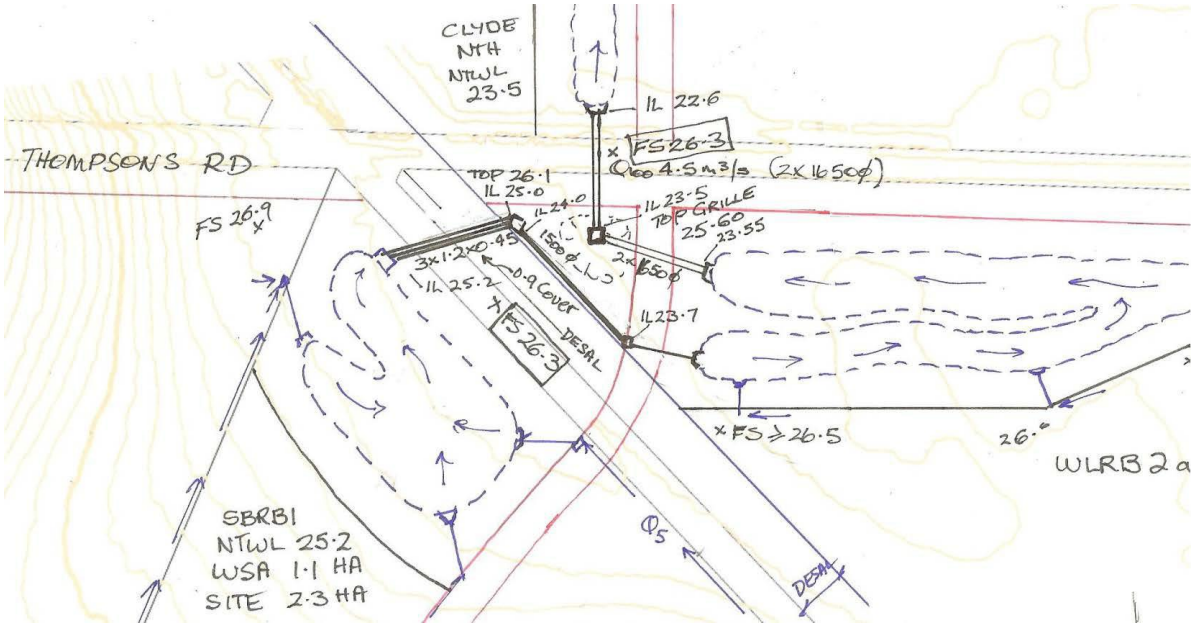


The internal roads for 1350 Pound Road, and associated lot finished surface levels, will be designed to ensure that the 1 in 100 year ARI overland flows through the site are within the safe hydraulic capacity of road floodways. Overland flows from external catchments will be directed though the subject site.

Design of the sediment basin / retarding basin within the subject site will be in accordance with the Neil Craigie Report and the Melbourne Water constructed waterways guidelines, which are on their web site at :
http://ldm.melbournewater.com.au/content/drainage_design_and_construction_guidelines_and_requirements/constructed_waterways_in_urban_developments_guidelines.asp

4.3 Detention and treatment

It is expected that Melbourne Water will require all developments to provide as a minimum best-practice water quality treatment via 'at source' methods.

This means that it will be necessary for the development to provide stormwater quality mitigation measures, as well as provide a 1 in 100 year ARI detention for the site.

The WSUD options to be utilised for this development will include a Sediment Basin / Retarding Basin incorporated with the proposed neighbouring Wetland / Retarding Basins. These, in combination will provide the required stormwater treatment for both quality and quantity.

The SBRB will be located in the northern corner of the site where Pound Road meets Thompsons Road. Within Neil Craigie's draft report and the draft PSP the SBRB is wholly within 1350 Pound Road while there are WLRB's within 1425 Pound Road and is subject to the drainage strategy for that site. All flows from the subject site will be treated for water quality within 1425 Pound Road. The designs will be in accordance with the specific technical details contained in the design and construction WSUD Technical Manual .

A MUSIC model of the overall catchment (including other treatments) has been prepared in Neil Craigie's report (Figure 9 of the Neil Craigie report). The summary of this model is shown below in Table 4. A summary of the MUSIC model results for Individual Assets is shown in Table 5. A total of 4.65ha of Water Surface area for the Ti-Tree catchment is required, of which 1.1 ha for the SBRB1 is

located within the property at 1350 Pound Road. The Normal Top Water Level (NTWL) will be 25.2m and the 100 Year flood level is 26.28m for SBRB1, 23.7m and 25.66m respectively for WLRB2a & b.

Table 4: (Taken from Neil M Craigie Report "TABLE 7: MUSIC Model Results for the whole system performance.)

Location / Asset / Parameter **SBRB1**	Catchment Source Loads	Residual Loads	% Load Removal in System to Asset Outlet
Flow (ML/yr)	485	477	2
Suspended Solids (Kg/yr)	96,800	18,600	81
Total Phosphorus (Kg/yr)	199	80	60
Total Nitrogen (Kg/yr)	1,380	928	33
Gross Pollutants (Kg/yr)	17,000	0	100
WLRB2 (includes SBRB1 and SBRB2) (Neighbouring Site)			
Flow (ML/yr)	1,230	1,180	4
Suspended Solids (Kg/yr)	248,000	38,300	85
Total Phosphorus (Kg/yr)	506	146	71
Total Nitrogen (Kg/yr)	3,480	1,900	46
Gross Pollutants (Kg/yr)	43,400	0	100

Table 5: (Taken from Neil M Craigie Report) "TABLE 8: MUSIC Model Results for Individual Assets.

Location / Asset / Parameter WLRB2 (includes SBRB2)	**Input Loads**	**Residual Loads**	**Load Removal in Asset**
Flow (ML/yr)	1,220	1,180	40
Suspended Solids (Kg/yr)	166,000	38,300	127,700
Total Phosphorus (Kg/yr)	382	146	236
Total Nitrogen (Kg/yr)	3,080	1,900	1,180
Gross Pollutants (Kg/yr)	26,400	0	26,400

The detailed design of the Sediment Basin / Retarding Basin has not yet been completed, but this will be submitted to Melbourne Water during the detailed design phase.

5 STAGING AND SEQUENCING

There is only provision for retardation and the removal of sediments within the subject site and therefore there is a reliance on 1425 Pound Road to construct the proposed Wetland on their site to enable treatment of nutrients as well as constructing the temporary outfall drain.

It is anticipated that the neighbouring site will commence ahead of the subject site, however, should there be a delay in the construction of the full development of the site or should they initially only provide a portion of the overall proposed wetland, the developer for 1350 Pound Road will need to either provide temporary treatment of nutrients on site or arrange an agreement between the two developers to construct part of the neighbouring Wetland on 1425 Pound Road (see staged concept below – Figure 11 and Appendix E). The latter option would be a better alternative as it would be able to be permanent works that will be reimbursable by Melbourne Water under the Ti-Tree Creek Drainage Scheme. Permission will be required from the property owner to construct the Wetland.

As 1425 Pound Road are likely to commence ahead of the subject site they will be required to create a free flowing outlet. In the interim they have proposed, a 900mm dia pipe culvert to be installed along the frontage of 1275 Pound Road and into the existing Wetlands constructed as part of the Berwick Waters development 1.2 km to the north-west. This pipe will carry approx. half the ultimate developed flows for Ti-Tree Creek catchment south of Thompsons Road for the 1 year storm event. In the event that the waterway is delayed downstream, the excess detention required on-site for up to the 100 year ARI event will be increased to compensate.

By constructing the Sediment Basin / Retarding Basin on site and coming to an agreement with the developer at 1425 Pound Road, development of the site will be able to commence, however, there will become a limit to the extent of works that can be completed if downstream works are not yet completed.

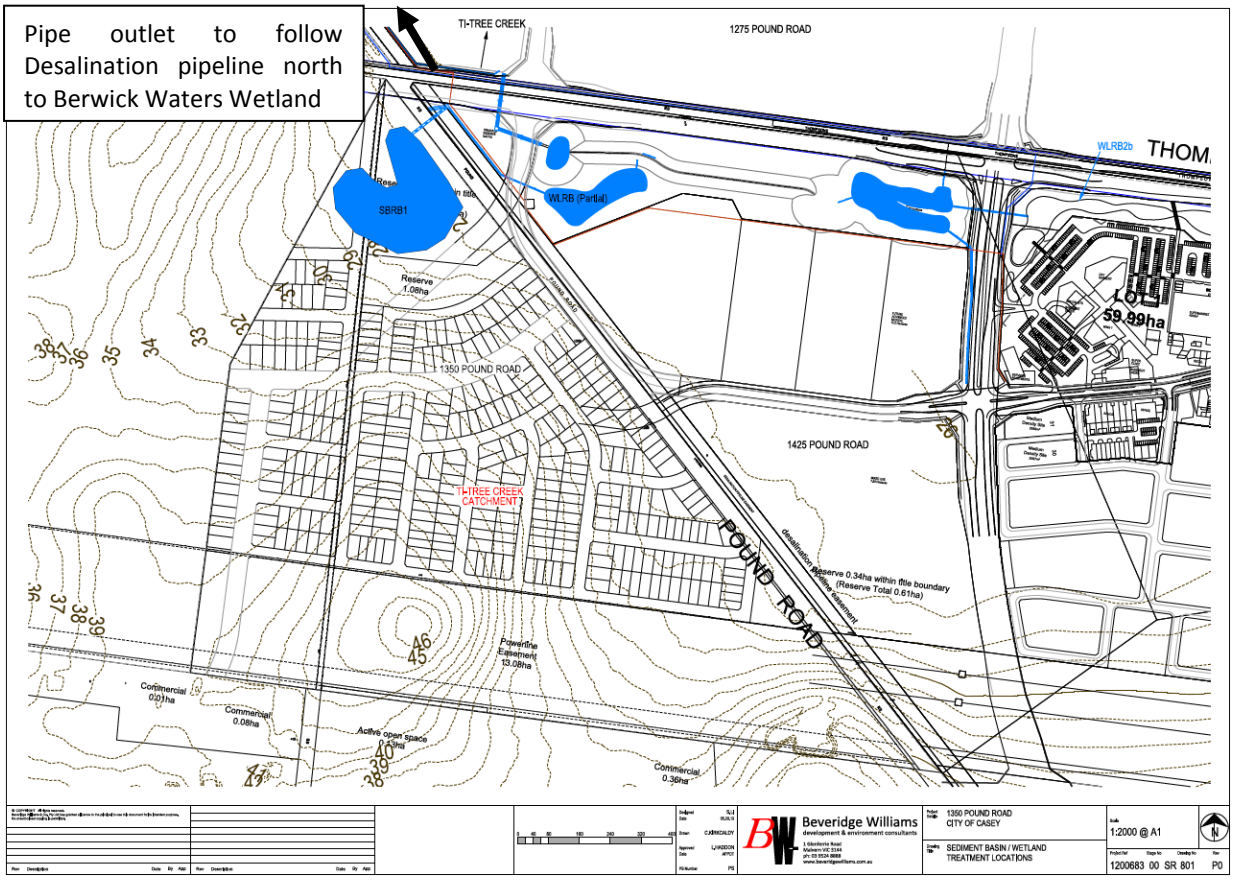


Figure 11: Sediment Basin on site and External Wetland Concept Layout.

6 CONCLUSION

This report has identified a drainage management strategy for the proposed residential development located at 1350 Pound Road, Clyde North, based on the SWMS prepared by Neil M Craigie.

The strategy provides a methodology for the management of stormwater on the subject site which would result in:

- Conveyance of external catchment flows through the site in accordance with the Melbourne Water Land Development Manual Safe Floodway Criteria;
- Construction of drainage to meet the likely requirements of Melbourne Water and Council, including a 1 in 100 year ARI capacity overland flow paths and underground drainage for 1 in 5 year ARI storm event for the Residential areas as needed;
- Construction of Wetlands / Retarding Basins to meet the retardation and water quality treatment requirements.

The above strategy can be implemented and all of Melbourne Water and Council's development requirements can be achieved, in accordance with the Proposed Draft Precinct Structure Plan and with no net effect on the downstream properties.

7 REFERENCES

Neil M Craigie Pty Ltd (2012) *Casey Growth Area, Thompsons Road PSP 53 and Clyde Creek PSP 54, Stormwater Management Strategy (SWMS). Draft Version 2, 3rd November 2012*.

http://ldm.melbournewater.com.au/content/drainage_design_and_construction_guidelines_and_requirements/constructed_waterways_in_urban_developments_guidelines.asp

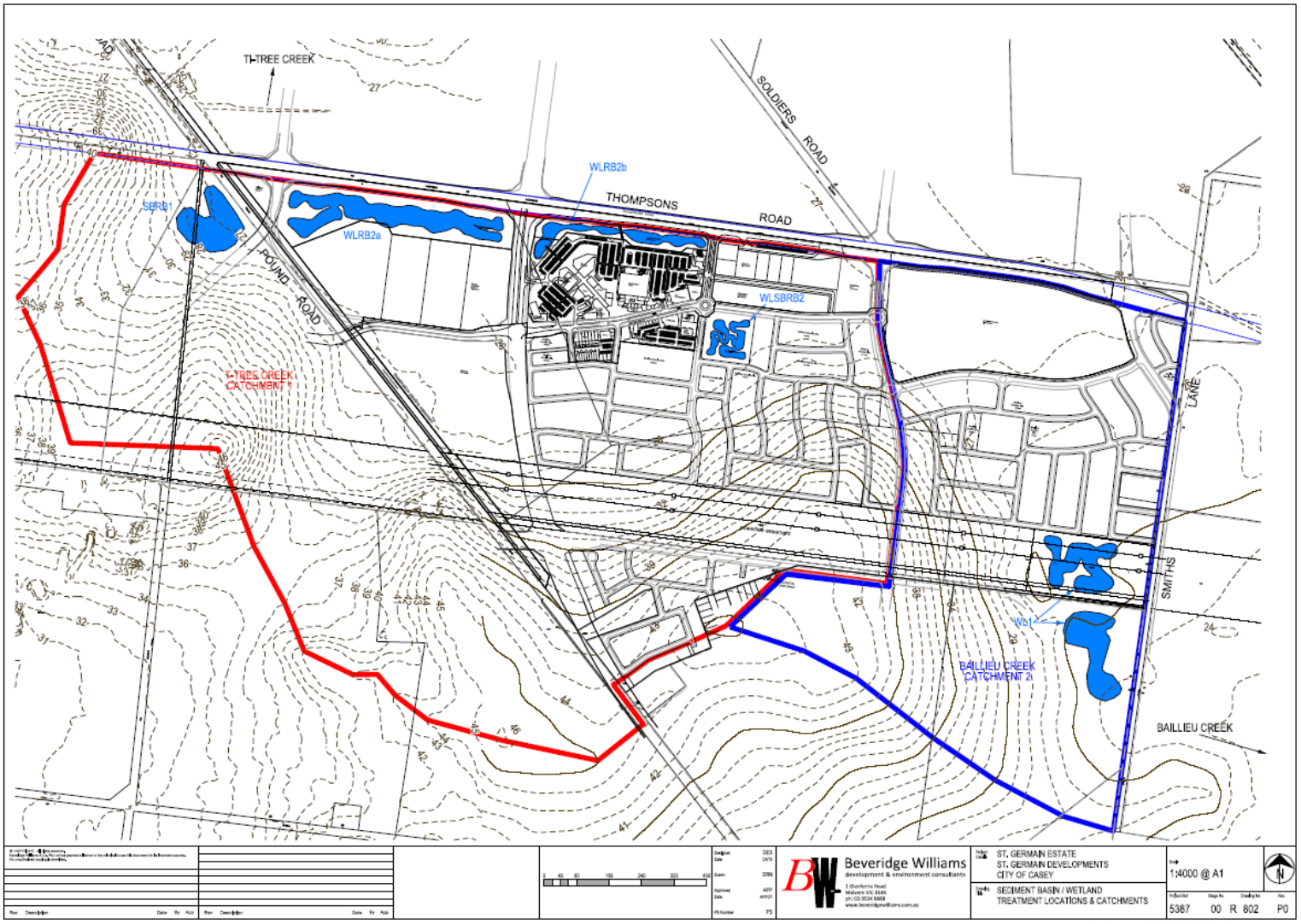
BEVERIDGE WILLIAMS & CO PTY LTD

Prepared by	Approved for issue by
Luke Haddon	Adam Davis
Senior Engineer	Project Manager

APPENDIX A.
Neil M Craigie Pty Ltd (2012) Report.

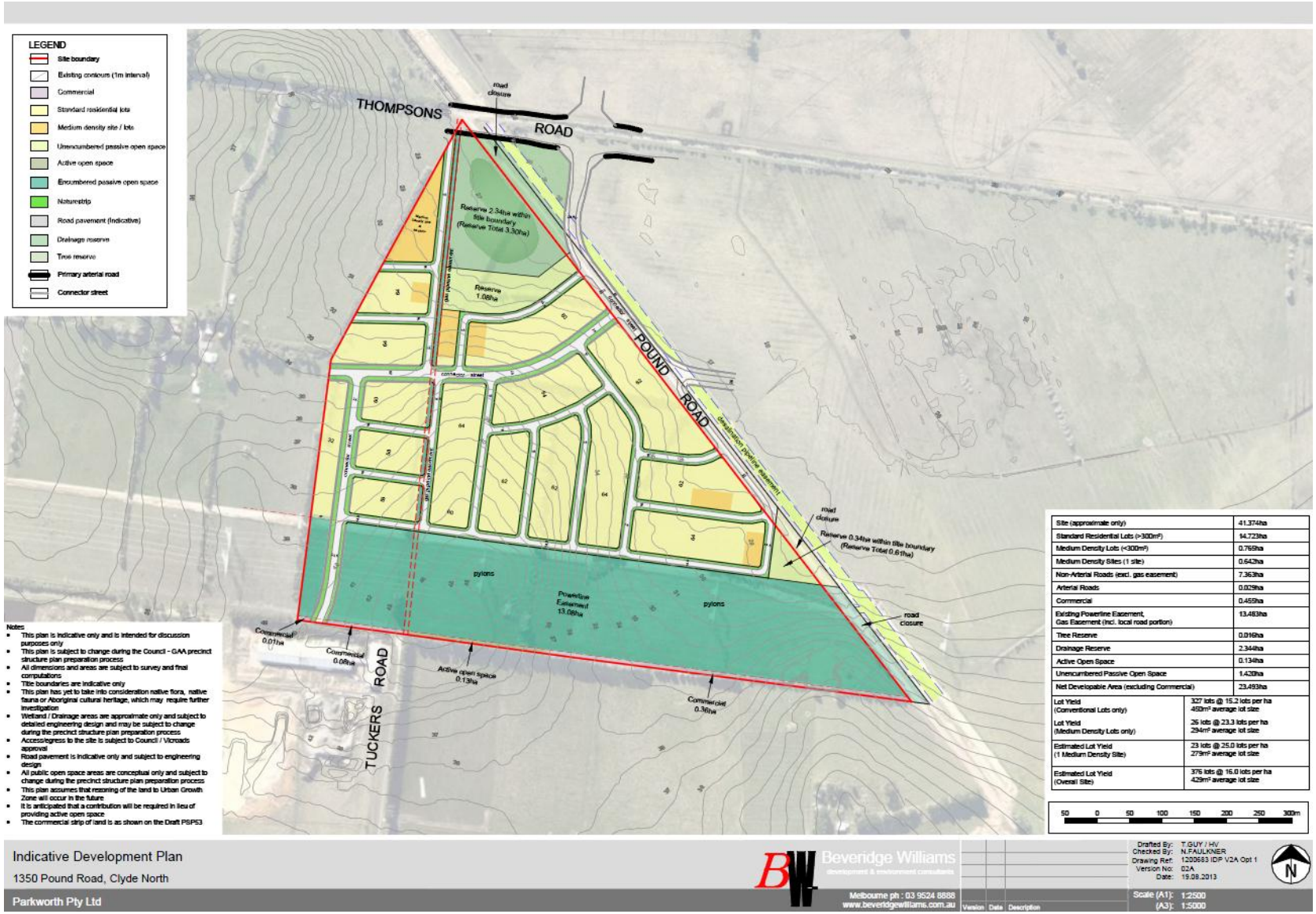
APPENDIX B.
Drainage Catchment Areas

PROPOSED WETLAND RETARDING BASIN LAYOUT



APPENDIX C.
Indicative Development Plan

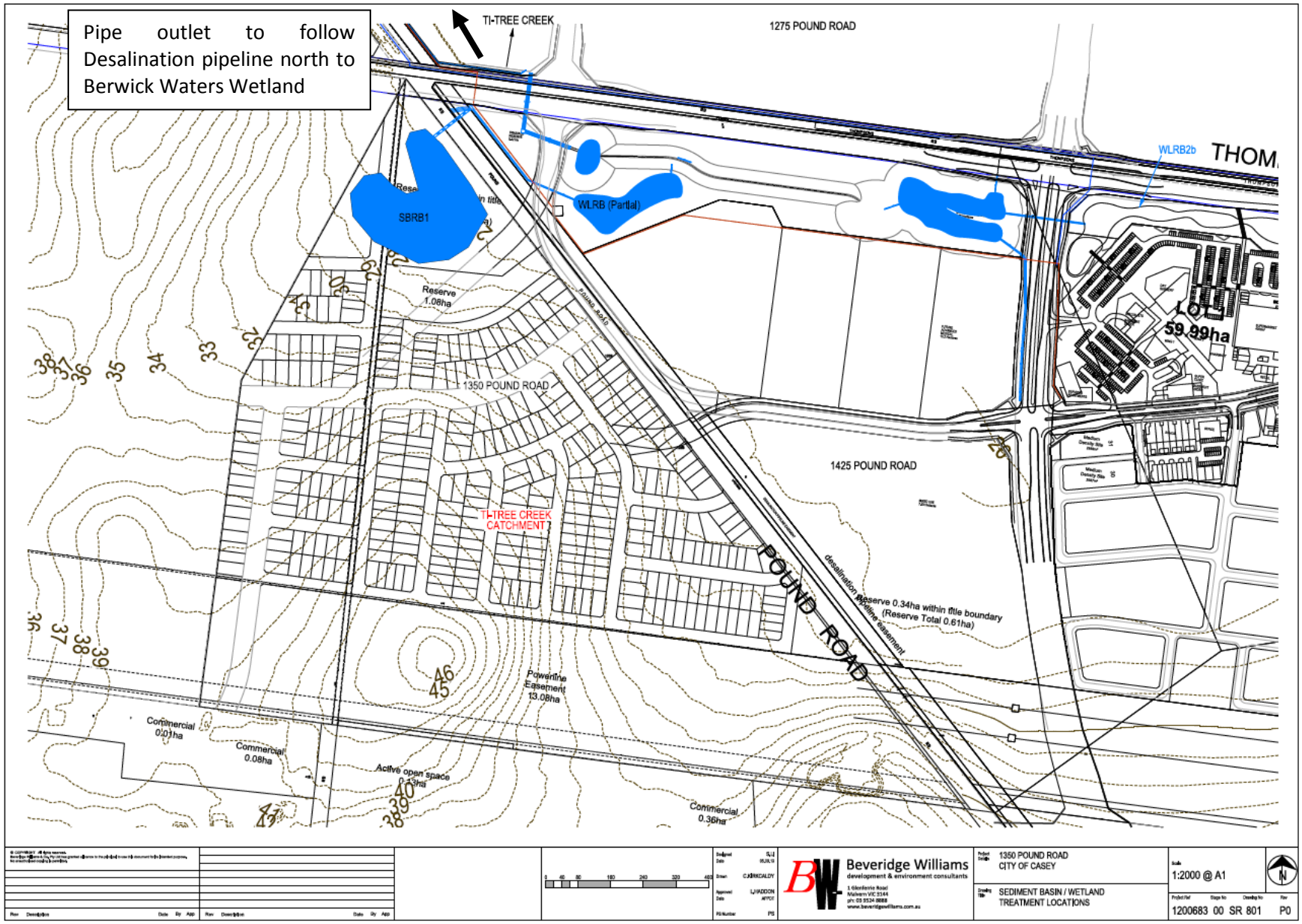
INDICATIVE DEVELOPMENT PLAN



APPENDIX D.
Overland Flowpath Plan

OVERLAND FLOWPATH PLAN

APPENDIX E. Sediment Basin / Retarding Basin on site and External Wetland Concept Layout


Pipe outlet to follow Desalination pipeline north to Berwick Waters Wetland
TI-TREE CREEK
1275 POUND ROAD
WLRB2b
THOM
SBRB1
WLRB (Partial)
Reserve 1.08ha
1350 POUND ROAD
LOT 59.99ha
1425 POUND ROAD
TI-TREE CREEK CATCHMENT
POUND ROAD
desalination pipeline easement
Reserve 0.34ha within title boundary (Reserve Total 0.61ha)
Powerline Easement 13.08ha
Commercial 0.01ha
Commercial 0.08ha
Active open space 0.9ha
Commercial 0.36ha
Beveridge Williams
development & environment consultants
1350 POUND ROAD
CITY OF CASEY
SEDIMENT BASIN / WETLAND TREATMENT LOCATIONS
1:2000 @ A1
1200683 00 SR 801 P0