PLANS AND DOCUMENTS
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DEVELOPMENT APPROVAL

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# Stormwater Management Report

## Proposed Residential Development

## 85-91 Hamilton Street
## Redland Bay

For Mion Pty Ltd

22 November 2017


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*This report has been prepared for Mion Pty Ltd for the purpose of accompanying a development application to Economic Development Queensland (EDQ). This report must only be used by Mion Pty Ltd for this purpose and must not be used or relied upon by any other person for any other purpose.*

*The assessment, conclusions or recommendations in this report are based on conditions encountered and information received at the time of preparing the report and may not be relied upon as site conditions or operations vary over time.*

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# 1. Introduction

This development involves the construction of a multi residential apartment building consisting of 45 units and associated infrastructure. Driveway access shall be provided via a single standard access crossover from Hamilton Street.

The development site is located in the Weinam Creek Priority Development Area (PDA) and as such is subject to assessment via Economic Development Queensland (EDQ). This report documents how stormwater runoff will be managed on site in accordance with EDQ's and Redland City Council's (RCC's) requirements.

# 2. Site Description

## 2.1 Location and Land Use

The proposed development is located at 85-91 Hamilton Street; also known as Lots 13 & 14 on RP107394. Lot 13 is currently occupied by a single occupancy dwelling and Lot 14 is occupied by vacant land consisting primarily of grassed & vegetated areas. The proposed development area is approximately 1,633m$^2$.

The northern portion of the site generally falls northwest toward the adjoining property and Hamilton Street at an average grade of approximately 2%. The southern portion of the site falls generally east towards Hamilton Street at an average grade of approximately 1%. The site is bound by residential dwellings to the north, south and west and Hamilton Street to the east. Refer to Figure 1 for an indicative site location and Appendix D for detailed site survey information.


**Figure 1** – Indicative site location (Nearmap, 2017)

## 2.2 Lawful point of discharge

The development site is fronting a crest within Hamilton Street. Stormwater runoff from the northern portion of the site including the existing dwelling on Lot 13 subsequently discharges north and stormwater runoff from the southern portion of the site consisting predominantly of grasses & vegetated areas discharges south.

The proposed lawful point of discharge for approximately 65% of the roof area shall be the Hamilton Street kerb & channel at the northeast corner of the site. The proposed lawful point of discharge for ground areas including the exposed basement driveway and the balance of the roof area shall be existing stormwater infrastructure south of the site at the Hamilton Street & Meissner Street intersection via the construction of new underground drainage infrastructure.

Stormwater runoff from the development shall be captured and piped to the proposed lawful points of discharge in accordance with the requirements of the Weinam Creek PDA development scheme & RCC's standards & specifications. Refer to Appendix C for details.

# 3. Stormwater Quantity Management

The stormwater quantity analysis of the existing and developed site conditions has been undertaken with reference to the requirements and procedure outlined by:

- Queensland Urban Drainage Manual (QUDM)
- Australian Rainfall and Runoff Volumes 1 & 2 (Aust R&R)

The following section of the report discusses the proposed development's impact on peak stormwater runoff from the site and compares the existing site condition to ensure a no worsening effect to downstream properties.

The DRAINS software package has been used for modelling the peak flows off site. The hydrological model adopted was the Extended Rational Method with hyetograph input as specified in Australian Rainfall and Runoff (AR&R) Volumes 1 and 2.

The 1 hour rainfall intensity for a 1 in 10 year ARI was extracted from RCC's Infrastructure Works Planning Scheme Policy and was found to be 67 mm/hr. The site is assumed to have medium soil permeability. Coefficient of discharge (C10) values used for the model were derived from Table 4.05.3 (a) and Table 4.05.3 (b) of the Queensland Urban Drainage Manual 2008, and are outlined below:

- Impervious area C10 value 0.90
- Pervious area C10 value 0.66

## 3.1 Existing Catchment

### Catchment Area

The existing site consists of two subcatchments; hydrologic characteristics for each subcatchment are described below.

#### North Subcatchment

The northern portion of the site consists of a single occupancy dwelling and landscaped ground level areas. Stormwater runoff falls north and east towards Hamilton Street and the neighbouring property.

The subcatchment area is approximately 996m$^2$.

The total impervious area was extrapolated from the survey plan and was found to be approximately 200m$^2$ which equates to a 20% fraction impervious (**$f_i$=0.20**)

**Time of Concentration (tc)**

The time of concentration is determined by using a combination of overland flow time, channel flow time & standard inlet time as described in QUDM.

A standard inlet time of 5 minutes has been adopted for the impervious area of the subcatchment. An overland flow time of 14 minutes & channel flow time of 1 minute has been adopted for the pervious area.

**$t_{c,\ existing,\ impervious}$ = 5 minutes**

**$t_{c,\ existing,\ pervious}$ = 15 minutes**

**South Subcatchment**

The southern portion of the site consists of a grassed & vegetated areas. Stormwater runoff falls south and east towards Hamilton Street.

The subcatchment area is approximately 637m$^2$.

The subcatchment is fully pervious which equates to a 0% fraction impervious (**$f_i$=0.00**)

**Time of Concentration (tc)**

An overland flow time of 14 minutes & channel flow time of 1 minute has been adopted.

**$t_{c,\ existing}$ = 15 minutes**

### 3.1.1. DRAINS results for existing site

The existing site catchment is summarised in Table 1 below:

**Table 1 –** Existing Catchment Characteristics

| **Catchment Characteristics** | **Sub-catchment** | |
|---|---|---|
| | **North** | **South** |
| **Area** | 0.0996Ha | 0.0637Ha |
| **Total time of concentration** | 5 min (impervious); 15 min (pervious) | 15 min |
| **Percent Impervious** | 20% | 0% |

Peak flow rates from the existing site were determined by modelling various storm durations for each ARI storm. The peak flows are outlined in Table 2.

**Table 2 -** Existing site peak flow rates

| ARI Storm Event | Peak Flow Rate North (L/s) | Peak Flow Rate South (L/s) | Peak Flow Rate Total (L/s) |
|---|---|---|---|
| $Q_1$ | 15 | 8 | 23 |
| $Q_2$ | 20 | 11 | 31 |
| $Q_5$ | 28 | 15 | 43 |
| $Q_{10}$ | 33 | 18 | 51 |
| $Q_{20}$ | 39 | 21 | 61 |
| $Q_{50}$ | 46 | 26 | 71 |
| $Q_{100}$ | 52 | 29 | 81 |

## 3.2 Developed Site

### Catchment Area

The development involves the construction of a multi-residential apartment building consisting of 45 apartments & associated infrastructure. Stormwater shall be collected on site and directed to the lawful points of discharge at Hamilton Street. Hydrologic characteristics for each subcatchment are described below.

#### North Subcatchment

Stormwater runoff from approximately 65% of the roof area shall be directed to the Hamilton Street kerb & channel via charged line.

The subcatchment area is approximately 600m$^2$.

The total impervious area was calculated to be 600m$^2$ which equates to 100% fraction impervious (**$f_i$=1.00**).

#### Time of Concentration (tc)

The time of concentration has been determined by using the standard inlet time as described in QUDM.

A time of concentration of 5 minutes has been deemed appropriate.

**$t_{c,\ developed}$ = 5 minutes**

#### South Subcatchment

Stormwater runoff from ground areas including the exposed basement driveway and approximately 35% of the roof area shall be existing stormwater infrastructure south of the site at the Hamilton Street & Meissner Street intersection via the construction of underground stormwater drainage infrastructure.

The subcatchment area is approximately 1033m$^2$.

The total impervious area was calculated to be 437m$^2$ which equates to approximately 42% fraction impervious (**$f_i$=0.42**).

#### Time of Concentration (tc)

The time of concentration has been determined by using the standard inlet time as described in QUDM.

A time of concentration of 5 minutes has been deemed appropriate.

**$t_{c,\ developed}$ = 5 minutes**

### 3.2.1. DRAINS results for developed site

The developed site catchment is summarised in Table 3 below:

**Table 3 –** Developed Catchment Characteristics

| **Catchment Characteristics** | **Sub-catchment** | |
|---|---|---|
| | **North** | **South** |
| **Area** | 0.0600Ha | 0.1033Ha |
| **Total time of concentration** | 5 min | 5 min |
| **Percent Impervious** | 100% | 42% |

Peak flow rates from the developed site were determined by modelling various storm durations for each ARI storm. The peak flows are outlined in Table 4.

**Table 4 -** Developed site peak flow rates

| **ARI Storm Event** | **Peak Flow Rate North (L/s)** | **Peak Flow Rate South (L/s)** | **Peak Flow Rate Total (L/s)** |
|---|---|---|---|
| **$Q_1$** | 15 | 21 | 36 |
| **$Q_2$** | 20 | 29 | 49 |
| **$Q_5$** | 27 | 40 | 67 |
| **$Q_{10}$** | 32 | 46 | 79 |
| **$Q_{20}$** | 38 | 55 | 94 |
| **$Q_{50}$** | 46 | 68 | 114 |
| **$Q_{100}$** | 51 | 77 | 127 |

## 3.3 Water Quantity Comparison

Table 5 below compares the peak flow rates for the existing and developed cases.

**Table 5 -** Existing vs developed peak flow rates

| ARI Storm Event | Change in Peak Flow Rate (L/s) | | |
|---|---|---|---|
| | North | South | Total |
| $Q_1$ | 0 | 13 | 13 |
| $Q_2$ | 0 | 18 | 18 |
| $Q_5$ | -1 | 25 | 24 |
| $Q_{10}$ | -1 | 28 | 28 |
| $Q_{20}$ | -1 | 34 | 33 |
| $Q_{50}$ | 0 | 42 | 43 |
| $Q_{100}$ | -1 | 48 | 46 |

As shown in Table 5, the peak flow rate of stormwater runoff to the north has either decreased or remains unchanged due to a reduction in the catchment area directed here. The peak flow rate of stormwater runoff to the south has increased due to an increase in catchment area directed here & an increase in impervious area. The total site discharge has also consequently increased. Stormwater detention is therefore required to offset the increase in peak flow rate.

## 3.4 Stormwater Detention

Stormwater detention is to be provided by a 37.3kL detention tank located in the south east corner of the development site above the level 1 basement slab. Stormwater runoff from ground areas and approximately 35% of the roof area shall be directed here prior to site discharge. The model has accounted for roof flows in excess of Q20 bypassing the tank. The final detention system must be confirmed during detailed design based on the final hydraulic design of the underground stormwater network. Refer to Table 6 and Appendix B for further details of the detention tank.

**Table 6** - Detention system details

| Description | Specification |
|---|---|
| Assumed development catchment roof area to tank | 325m$^2$ (100% impervious) |
| Assumed development catchment ground area to tank | 708m$^2$ (15% impervious) |
| Orifice plate diameter | 100mm |
| Tank outlet pipe diameter | 225mm |

| Description | Specification |
|---|---|
| Total tank volume | 37.3kL |
| Assumed development catchment area bypassing tanks | 600m$^2$ (48% impervious) |

Figure 2 illustrates the DRAINS model layout developed for this detention system.

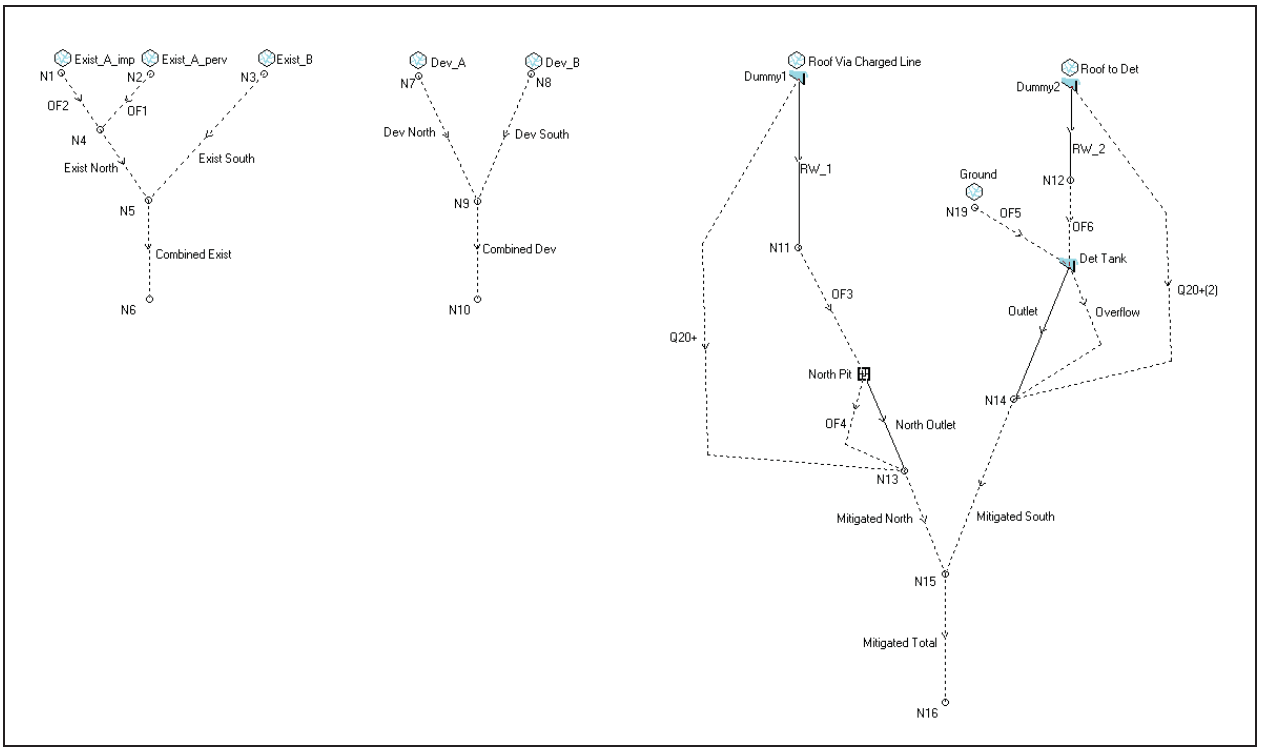



Figure 2 - Drains model layout

Flow rates determined for the three cases modelled are outlined in Table 7.

**Table 7** - Developed site peak flow rates - South

| ARI Storm Event | Existing Peak Flow Rate (L/s) | | | Developed Peak Flow Rate (L/s) | | | Mitigated Peak Flow Rate (L/s) | | |
|---|---|---|---|---|---|---|---|---|---|
| | North | South | Total | North | South | Total | North | South | Total |
| $Q_1$ | 15 | 8 | 23 | 15 | 21 | 36 | 14 | 10 | 23 |
| $Q_2$ | 20 | 11 | 31 | 20 | 29 | 49 | 19 | 12 | 30 |
| $Q_5$ | 28 | 15 | 43 | 27 | 40 | 67 | 25 | 15 | 39 |
| $Q_{10}$ | 33 | 18 | 51 | 32 | 46 | 79 | 31 | 17 | 46 |
| $Q_{20}$ | 39 | 21 | 61 | 38 | 55 | 94 | 37 | 20 | 54 |
| $Q_{50}$ | 46 | 26 | 71 | 46 | 68 | 114 | 45 | 22 | 62 |
| $Q_{100}$ | 52 | 29 | 81 | 51 | 77 | 127 | 51 | 28 | 70 |

As shown in Table 7, the proposed detention tank effectively mitigates the increase in peak discharge flow rate to the south and the total site discharge for all events up to and including the 100 year design storm. The 2L/s increase in the 1 year ARI event & 1 L/s increase in the 2 year ARI event for the south subcatchment is considered to be within the tolerance of the modelling program. The proposed stormwater detention tank is therefore considered to be adequate for the development. Further refinement of the stormwater detention tank should be undertaken at the detailed design phase.

# 4. Water Quality Management

## 4.1 Operational Phase

The development is not required to meet the Queensland Governments State Planning Policy (July 2017) as the site does not exceed the 2,500m$^2$ minimum site area. However stormwater quality management must still be undertaken via the application of best management practices (BMPs) to ensure no adverse impacts to the downstream environment.

Pollutants typically generated during the operational phase of the development include:

- litter/gross pollutants
- sediment (Total Suspended Solids – TSS)
- nutrients (Total Nitrogen and Total Phosphorus – TN & TP)
- hydrocarbons (oils and grease)
- heavy metals

Stormwater quality best management practices may be implemented for the development as follows:

- First flush diversion system for roof water diverting the roof water for irrigation purposes
- Gross pollutant filter baskets in field inlet pits collection runoff from ground areas.

Best management practices have been deemed sufficient for the site area and use. Refer to Appendix B for the preliminary civil engineering drawings.

## 4.2 Construction Phase

Pollutants typically generated during construction phase are described in Table 8 below.

**Table 8 -** Pollutants typically generated during the construction phase

| Pollutant | Sources |
|---|---|
| Litter (Gross Pollutants) | Paper, construction packaging, food packaging, cement bags. |
| Sediment | Unprotected exposed soils and stockpiles during earthworks and building. |
| Hydrocarbons | Fuel and oil spills, leaks from construction equipment. |
| Toxic materials | Cement slurry, asphalt prime, solvents, cleaning agents, wash waters. |

| Pollutant | Sources |
|---|---|
| pH altering substances | Acid sulphate soils, cement slurry and wash waters. |

## 5. Erosion and Sediment Control

Management of stormwater runoff during construction is necessary to avoid pollution of downstream waterways from sediment and gross pollutant loading. Impacts of inadequate erosion and sediment control downstream from the site include:

- traffic safety problems;
- blocked drains;
- local flooding problems;
- aesthetic pollution of drainage paths; and
- damage to local ecosystems.

Best practice erosion and sediment controls must be installed to minimise the discharge of sediment laden runoff during construction. Erosion and sediment control plans shall be developed during detailed design phase and must be continually maintained and amended as required to minimise environmental harm.

Erosion and sediment control plans are based on three sets of control measures:

- drainage control;
- erosion control; and
- sediment control.

These control measures must be maintained in an effective operational condition. Sediment disposal from site is to occur to the satisfaction of RCC. Defects in erosion and sediment control devices, such as sediment fences, are to be inspected and documented. Upon Inspection, the Contractor is to determine whether the device should be replaced or repaired. Documentation is to include how the damage was caused and what measures can be implemented to reduce the possibility of repeat occurrences. Any damage to either permanent or temporary water quality control structures or devices is to be immediately rectified at the contractor's expense.

The effectiveness of the erosion and sediment control devices can be monitored by visual audits. All ESC measures are to be inspected:

- at least daily (when work is occurring on site) or weekly (when work is not occurring on site);
- within 24 hours of expected rain; and
- within 18 hours of a rainfall event (i.e. an event of sufficient intensity and duration to mobilise sediment on site).

Drainage paths are to be inspected to ensure the sediment fences are not being bypassed as a result of soil erosion.

Sediment laden runoff shall be prevented from entering neighbouring properties. This shall be achieved by landscaping disturbed areas immediately and prior to a rainfall event.

The proposed development received an erosion hazard score of 15. This score does not exceed the minimum cut off score of 17, indicating there is no requirement for a preliminary ESCP to be submitted to

EDQ for approval during the planning phase of the development. See Appendix A for the competed erosion hazard assessment form.

### 5.1 Maintenance and Monitoring Requirements

Periodic maintenance and monitoring of stormwater devices proposed in this report is crucial to ensure effective operation and design life.

Inspect field inlet grates, pits and underground pipes for blockage or damage at least 6 monthly or after significant rainfall event. The filter baskets shall be inspected and maintained preferably by the manufacturer to avoid damage to units and to ensure adequate cleaning and record keeping. For the first 12 months routine inspections of filter baskets shall be carried out monthly with routine clean out at alternate months. Results of the initial 12 months maintenance program shall be used to determine future maintenance intervals. Refer manufactures maintenance and monitoring methodology for specific details.

Maintenance of ESC measures must occur in accordance with Table 9.

**Table 9 -** ESC maintenance requirements.

| ESC Measure | Maintenance Trigger | Timeframe for Completion of Maintenance |
|---|---|---|
| Sediment basins | When settled sediment exceeds the volume of the sediment storage zone | Within 7 days of the inspection. |
| Other ESC measures | The capacity of ESC measures falls below 75%. | By the end of the day. |

Sediment accumulation on ESC devices is to be removed and disposed of to the satisfaction of RCC.

## 6. Conclusion

This SWMP outlines how stormwater runoff from the site will be managed in order to not adversely impact the receiving environment.

The proposed lawful point of discharge for approximately 65% of the roof area shall be the Hamilton Street kerb & channel. The proposed lawful point of discharge for ground areas and the balance of the roof area shall be existing stormwater infrastructure south of the site at the Hamilton Street & Meissner Street intersection via the construction of new underground drainage infrastructure.

Stormwater detention will be provided by a proposed 37.3kL detention tank suspended above the level 1 basement to reduce the peak stormwater discharge flow rate to pre-development levels.

Stormwater treatment could be managed on site by first flush diverters directing runoff for irrigation of landscaped areas and/or the installation of field inlet pit inserts. Based on the scale of the proposed development, and typical pollutants produced, these measures are considered adequate.

By implementing the proposed stormwater management system, and providing adequate maintenance, the downstream environment and neighbouring properties will not experience any adverse deterioration of water quality as a result of the proposed development.

# Appendices

## Appendix A – Erosion Hazard Assessment (IECA)

## Erosion Hazard Assessment Form

| Condition | Points | Score | Trigger value |
|---|---|---|---|
| **AVERAGE SLOPE OF DISTURBANCE AREA** [1] | | | |
| • not more than 3% [3% . 33H:1V] | 0 | | |
| • more than 3% but not more than 5% [5% = 20H:1V] | 1 | **0** | **4** |
| • more than 5% but not more than 10% [10% = 10H:1V] | 2 | | |
| • more than 10% but not more than 15% [15% . 6.7H:1V] | 4 | | |
| • more than 15% | 6 | | |
| **SOIL CLASSIFICATION GROUP (AS1726)** [2] | | | |
| • GW, GP, GM, GC | 0 | | |
| • SW, SP, OL, OH | 1 | **3** | |
| • SM, SC, MH, CH | 2 | | |
| • ML, CL, or if *imported fill* is used, or if soils are untested | 3 | | |
| **EMERSON (DISPERSION) CLASS NUMBER** [3] | | | |
| • Class 4, 6, 7, or 8 | 0 | | |
| • Class 5 | 2 | **4** | **6** |
| • Class 3, (default value if soils are untested) | 4 | | |
| • Class 1 or 2 | 6 | | |
| **DURATION OF SOIL DISTURBANCE** [4] | | | |
| • not more than 1 month | 0 | | |
| • more than 1 month but not more than 4 months | 2 | **4** | **6** |
| • more than 4 months but not more than 6 months | 4 | | |
| • more than 6 months | 6 | | |
| **AREA OF DISTURBANCE** [5] | | | |
| • not more than 1000 $m^2$ | 0 | | |
| • more than 1000 $m^2$ but not more than 5000 $m^2$ | 1 | **1** | **4** |
| • more than 5000 $m^2$ but not more than 1 ha | 2 | | |
| • more than 1 ha but not more than 4 ha | 4 | | |
| • more than 4 ha | 6 | | |
| **WATERWAY DISTURBANCE** [6] | | | |
| • No disturbance to a watercourse, open drain or channel | 0 | **0** | **2** |
| • Involves disturbance to a constructed open drain or channel | 1 | | |
| • Involves disturbance to a natural watercourse | 2 | | |
| **REHABILITATION METHOD** [7] | | | |
| Percentage of area (relative to total disturbance) revegetated by seeding without light mulching (i.e. worst-case revegetation method). | | | |
| • not more than 1% | 0 | **0** | |
| • more than 1% but not more than 5% | 1 | | |
| • more than 5% but not more than 10% | 2 | | |
| • more than 10% | 4 | | |
| **RECEIVING WATERS** [8] | | | |
| • Saline waters only | 0 | **0** | |
| • Freshwater body (e.g. creek or freshwater lake or river) | 2 | | |
| **SUBSOIL EXPOSURE** [9] | | | |
| • No subsoil exposure except of service trenches | 0 | **2** | |
| • Subsoils are likely to be exposed | 2 | | |
| **EXTERNAL CATCHMENTS** [10] | | | |
| • No external catchment | 0 | **0** | |
| • External catchment diverted around the soil disturbance | 1 | | |
| • External catchment not diverted around the soil disturbance | 2 | | |
| **ROAD CONSTRUCTION** [11] | | | |
| • No road construction | 0 | **0** | |
| • Involves road construction works | 2 | | |
| **pH OF SOILS TO BE REVEGETATED** [12] | | | |
| • more than pH 5.5 but less than pH 8 | 0 | **1** | |
| • other pH values, or if soils are untested | 1 | | |
| **Total Score** [13] | | **15** | |

## Explanatory notes

**Requirements:** Specific issues or actions required by the proponent.

**Warnings:** Issues that should be considered by the proponent.

**Comments:** General information relating to the topic.

[1] **REQUIREMENTS:**
For sites with an average slope of proposed land disturbance greater than 10%, a preliminary ESCP must be submitted to the regulatory authority for approval during planning negotiations.

Proponents must demonstrate that adequate erosion and sediment control measures can be implemented on-site to effectively protect downstream environmental values.

If site or financial constraints suggest that it is not reasonable or practicable for the prescribed water quality objectives to be achieved for the proposal, then the proponent must demonstrate that alternative designs or construction techniques (e.g. pole homes, suspended slab) cannot reasonably be implemented on the site.

**WARNINGS:**
Steep sites usually require more stringent drainage and erosion controls than flatter grade sites.

**COMMENTS:**
The steeper the land, the greater the need for adequate drainage controls to prevent soil and mulch from being washed from the site.

[2] **REQUIREMENTS:**
If the actual soil K-factor is known from soil testing, then the Score shall be determined from Table 1.

If a preliminary ESCP is required during planning negotiations, then it must be demonstrated that adequate space is available for the construction and operation of any major sediment traps, including the provision for any sediment basins and their associated embankments and spillways. It must also be demonstrated that all reasonable and practicable measures can be taken to divert the maximum quantity of sediment-laden runoff (up to the specified design storm) to these sediment traps throughout the construction phase and until the contributing catchment is adequately stabilised against erosion.

**WARNINGS:**
The higher the point score, the greater the need to protect the soil from raindrop impact and thus the greater the need for effective erosion control measures. A point score of 2 or greater will require a greater emphasis to be placed on revegetation techniques that do not expose the soil to direct rainfall contact during vegetation establishment, e.g. turfing and *Hydromulching*.

**COMMENTS:**
Table 2 provides an *indication* of soil conditions likely to be associated with a particular Soil group based on a statistical analysis of soil testing across NSW. This table provides only an initial estimate of the likely soil conditions.

The left-hand-side of the table provides an indication of the type of sediment basin that will be required (Type C, F or D). The right-hand-side of the table provides an indication of the likely erodibility of the soil based on the Revised Universal Soil Loss Equation (RUSLE) K-factor.

Table 3 provides some general comments on the erosion potential of the various soil groups.

**Table 1 – Score if soil K-factor is known**

| | RUSLE soil erodibility K-factor | | | |
|---|---|---|---|---|
| | K < 0.02 | 0.02<K<0.04 | 0.04<K<0.06 | K > 0.06 |
| **Score** | 0 | 1 | 2 | 3 |

**Table 2 – Statistical analysis of NSW soil data [1]**

| Unified Soil Class System | Likely sediment basin classification (%) | | | Probable soil erodibility K-factor (%) [2] | | | |
|---|---|---|---|---|---|---|---|
| | Dry | Wet | | Low | Moderate | High | Very High |
| | Type C | Type F | Type D | K < 0.02 | 0.02<K<0.04 | 0.04<K<0.06 | K > 0.06 |
| **GM** | 30 | **58** | 12 | 12 | **51** | 26 | 12 |
| **GC** | **42** | 33 | 25 | 13 | **71** | 17 | 0 |
| **SW** | 40 | **48** | 12 | **49** | 39 | 12 | 0 |
| **SP** | **53** | 32 | 15 | **76** | 18 | 5 | 1 |
| **SM** | 21 | **67** | 12 | 26 | **48** | 25 | 1 |
| **SC** | 26 | **50** | 24 | 16 | **64** | 18 | 2 |
| **ML** | 5 | **63** | 32 | 4 | 35 | **45** | 16 |
| **CL** | 9 | **51** | 39 | 12 | **56** | 19 | 13 |
| **OL** | 2 | **80** | 18 | 34 | **61** | 5 | 1 |
| **MH** | 12 | 41 | **48** | 15 | 19 | **41** | 25 |
| **CH** | 5 | 44 | **51** | 39 | **43** | 11 | 7 |

Notes: [1] Analysis of soil data presented in Landcom (2004).
[2] Soil erodibility based on Revised Universal Soil Loss Equation (RUSLE) K-factor.

### Unified Soil Classification System (USCS)

GW Well graded gravels, gravel-sand mixtures, little or no fines
GP Poorly graded gravels, gravel-sand mixture, little or no fines
GM Silty gravels, poorly graded gravel-sand-silt mixtures
GC Clayey gravels, poorly graded gravel-sand-clay mixtures
SW Well graded sands, gravelly sands, little or no fines
SP Poorly graded sands, gravelly sands, little or no fines
SM Silty sands, poorly graded sand-silt mixtures
SC Clayey sands, poorly graded sand-clay mixtures
ML Inorganic silts & very fine sands, rock flour, silty or clayey fine sands with slight plasticity
CL Inorganic clays, low–medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
OL Organic silts and organic silt-clays of low plasticity
MH Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
CH Inorganic clays of high plasticity, fat clays
OH Organic clays of medium to high plasticity

**Table 3 – Typical properties of various soil groups [1]**

| Soil Groups | Typical properties [2] |
|---|---|
| GW, GP | • Low erodibility potential. |
| GM, GC | • Low to medium erodibility potential.<br>• May create turbid runoff if disturbed as a result of the release of silt and clay particles. |
| SW, SP | • Low to medium erodibility potential. |
| SM, SC | • Medium erodibility potential.<br>• May create turbid runoff if disturbed as a result of the release of silt and clay particles. |
| MH, CH | • Highly variable (low to high) erodibility potential.<br>• Will generally create turbid runoff if disturbed. |
| ML, CL | • High erodibility potential.<br>• Tendency to be dispersive.<br>• May create some turbidity in runoff if disturbed. |

Note: [1] After Soil Services & NSW DLWC (1998).
[2] Any soil can represent a high erosion risk if the binding clays or silts are unstable.

Table 4 provides **general** guidelines on the suitability of various soil groups to various engineering applications.

**Table 4 – Engineering suitability based on Unified Soil Classification [1]**

| Unified Soil Class | USC Group | Embankments | | Fill | Slope stability | Untreated roads |
|---|---|---|---|---|---|---|
| | | Water retaining | Non water retaining | | | |
| Well graded gravels | GW | Unsuitable | Excellent | Excellent | Excellent | Average |
| Poorly graded gravel | GP | Unsuitable | Average | Excellent | Average | Unsuitable |
| Silty gravels | GM | Unsuitable | Average | Good | Average | Average |
| Clayey gravels | GC | Suitable | Average | Good | Average | Excellent |
| Well graded sands | SW | Unsuitable | Excellent | Excellent | Excellent | Average |
| Poorly graded sands | SP | Unsuitable | Average | Good | Average | Unsuitable |
| Silty sands | SM | Suitable [2] | Average | Average | Average | Poor |
| Clayey sands | SC | Suitable | Average | Average | Average | Good |
| Inorganic silts | ML | Unsuitable | Poor | Average | Poor | Unsuitable |
| Inorganic clays | CL | Suitable [2] | Good | Average | Good | Poor |
| Organic silts | OL | Unsuitable | Unsuitable | Poor | Unsuitable | Unsuitable |
| Inorganic silts | MH | Unsuitable | Poor | Poor | Poor | Unsuitable |
| Inorganic clays | CH | Suitable [2] | Average | Unsuitable | Average | Unsuitable |
| Organic clays | OH | Unsuitable | Unsuitable | Unsuitable | Unsuitable | Unsuitable |
| Highly organic soils | Pt | Unsuitable | Unsuitable | Unsuitable | Unsuitable | Unsuitable |

Notes: [1] Modified from Hazelton & Murphy (1992)
[2] Suitable only after modifications to soil such as compaction and/or erosion protection

[3] If the soils have not been tested for Emerson Class, then adopt a score of 4.

**REQUIREMENTS:**
Works proposed on sites containing Emerson Class 1 or 2 soils have a very high pollution potential and must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the authority) during planning negotiations.

**WARNINGS:**
Class 3 and 5 soils disturbed by cut and fill operations or construction traffic are highly likely to discolour stormwater (i.e. cause turbid runoff). Chemical stabilisation will likely be required if these soils are placed immediately adjacent to a retaining wall. Any disturbed Class 1, 2, 3 and 5 soils that are to be revegetated must be covered with a non-dispersive topsoil as soon as possible (unless otherwise agreed by the regulatory authority).

Class 1 and 2 soils are highly likely to discolour (pollute) stormwater if exposed to rainfall or flowing water. Treatment of these soils with gypsum (or other suitable substance) will most likely be required. These soils should not be placed directly behind a retaining wall unless it has been adequately treated (stabilised) or covered with a non-dispersible soil.

[4] The duration of disturbance refers to the total duration of soil exposure to rainfall up until a time when there is at least 70% coverage of all areas of soil.

**REQUIREMENTS:**
All land developments with an expected soil disturbance period greater than 6 months must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the authority) during planning negotiations.

**COMMENTS:**
Construction periods greater than 3 months will generally experience at least some significant storm events, independent of the time of year that the construction (soil disturbance) occurs.

[5] **REQUIREMENTS:**
Development proposals with an expected soil disturbance in excess of 1ha must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the regulatory authority) during planning negotiations.

The area of disturbance refers to the total area of soil exposed to rainfall or dust-producing winds either as a result of:

(a) the removal of ground cover vegetation, mulch or sealed surfaces;

(b) past land management practices;

(c) natural conditions.

**WARNINGS:**
A *Sediment Basin* will usually be required if the disturbed area exceeds 0.25ha (2500m$^2$) within any sub-catchment (i.e. land flowing to one outlet point).

**COMMENTS:**
For soil disturbances greater than 0.25ha, the revegetation phase should be staged to minimise the duration for which soils are exposed to wind, rain and concentrated runoff.

[6] **REQUIREMENTS:**
All developments that involve earthworks or construction within a natural watercourse (whether that watercourse is in a natural or modified condition) must submit a conceptual ESCP to the regulatory authority for review and/or approval (as required by the regulatory authority) during planning negotiations.

Permits and/or licences may be required from the State Government, including possible submission of the ESCP to the relevant Government department.

[7] **REQUIREMENTS:**
No areas of soil disturbance shall be left exposed to rainfall or dust-producing winds at the end of a development without an adequate degree of protection and/or an appropriate action plan for the establishment of at least 70% cover.

**COMMENTS:**
Grass seeding without the application of a light mulch cover is considered the least favourable revegetation technique. A light mulch cover is required to protect the soil from raindrop impact, excessive temperature fluctuations, and the loss of essential soil moisture.

[8] **COMMENTS:**
All receiving waters can be adversely affected by unnatural quantities of sediment-laden runoff. Freshwater ecosystems are generally more susceptible to ecological harm resulting from the inflow of fine or dispersible clays than saline water bodies. The further inland a land disturbance is, the greater the potential for the released sediment to cause environmental harm as this sediment travels towards the coast.

For the purpose of this clause it is assumed that all sediment-laden runoff will eventually flow into saline waters. Thus, sediment-laden discharges that flow first into freshwater are likely to adversely affect both fresh and saline water bodies and are therefore considered potentially more damaging to the environment.

This clause does **not** imply that sediment-laden runoff will not cause harm to saline waters.

[9] **COMMENTS:**
This clause refers to subsoils exposed during the construction phase either as a result of past land practices or proposed construction activities. The exposure of subsoils resulting from the excavation of minor service trenches should not be considered.

[10] **WARNINGS:**
The greater the extent of external catchment, the greater the need to divert up-slope stormwater runoff around any soil disturbance.

**COMMENTS:**
The ability to separate “clean” (i.e. external catchment) stormwater runoff from “dirty” site runoff can have a significant effect on the size, efficiency and cost of the temporary drainage, erosion, and sediment control measures.

[11] **REQUIREMENTS:**
Permission must be obtained from the owner of a road reserve before placing any erosion and sediment control measures within the road reserve.

**WARNINGS:**
Few sediment control techniques work efficiently when placed on a road and/or around roadside stormwater inlets. Great care must be taken if sediment control measures are located on a public roadway, specifically:

- safety issues relating to road users;
- the risk of causing flooding on the road or within private property.

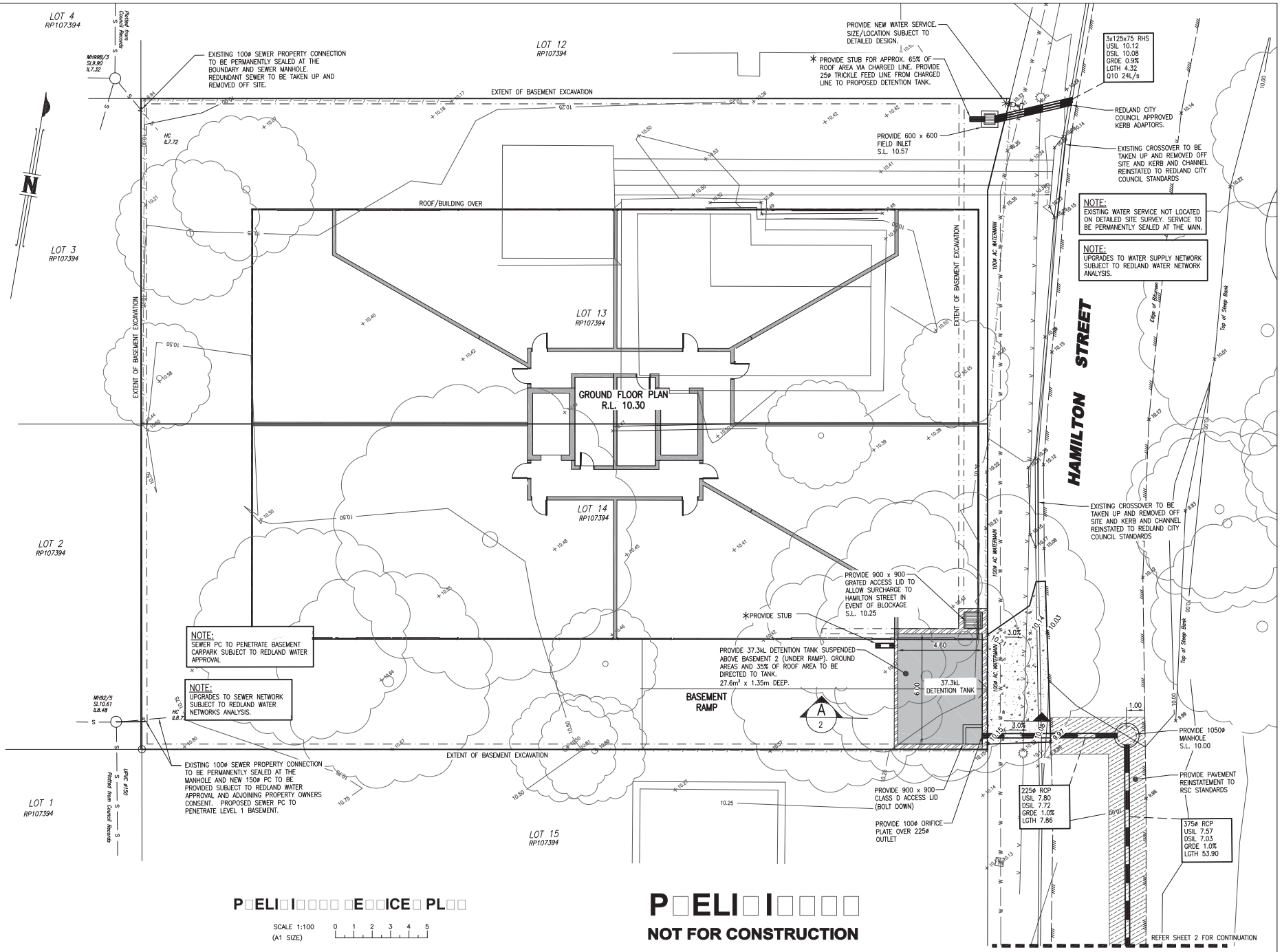
The construction of roads (whether temporary or permanent) will usually modify the flow path of stormwater runoff. This can affect how "dirty" site runoff is directed to the sediment control measures.

**COMMENTS:**
"On-road" sediment control devices are at best viewed as secondary or supplementary sediment control measures. Only in special cases and/or on very small projects (e.g. kerb and channel replacement) might these controls be considered as the "primary" sediment control measure.

[12] **WARNINGS:**
Soils with a pH less than 5.5 or greater than 8 will usually require treatment in order to achieve satisfactory revegetation. Soils with a pH of less than 5 (whether naturally acidic or in acid sulfate soil areas) may also limit the choice of chemical flocculants (e.g. Alum) for use in the flocculation of *Sediment Basins*.

[13] **REQUIREMENTS:**
A preliminary ESCP must be submitted to the local government for approval during the planning phase for any development that obtains a total point score of 17 or greater or when any trigger value is scored or exceeded.

# Appendix B – Civil Engineering Plans




## LEGEND

| | |
|---|---|
| | DETENTION TANK |
| | REINFORCED CONCRETE PAVEMENT |
| | ASPHALTIC CONCRETE PAVEMENT |
| | PROPOSED SEWER MANHOLE |
| | EXISTING SEWER MANHOLE |
| S | EXISTING SEWER |
| S | PROPOSED SEWER |
| 2/5 | SEWER MANHOLE NUMBER |
| | ON GRADE GULLY PIT |
| | SAG GULLY PIT |
| | 600 x 600 FIELD INLET |
| | 900 x 600 FIELD INLET |
| | 1500 DIA FIELD INLET |
| | STORMWATER LINE |
| | STORMWATER HEADWALL |
| | EXISTING STORMWATER LINE |
| × 23.49 | NATURAL SURFACE LEVEL |
| 2C | STORMWATER NUMBER |
| | WATER RETICULATION U.P.V.C. |
| | WATER RETICULATION D.I.C.L. |
| C | WATER RETICULATION CONDUIT |
| | GATE VALVE |
| FH | FIRE HYDRANT |
| | WATER METER |
| FH | DUAL OUTLET HYDRANT |
| SFH | SWABBING FIRE HYDRANT |
| W W | WATER SERVICE FITTING |
| T | TELEPHONE |
| E | ELECTRICITY |
| | EDGE OF BITUMEN |
| | FENCE |
| 21.00 | NATURAL CONTOURS |
| × 22.00 | FINISHED SURFACE LEVEL |
| V | OVERHEAD POWER |

## NOTES

1. STORMWATER DRAINAGE SHALL BE IN ACCORDANCE WITH REDLAND CITY COUNCIL GUIDELINES AND SPECIFICATIONS. EXISTING SERVICES ARE TO BE LOCATED AND VERIFIED PRIOR TO COMMENCEMENT OF CONSTRUCTION.
2. EXISTING SERVICES ARE TO BE LOCATED AND VERIFIED PRIOR TO COMMENCEMENT OF CONSTRUCTION.
3. INFORMATION CONTAINED IN THIS DRAWING IS PRELIMINARY ONLY AND SUBJECT TO DETAILED DESIGN INCLUDING BUT NOT LIMITED TO PIPE SIZES, ALIGNMENTS, PIT TYPES AND SIZES, AND EARTHWORKS EXTENTS.

**STORMWATER INLET PIT NOTE:**
STORMWATER INLET PITS AS SHOWN ARE TO BE FITTED WITH ENVIROPOD 200 FILTER BASKETS.

**NOTE:**
THE INVERT LEVEL & LOCATION OF ALL EXISTING STORMWATER & SEWER INFRASTRUCTURE SHALL BE CONFIRMED ON SITE PRIOR TO THE COMMENCEMENT OF CONSTRUCTION.

**✱ STORMWATER STUB NOTE:**
PROVIDE STUBS AS SHOWN FOR ROOF AND/OR YARD DRAINAGE CONNECTION. RUNOFF FROM GROUND AREAS & APPROXIMATELY 35% OF ROOF AREA TO BE DIRECTED TO DETENTION TANK.

P□ELI□I□□□□ □E□□ICE□ PL□□

SCALE 1:100 (A1 SIZE) 0 1 2 3 4 5

# P□ELI□I□□□□

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E nsw@westerapartners.com.au


SURVEYOR: A & T SURVEYING, (07) 3714 9141
DATUM: A.H.D, PM 113437, RL 1.995



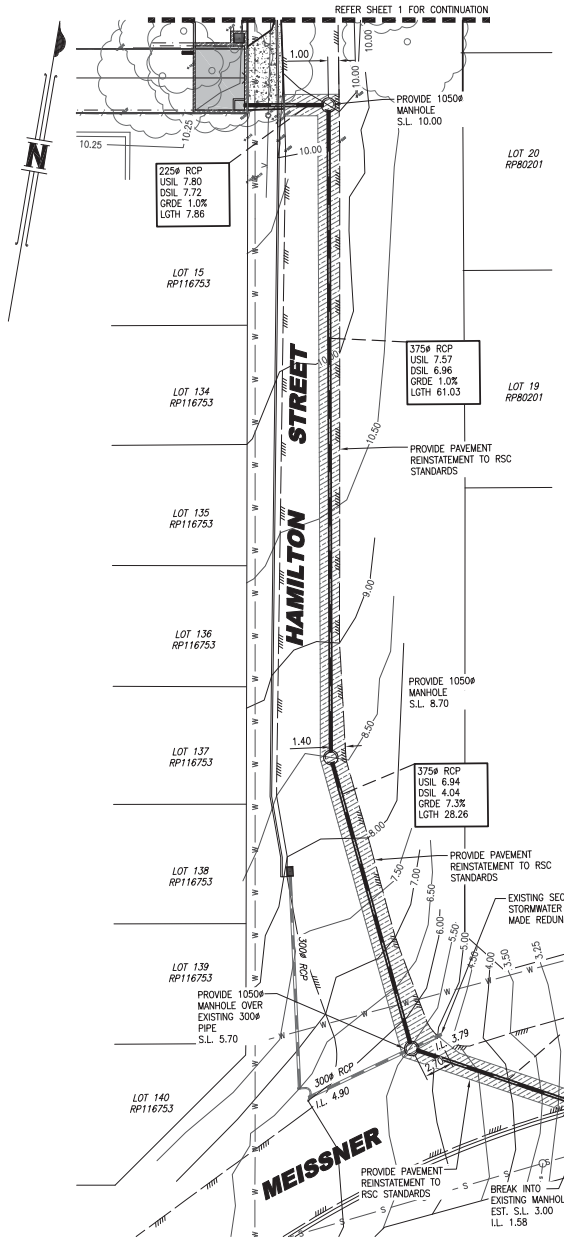
| No. | DATE | REVISIONS |
|---|---|---|
| | | |

| | |
|---|---|
| SHEET | PRELIMINARY SERVICES PLAN 1 OF 2 |
| PROJECT | **PROPOSED RESIDENTIAL DEVELOPMENT** |
| LOCATION | LOT 13 AND 14 ON RP107394<br>85 –91 HAMILTON STREET, REDLAND BAY |
| CLIENT | **MION PTY LTD** |

APPROVED
S. IDE RPEQ 12231
For and on behalf of WESTERA PARTNERS PTY. LTD.

| | |
|---|---|
| DESIGNED | J.H.C |
| DRAWN | P.A. |
| DATE DRAWN | JULY 2017 |
| FILE NAME | Services_PRE.dwg |

| | |
|---|---|
| SHEET NUMBER | 1 OF 2 |
| REVISION | |
| PROJECT NUMBER | B17/063 P |




## LEGEND

| | |
|---|---|
| | DETENTION TANK |
| | REINFORCED CONCRETE PAVEMENT |
| | ASPHALTIC CONCRETE PAVEMENT |
| | PROPOSED SEWER MANHOLE |
| | EXISTING SEWER MANHOLE |
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| 2C | STORMWATER NUMBER |
| W | WATER RETICULATION U.P.V.C. |
| W | WATER RETICULATION D.I.C.L. |
| C | WATER RETICULATION CONDUIT |
| | GATE VALVE |
| FH | FIRE HYDRANT |
| | WATER METER |
| FH | DUAL OUTLET HYDRANT |
| SFH | SWABBING FIRE HYDRANT |
| W W | WATER SERVICE FITTING |
| T | TELEPHONE |
| E | ELECTRICITY |
| | EDGE OF BITUMEN |
| | FENCE |
| 21.00 | NATURAL CONTOURS |
| × 22.00 | FINISHED SURFACE LEVEL |
| V | OVERHEAD POWER |

## NOTES

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**NOTE:**
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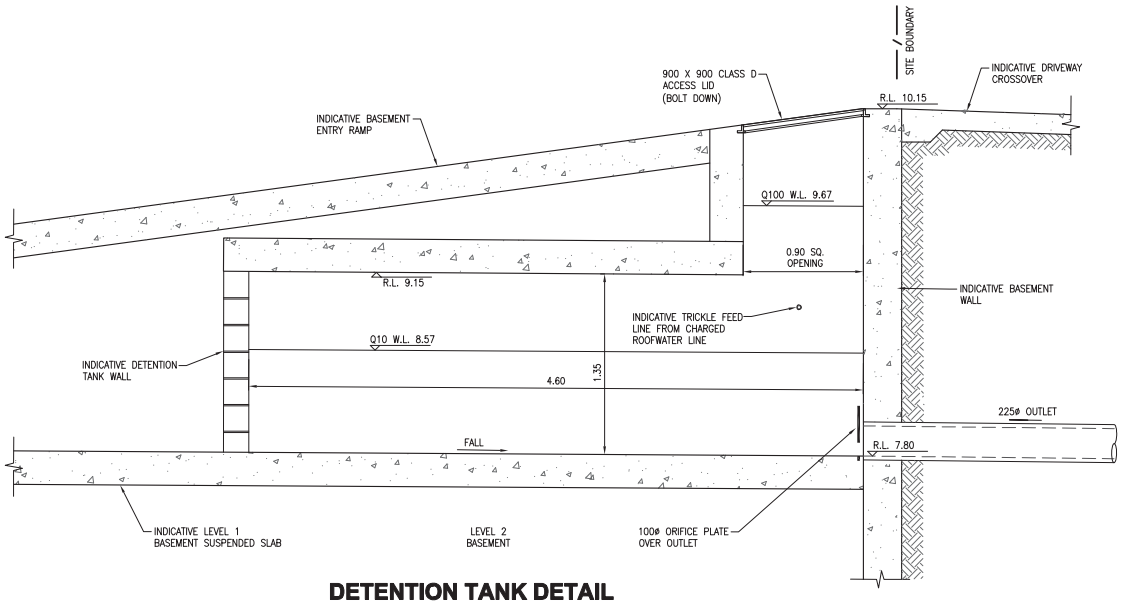
*** STORMWATER STUB NOTE:**
PROVIDE STUBS AS SHOWN FOR ROOF AND/OR YARD DRAINAGE CONNECTION. RUNOFF FROM GROUND AREAS & APPROXIMATELY 35% OF ROOF AREA TO BE DIRECTED TO DETENTION TANK.

**NOTE:**
AREA BEYOND EXTENT OF DETAILED SITE SURVEY. LEVELS AND DIMENSIONS HAVE BEEN APPROXIMATED FROM COUNCIL RECORDS AND SATELLITE IMAGERY.

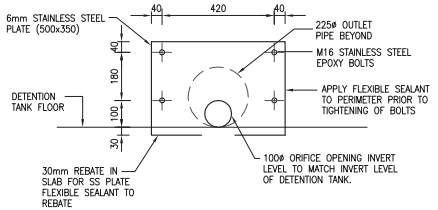
## PRELIMINARY SERVICES PLAN

SCALE 1:250 (A1 SIZE)
0 2.5 5 7.5 10 12.5



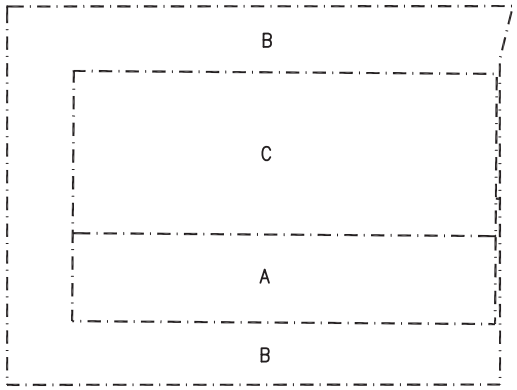

## DETENTION TANK DETAIL

**SECTION** A/1
1:20 SCALE @ A1 SIZE




## ORIFICE PLATE DETAIL

SCALE 1:10 @ A1




## CATCHMENT PLAN

SCALE 1:250 (A1 SIZE)
0 2.5 5 7.5 10 12.5

## CATCHMENT TABLE

| CATCHMENT LABEL | CATCHMENT DESCRIPTION | CATCHMENT AREA (m²) |
|---|---|---|
| A | PROPOSED ROOF TO DETENTION TANK | 325 |
| B | PROPOSED GROUND TO DETENTION TANK | 708 |
| C | PROPOSED ROOF TO NORTH OUTLET VIA CHARGED LINE | 600 |
| | SITE AREA (TOTAL) | 1633 |

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SURVEYOR: A & T SURVEYING (07) 3714 9141
DATUM: A.H.D PM 113437 RL 1.995



| No. | DATE | REVISIONS |
|---|---|---|
| | | |

SHEET: PRELIMINARY SERVICES PLAN 2 OF 2
PROJECT: **PROPOSED RESIDENTIAL DEVELOPMENT**
LOCATION: LOT 13 AND 14 ON RP107394 85 –91 HAMILTON STREET, REDLAND BAY
CLIENT: **MION PTY LTD**

APPROVED
S. IDE RPEQ 12231
For and on behalf of WESTERA PARTNERS PTY. LTD.

DESIGNED J.H.C
DRAWN P.A.
DATE DRAWN JULY 2017
FILE NAME Services_PRE.dwg

SHEET NUMBER 2 OF 2
REVISION
PROJECT NUMBER B17/063 P