ENGINEERING SERVICES MASTER PLAN

1200 Stage Highway 50, Ongaonga – Central Hawke's Bay

H20210003-ESMPR

Prepared for Springhill Farm Holdings

July 2021_V2

DEVELOPMENT NOUS

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Contents

LIST OF APPENDICES:

1. INTRODUCTION & SCOPE

Development Nous Ltd (DNL) was engaged by **Springhill Farm Holdings** (the Applicant) seeking to subdivide and develop 1200 Highway 50, Ongaonga & 612 Wakarara Road, Wakarara, Central Hawkes Bay (herein referred to as the "Site"). The proposal seeks to develop 312 Rural Lots.

The purpose of this report is to address the three-water servicing and roading for the multi-staged development. The report has been prepared for the applicant to accompany a subdivision consent application to Central Hawkes Bay District Council (CHBDC) for the proposed development.

Revision 1 of this report (dated 16 April 2021) was prepared to support the Resource Consent application submitted to CHBDC. Since the submission of the resource consent application CHBDC has returned with a Section 92 (dated 3 June 2021) request for further information concerning the development. This report (Revision 2) has been prepared to address these comments.

1.1. Information and Standards

Information provided includes the site location and a proposed scheme plan outlining the number of lots in the development presented in **Appendix A.**

Information on existing services was made available through the CHBDC GIS system and UAV site survey.

The investigation referenced the following resources:

- Central Hawke's Bay District Council – *District Plan* (dated September 2017);
- Central Hawke's Bay District Council – *GIS;*
- Freeman Cook Associates Pty Ltd – *Preliminary On-Site Wastewater Management Site Evaluation Report* (dated April 2021);
- Hawke's Bay Regional Council - *Hawke's Bay Waterway Guidelines Industrial Stormwater Design* (dated April 2009);
- Hawke's Bay Regional Council - *Hawke's Bay Waterway Guidelines Stormwater Management* (dated May 2009);
- Initia Geotechnical Specialists – *Springhill Farm Lifestyle Development Preliminary Geotechnical Assessment* (Ref: P-001061 Rev 1 dated April 2021);
- Ministry of Business, Innovation & Employment - *Acceptable Solutions and Verification Methods for New Zealand Building Code Clause – E1 Surface Water V9* (dated February 2014)
- NZS 4404:2010 - *Land Development and Subdivision Infrastructure*; and
- SNZ PAS 4509:2008 New Zealand Fire Service Firefighting Water Supplies Code of Practice, particularly Table 1: (method for determining required water supply classification) and Table 2: (method for determining Firefighting water supply).

2. SITE LOCATION

The extent of the development is bounded by State Highway 50 on the south eastern boundary, Wakarara Road on the south western boundary and agricultural land on the north eastern and north western boundary, as shown on **Figure 1-1** below. The total area extent of the development approximates to 220.77 hectares.

Figure 1-1 - Site Location (Source: CHBDC GIS)
Black boundary line indicates total extent of Development.

Under existing conditions the site is predominantly used for agricultural purposes. The natural topography of the site slopes from the north western boundary to the south eastern boundary at a grade of approximately 1.5%. An existing ephemeral channel traverses the southern porton of the site. Refer to the existing site plan in **Appendix B** for further details.

3. STORMWATER MASTER PLAN ANALYSIS

3.1. Site Based Stormwater Assessment

The site falls within a large stormwater catchment discharcharging flows to the existing ephemeral drain traversing the southern portion of the site and the existing State Highway 50 roadside swale. An assessment of this external upstream stormwater catchment discharging to the development has been undertaken as documented in **Section 3.2**.

The following section assesses the impact of the proposed development on stormwater generated within the site. Mitigation techniques are investigated to ensure the development achieves stormwater discharge neutrality.

3.1.1. Pre-Development Stormwater

3.1.1.1. Pre-Development Stormwater Drainage Conditions

The existing natural topography of the development slopes from the north western boundary to the south eastern boundary. An existing swale bounding the length of the site within the State Highway 50 road reserve flows north east / south west with the dividing high point approximately midway along the frontage of the site. Flows travelling south west discharge to the channel traversing the site while flows travelling north east flow towards the Waipawa River. Refer to drawing H20210003-RC-C500 in **Appendix F** for the pre-development catchments and overland flow pathways.

3.1.1.2. Pre-Development Stormwater Hydrology

The Rational Method was used to calculate the pre-development runoff flows. The following sections provide summaries of the calculations.

3.1.1.3. Pre-Development Catchment Data

Catchment parameters were delineated based on the existing topography. Catchments were delineated based on the two site discharge locations, A & B. Discharge Location A discharges to the existing channel traversing the site, Discharge Location B flows toward the Waipawa River. Refer to drawing No. H20210003-RC-C500 in **Appendix F** for the pre-development topographical catchment layout.

The development site currently consists of agricultural pasture. The pre-developed run-off coefficients for the development are derived from Table 1 of clause E1 in the New Zealand Building Code for Surface Water (Rational Method):

- Medium soakage soil types:
  - Pasture and grass cover = 0.30 (Subtract slope correction, 0 - 0.5%)

Table 3-1 Pre-Development Catchment Data

PRE-DEVELOPMENT CATCHMENT DATA			
Catchment Area Name	**Catchment Area (ha)**	**Runoff Coefficient (C)**	**Time of Concentration (Tc)**
Pre-A1	28.781	0.25	52 min
Pre-A2	67.462	0.25	48 min
Pre-A3	42.075	0.25	52 min
Pre-A4	22.310	0.25	37 min
Pre-B1	44.211	0.25	51 min
Pre-B2	52.237	0.25	51 min

3.1.1.4. Rainfall Data

Rainfall intensity data was generated using NIWA's *High Intensity Rainfall Design System – V4* for the the site. Calculations were based on the RCP6.0 for period 2081-2100 rainfall data

3.1.1.5. Pre-Development Stormwater Run-off Summary

The pre-development stormwater run-off flows are summarised and tabulated in **Table 3-2** below with consideration of discharge location;

Table 3-2 Pre-Development Runoff Flows

PRE-DEVELOPMENT RUNOFF FLOWS*					
Catchment Area Name	**1:2 year flood (m^3/s)**	**1:5 year flood (m^3/s)**	**1:10 year flood (m^3/s)**	**1:50 year flood (m^3/s)**	**1:100 year flood (m^3/s)**
Pre-A1	0.410	0.571	0.699	1.028	1.182
Pre-A2	0.997	1.393	1.705	2.511	2.890
Pre-A3	0.596	0.831	1.017	1.495	1.718
Pre-A4	0.365	0.512	0.627	0.928	1.070
Total A	**2.368**	**3.307**	**4.048**	**5.961**	**6.860**
Pre-B1	0.636	0.887	1.086	1.597	1.837
Pre-B2	0.754	1.051	1.287	1.893	2.177
Total B	**1.390**	**1.939**	**2.373**	**3.490**	**4.015**
Total Combined:	**3.758**	**5.246**	**6.421**	**9.452**	**10.875**

Refer to **Appendix C** for the detailed calculations.

3.1.2. Post-Development Stormwater

3.1.2.1. Post-Development Stormwater Drainage Conditions

The post-development design topography is proposed to maintain the pre-development landform with the exception of the building platforms and roads (which will generally following existing topography). As such, the development will maintain the existing direction of flow.

Each lot will be required to construct an onsite soakage pit or soakage swale which will act as the discharge location for each dwelling (including overflow from water storage tanks) and surrounding hardstand areas. This will assist to minimise the impact of the development on the downstream receiving waterway. Further details of the recommended soakage pit / swale sizing will be provided at detailed design stage following further site investigations. It is intended that the discharge soakage for each lot is formed at the time of built development of that lot.

All roads within the development are proposed to be constructed with roadside swales as a means to collect and convey runoff to the discharge locations. Culverts will be installed where necessary to achieve continuity of flows throughout the development. As discussed in **Section 6.3.4** the existing soil characteristics throughout the site are suitable for stormwater infiltration, as such it is expected natural infiltration will occur throughout the the roadside swales. Refer to drawing H20210003-RC-401 for the proposed typical roading detail.

Refer to drawing H20210003-RC-501 in **Appendix F** for the post-development catchment, overland flow directional arrows and discharge locations.

3.1.2.2. Post-Development Stormwater Hydrology

The Rational Method was used to calculate the post-development runoff flows. The following sections provides summaries of the calculations:

3.1.2.3. Post-Development Catchment Data

Catchment parameters were delineated by dividing the post-development areas into sub-catchments as per the proposed scheme plan layout, refer to drawing No. H20210003-RC-501 in **Appendix F**.

The post-developed run-off coefficients for the development are derived from table 1 in the New Zealand Building Code Clause E1-Surface Water (Rational Method):

<u>Road Reserve Surfaces:</u>

- Natural surface types:
  - Mainly Grassed = 0.30
- Developed surface types:
  - Unsealed Roads = 0.50
  - Asphalt and Concrete Paved Surfaces = 0.85

(Subtract slope correction, 0 - 0.5%)

The summary of the catchment data is tabulated in **Table 3-3** below, note the following table details the catchment areas excluding roof areas as all roof areas will discharge to ground (if not contained within water storage tanks) and ultimately not contribute to the runoff discharging the site. Runoff Coefficient calculations do not include the roof areas;

Table 3-3 Post-Development Catchment Data

POST-DEVELOPMENT CATCHMENT DATA				
Catchment Area Name	**Catchment Area* (ha)**	**Runoff Coefficient* (C)**	**Time of Concentration (Tc)**	**Roof Area (ha)**
1	17.94	0.27	36 min	0.66
2	18.68	0.28	41 min	0.75
3	5.41	0.27	21 min	0.12
4	8.63	0.28	43 min	0.36

5	15.55	0.28	17 min	0.66
6	9.81	0.28	33 min	0.42
7	10.34	0.29	24 min	0.54
8	40.48	0.27	53 min	1.86
9	51.16	0.29	60 min	2.40
10	41.25	0.26	65 min	1.59

*Catchment Areas and Runoff Coefficient calculations exclude roof areas.

Its noted from the **Table 3-3** above that the Runoff coefficient (C-values) of each catchment varies because of the different pervious and impervious area combinations of each catchment.

3.1.2.4. Rainfall Data

Rainfall intensity data was generated using NIWA's *High Intensity Rainfall Design System – V4* for the the site. Calculations were based on the RCP6.0 for period 2081-2100 rainfall data

3.1.2.5. Post-Development Stormwater Run-off Summary

The post-development stormwater run-off flows are summarised and tabulated in **Table 3-4** below;

Table 3-4 Post-Development Runoff Flows

POST-DEVELOPMENT RUNOFF FLOWS					
Catchment Area Name	**1:2 year flood (m^3/s)**	**1:5 year flood (m^3/s)**	**1:10 year flood (m^3/s)**	**1:50 year flood (m^3/s)**	**1:100 year flood (m^3/s)**
1	0.327	0.459	0.562	0.832	0.960
2	0.325	0.455	0.557	0.823	0.949
3	0.094	0.131	0.161	0.238	0.274
4	0.150	0.210	0.257	0.380	0.438
5	0.406	0.576	0.710	1.067	1.240
6	0.186	0.261	0.321	0.475	0.548
7	0.233	0.329	0.404	0.603	0.698
8	0.605	0.843	1.031	1.516	1.743
Total A	**2.326**	**3.264**	**4.005**	**5.934**	**6.848**
9	0.765	1.062	1.297	1.899	2.180
10	0.555	0.770	0.941	1.376	1.579
Total B	**1.320**	**1.832**	**2.238**	**3.276**	**3.759**
Total Combinded:	**3.645**	**5.096**	**6.243**	**9.209**	**10.607**

Refer to **Appendix C** for the detailed calculations.

3.1.2.6. Scour Protection

To maintain the integrity of stormwater outlets discharing to the existing roadside swales and waterways, scour protection in the form of rip rap or similarly acceptable solutions is proposed. The design of the scour protection will be undertaken at details design stage and will be done so in accordance with *Section 9.4* of the Hawke's Bay Waterway Guidelines – *Stormwater Management.*

3.1.2.7. Stormwater Mitigation

As discussed in **Section 3.2.1** each dwelling will be required to discharge water storage tank overflow to an infiltration pit / swale to minimise the impact of the development on stormwater discharge from the site. While not sought as part of the subject development proposal, should a non residential activity ever occur within the development (ie. commercial or industrial

development), peak flow mitigation in the form of an attenuation tank or onsite disposal could be provided to ensure the development does not increase runoff discharge.

As discussed in **Section 6.3.4** below, the preliminary geotechnical investigation identified the permeable nature of the underlying soil composition. This finding confirms that stormwater infiltration or soakage will be an appropriate disposal method for the site. Further investigations are to be undertaken to confirm the suitability and size of the individual infiltration systems at Building Consent phase to relate the sizing to the form of development and run off. Preliminay sizing of the systems have been undertaken based on an assumed infiltration rate of 41.4 mm/hr (with no local guideline available specifying the infiltration rate for gravelly sand, the infiltration rate assumption was determined in accordance with research undertaken by the Minnesota Pollution Control Agency as specified in the *Minnesota Stormwater Manual* dated 2020). Sizing and infiltration rates will be confirmed during detailed design. **Table 3-5** below details the storage volume required to be provided based on a hardstand area of 100m². At the time of writing this report it is unknown as to the specific hardstand breakdown, as such it is unreasonable to provide an infiltration system configuration.

Table 3-5 Post-Development Runoff Flows

Parameter	Value
Contributing Catchment of hardstand (ha)	100
Runoff Coefficient	0.9
Infiltration Rate (mm/hr)*	41.4
Storage Volume (m³)	4.5

*Infiltration rate to be confirmed at building consent stage.

If specific soakage testing determines infiltration to not be a viable solution for stormwater mitigation, an alternate solution utilisign a form of onsite attenuation will be sized to ensure post development stormwater neutrality is achieved. Given the large lot sized of the development, there is significant flexibility to accommodate any required attenuation method.

3.1.2.8. Stormwater Easements

The previously referenced unnamed ephemeral drain running through the southern portion of the site provides the main drainage corridor and discharge location for the majority of the development site. It is recommended that easements in gross be provided in favour of the CHBDC at the time of survey certification when applicable.

No works are proposed to be undertaken on or within the drain (excluding pipe discharges). The proposed easement will protect the drain from any work or other activity being undertaken which may cause or lead to failure of the bank. Any development undertaken near the drain will require geotechnical investigation, which will assess and mitigate any potential impacts to the drain structure.

3.2. Stormwater Infrastructure Maintenance

Once the vegetated swales and or infiltration pits have been constructed and planted, they must be inspected and maintained at regular intervals to ensure they are functioning properly and satisfy the design intent.

The ongoing maintenance of the private stormwater systems is to be undertaken by the individual owners of the systems. All vested systems are to be maintained by CHBDC.

Maintenance Schedules have been developed by Auckland Council for the systems to ensure functionality of the swales. It is recommended that maintenance carried out is to be recorded at the time of the inspection and/or maintenance is undertaken. A copy of the maintenance schedule developed by Auckland Council is presented in **Appendix E**. The following maintenance summary has been devised in accordance with Auckland Council's *Swales & Filter Strips – Operation & Maintenance Guide* and Auckland Regional Council's *Technical Publication 10 – Chapter 10 Infiltration design construction & maintenance*.

3.2.1. Inspection Requirements

Maintenance personnel should be encouraged to report and document changes in vegetation type within the swales. Photographic documentation and mapping of the vegetation types are to be recorded annually to determine any changes in vegetation.

Through these procedures a reliable maintenance database can be developed and used to determine if the maintenance undertaken is ensuring the Stormwater Quality Improvement Device (SQID) is functioning as intended.

3.2.2. Monitoring

Visual monitoring is to occur regularly throughout the year. To ensure the swales are effectively maintained, it is recommended visual inspections be undertaken following each storm event and at monthly and two-yearly intervals. Maintenance is to be undertaken if deemed necessary following any inspection.

3.2.2.1. Following Storm Events

Visual inspections of the swales and pits are to occur no more than 72 hours following any rainfall event if the total rainfall exceeds 100mm. As documented in **Appendix E**, inspections following storm event should focus on scouring along the banks or base of the swale and the culmination of debris throughout the swale and pits or at the outlet. Any debris throughout the swales and pits are to be removed. If scouring is significant and expected to change the flow regime within the swale, repair with soil or replanting.

3.2.2.2. Monthly

During the monthly inspection, attention should be paid to the swale outlet (if applicable) to ensure no scouring or erosion has occurred, if required, repair as necessary. Vegetation throughout the swale is to be maintained to a length of 150mm, ensure excess clippings are removed from the swale. Furthermore, ensure plant growth is healthy by removing any weeds and replanting gaps in the vegetation. Debris within the systems are to be removed.

3.2.2.3. Two Yearly

During the two-yearly inspection, attention is to be paid to the base of the swale and pits to ensure no extended ponding has occurred by looking for ponding water or muddy areas. Furthermore, ensure soil has not compacted, loosening, and aerating as necessary. Remove any accumulation of debris throughout the swale and inspect the swale outlet to ensure integrity.

3.2.2.4. Pipe Maintenance

If applicable, inspections are to be undertaken to ensure the pipes are clear of blockages and or silt buildup. Inspections are to be undertaken during the scheduled monitoring / inspections. If blockages or silt buildup is evident, these are to be cleared immediately.

3.3. Regional Stormwater Assessment

The existing ephemeral drain traversing the site is the primary discharge location for an upstream stormwater catchment of approximately 1,930 ha. To understand the quantity of flows discharging to, and the conveyance capacity of the drain, a regional stormwater assessment was undertaken.

Due to the size and length of the upstream catchment (extending 10 km to the west), standard rational method calculations were deemed an inappropriate method for determining the flow within the channel as this calculation does not consider routing between catchments. As such a hydrological model was prepared using Autodesk's *Storm & Sanitary Analysis* (2020).

The following section provides a summary of the contributing catchments and the analysis undertaken to determine the quantity of flows discharging to the site.

3.3.1. Regional Stormwater Drainage Conditions

The upstream catchment extends approximately 10km to the west, expanding across approximately 1,930ha. A network of meandering valleys convey runoff east before converging on a relatively flat plain gently flowing towards an ephemeral drain. The drain continues east towards and ultimately through the site.

An overland flow path also traverses the southern portion of the site approximately 150 to 200m to the south of the ephemeral drain. This overland flow path ultimately discharges to the ephemeral drain. It is proposed the overland flow path will be channelised and diverted within the site to optimise the developable area of the related Lots.

Refer to drawing H20210003-RC-C503 in **Appendix F** for the regional catchment and overland flow pathways.

3.3.2. Regional Stormwater Hydrology

To ensure routing between each catchment is considered, stormwater quantity analysis was undertaken using the AutoDesk Storm and Sanitary Analysis (ACAD SSA) software, which is a 1D hydraulic modelling software that allows for the modelling of watershed catchments and complex drainage systems. Rational method calculations were undertaken to verify the results determined in the hydraulic model.

3.3.3. Regional Catchment Data

Catchment parameters were delineated based on aerial imagery, LIDAR data and UAV data for flows discharging to the ephemeral drain / overland flow path and the site in general. Refer to drawing H20210003-RC-C503 in **Appendix F** for the regional catchment and overland flow pathways.

The development site currently consists of agricultural pasture. The pre-developed run-off coefficients for the development are derived from Table 1 of clause E1 in the New Zealand Building Code for Surface Water (Rational Method):

- Bush - 0.25

Table 3-6 Regional Catchment Data

REGIONAL CATCHMENT DATA			
Catchment Area Name	**Catchment Area (ha)**	**Runoff Coefficient (C)**	**Time of Concentration (Tc)**
Discharge to Ephemeral Stream			
EXT-A	24.273	0.25	15 min
EXT-B	30.423	0.25	13 min
EXT-C	99.712	0.25	38 min
EXT-D	81.826	0.25	19 min
EXT-E	51.558	0.25	14 min
EXT-F	80.408	0.25	18 min
EXT-G	117.351	0.25	28 min
EXT-H	41.717	0.25	15 min
EXT-I	137.906	0.25	33 min
EXT-J	69.038	0.25	21 min
EXT-K	80.139	0.25	23 min
EXT-L	51.913	0.25	19 min
EXT-M	109.106	0.25	17 min
EXT-N	62.415	0.25	23 min
EXT-O	124.441	0.25	49 min
EXT-P	95.508	0.25	31 min
EXT-Q	154.901	0.25	47 min
EXT-R	26.263	0.25	15 min
EXT-S	104.517	0.25	38 min
EXT-T	91.624	0.25	55 min
EXT-U	121.391	0.25	41 min
EXT-V	31.915	0.25	13 min
EXT-X	41.252	0.25	53 min
EXT-Y	38.051	0.25	33 min
Discharge to Overland Flow Path			
EXT-W	62.674	0.25	49 min
Sheet Flow Dischage to Site			
EXT-Z	33.917	0.25	33 min
EXT-AA	32.354	0.25	36 min
EXT-AB	107.455	0.25	43 min

3.3.4. Rainfall Data

Rainfall intensity data was generated using NIWA's *High Intensity Rainfall Design System – V4* for the the site. Calculations were based on the RCP6.0 for period 2081-2100 rainfall data

3.3.5. Stormwater Run-off Summary

Table 3-2 below demonstrates the watershed generated on each catchment shown on Drawing No. H20210003-RC-C503 in **Appendix F**. Note as the site will utilise onsite soakage to dispose of any additional runoff generated by the potential hardstand, the following results depict the site under "pre-developed" conditions for a conservative flow within the channels.

Table 3-7 Regional Catchment Runoff Flows

REGIONAL CATCHMENT RUNOFF FLOWS					
Catchment Area Name	**1:2 year flood** 0.534	**1:5 year flood** 0.852	**1:10 year flood** 1.116	**1:50 year flood** 1.978	**1:100 year flood** 2.428
Discharge to Ephemeral Stream					
EXT-A	0.534	0.852	1.116	1.978	2.428
EXT-B	0.712	1.140	1.496	2.662	3.277
EXT-C	1.454	2.283	2.955	5.109	6.213
EXT-D	1.617	2.570	3.355	5.903	7.206
EXT-E	1.170	1.871	2.453	4.357	5.355
EXT-F	1.638	2.606	3.405	6.004	7.341
EXT-G	1.919	3.025	3.926	6.831	8.320
EXT-H	0.924	1.476	1.933	3.428	4.208
EXT-I	2.106	3.312	4.291	7.437	9.054
EXT-J	1.289	2.042	2.660	4.662	5.677
EXT-K	1.448	2.292	2.984	5.220	6.357
EXT-L	1.007	1.598	2.085	3.663	4.467
EXT-M	2.276	3.627	4.742	8.375	10.253
EXT-N	1.119	1.770	2.304	4.029	4.906
EXT-O	1.622	2.538	3.278	5.630	6.829
EXT-P	1.489	2.343	3.037	5.270	6.418
EXT-Q	2.066	3.235	4.180	7.191	8.728
EXT-R	0.578	0.924	1.210	2.145	2.633
EXT-S	1.525	2.395	3.100	5.361	6.520
EXT-T	1.104	1.724	2.222	3.797	4.597
EXT-U	1.723	2.704	3.499	6.041	7.342
EXT-V	0.751	1.203	1.578	2.809	3.457
EXT-X	0.515	0.804	1.038	1.777	2.154
EXT-Y	0.581	0.914	1.185	2.053	2.500
Discharge to Overland Flow Path					
EXT-W	0.812	1.270	1.640	2.816	3.415
Sheet Flow Discharge to Site					
EXT-Z	0.522	0.821	1.064	1.845	2.247
EXT-AA	0.484	0.760	0.985	1.705	2.075
EXT-AB	1.488	2.334	3.018	5.203	6.320

Refer to **Appendix C** for the detailed calculations.

3.3.6. Ephemeral Stream Conveyance Capacity

Table 3-8 below summarises the combined flow at the property boundary.

Table 3-8 Site Inflow

SITE INFLOW*					
LOCATION	**1:2 year flood**	**1:5 year flood**	**1:10 year flood**	**1:50 year flood**	**1:100 year flood**
1	0.365	0.511	0.634	0.973	1.143
2	17.350	24.322	29.963	45.291	52.919
3	0.498	0.694	0.851	1.274	1.483
4	0.456	0.635	0.778	1.161	1.351
5	1.394	1.937	2.365	3.514	4.082

**Note, flows documented in above do not consider the type of flows conveyed across the boundary, ie, flows at location 1 & 2 are likely to be channelised within the stream and overland flow path whilst locations 3 to 5 are likely to be under sheet flow conditions due to the flat nature of the catchment.*

Cross-sections were cut at 50m intervals along the ephemeral drain (utilising LIDAR data) and input in to the hydrological model to determine the conveyance capacity of the the channel. As demonstrated in the *Link Flow Summary* of the ACAD SSA model output file in **Appendix D**. The assessment determines the existing ephemeral drain has capacity to convey flows generated by the upstream catchment.

3.3.7. Proposed Overland Flow Path Diversion

While the majority of the upstream catchment is conveyed within the ephemeral drain, a small external catchment does discharge to the site via an existing overland flow path (approximately 150 to 200m to the south of the ephemeral drain). As demonstrated in **Table 3-8** above, this overland flow path is expected to convey up to 3.41m³/s (100yr storm event). To best manage this overland flow path, it is proposed an engineered swale be constructed along the boundary of Lots 38, 45, 46 & 50 to direct this into the main ephemeral drain. **Table 3-9** below summarises the proposed overland flow path diversion swale parameters.

Table 3-9 Post-Development Runoff Flows

Parameter	Value
Top Width (m)	4.5
Base Width (m)	0.5
Batter	4
Depth (m)	0.5

3.3.8. Remaining External Discharge

The site is also subject to sheet flow discharge from the remaining external catchments to the north west. This runoff, denoted as *Sheet Flow Discharge to Site* in **Table 3-8** is considered as sheet flow discharge to the site due to the wide and flat flow paths of the catchment. This runoff will be collected within the Lot 431 road side swale. Due to the size of each lot, this runoff is not expected to result in notable scouring or channelisation within the lots.

4. WATER SUPPLY

4.1. Existing & Proposed Water Services Infrastructure

There is no reticulated water network in the vicinity of the site. As such, potable water supply will be via onsite collection and storage methods.

4.2. Post-Development Water Supply

Potable water supply for each lot will be sourced from rainwater collected from roofs and stored in individual storage tanks or via an onsite bore. Further details of tank size or bore details are to be provided at building consent stage for each lot.

4.3. Firefighting Demand

Each lot will have individual firefighting water supply arrangements. Thse firefighting arrangements are to be confirmed at the time of building consent based on the lot specific design. All firefighting arrangements are to be in accordance with the New Zealand Fire Service - *Firefighting Water Supplies Code of Practice SNZ PAS 4509:2008*.

The following options are recommended for a single family residential dwellings in accordance with the *SNZ PAS 4509:2008*:

- *Non-Sprinkler* – dwellings with no sprinkler system installed (water supply classification – FW2) are to provide a minimum water supply of 45m³.
- *Sprinkler System* – dwellings with a sprinkler system installed (water supply classification – FW1) are to provide a mimium water supply of 7m³.

Confirmation and design of water supply for each dwelling is to be undertaken at building consent stage.

If a commercial / industrial development does occur, a development specific firefighting arrangement is to be design based on the proposed activity and building characteristics

5. WASTEWATER

5.1. Existing & Proposed Wastewater Infrastructure

There is no reticulated wastewater network in the vicinity of the site. As such, domestic wastewater disposal will be via individual lot onsite methods.

5.2. Post-Development Wastewater

As there is no council reticulated wastewater system in the vicinity of the site, each lot will require onsite treatment for wastewater. A wastewater management site evaluation undertaken by Freeman Cook Associates Pty Ltd documented in the *Preliminary On-Site Wastewater Management Site Evaluation Report* (dated April 2021) determind the following.

- The flat nature of the site will allow for the onsite wastewater disposal.
- The soil composition varies across the site. All soils are appropriate for on-site disposal, however further investigation at building consent will be necessary to ensure the correct method and size of disposal is installed.
- Ground water, as discussed in **Section 6.3.1** below is greater than 2m below ground level which exceeds the minimum discharge depth of 0.6m.
- No stability issues are anticipated.

- On-site disposal will have a minimal environmental impact.

Design of each system will be required to be undertaken at Building Consent stage.

6. EARTHWORKS

6.1. Earthworks

Earthworks to be undertaken on site include the formation of the internal road, associated road reserve infrastructure and remediation of contaminated soils (as discussed in **Section 6.2**). All earthworks within the proposed lots such as building foundation pads or driveways are to be undertaken at building consent stage for each Lot.

6.2. Soil Contamination

A Detailed Site Investigation (DSI) was undertaken to determine the presence and concentration of any soil contaminants within the site. Refer to Geosciences Ltd (GSL) *Detailed Site Investigation (DSI) for Springhill Farm Lifestyle Development, State Highway 50, Ongaonga* (Reference REP-H0151/DSI/Apr21) for details.

The following sections provide a summary of the findings of the DSI undertaken by Geosciences.

6.2.1. HAIL Activities

During GSL's DSI, it was determined HAIL Activities were identified within isolated areas of the site. These activites included:

- Sheep dip / spray race;
- Potential use of lead based paints;
- Farm Dump;
- Fuel storage drums; and
- Onsite wastewater discharge to land.

Based on the results of the soil sampling undertaken throughout the site, there is a potential risk to human health and sensitive environmental receptors due to the concentration of identified priority soil contaminants. As such remedial actions will be required to mitigate these potential risks.

6.2.2. Remediation Action Plan

Following the DSI, GSL prepared a *Draft Remediation Action Plan (RAP) for Springhill Farm Lifestyle Development, State Highway 50, Ongaonga* (Reference: REP-H0151/SMP/Apr21). The remediation plan details techniques to mitigate the onsite soil contamination. Remediation strategies likely to be undertaken on site are summariesed below:

- Excavate and dispose of (offsite) soils with levels in excess of the commercial and industrial soil contaminant standard. Any refuse / unused septic systems are to be decommissioned.
- Vertical mixing of low level impacted soils to meet the required rural residential soil contaminant standards.

Further details of the remediation action plan will be confirmed following further onsite assessments, delineation and calculations of the impacted soils.

6.3. Geotechncial Investigation

Initia Limited were engaged to undertake a geotechnical investigation as documented in the *Springhill Farm Lifestyle Development – Preliminary Geotechnical Assessment* (reference: P-001061 Rev 1), dated 14 April 2021. This investigation determined the existing soil composition consists of topsoil comprising of approximately 200mm of alluvial sandy gravels with some cobles and trace boulders.

6.3.1. Groundwater

Groundwater levels assessed approximately found ground water in one test pit at a depth of 3.3m bgl. It is anticipated the groundwater will be limited to a depth no greater than 2m bgl.

6.3.2. Liquifaction

Due to the river deposits across the site, the risk of liquefaction across the site is considered to be negligible.

6.3.3. Foundation Recommendations

Due to the silt and gravel a shallow foundation system such as strip footings or raft foundations are appropriate for a 1 or 2 storey dwelling. If large cobbles and boulders are encountered, it is recommended that the foundation footprint be over excavated and filled with a 200mm layer of hardfill placed and compacted below the foundation.

Further investigation will be require at building consent stage of each lot to confirm foundation details.

6.3.4. Infiltration Characteristics

Due to the permeable nature of the underlying soil composition, it is expected that infiltration / soakage is an appropriate method of both stormwater and wastewater onsite management.

Further investigations are to be undertaken to confirm the suitability and final design parameters of infiltration systems at the time of lot development.

6.4. Erosion and Sediment Control

There is a potential for site earthworks to produce pollution from erosion and sediment migration onsite. A Erosion and Sediment Control Plan (ESCP) will be developed in accordance with the requirements of the Hawke's Bay Regional Council Guidelines for Erosion and Sediment Controls and will be submitted to Central Hawke's Bay District Council for approval with the detailed design drawings for each stage of the proposed development.

7. ROADS, ACCESS RIGHTS OF WAY & PAVED SURFACES

An assessment has been undertaken by East Cape Consulting (ECC) to determine how the proposed development sits within the current network. The following section provides a summary of ECC's investigation.

7.1. Roading Layout

As detailed in *Section 5.2* of ECC's *Transportation Assessment Report, Springhill Subdivison* (dated 30 March 2021) the development will see a variety of access points for the proposed lots as follows:

- Lots 1 to 12 via Wakarara Road,

- Lots 146 to 149 via a shared driveway off Wakarara Road
- Lot 26 and Lot 129 will retain their existing access to SH 50;
- All other lots to be serviced via the internal subdivision network.
- The two roads formed to provide access to the development, one from the State Highway 50 and the other from Wakarara and the circulation roads are proposed to be vested. Waka Kotahi intersection to be design and approved by them with ongoing liaison to be upheld during the process.

The internal networks will see a mixture of 20m and 15m wide transportation corridors to provide vehicle, pedestrian and cycle access around the site as well as providing overland flow paths in the form of roadside swales.

Road servicing less than 10 lots will remain private while roads servicing greater than 10 lots are intended to be vested with council. Refer to drawing H2021003-RC-C400 & C401 in **Appendix D**

7.2. Pavement Design

All pavement designs will be undertaken in accordance with the recommendations of the Geotechnical Engineer. Further details for the road pavements design will be submitted during detailed engineering approval submission of each stage. It is intended for all roads to be chip sealed.

7.3. On-Street Parking

On-street parking will be provided along the new proposed road network. As a rural development with large siuzed lots, related car parking needs are expected to be met within each lot.

7.4. Road Infrastructure Assets Private/Public

It is proposed for the circulation roads to be vested to council whilst the access lots servicing less than 10 lots to remain private.

7.5. Stream Crossings

Two bridges (or culvert structures) are required for the road crossing the ephemeral stream. Design of these structures are to be undertaken at detailed design.

8. UTILITY SERVICES

The utility companies Centralines (power) and Chorus (telecommunications) have been consulted regarding servicing the site. It has been indicated that power and telecommunications may be available for reticulation throughout the site, subject to the detailed design process

Centralines are busy compiling a master reticulation layout design. Designs will be formalised and approved during detailed engineering approval or 224 applications for each stage, acknowledging that the CHBDC District Plan and Engineering Code of Practice does not specifically require these services to be reticulated.

9. CONCLUSION

The servicing, earthworks and roading proposed for the proposed Springhill development, has been designed with guidance from the New Zealand Standard *Land Development and Subdivisions Infrastructure – NZ4404:2010*. The servicing strategy is summarised below:

- Earthworks – Earthworks will be undertaken on site including remedial works as per GeoSciences Ltd *Detailed Site Investigation* and *Draft Remedial Action Plan.* Earthworks will also be necessary to form roads and private shared accesses throughout the site.
- Roads - Geometrical layout at detailed design will accord with design guidance specified within NZ4404.
- Pavement – To be defined at detailed design in accordance with the geotechnical engineering recommendation. Refer to the typical road and pavement for the preliminary pavement detail, layer works to be confirmed at detailed design
- Stormwater – Excess runoff generated by each dwelling and associated paved curtilage not captured and retained within a domestic water storage system, shall discharge to an onsite infiltration pit or swale. All other runoff generated by the site will be conveyed via overland flow before discharging to the proposed internal roadside swales.The roadside swales will convey flows to the site discharge locations.
- Water – With no reticulated network in the vicinity of the site, each dwelling will be required to provide potable water via onsite solutions such as rainwater storage tanks or a bore.
- Firefighting – Each lot will be required to provide an onsite water source for firefighting purposes.
- Wastewater – Wastewater is to be treated via on-site methods and disposed through effluent dispersal fields.
- Utilities – The relevant utility companies have confirmed the development may be serviceable for both power and telecommunications. Master planning is currently in progress.

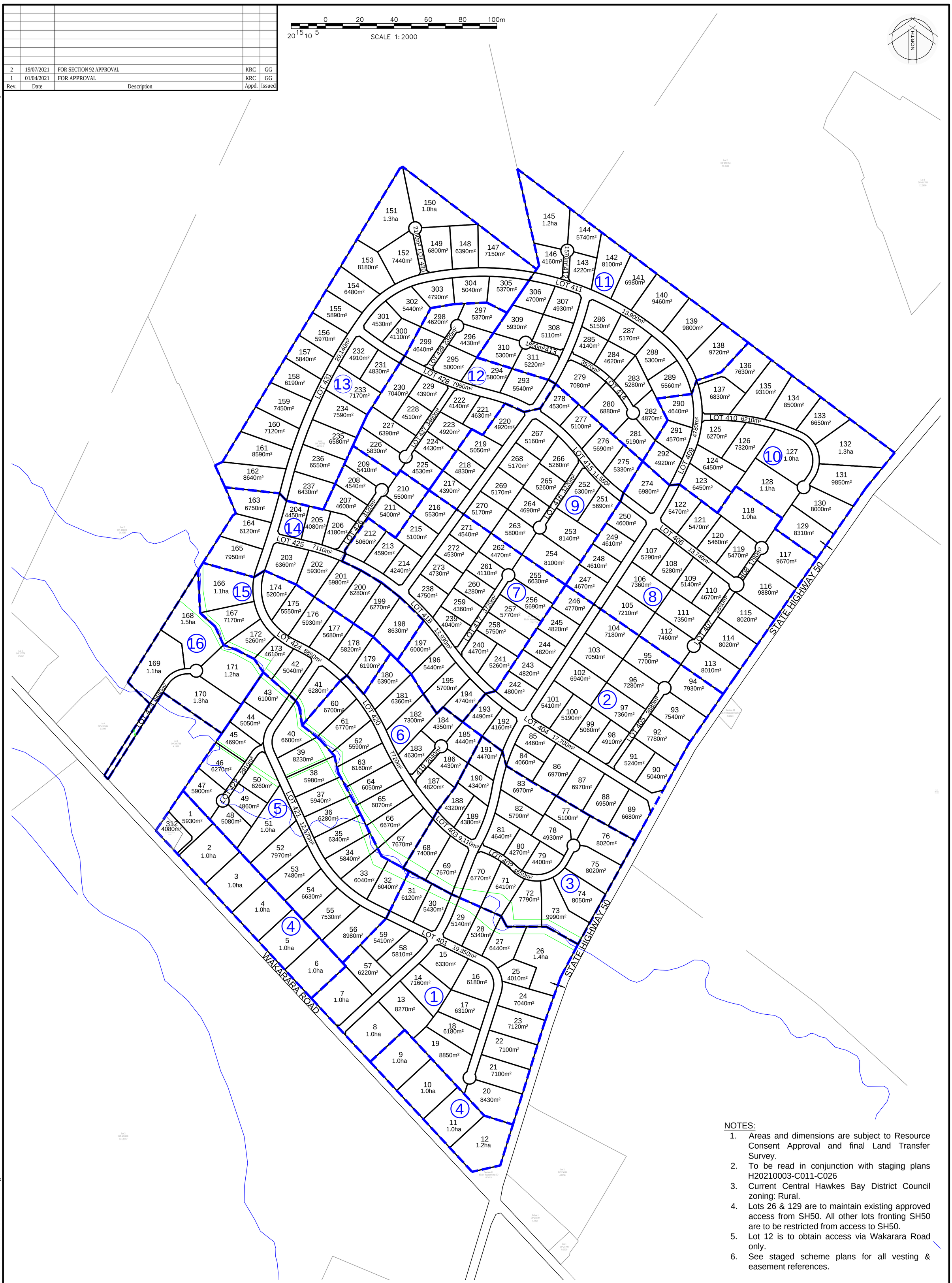
DOCUMENT CONTROL	
PREPARED FOR:	***Springhill Farm Holdings***
PROJECT NAME:	***Springhill Farm Lifestyle Development***
PROJECT NO.:	***H20210003-ESMPR***
FILE REFERENCE:	***Engineering Services Master Planning Report***
DATE:	***29 July 2021***
VERSION:	***2***
AUTHOR(S):	 ***Mitchell Pal*** *CIVIL ENGINEER* *29 July 2021* ***DEVELOPMENT NOUS LIMITED*** *212 Queen St. East, Hastings* *4122 New Zealand* *P.O. Box 385 Hastings 4156* *mitchell.pal@developmentnous.nz*
REVIEWED:	 ***Karl Carew*** *DIRECTOR / LICENSED CADASTRAL SURVEYOR* *29 July 2021* ***DEVELOPMENT NOUS LIMITED*** *212 Queen St. East, Hastings* *4122 New Zealand* *P.O. Box 385 Hastings 4156* *karl.carew@developmentnous.nz*

ENGINEERING SERVICES REPORT

APPENDIX A

PROPOSED SCHEME PLAN

Rev.	Date	Description	Appd.	Issued
2	19/07/2021	FOR SECTION 92 APPROVAL	KRC	GG
1	01/04/2021	FOR APPROVAL	KRC	GG



NOTES:

1. Areas and dimensions are subject to Resource Consent Approval and final Land Transfer Survey.
2. To be read in conjunction with staging plans H20210003-C011-C026
3. Current Central Hawkes Bay District Council zoning: Rural.
4. Lots 26 & 129 are to maintain existing approved access from SH50. All other lots fronting SH50 are to be restricted from access to SH50.
5. Lot 12 is to obtain access via Wakarara Road only.
6. See staged scheme plans for all vesting & easement references.

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ENVIRONMENTAL • LANDSCAPE ARCHITECTURE

Fieldworked		Date
Drawn	LT	19/03/2021
Checked	KRC	25/01/2021
Designed	GG	19/02/2021
Approved	KC	19/03/2021

Client: SPRINGHILL FARM HOLDINGS

Project: 1200 STATE HIGHWAY 50 & 612 WAKARARA ROAD, ONGAONGA
SPRINGHILL FARM LIFESTYLE DEVELOPMENT
OVERALL SCHEME PLAN

Title: SUBDIVISION OF LOT PT SECTION 2 BLK IV RUATANIWHA SD, SECTION 10 BLK IV RUATANIWHA SD & LOT 2 DP 395788 COMPRISED IN RT HB91/1065, 382377 & HBA2/1134

Status: FOR APPROVAL
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Datum	Council Ref.	Scale	Size
HB2000		1:2000	A1

Drawing Number: H20210003-C010
Revision: 2

DATE PLOTTED: 19 July 2021 10:17 AM BY : GEMMA GUILFORD

XREFs: H20210003_Springhill_CONSENT; XR_EX_BD_Boundaries; hawkes-bay-03m-rural-aerial-photos-2014-2015
CAD File: H:_2021\H20210003 - Springhill\CAD\SURV\H20210003-CONSENT-C010.dwg

ENGINEERING SERVICES REPORT

APPENDIX B

EXISTING SITE PLAN

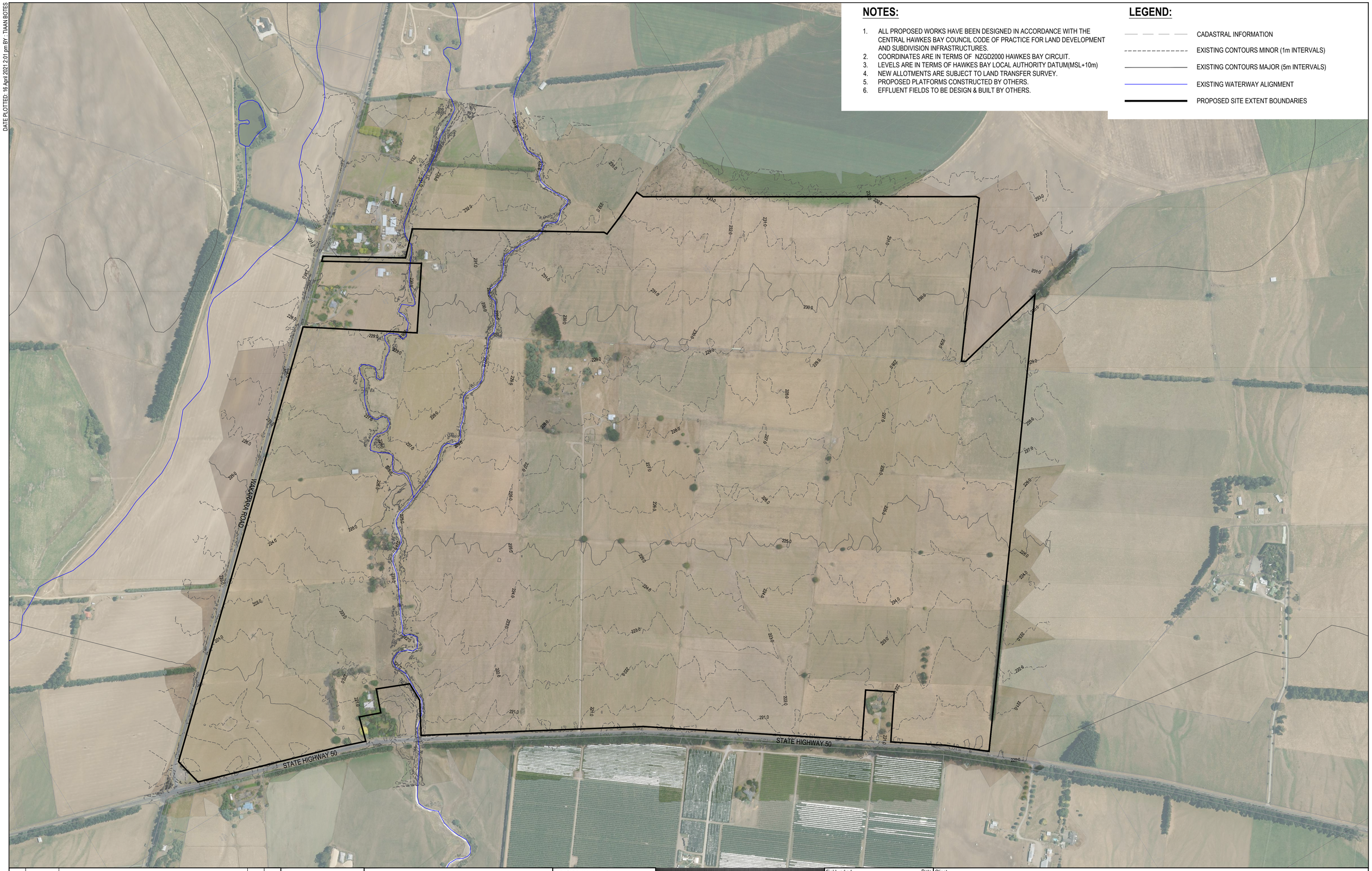
DATE PLOTTED: 16 April 2021 2:01 pm BY: TIAAN BOTES

NOTES:

1. ALL PROPOSED WORKS HAVE BEEN DESIGNED IN ACCORDANCE WITH THE CENTRAL HAWKES BAY COUNCIL CODE OF PRACTICE FOR LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURES.
2. COORDINATES ARE IN TERMS OF NZGD2000 HAWKES BAY CIRCUIT.
3. LEVELS ARE IN TERMS OF HAWKES BAY LOCAL AUTHORITY DATUM(MSL+10m)
4. NEW ALLOTMENTS ARE SUBJECT TO LAND TRANSFER SURVEY.
5. PROPOSED PLATFORMS CONSTRUCTED BY OTHERS.
6. EFFLUENT FIELDS TO BE DESIGN & BUILT BY OTHERS.

LEGEND:

- CADASTRAL INFORMATION
- EXISTING CONTOURS MINOR (1m INTERVALS)
- EXISTING CONTOURS MAJOR (5m INTERVALS)
- EXISTING WATERWAY ALIGNMENT
- PROPOSED SITE EXTENT BOUNDARIES



Rev.	Date	Description	Appd.	Issued
1	14/04/2021	FOR APPROVAL	DS	MP

NORTH

0 100 200 300 400m
SCALE 1:4000 @A1

DEVELOPMENT NOUS
SURVEYING • URBAN DESIGN • ENGINEERING • TOWN PLANNING
ENVIRONMENTAL • LANDSCAPE ARCHITECTURE

Fieldworked MV	Date 19/03/2021	
Drawn TB	Date 26/03/2021	
Checked KC	Date 08/04/2021	
Designed MP	Date 22/03/2021	
Approved DS	Date	

Client: SPRINGHILL FARM HOLDINGS

Project: SPRINGHILL FARM LIFESTYLE DEVELOPMENT

Title: EXISTING SITE PLAN

Status: FOR RESOURCE CONSENT
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Datum	Council Ref.	Scale	Size
HB2000		1:4000	A1

Drawing Number: H20210003-RC-C300

Revision: 1

CAD File: H20210003-RC.dwg

ENGINEERING SERVICES REPORT

APPENDIX C

STORMWATER CALCULATIONS

Springhill - Rational Method Calculation

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]10
Date: 14/04/2021
Job: H20210003

PRE-DEVELOPMENT CATCHMENT DATA			
Catchment Area Name	Catchment Area (ha)	Runoff Coefficient (C)	Time of Concentration (Tc)
Pre-A1	28.781	0.25	52 min
Pre-A2	67.462	0.25	48 min
Pre-A3	42.075	0.25	52 min
Pre-A4	22.310	0.25	37 min
Pre-B1	44.211	0.25	51 min
Pre-B2	52.237	0.25	51 min

POST-DEVELOPMENT CATCHMENT DATA			
Catchment Area Name	Catchment Area (ha)	Runoff Coefficient (C)	Time of Concentration (Tc)
1	18.596	0.27	36 min
2	19.428	0.28	41 min
3	5.525	0.27	41 min
4	8.746	0.28	43 min
5	16.207	0.28	17 min
6	10.232	0.28	33 min
7	10.883	0.29	24 min
8	42.340	0.27	53 min
9	53.555	0.29	60 min
10	42.838	0.26	65 min

PRE-DEVELOPMENT RUNOFF FLOWS					
Catchment Area Name	1:2 year flood (m^3/s)	1:5 year flood (m^3/s)	1:10 year flood (m^3/s)	1:50 year flood (m^3/s)	1:100 year flood (m^3/s)
Pre-A1	0.410	0.571	0.699	1.028	1.182
Pre-A2	0.997	1.393	1.705	2.511	2.890
Pre-A3	0.596	0.831	1.017	1.495	1.718
Pre-A4	0.365	0.512	0.627	0.928	1.070
TOTAL A:	**2.368**	**3.307**	**4.048**	**5.961**	**6.860**
Pre-B1	0.636	0.887	1.086	1.597	1.837
Pre-B2	0.754	1.051	1.287	1.893	2.177
TOTAL B:	**1.390**	**1.939**	**2.373**	**3.490**	**4.015**

POST-DEVELOPMENT RUNOFF FLOWS					
Catchment Area Name	1:2 year flood (m^3/s)	1:5 year flood (m^3/s)	1:10 year flood (m^3/s)	1:50 year flood (m^3/s)	1:100 year flood (m^3/s)
1	0.327	0.459	0.562	0.832	0.960
2	0.325	0.455	0.557	0.823	0.949
3	0.094	0.131	0.161	0.238	0.274
4	0.150	0.210	0.257	0.380	0.438
5	0.406	0.576	0.710	1.067	1.240
6	0.186	0.261	0.321	0.475	0.548
7	0.233	0.329	0.404	0.603	0.698
8	0.605	0.843	1.031	1.516	1.743
TOTAL A:	**2.326**	**3.264**	**4.005**	**5.934**	**6.848**
9	0.765	1.062	1.297	1.899	2.180
10	0.555	0.770	0.941	1.376	1.579
TOTAL B:	**1.320**	**1.832**	**2.238**	**3.276**	**3.759**

Rational Method Peak Flow Estimation - **Catchment** **Pre-A1**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]Pre-A1
Date: 14/04/2021
Job: H20200003
Catchment Area Pre-A1

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	287,812						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		1580	1.0			0.045	**51.90**
							tc (min)	**52 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Medium Soakage - Pusture and scrub cover	0.3	287,812 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.30
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	TRUE
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.25	28.781	20.502	0.410	409.772
5	0.20	0.25	28.781	28.585	0.571	571.336
10	0.10	0.25	28.781	34.980	0.699	699.139
20	0.05	0.25	28.781	41.755	0.835	834.558
50	0.02	0.25	28.781	51.428	1.028	1027.883
100	0.01	0.25	28.781	59.138	1.182	1181.992

Rational Method Peak Flow Estimation - **Catchment** **Pre-A2**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]Pre-A2
Date: 14/04/2021
Job: H20200003
Catchment Area Pre-A2

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	674,621						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		1160	0.9			0.045	**48.18**
							tc (min)	**48 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Medium Soakage - Pusture and scrub cover	0.3	674,621 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.30
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.25	67.462	21.283	0.997	997.085
5	0.20	0.25	67.462	29.726	1.393	1392.629
10	0.10	0.25	67.462	36.393	1.705	1704.974
20	0.05	0.25	67.462	43.479	2.037	2036.914
50	0.02	0.25	67.462	53.597	2.511	2510.971
100	0.01	0.25	67.462	61.680	2.890	2889.622

Rational Method Peak Flow Estimation - **Catchment** **Pre-A3**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]Pre-A3
Date: 14/04/2021
Job: H20200003
Catchment Area Pre-A3

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	420,753						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		1469	0.9			0.045	**52.37**
							tc (min)	**52 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Medium Soakage - Pusture and scrub cover	0.3	420,753 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.30
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.25	42.075	20.401	0.596	596.108
5	0.20	0.25	42.075	28.439	0.831	830.946
10	0.10	0.25	42.075	34.798	1.017	1016.756
20	0.05	0.25	42.075	41.533	1.214	1213.560
50	0.02	0.25	42.075	51.148	1.495	1494.503
100	0.01	0.25	42.075	58.811	1.718	1718.396

Rational Method Peak Flow Estimation - **Catchment** **Pre-A4**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]Pre-A4
Date: 14/04/2021
Job: H20210003
Catchment Area Pre-A4

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	223,096						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		735	1.5			0.045	**37.37**
							tc (min)	**37 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Medium Soakage - Pusture and scrub cover	0.3	223,096 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.30
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.25	22.310	23.553	0.365	364.906
5	0.20	0.25	22.310	33.041	0.512	511.902
10	0.10	0.25	22.310	40.501	0.627	627.476
20	0.05	0.25	22.310	48.487	0.751	751.205
50	0.02	0.25	22.310	59.904	0.928	928.073
100	0.01	0.25	22.310	69.067	1.070	1070.041

Rational Method Peak Flow Estimation - **Catchment** **Pre-B1**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]Pre-B1
Date: 14/04/2021
Job: H20210003
Catchment Area Pre-B1

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	442,106						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		1422	1.0			0.045	**50.86**
							tc (min)	**51 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Medium Soakage - Pusture and scrub cover	0.3	442,106 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.30
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.25	44.211	20.720	0.636	636.132
5	0.20	0.25	44.211	28.903	0.887	887.386
10	0.10	0.25	44.211	35.374	1.086	1086.038
20	0.05	0.25	44.211	42.236	1.297	1296.707
50	0.02	0.25	44.211	52.033	1.597	1597.492
100	0.01	0.25	44.211	59.847	1.837	1837.401

Rational Method Peak Flow Estimation - **Catchment** **Pre-B2**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]Pre-B2
Date: 14/04/2021
Job: H20210003
Catchment Area Pre-B2

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	522,372						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		1401	1.0			0.045	**50.61**
							tc (min)	**51 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Medium Soakage - Pusture and scrub cover	0.3	522,372 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.30
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.25	52.237	20.773	0.754	753.553
5	0.20	0.25	52.237	28.981	1.051	1051.310
10	0.10	0.25	52.237	35.470	1.287	1286.701
20	0.05	0.25	52.237	42.353	1.536	1536.383
50	0.02	0.25	52.237	52.180	1.893	1892.879
100	0.01	0.25	52.237	60.020	2.177	2177.261

Rational Method Peak Flow Estimation - **Catchment 1**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]1
Date: 14/04/2021
Job: H20210003
Catchment Area 1

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²) ***	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	179357						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		474	0.9			0.045	**35.76**
							tc (min)	**36 min**

*Note: Total catchment areas excludes assumed roof area of 300m² per lot as all roof areas are required to discharge roof runoff to on lot soakage pit.

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Grassed	0.3	163,174 m²
Unsealed roads	0.5	12,883 m²
Asphalt and concrete paved surfaces	0.85	3,300 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.32
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.27**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.27	17.936	23.890	0.327	326.707
5	0.20	0.27	17.936	33.534	0.459	458.580
10	0.10	0.27	17.936	41.111	0.562	562.205
20	0.05	0.27	17.936	49.231	0.673	673.248
50	0.02	0.27	17.936	60.840	0.832	832.001
100	0.01	0.27	17.936	70.164	0.960	959.509

Rational Method Peak Flow Estimation - **Catchment 2**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]2
Date: 14/04/2021
Job: H20200003
Catchment Area 2

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)***	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	186777						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		684	0.8			0.045	**41.33**
							tc (min)	**41 min**

*Note: Total catchment areas excludes assumed roof area of 300m² per lot as all roof areas are required to discharge roof runoff to on lot soakage pit.

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Grassed	0.3	169,489 m²
Unsealed roads	0.5	13,538 m²
Asphalt and concrete paved surfaces	0.85	3,750 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.33
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.28**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.28	18.678	22.722	0.325	324.819
5	0.20	0.28	18.678	31.827	0.455	454.983
10	0.10	0.28	18.678	38.996	0.557	557.474
20	0.05	0.28	18.678	46.652	0.667	666.924
50	0.02	0.28	18.678	57.593	0.823	823.331
100	0.01	0.28	18.678	66.360	0.949	948.666

Rational Method Peak Flow Estimation - **Catchment 3**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]3
Date: 14/04/2021
Job: H20210003
Catchment Area 3

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)***	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	54051						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		164	0.4			0.045	**29.54**
							tc (min)	**41 min**

*Note: Total catchment areas excludes assumed roof area of 300m² per lot as all roof areas are required to discharge roof runoff to on lot soakage pit.

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Grassed	0.3	48,786 m²
Unsealed roads	0.5	4,665 m²
Asphalt and concrete paved surfaces	0.85	600 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.32
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.27**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.27	5.405	22.829	0.094	93.699
5	0.20	0.27	5.405	31.984	0.131	131.273
10	0.10	0.27	5.405	39.191	0.161	160.854
20	0.05	0.27	5.405	46.890	0.192	192.453
50	0.02	0.27	5.405	57.892	0.238	237.610
100	0.01	0.27	5.405	66.711	0.274	273.805

Rational Method Peak Flow Estimation - **Catchment 4**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]4
Date: 14/04/2021
Job: H20210003
Catchment Area 4

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)***	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	86258						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		115	1.0			0.045	**21.85**
4.6.8 QUDM (2013) or E1_2.3.2 table 2	Road/Channel		725	0.8				**20.81**
							tc (min)	**43 min**

*Note: Total catchment areas excludes assumed roof area of 300m² per lot as all roof areas are required to discharge roof runoff to on lot soakage pit.

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Grassed	0.3	76,844 m²
Unsealed roads	0.5	7,614 m²
Asphalt and concrete paved surfaces	0.85	1,800 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.33
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.28**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.28	8.626	22.442	0.150	150.094
5	0.20	0.28	8.626	31.418	0.210	210.129
10	0.10	0.28	8.626	38.490	0.257	257.425
20	0.05	0.28	8.626	46.035	0.308	307.888
50	0.02	0.28	8.626	56.816	0.380	379.993
100	0.01	0.28	8.626	65.450	0.438	437.740

Rational Method Peak Flow Estimation - **Catchment 5**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]5
Date: 14/04/2021
Job: H20210003
Catchment Area 5

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)***	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	155470						**0.00**
4.6.8 QUDM (2013) or E1_2.3.2 table 2	Road/Channel		636	0.9				**16.76**
							tc (min)	**17 min**

*Note: Total catchment areas excludes assumed roof area of 300m² per lot as all roof areas are required to discharge roof runoff to on lot soakage pit.

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Grassed	0.3	135,817 m²
Unsealed roads	0.5	16,353 m²
Asphalt and concrete paved surfaces	0.85	3,300 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.33
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.28**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.28	15.547	33.267	0.406	406.160
5	0.20	0.28	15.547	47.154	0.576	575.716
10	0.10	0.28	15.547	58.183	0.710	710.363
20	0.05	0.28	15.547	70.141	0.856	856.361
50	0.02	0.28	15.547	87.382	1.067	1066.861
100	0.01	0.28	15.547	101.529	1.240	1239.582

Rational Method Peak Flow Estimation - **Catchment 6**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]6
Date: 14/04/2021
Job: H20210003
Catchment Area 6

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)***	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	98115						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		344	0.8			0.045	**32.56**
							tc (min)	**33 min**

*Note: Total catchment areas excludes assumed roof area of 300m² per lot as all roof areas are required to discharge roof runoff to on lot soakage pit.

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Grassed	0.3	88,067 m²
Unsealed roads	0.5	7,948 m²
Asphalt and concrete paved surfaces	0.85	2,100 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.33
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.28**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.28	9.812	24.562	0.186	186.079
5	0.20	0.28	9.812	34.514	0.261	261.477
10	0.10	0.28	9.812	42.326	0.321	320.661
20	0.05	0.28	9.812	50.713	0.384	384.196
50	0.02	0.28	9.812	62.705	0.475	475.050
100	0.01	0.28	9.812	72.349	0.548	548.110

Rational Method Peak Flow Estimation - **Catchment 7**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]7
Date: 14/04/2021
Job: H20210003
Catchment Area 7

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)***	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	103430						**0.00**
4.6.8 QUDM (2013) or E1_2.3.2 table 2	Road/Channel		829	0.8				**23.59**
							tc (min)	**24 min**

*Note: Total catchment areas excludes assumed roof area of 300m² per lot as all roof areas are required to discharge roof runoff to on lot soakage pit.

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Grassed	0.3	88,162 m²
Unsealed roads	0.5	12,568 m²
Asphalt and concrete paved surfaces	0.85	2,700 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.34
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.29**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.29	10.343	28.114	0.233	233.159
5	0.20	0.29	10.343	39.661	0.329	328.919
10	0.10	0.29	10.343	48.751	0.404	404.307
20	0.05	0.29	10.343	58.569	0.486	485.734
50	0.02	0.29	10.343	72.729	0.603	603.165
100	0.01	0.29	10.343	84.168	0.698	698.033

Rational Method Peak Flow Estimation - **Catchment 8**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]8
Date: 14/04/2021
Job: H20210003
Catchment Area 8

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)***	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	404797						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		202	0.9			0.045	**26.92**
4.6.8 QUDM (2013) or E1_2.3.2 table 2	Road/Channel		992	0.9				**26.04**
							tc (min)	**53 min**

*Note: Total catchment areas excludes assumed roof area of 300m² per lot as all roof areas are required to discharge roof runoff to on lot soakage pit.

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Grassed	0.3	390,120 m²
Unsealed roads	0.5	5,377 m²
Asphalt and concrete paved surfaces	0.85	9,300 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.32
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.27**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.27	40.480	20.279	0.605	604.946
5	0.20	0.27	40.480	28.260	0.843	843.023
10	0.10	0.27	40.480	34.577	1.031	1031.452
20	0.05	0.27	40.480	41.264	1.231	1230.931
50	0.02	0.27	40.480	50.810	1.516	1515.675
100	0.01	0.27	40.480	58.414	1.743	1742.521

Rational Method Peak Flow Estimation - **Catchment 9**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]9
Date: 14/04/2021
Job: H20210003
Catchment Area 9

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)***	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	511549						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		240	0.9			0.045	**28.67**
4.6.8 QUDM (2013) or E1_2.3.2 table 2	Road/Channel		1069	0.7				**31.70**
							tc (min)	**60 min**

*Note: Total catchment areas excludes assumed roof area of 300m² per lot as all roof areas are required to discharge roof runoff to on lot soakage pit.

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Grassed	0.3	438,667 m²
Unsealed roads	0.5	60,882 m²
Asphalt and concrete paved surfaces	0.85	12,000 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.34
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.29**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.29	51.155	18.770	0.765	764.695
5	0.20	0.29	51.155	26.057	1.062	1061.576
10	0.10	0.29	51.155	31.847	1.297	1297.445
20	0.05	0.29	51.155	37.936	1.546	1545.512
50	0.02	0.29	51.155	46.620	1.899	1899.280
100	0.01	0.29	51.155	53.507	2.180	2179.865

Rational Method Peak Flow Estimation - **Catchment 10**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(2021 04 12).xlsx]10
Date: 14/04/2021
Job: H20210003
Catchment Area 10

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)***	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	412478						**0.00**
E1_2.3.2(b)(i)	Time of Overland flow		159	1.1			0.045	**23.74**
4.6.8 QUDM (2013) or E1_2.3.2 table 2	Road/Channel		1402	0.7				**40.89**
							tc (min)	**65 min**

*Note: Total catchment areas excludes assumed roof area of 300m² per lot as all roof areas are required to discharge roof runoff to on lot soakage pit.

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Grassed	0.3	399,650 m²
Unsealed roads	0.5	4,878 m²
Asphalt and concrete paved surfaces	0.85	7,950 m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
No Data	0	m²
	Sub-Total:	0.31
Slope Correction for Runoff Coefficients (E1_Table 2)		
0-5%	subtracting	0.05
	Coefficent of Runoff "C"	**0.26**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.26	41.248	18.422	0.555	555.040
5	0.20	0.26	41.248	25.559	0.770	770.102
10	0.10	0.26	41.248	31.228	0.941	940.900
20	0.05	0.26	41.248	37.189	1.121	1120.504
50	0.02	0.26	41.248	45.681	1.376	1376.351
100	0.01	0.26	41.248	52.418	1.579	1579.361

Springhill External Catchment - Rational Method Calculation Summary

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater_Runoff_R1(External).xlsx]Runoff Summary For Report
Date: 23/07/2021
Job: H20200078

PRE-DEVELOPMENT CATCHMENT DATA			
Catchment Area Name	Catchment Area (ha)	Runoff Coefficient (C)	Time of Concentration (Tc)
EXT-A	24.273	0.25	15 min
EXT-B	30.423	0.25	13 min
EXT-C	99.712	0.25	38 min
EXT-D	81.826	0.25	19 min
EXT-E	51.558	0.25	14 min
EXT-F	80.408	0.25	18 min
EXT-G	117.351	0.25	28 min
EXT-H	41.717	0.25	15 min
EXT-I	137.906	0.25	33 min
EXT-J	69.038	0.25	21 min
EXT-K	80.139	0.25	23 min
EXT-L	51.913	0.25	19 min
EXT-M	109.106	0.25	17 min
EXT-N	62.415	0.25	23 min
EXT-O	124.441	0.25	49 min
EXT-P	95.508	0.25	31 min
EXT-Q	154.901	0.25	47 min
EXT-R	26.263	0.25	15 min
EXT-S	104.517	0.25	38 min
EXT-T	91.624	0.25	55 min
EXT-U	121.391	0.25	41 min
EXT-V	31.915	0.25	13 min
EXT-W	62.674	0.25	49 min
EXT-X	41.252	0.25	53 min
EXT-Y	38.051	0.25	33 min
EXT-Z	33.917	0.25	33 min
EXT-AA	32.354	0.25	36 min
EXT-AB	107.455	0.25	43 min

PRE-DEVELOPMENT RUNOFF FLOWS					
Catchment Area Name	1:2 year flood (m^3/s)	1:5 year flood (m^3/s)	1:10 year flood (m^3/s)	1:50 year flood (m^3/s)	1:100 year flood (m^3/s)
EXT-A	0.534	0.852	1.116	1.978	2.428
EXT-B	0.712	1.140	1.496	2.662	3.277
EXT-C	1.454	2.283	2.955	5.109	6.213
EXT-D	1.617	2.570	3.355	5.903	7.206
EXT-E	1.170	1.871	2.453	4.357	5.355
EXT-F	1.638	2.606	3.405	6.004	7.341
EXT-G	1.919	3.025	3.926	6.831	8.320
EXT-H	0.924	1.476	1.933	3.428	4.208
EXT-I	2.106	3.312	4.291	7.437	9.054
EXT-J	1.289	2.042	2.660	4.662	5.677
EXT-K	1.448	2.292	2.984	5.220	6.357
EXT-L	1.007	1.598	2.085	3.663	4.467
EXT-M	2.276	3.627	4.742	8.375	10.253
EXT-N	1.119	1.770	2.304	4.029	4.906
EXT-O	1.622	2.538	3.278	5.630	6.829
EXT-P	1.489	2.343	3.037	5.270	6.418
EXT-Q	2.066	3.235	4.180	7.191	8.728
EXT-R	0.578	0.924	1.210	2.145	2.633
EXT-S	1.525	2.395	3.100	5.361	6.520
EXT-T	1.104	1.724	2.222	3.797	4.597
EXT-U	1.723	2.704	3.499	6.041	7.342
EXT-V	0.751	1.203	1.578	2.809	3.457
EXT-W	0.812	1.270	1.640	2.816	3.415
EXT-X	0.515	0.804	1.038	1.777	2.154
EXT-Y	0.581	0.914	1.185	2.053	2.500
EXT-Z	0.522	0.821	1.064	1.845	2.247
EXT-AA	0.484	0.760	0.985	1.705	2.075
EXT-AB	1.488	2.334	3.018	5.203	6.320

Rational Method Peak Flow Estimation - **Catchment EXT-A**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-A

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	242732						**0.00**
E1_2.3.6	Alternative method		1251		60			**15.23**
							tc (min)	**15 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	242,732 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	24.273	37.244	0.534	533.629
5	0.20	0.24	24.273	53.218	0.852	852.215
10	0.10	0.25	24.273	66.211	1.116	1116.082
20	0.05	0.26	24.273	80.590	1.426	1426.382
50	0.02	0.29	24.273	102.052	1.978	1978.255
100	0.01	0.30	24.273	120.022	2.428	2427.773

Rational Method Peak Flow Estimation - **Catchment EXT-B**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-B

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	304234						**0.00**
E1_2.3.6	Alternative method		1093		60			**13.04**
							tc (min)	**13 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	304,234 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	30.423	39.658	0.712	712.184
5	0.20	0.24	30.423	56.817	1.140	1140.374
10	0.10	0.25	30.423	70.819	1.496	1496.226
20	0.05	0.26	30.423	86.339	1.915	1915.329
50	0.02	0.29	30.423	109.578	2.662	2662.364
100	0.01	0.30	30.423	129.239	3.277	3276.566

Rational Method Peak Flow Estimation - **Catchment EXT-C**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-C

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	997120						**0.00**
E1_2.3.6	Alternative method		3047		80			**38.13**
							tc (min)	**38 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Bush	0.25	997,120 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	**AEP**	**C**	**A (ha)**	**I (mm/hr)**	**Q (m^3/s)**	**Q (l/s)**
2	0.50	0.21	99.712	24.696	1.454	1453.532
5	0.20	0.24	99.712	34.702	2.283	2282.764
10	0.10	0.25	99.712	42.671	2.955	2954.697
20	0.05	0.26	99.712	51.431	3.739	3739.367
50	0.02	0.29	99.712	64.158	5.109	5108.961
100	0.01	0.30	99.712	74.774	6.213	6213.256

Rational Method Peak Flow Estimation - **Catchment EXT-D**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-D

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	818257						**0.00**
E1_2.3.6	Alternative method		1878		120			**18.65**
							tc (min)	**19 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Bush	0.25	818,257 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	**AEP**	**C**	**A (ha)**	**I (mm/hr)**	**Q (m^3/s)**	**Q (l/s)**
2	0.50	0.21	81.826	33.486	1.617	1617.346
5	0.20	0.24	81.826	47.615	2.570	2570.350
10	0.10	0.25	81.826	59.036	3.355	3354.624
20	0.05	0.26	81.826	71.638	4.274	4274.262
50	0.02	0.29	81.826	90.332	5.903	5902.921
100	0.01	0.30	81.826	105.672	7.206	7205.565

Rational Method Peak Flow Estimation - **Catchment EXT-E**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-E

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	515582						**0.00**
E1_2.3.6	Alternative method		813		20			**14.13**
							tc (min)	**14 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	515,582 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	51.558	38.452	1.170	1170.223
5	0.20	0.24	51.558	55.019	1.871	1871.413
10	0.10	0.25	51.558	68.517	2.453	2453.193
20	0.05	0.26	51.558	83.467	3.138	3137.886
50	0.02	0.29	51.558	105.817	4.357	4357.022
100	0.01	0.30	51.558	124.633	5.355	5354.896

Rational Method Peak Flow Estimation - **Catchment EXT-F**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date: 23/07/2021
Job: H20200078
Catchment Area EXT-F

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	804077						**0.00**
							tc (min)	**18 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Bush	0.25	804,077 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	80.408	34.501	1.638	1637.518
5	0.20	0.24	80.408	49.129	2.606	2606.123
10	0.10	0.25	80.408	60.975	3.405	3404.745
20	0.05	0.26	80.408	74.057	4.342	4342.006
50	0.02	0.29	80.408	93.499	6.004	6003.966
100	0.01	0.30	80.408	109.549	7.341	7340.509

Rational Method Peak Flow Estimation - **Catchment EXT-G**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date: 23/07/2021
Job: H20200078
Catchment Area EXT-G

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	1173505						**0.00**
E1_2.3.6	Alternative method		2521		100			**28.11**
							tc (min)	**28 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Bush	0.25	1,173,505 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	117.351	27.702	1.919	1918.903
5	0.20	0.24	117.351	39.075	3.025	3025.113
10	0.10	0.25	117.351	48.172	3.926	3925.677
20	0.05	0.26	117.351	58.207	4.981	4980.623
50	0.02	0.29	117.351	72.887	6.831	6830.798
100	0.01	0.30	117.351	85.079	8.320	8320.028

Rational Method Peak Flow Estimation - **Catchment EXT-H**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-H

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	417167						**0.00**
E1_2.3.6	Alternative method		1161		50			**14.99**
							tc (min)	**15 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	417,167 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	41.717	37.511	0.924	923.677
5	0.20	0.24	41.717	53.616	1.476	1475.583
10	0.10	0.25	41.717	66.720	1.933	1932.880
20	0.05	0.26	41.717	81.225	2.471	2470.744
50	0.02	0.29	41.717	102.883	3.428	3427.591
100	0.01	0.30	41.717	121.040	4.208	4207.840

Rational Method Peak Flow Estimation - **Catchment EXT-I**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-I

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	1379059						**0.00**
E1_2.3.6	Alternative method		2154		40			**33.35**
							tc (min)	**33 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	1,379,059 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	137.906	25.873	2.106	2106.120
5	0.20	0.24	137.906	36.404	3.312	3312.016
10	0.10	0.25	137.906	44.802	4.291	4290.611
20	0.05	0.26	137.906	54.056	5.436	5435.638
50	0.02	0.29	137.906	67.530	7.437	7437.322
100	0.01	0.30	137.906	78.783	9.054	9053.882

Rational Method Peak Flow Estimation - **Catchment EXT-J**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-J

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	690375						**0.00**
E1_2.3.6	Alternative method		1869		90			**20.72**
							tc (min)	**21 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	690,375 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	69.038	31.619	1.289	1288.522
5	0.20	0.24	69.038	44.840	2.042	2042.241
10	0.10	0.25	69.038	55.489	2.660	2660.274
20	0.05	0.26	69.038	67.223	3.384	3384.012
50	0.02	0.29	69.038	84.565	4.662	4662.397
100	0.01	0.30	69.038	98.678	5.677	5677.058

Rational Method Peak Flow Estimation - **Catchment EXT-K**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-K

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	801391						**0.00**
E1_2.3.6	Alternative method		1398		30			**22.62**
							tc (min)	**23 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	801,391 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	80.139	30.614	1.448	1448.168
5	0.20	0.24	80.139	43.360	2.292	2292.424
10	0.10	0.25	80.139	53.611	2.984	2983.555
20	0.05	0.26	80.139	64.909	3.793	3792.956
50	0.02	0.29	80.139	81.568	5.220	5220.332
100	0.01	0.30	80.139	95.188	6.357	6356.882

Rational Method Peak Flow Estimation - **Catchment EXT-L**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date: 23/07/2021
Job: H20200078
Catchment Area EXT-L

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	519128						**0.00**
E1_2.3.6	Alternative method		1061		20			**19.22**
							tc (min)	**19 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Bush	0.25	519,128 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	51.913	32.854	1.007	1006.739
5	0.20	0.24	51.913	46.673	1.598	1598.457
10	0.10	0.25	51.913	57.830	2.085	2084.804
20	0.05	0.26	51.913	70.134	2.655	2654.774
50	0.02	0.29	51.913	88.362	3.663	3663.339
100	0.01	0.30	51.913	103.260	4.467	4467.097

Rational Method Peak Flow Estimation - **Catchment EXT-M**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date: 23/07/2021
Job: H20200078
Catchment Area EXT-M

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	1091064						**0.00**
E1_2.3.6	Alternative method		952		20			**16.96**
							tc (min)	**17 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Bush	0.25	1,091,064 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	109.106	35.342	2.276	2276.158
5	0.20	0.24	109.106	50.383	3.627	3626.577
10	0.10	0.25	109.106	62.581	4.742	4741.650
20	0.05	0.26	109.106	76.061	6.051	6051.160
50	0.02	0.29	109.106	96.122	8.375	8375.465
100	0.01	0.30	109.106	112.762	10.253	10252.527

Rational Method Peak Flow Estimation - **Catchment EXT-N**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-N

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	624146						**0.00**
E1_2.3.6	Alternative method		1243		20			**23.08**
							tc (min)	**23 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	624,146 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	62.415	30.367	1.119	1118.785
5	0.20	0.24	62.415	42.997	1.770	1770.454
10	0.10	0.25	62.415	53.150	2.304	2303.703
20	0.05	0.26	62.415	64.341	2.928	2928.216
50	0.02	0.29	62.415	80.832	4.029	4029.082
100	0.01	0.30	62.415	94.331	4.906	4906.370

Rational Method Peak Flow Estimation - **Catchment EXT-O**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date: 23/07/2021
Job: H20200078
Catchment Area EXT-O

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	1244412						**0.00**
E1_2.3.6	Alternative method		3920		90			**48.74**
							tc (min)	**49 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Bush	0.25	1,244,412 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	124.441	22.077	1.622	1621.675
5	0.20	0.24	124.441	30.916	2.538	2538.068
10	0.10	0.25	124.441	37.929	3.278	3277.721
20	0.05	0.26	124.441	45.592	4.137	4136.972
50	0.02	0.29	124.441	56.656	5.630	5630.499
100	0.01	0.30	124.441	65.857	6.829	6829.473

Rational Method Peak Flow Estimation - **Catchment EXT-P**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date: 23/07/2021
Job: H20200078
Catchment Area EXT-P

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	955080						**0.00**
E1_2.3.6	Alternative method		2446		70			**31.14**
							tc (min)	**31 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Bush	0.25	955,080 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	95.508	26.418	1.489	1489.372
5	0.20	0.24	95.508	37.193	2.343	2343.477
10	0.10	0.25	95.508	45.790	3.037	3037.031
20	0.05	0.26	95.508	55.272	3.849	3849.225
50	0.02	0.29	95.508	69.093	5.270	5270.010
100	0.01	0.30	95.508	80.641	6.418	6418.231

Rational Method Peak Flow Estimation - **Catchment EXT-Q**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-Q

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	1549012						**0.00**
E1_2.3.6	Alternative method		2286		20			**46.65**
							tc (min)	**47 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	1,549,012 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	154.901	22.592	2.066	2065.738
5	0.20	0.24	154.901	31.661	3.235	3235.468
10	0.10	0.25	154.901	38.862	4.180	4180.403
20	0.05	0.26	154.901	46.741	5.279	5279.379
50	0.02	0.29	154.901	58.133	7.191	7191.331
100	0.01	0.30	154.901	67.612	8.728	8727.682

Rational Method Peak Flow Estimation - **Catchment EXT-R**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-R

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	262625						**0.00**
E1_2.3.6	Alternative method		1312		70			**15.17**
							tc (min)	**15 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	262,625 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	26.263	37.317	0.578	578.492
5	0.20	0.24	26.263	53.327	0.924	923.940
10	0.10	0.25	26.263	66.350	1.210	1210.087
20	0.05	0.26	26.263	80.764	1.547	1546.605
50	0.02	0.29	26.263	102.279	2.145	2145.149
100	0.01	0.30	26.263	120.301	2.633	2632.831

Rational Method Peak Flow Estimation - **Catchment EXT-S**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-S

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	1045171						**0.00**
E1_2.3.6	Alternative method		2413		40			**38.03**
							tc (min)	**38 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	1,045,171 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	104.517	24.720	1.525	1525.075
5	0.20	0.24	104.517	34.737	2.395	2395.190
10	0.10	0.25	104.517	42.714	3.100	3100.274
20	0.05	0.26	104.517	51.485	3.924	3923.692
50	0.02	0.29	104.517	64.227	5.361	5360.965
100	0.01	0.30	104.517	74.857	6.520	6519.871

Rational Method Peak Flow Estimation - **Catchment EXT-T**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-T

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	916239						**0.00**
E1_2.3.6	Alternative method		2413		15			**55.47**
							tc (min)	**55 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	916,239 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	91.624	20.416	1.104	1104.186
5	0.20	0.24	91.624	28.514	1.724	1723.573
10	0.10	0.25	91.624	34.921	2.222	2221.969
20	0.05	0.26	91.624	41.889	2.799	2798.569
50	0.02	0.29	91.624	51.898	3.797	3797.476
100	0.01	0.30	91.624	60.201	4.597	4596.576

Rational Method Peak Flow Estimation - **Catchment EXT-U**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-U

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	1213907						**0.00**
E1_2.3.6	Alternative method		1847		15			**40.74**
							tc (min)	**41 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	1,213,907 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	121.391	24.051	1.723	1723.362
5	0.20	0.24	121.391	33.770	2.704	2704.426
10	0.10	0.25	121.391	41.503	3.499	3498.692
20	0.05	0.26	121.391	49.994	4.425	4425.139
50	0.02	0.29	121.391	62.311	6.041	6040.696
100	0.01	0.30	121.391	72.579	7.342	7342.050

Rational Method Peak Flow Estimation - **Catchment** **EXT-V**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date: 23/07/2021
Job: H20200078
Catchment Area EXT-V

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	319146						**0.00**
E1_2.3.6	Alternative method		749		20			**12.86**
							tc (min)	**13 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Bush	0.25	319,146 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	31.915	39.856	0.751	750.836
5	0.20	0.24	31.915	57.113	1.203	1202.508
10	0.10	0.25	31.915	71.199	1.578	1577.972
20	0.05	0.26	31.915	86.813	2.020	2020.224
50	0.02	0.29	31.915	110.198	2.809	2808.654
100	0.01	0.30	31.915	129.998	3.457	3457.349

Rational Method Peak Flow Estimation - **Catchment EXT-W**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-W

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	626744						**0.00**
E1_2.3.6	Alternative method		1838		9			**49.31**
							tc (min)	**49 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	626,744 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	62.674	21.936	0.812	811.525
5	0.20	0.24	62.674	30.711	1.270	1269.843
10	0.10	0.25	62.674	37.673	1.640	1639.679
20	0.05	0.26	62.674	45.277	2.069	2069.176
50	0.02	0.29	62.674	56.251	2.816	2815.523
100	0.01	0.30	62.674	65.376	3.415	3414.513

Rational Method Peak Flow Estimation - **Catchment EXT-X**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-X

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	412515						**0.00**
E1_2.3.6	Alternative method		2303		15			**52.56**
							tc (min)	**53 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	412,515 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	41.252	21.134	0.515	514.614
5	0.20	0.24	41.252	29.552	0.804	804.248
10	0.10	0.25	41.252	36.221	1.038	1037.629
20	0.05	0.26	41.252	43.490	1.308	1308.138
50	0.02	0.29	41.252	53.955	1.777	1777.479
100	0.01	0.30	41.252	62.646	2.154	2153.541

Rational Method Peak Flow Estimation - **Catchment EXT-Y**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-Y

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	380507						**0.00**
E1_2.3.6	Alternative method		1355		10			**33.30**
							tc (min)	**33 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	380,507 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	38.051	25.886	0.581	581.420
5	0.20	0.24	38.051	36.424	0.914	914.336
10	0.10	0.25	38.051	44.827	1.185	1184.504
20	0.05	0.26	38.051	54.086	1.501	1500.628
50	0.02	0.29	38.051	67.569	2.053	2053.269
100	0.01	0.30	38.051	78.829	2.500	2499.591

Rational Method Peak Flow Estimation - **Catchment EXT-Z**

File: H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date: 23/07/2021
Job: H20200078
Catchment Area EXT-Z

Time of Concentration Calculations								
Reference	**Equation Type / Method**	**Area (m²)**	**Length (m)**	**Av. Slope (%)**	**Height diff. of catchment**	**Velocity (m/s)**	**Mannings Roughness**	**tc (mins)**
E1_2.3.2 (a)	Time of entry	339172						**0.00**
E1_2.3.6	Alternative method		1519		15			**32.50**
							tc (min)	**33 min**

Coefficent of Runoff "C" (E1_Table 1)		
Surface Description	**Landuse "Ci"**	**Landuse Area "Ai"**
Bush	0.25	339,172 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	33.917	26.082	0.522	522.183
5	0.20	0.24	33.917	36.707	0.821	821.350
10	0.10	0.25	33.917	45.181	1.064	1064.187
20	0.05	0.26	33.917	54.523	1.348	1348.417
50	0.02	0.29	33.917	68.130	1.845	1845.425
100	0.01	0.30	33.917	79.497	2.247	2246.916

Rational Method Peak Flow Estimation - **Catchment EXT-AA**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-AA

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	323535						**0.00**
E1_2.3.6	Alternative method		1641		15			**35.54**
							tc (min)	**36 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	323,535 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	32.354	25.334	0.484	483.818
5	0.20	0.24	32.354	35.625	0.760	760.389
10	0.10	0.25	32.354	43.826	0.985	984.680
20	0.05	0.26	32.354	52.854	1.247	1246.889
50	0.02	0.29	32.354	65.987	1.705	1704.954
100	0.01	0.30	32.354	76.948	2.075	2074.622

Rational Method Peak Flow Estimation - **Catchment EXT-AB**

File:	H:_2021\H20210003 - Springhill\Engineers\Calculations\[0.DNL-Stormwater Runoff_Pre & Post Dev_R1(Internal).xlsx]Soakage Pit
Date:	23/07/2021
Job:	H20200078
Catchment Area	EXT-AB

Time of Concentration Calculations

Reference	Equation Type / Method	Area (m²)	Length (m)	Av. Slope (%)	Height diff. of catchment	Velocity (m/s)	Mannings Roughness	tc (mins)
E1_2.3.2 (a)	Time of entry	1074546						**0.00**
E1_2.3.6	Alternative method		1940		15			**43.12**
							tc (min)	**43 min**

Coefficent of Runoff "C" (E1_Table 1)

Surface Description	Landuse "Ci"	Landuse Area "Ai"
Bush	0.25	1,074,546 m²
	Sub-Total:	0.25
Slope Correction for Runoff Coefficients (E1_Table 2)		
5-10%	no adjustment	-
	Coefficent of Runoff "C"	**0.25**

Rainfall intensities (mm/hr) :: RCP6.0 for the period 2081-2100

ARI	AEP	C	A (ha)	I (mm/hr)	Q (m^3/s)	Q (l/s)
2	0.50	0.21	107.455	23.464	1.488	1488.303
5	0.20	0.24	107.455	32.922	2.334	2333.814
10	0.10	0.25	107.455	40.441	3.018	3017.757
20	0.05	0.26	107.455	48.686	3.815	3814.625
50	0.02	0.29	107.455	60.631	5.203	5202.974
100	0.01	0.30	107.455	70.582	6.320	6320.261

ENGINEERING SERVICES REPORT

APPENDIX D

STORMWATER MODELLING OUTPUT

Autodesk® Storm and Sanitary Analysis 2016 - Version 13.2.147 (Build 0)

****
Project Description
****
File Name POST-002.SPF

****
Analysis Options
****
Flow Units ..... cms
Subbasin Hydrograph Method. Rational
Time of Concentration..... User-Defined
Return Period..... 50 years
Link Routing Method ..... Kinematic Wave
Storage Node Exfiltration.. Constant rate, wetted area
Starting Date JUL-12-2021 00:00:00
Ending Date JUL-12-2021 12:00:00
Report Time Step 00:00:10

****
Element Count
****
Number of subbasins 31
Number of nodes 88
Number of links 85

****
Subbasin Summary
****

Subbasin ID	Total Area hectares
Catch-A3	42.08
Catch-B1	44.21
Ext-A	24.27
Ext-B	30.42
Ext-C	99.71
Ext-D	81.83
Ext-E	51.56
Ext-F	80.41
Ext-G	117.35
Ext-H	41.74
Ext-I	137.91
Ext-J	69.04
Ext-K	80.14
Ext-L	51.91
Ext-M	109.11
Ext-O	124.44
Ext-P	95.51
Ext-R	26.26
Ext-S	104.52
Ext-T	91.62
Ext-U	121.39
Ext-W	62.67
Ext-X	41.25
Ext-Y	38.05
Ext-Z	33.92
Sub-24	107.45
Sub-25	32.35
Sub-28	22.31
Sub-30	52.37
Sub-31	28.78
Sub-32	5.00

****

Node Summary
****

Node ID	Element Type	Invert Elevation m	Maximum Depth m	Ponded Area m²	External Inflow
Jun-01	JUNCTION	440.00	0.00	0.000	
Jun-02	JUNCTION	360.00	0.00	0.000	
Jun-03	JUNCTION	360.00	0.00	0.000	
Jun-04	JUNCTION	380.00	0.00	0.000	
Jun-05	JUNCTION	440.00	0.00	0.000	
Jun-06	JUNCTION	360.00	0.00	0.000	
Jun-07	JUNCTION	330.00	0.00	0.000	
Jun-08	JUNCTION	330.00	0.00	0.000	
Jun-09	JUNCTION	340.00	0.00	0.000	
Jun-10	JUNCTION	320.00	0.00	0.000	
Jun-11	JUNCTION	340.00	0.00	0.000	
Jun-12	JUNCTION	300.00	0.00	0.000	
Jun-13	JUNCTION	290.00	0.00	0.000	
Jun-14	JUNCTION	280.00	0.00	0.000	
Jun-15	JUNCTION	260.00	0.00	0.000	
Jun-16	JUNCTION	250.00	0.00	0.000	
Jun-17	JUNCTION	240.00	0.00	0.000	
Jun-18	JUNCTION	240.00	0.00	0.000	
Jun-19	JUNCTION	245.00	0.00	0.000	
Jun-20	JUNCTION	280.00	0.00	0.000	
Jun-22	JUNCTION	229.34	2.66	0.000	
Jun-23	JUNCTION	218.80	2.54	0.000	
Jun-24	JUNCTION	500.00	0.00	0.000	
Jun-25	JUNCTION	500.00	0.00	0.000	
Jun-26	JUNCTION	435.00	0.00	0.000	
Jun-27	JUNCTION	500.00	0.00	0.000	
Jun-28	JUNCTION	500.00	0.00	0.000	
Jun-29	JUNCTION	440.00	0.00	0.000	
Jun-30	JUNCTION	340.00	0.00	0.000	
Jun-31	JUNCTION	390.00	0.00	0.000	
Jun-32	JUNCTION	350.00	0.00	0.000	
Jun-33	JUNCTION	350.00	0.00	0.000	
Jun-34	JUNCTION	350.00	0.00	0.000	
Jun-35	JUNCTION	320.00	0.00	0.000	
Jun-36	JUNCTION	278.00	0.00	0.000	
Jun-38	JUNCTION	235.00	0.00	0.000	
Jun-39	JUNCTION	260.00	0.00	0.000	
Jun-41	JUNCTION	240.00	2.00	0.000	
Jun-42	JUNCTION	0.00	6.00	0.000	
Jun-43	JUNCTION	234.00	0.00	0.000	
Jun-44	JUNCTION	0.00	6.00	0.000	
Jun-45	JUNCTION	234.00	0.00	0.000	
Jun-46	JUNCTION	0.00	6.00	0.000	
Jun-47	JUNCTION	234.00	0.00	0.000	
Jun-48	JUNCTION	220.00	0.00	0.000	
Jun-49	JUNCTION	221.00	0.00	0.000	
Jun-50	JUNCTION	222.00	0.00	0.000	
Jun-51	JUNCTION	221.00	0.00	0.000	
Jun-52	JUNCTION	228.00	0.00	0.000	
Jun-53	JUNCTION	228.00	0.00	0.000	
Jun-54	JUNCTION	228.00	0.00	0.000	
Jun-55	JUNCTION	0.00	6.00	0.000	
Jun-56	JUNCTION	228.00	2.00	0.000	
Jun-57	JUNCTION	227.25	0.50	0.000	
Jun-58	JUNCTION	227.09	1.50	0.000	
Jun-59	JUNCTION	226.29	1.50	0.000	
Jun-60	JUNCTION	226.08	0.50	0.000	
Jun-61	JUNCTION	225.10	1.38	0.000	
Jun-62	JUNCTION	229.00	6.00	0.000	
Jun-64	JUNCTION	228.75	6.00	0.000	
Jun-65	JUNCTION	227.00	6.00	0.000	
Jun-66	JUNCTION	228.50	6.00	0.000	
Jun-67	JUNCTION	228.25	6.00	0.000	
Jun-68	JUNCTION	227.99	6.00	0.000	
Jun-69	JUNCTION	227.50	6.00	0.000	
Jun-70	JUNCTION	226.70	6.00	0.000	
Jun-71	JUNCTION	226.25	6.00	0.000	

Jun-72	JUNCTION	226.00	6.00	0.000
Jun-73	JUNCTION	225.50	6.00	0.000
Jun-74	JUNCTION	225.00	6.00	0.000
Jun-75	JUNCTION	224.60	6.00	0.000
Jun-76	JUNCTION	224.35	6.00	0.000
Jun-77	JUNCTION	224.10	6.00	0.000
Jun-78	JUNCTION	223.90	6.00	0.000
Jun-79	JUNCTION	223.50	6.00	0.000
Jun-80	JUNCTION	223.10	6.00	0.000
Jun-81	JUNCTION	222.80	1.98	0.000
Jun-82	JUNCTION	222.25	6.00	0.000
Jun-83	JUNCTION	221.75	6.00	0.000
Jun-84	JUNCTION	221.16	6.00	0.000
Jun-85	JUNCTION	0.00	6.00	0.000
Jun-86	JUNCTION	220.50	6.00	0.000
Jun-87	JUNCTION	220.00	6.00	0.000
Jun-88	JUNCTION	219.60	6.00	0.000
Jun-89	JUNCTION	219.00	6.00	0.000
Jun-90	JUNCTION	218.90	6.00	0.000
Out-01	OUTFALL	210.00	0.00	0.000
Out-02	OUTFALL	0.00	0.00	0.000

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Link Summary
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Link ID	From Node	To Node	Element Type	Length m	Slope %	Manning's Roughness
Link-01	Jun-25	Jun-05	DIRECT	1065.8	5.6294	0.0150
Link-02	Jun-24	Jun-01	DIRECT	989.8	6.0620	0.0320
Link-03	Jun-27	Jun-04	DIRECT	1808.4	6.6356	0.0150
Link-04	Jun-05	Jun-26	DIRECT	100.6	4.9722	0.0150
Link-05	Jun-01	Jun-26	DIRECT	102.1	4.8981	0.0150
Link-06	Jun-26	Jun-02	DIRECT	2911.2	2.5763	0.0150
Link-07	Jun-04	Jun-03	DIRECT	815.7	2.4519	0.0150
Link-08	Jun-28	Jun-06	DIRECT	1703.4	8.2187	0.0150
Link-09	Jun-29	Jun-11	DIRECT	1842.8	5.4266	0.0150
Link-10	Jun-31	Jun-30	DIRECT	1158.4	4.3163	0.0150
Link-11	Jun-11	Jun-30	DIRECT	101.6	0.0003	0.0150
Link-12	Jun-30	Jun-12	DIRECT	1910.7	2.0934	0.0150
Link-13	Jun-03	Jun-08	DIRECT	1396.6	2.1480	0.0150
Link-14	Jun-06	Jun-32	DIRECT	182.8	5.4702	0.0150
Link-15	Jun-32	Jun-07	DIRECT	865.1	2.3120	0.0150
Link-16	Jun-02	Jun-09	DIRECT	1062.1	1.8831	0.0150
Link-17	Jun-09	Jun-10	DIRECT	968.3	2.0655	0.0150
Link-18	Jun-08	Jun-10	DIRECT	802.9	1.2455	0.0150
Link-19	Jun-10	Jun-13	DIRECT	1233.1	2.4329	0.0150
Link-20	Jun-13	Jun-20	DIRECT	2011.8	0.4971	0.0150
Link-21	Jun-12	Jun-13	DIRECT	220.6	4.5329	0.0150
Link-22	Jun-33	Jun-14	DIRECT	2135.5	3.2779	0.0150
Link-23	Jun-34	Jun-15	DIRECT	3783.8	2.3785	0.0150
Link-24	Jun-35	Jun-16	DIRECT	1250.6	5.5972	0.0150
Link-25	Jun-14	Jun-36	DIRECT	79.4	2.5198	0.0150
Link-26	Jun-20	Jun-36	DIRECT	77.8	2.5714	0.0150
Link-27	Jun-36	Jun-18	DIRECT	2328.8	1.6318	0.0150
Link-28	Jun-15	Jun-16	DIRECT	95.0	10.5208	0.0150
Link-29	Jun-16	Jun-17	DIRECT	742.9	1.3461	0.0150
Link-30	Jun-39	Jun-19	DIRECT	1191.9	1.2585	0.0150
Link-31	Jun-19	Jun-18	DIRECT	1848.2	0.2705	0.0150
Link-32	Jun-17	Jun-38	DIRECT	300.7	1.6626	0.0150
Link-33	Jun-18	Jun-38	DIRECT	607.1	0.8236	0.0150
Link-34	Jun-22	Jun-62	CHANNEL	44.2	0.7645	0.0320
Link-35	Jun-61	Jun-74	CHANNEL	11.1	0.8993	0.0320
Link-36	Jun-38	Jun-22	DIRECT	1187.1	0.4770	0.0150
Link-37	Jun-41	Jun-56	CHANNEL	2253.6	0.5325	0.0320
Link-39	Jun-23	Out-01	DIRECT	441.9	1.9913	0.0150
Link-40	Jun-07	Jun-12	DIRECT	1350.8	2.2209	0.0150
Link-42	Jun-42	Jun-43	DIRECT	748.2	-31.2742	0.0150
Link-43	Jun-44	Jun-45	DIRECT	647.9	-36.1150	0.0150
Link-44	Jun-46	Jun-47	DIRECT	842.4	-27.7781	0.0150
Link-45	Jun-43	Jun-54	DIRECT	491.8	1.2200	0.0150
Link-46	Jun-45	Jun-53	DIRECT	701.6	0.8551	0.0150

Link-47	Jun-47	Jun-52	DIRECT	578.1	1.0379	0.0150
Link-48	Jun-52	Jun-48	DIRECT	773.7	1.0340	0.0150
Link-49	Jun-53	Jun-49	DIRECT	665.2	1.0523	0.0150
Link-50	Jun-54	Jun-51	DIRECT	942.0	0.7431	0.0150
Link-51	Jun-50	Jun-51	DIRECT	322.0	0.3105	0.0150
Link-52	Jun-51	Jun-23	DIRECT	254.3	0.8651	0.0150
Link-53	Jun-49	Jun-48	DIRECT	311.8	0.3207	0.0150
Link-54	Jun-48	Out-02	DIRECT	252.0	87.3189	0.0150
Link-55	Jun-55	Jun-23	DIRECT	304.4	-71.8697	0.0150
Link-56	Jun-56	Jun-57	CHANNEL	80.0	0.9381	0.0320
Link-57	Jun-57	Jun-58	CONDUIT	18.9	0.8659	0.0150
Link-58	Jun-58	Jun-59	CONDUIT	75.7	1.0571	0.0150
Link-59	Jun-59	Jun-60	CONDUIT	22.9	0.9182	0.0150
Link-60	Jun-60	Jun-61	CHANNEL	119.7	0.8152	0.0320
Link-61	Jun-62	Jun-64	CHANNEL	49.9	0.5006	0.0320
Link-62	Jun-64	Jun-66	CHANNEL	52.1	0.4802	0.0320
Link-63	Jun-65	Jun-70	CHANNEL	50.8	0.5850	0.0320
Link-64	Jun-66	Jun-67	CHANNEL	48.8	0.5125	0.0320
Link-65	Jun-67	Jun-68	CHANNEL	50.5	0.5243	0.0320
Link-66	Jun-68	Jun-69	CHANNEL	48.8	0.9934	0.0320
Link-67	Jun-69	Jun-65	CHANNEL	50.9	0.9884	0.0320
Link-68	Jun-70	Jun-71	CHANNEL	50.2	0.8971	0.0320
Link-69	Jun-71	Jun-72	CHANNEL	50.0	0.5005	0.0320
Link-70	Jun-72	Jun-73	CHANNEL	50.5	0.9895	0.0320
Link-71	Jun-73	Jun-61	CHANNEL	39.6	1.0111	0.0320
Link-72	Jun-74	Jun-75	CHANNEL	49.2	0.8128	0.0320
Link-73	Jun-75	Jun-76	CHANNEL	49.5	0.5055	0.0320
Link-74	Jun-76	Jun-77	CHANNEL	51.4	0.4860	0.0320
Link-75	Jun-77	Jun-78	CHANNEL	49.7	0.4026	0.0320
Link-76	Jun-78	Jun-79	CHANNEL	48.2	0.8297	0.0320
Link-77	Jun-79	Jun-80	CHANNEL	40.7	0.9838	0.0320
Link-78	Jun-80	Jun-81	CHANNEL	51.8	0.5797	0.0320
Link-79	Jun-81	Jun-82	CHANNEL	49.5	1.1120	0.0320
Link-80	Jun-82	Jun-83	CHANNEL	49.8	1.0048	0.0320
Link-81	Jun-83	Jun-84	CHANNEL	39.7	1.4847	0.0320
Link-82	Jun-84	Jun-86	CHANNEL	48.8	1.3514	0.0320
Link-83	Jun-86	Jun-87	CHANNEL	39.9	1.2519	0.0320
Link-84	Jun-87	Jun-88	CHANNEL	39.3	1.0176	0.0320
Link-85	Jun-88	Jun-89	CHANNEL	39.6	1.5144	0.0320
Link-86	Jun-89	Jun-90	CHANNEL	39.6	0.2526	0.0320
Link-87	Jun-90	Jun-23	CHANNEL	22.1	0.4535	0.0320

****
Cross Section Summary
****

Link ID	Shape	Depth/ Diameter	Width	No. of Barrels	Cross Sectional Area	Full Flow Hydraulic Radius	Design Flow Capacity
		m	m		m²	m	cms
Link-01	DUMMY	0.00	0.00	1	0.00	0.00	0.00
Link-02	DUMMY	0.00	0.00	1	0.00	0.00	0.00
Link-03	DUMMY	0.00	0.00	1	0.00	0.00	0.00
Link-04	DUMMY	0.00	0.00	1	0.00	0.00	0.00
Link-05	DUMMY	0.00	0.00	1	0.00	0.00	0.00
Link-06	DUMMY	0.00	0.00	1	0.00	0.00	0.00
Link-07	DUMMY	0.00	0.00	1	0.00	0.00	0.00
Link-08	DUMMY	0.00	0.00	1	0.00	0.00	0.00

Link-09	DUMMY	0.00	0.00	1	0.00	0.00
Link-10	DUMMY	0.00	0.00	1	0.00	0.00
Link-11	DUMMY	0.00	0.00	1	0.00	0.00
Link-12	DUMMY	0.00	0.00	1	0.00	0.00
Link-13	DUMMY	0.00	0.00	1	0.00	0.00
Link-14	DUMMY	0.00	0.00	1	0.00	0.00
Link-15	DUMMY	0.00	0.00	1	0.00	0.00
Link-16	DUMMY	0.00	0.00	1	0.00	0.00
Link-17	DUMMY	0.00	0.00	1	0.00	0.00
Link-18	DUMMY	0.00	0.00	1	0.00	0.00
Link-19	DUMMY	0.00	0.00	1	0.00	0.00
Link-20	DUMMY	0.00	0.00	1	0.00	0.00
Link-21	DUMMY	0.00	0.00	1	0.00	0.00
Link-22	DUMMY	0.00	0.00	1	0.00	0.00
Link-23	DUMMY	0.00	0.00	1	0.00	0.00
Link-24	DUMMY	0.00	0.00	1	0.00	0.00
Link-25	DUMMY	0.00	0.00	1	0.00	0.00
Link-26	DUMMY	0.00	0.00	1	0.00	0.00
Link-27	DUMMY	0.00	0.00	1	0.00	0.00
Link-28	DUMMY	0.00	0.00	1	0.00	0.00
Link-29	DUMMY	0.00	0.00	1	0.00	0.00
Link-30	DUMMY	0.00	0.00	1	0.00	0.00
Link-31	DUMMY	0.00	0.00	1	0.00	0.00
Link-32	DUMMY	0.00	0.00	1	0.00	0.00
Link-33	DUMMY	0.00	0.00	1	0.00	0.00
Link-34	IRREGULAR	2.66	40.00	1	37.13	0.90
Link-35	IRREGULAR	1.38	40.00	1	20.79	0.78
Link-36	DUMMY	0.00	0.00	1	0.00	0.00
Link-37	IRREGULAR	2.00	127.09	1	55.35	0.44
Link-39	DUMMY	0.00	0.00	1	0.00	0.00
Link-40	DUMMY	0.00	0.00	1	0.00	0.00
Link-42	DUMMY	0.00	0.00	1	0.00	0.00
Link-43	DUMMY	0.00	0.00	1	0.00	0.00
Link-44	DUMMY	0.00	0.00	1	0.00	0.00
Link-45	DUMMY	0.00	0.00	1	0.00	0.00
Link-46	DUMMY	0.00	0.00	1	0.00	0.00
Link-47	DUMMY	0.00	0.00	1	0.00	0.00

```
0.00          0.00
  Link-48          DUMMY              0.00          0.00              1          0.00
0.00          0.00
  Link-49          DUMMY              0.00          0.00              1          0.00
0.00          0.00
  Link-50          DUMMY              0.00          0.00              1          0.00
0.00          0.00
  Link-51          DUMMY              0.00          0.00              1          0.00
0.00          0.00
  Link-52          DUMMY              0.00          0.00              1          0.00
0.00          0.00
  Link-53          DUMMY              0.00          0.00              1          0.00
0.00          0.00
  Link-54          DUMMY              0.00          0.00              1          0.00
0.00          0.00
  Link-55          DUMMY              0.00          0.00              1          0.00
0.00          0.00
  Link-56          TRAPEZOIDAL        0.50          4.50              1          1.25
0.27          1.58
  Link-57          RECT_CLOSED        0.45          1.20              1          0.54
0.16          1.00
  Link-58          CIRCULAR           1.50          1.50              1          1.77
0.38          6.30
  Link-59          RECT_CLOSED        0.45          1.20              1          0.54
0.16          1.03
  Link-60          TRAPEZOIDAL        0.50          4.50              1          1.25
0.27          1.47
  Link-61          IRREGULAR          2.66         40.00              1         37.13
0.90         76.33
  Link-62          IRREGULAR          2.00         40.00              1         23.78
0.97         50.42
  Link-63          IRREGULAR          3.00         39.77              1         46.10
1.26        128.60
  Link-64          IRREGULAR          2.02         40.00              1         23.85
1.08         56.28
  Link-65          IRREGULAR          2.98         40.00              1         45.98
0.96        101.42
  Link-66          IRREGULAR          2.01         34.14              1         35.14
0.98        108.21
  Link-67          IRREGULAR          3.00         39.77              1         46.10
1.26        167.16
  Link-68          IRREGULAR          2.00         40.00              1         22.73
0.80         57.82
  Link-69          IRREGULAR          2.00         39.95              1         26.72
0.86         53.36
  Link-70          IRREGULAR          2.00         39.95              1         26.72
0.86         75.02
  Link-71          IRREGULAR          1.38         40.00              1         20.79
0.78         55.43
  Link-72          IRREGULAR          2.00         37.65              1         38.02
0.85         96.10
  Link-73          IRREGULAR          1.54         40.00              1         24.81
0.81         48.05
  Link-74          IRREGULAR          1.54         40.00              1         24.81
0.81         47.11
  Link-75          IRREGULAR          1.85         40.00              1         32.12
0.92         60.13
  Link-76          IRREGULAR          1.85         40.00              1         32.12
0.92         86.33
  Link-77          IRREGULAR          1.31         40.00              1         41.00
0.73        102.70
  Link-78          IRREGULAR          1.98         40.00              1         30.48
0.53         47.56
  Link-79          IRREGULAR          1.09         40.00              1         19.57
0.72         51.59
  Link-80          IRREGULAR          1.09         40.00              1         19.57
0.72         49.04
  Link-81          IRREGULAR          1.78         40.00              1         33.18
0.58         88.01
  Link-82          IRREGULAR          1.84         40.00              1         30.85
0.53         73.57
  Link-83          IRREGULAR          2.00         38.56              1         34.50
1.06        125.38
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  Link-84          IRREGULAR          2.00        38.56             1        34.50
1.06       113.04
  Link-85          IRREGULAR          1.21        40.00             1        20.11
0.67        59.29
  Link-86          IRREGULAR          2.54        40.00             1        34.94
1.12        59.26
  Link-87          IRREGULAR          2.54        40.00             1        34.94
1.12        79.41


  ****************
  Transect Summary
  ****************

  Transect 1
  Area:
              0.0019     0.0061     0.0104     0.0148     0.0193
              0.0238     0.0284     0.0331     0.0378     0.0427
              0.0476     0.0526     0.0576     0.0628     0.0680
              0.0733     0.0786     0.0841     0.0896     0.0951
              0.1008     0.1065     0.1123     0.1182     0.1242
              0.1304     0.1436     0.1599     0.1784     0.1993
              0.2230     0.2496     0.2799     0.3149     0.3523
              0.3904     0.4293     0.4688     0.5091     0.5501
              0.5918     0.6342     0.6774     0.7212     0.7658
              0.8111     0.8572     0.9039     0.9514     1.0000
  Hrad:
              0.0270     0.0742     0.1243     0.1735     0.2218
              0.2692     0.3158     0.3617     0.4068     0.4504
              0.4940     0.5371     0.5795     0.6214     0.6628
              0.7036     0.7439     0.7837     0.8231     0.8621
              0.9006     0.9387     0.9764     1.0138     1.0504
              0.9852     0.9614     0.9283     0.8960     0.8653
              0.8345     0.8060     0.7834     0.7640     0.7524
              0.7502     0.7544     0.7633     0.7755     0.7904
              0.8072     0.8256     0.8452     0.8658     0.8872
              0.9089     0.9312     0.9538     0.9762     1.0000
  Width:
              0.0749     0.0871     0.0886     0.0901     0.0915
              0.0930     0.0945     0.0960     0.0975     0.0992
              0.1007     0.1022     0.1037     0.1053     0.1068
              0.1083     0.1098     0.1113     0.1128     0.1144
              0.1159     0.1174     0.1189     0.1204     0.1220
              0.1732     0.3083     0.3545     0.4007     0.4520
              0.5123     0.5727     0.6560     0.7538     0.7684
              0.7831     0.7977     0.8124     0.8270     0.8417
              0.8563     0.8710     0.8856     0.9003     0.9149
              0.9297     0.9444     0.9592     0.9754     1.0000

  Transect 2
  Area:
              0.0020     0.0040     0.0061     0.0082     0.0103
              0.0125     0.0146     0.0168     0.0191     0.0214
              0.0237     0.0260     0.0284     0.0308     0.0332
              0.0356     0.0381     0.0406     0.0432     0.0458
              0.0484     0.0510     0.0537     0.0564     0.0592
              0.0624     0.0660     0.0703     0.0755     0.0813
              0.0879     0.0952     0.1033     0.1121     0.1253
              0.1460     0.1745     0.2095     0.2496     0.2947
              0.3450     0.4003     0.4592     0.5221     0.5899
              0.6626     0.7402     0.8227     0.9097     1.0000
  Hrad:
              0.0874     0.1706     0.2500     0.3260     0.3989
              0.4689     0.5362     0.6011     0.6637     0.7242
              0.7828     0.8395     0.8946     0.9480     1.0001
              1.0508     1.1002     1.1484     1.1955     1.2415
              1.2864     1.3305     1.3737     1.4161     1.4577
              1.2903     1.2341     1.1077     1.0557     1.0232
              1.0048     0.9949     0.9894     0.9917     0.8113
              0.7421     0.7047     0.6660     0.6365     0.6238
              0.6200     0.6322     0.6631     0.6872     0.7342
              0.7938     0.8489     0.9005     0.9504     1.0000
  Width:
```

0.0219	0.0223	0.0226	0.0229	0.0233
0.0236	0.0239	0.0242	0.0246	0.0249
0.0252	0.0256	0.0259	0.0262	0.0266
0.0269	0.0273	0.0276	0.0279	0.0283
0.0286	0.0290	0.0293	0.0297	0.0300
0.0375	0.0425	0.0522	0.0600	0.0677
0.0755	0.0835	0.0919	0.1003	0.1954
0.2643	0.3470	0.4084	0.4635	0.5188
0.5759	0.6233	0.6598	0.7111	0.7647
0.8182	0.8716	0.9250	0.9657	1.0000

Transect 3
Area:

0.0002	0.0008	0.0017	0.0030	0.0046
0.0065	0.0087	0.0111	0.0138	0.0166
0.0196	0.0227	0.0260	0.0296	0.0334
0.0374	0.0418	0.0465	0.0514	0.0567
0.0622	0.0680	0.0740	0.0804	0.0870
0.0940	0.1012	0.1087	0.1164	0.1245
0.1329	0.1415	0.1674	0.2102	0.2537
0.2975	0.3414	0.3855	0.4298	0.4743
0.5190	0.5638	0.6088	0.6540	0.6994
0.7451	0.8000	0.8608	0.9280	1.0000

Hrad:

0.0318	0.0613	0.0973	0.1320	0.1655
0.1984	0.2336	0.2759	0.3170	0.3576
0.3970	0.4354	0.4730	0.5098	0.5237
0.5486	0.5743	0.6005	0.6273	0.6546
0.6822	0.7101	0.7383	0.7667	0.7953
0.8243	0.8527	0.8812	0.9100	0.9388
0.9676	0.9938	0.7747	0.6811	0.6454
0.6379	0.6462	0.6641	0.6882	0.7167
0.7482	0.7820	0.8175	0.8543	0.8921
0.9303	0.9549	0.9738	0.9878	1.0000

Width:

0.0047	0.0106	0.0149	0.0191	0.0232
0.0274	0.0311	0.0337	0.0361	0.0385
0.0408	0.0432	0.0455	0.0479	0.0526
0.0564	0.0601	0.0639	0.0677	0.0714
0.0752	0.0790	0.0827	0.0865	0.0903
0.0940	0.0978	0.1016	0.1055	0.1093
0.1132	0.1173	0.4419	0.5787	0.5811
0.5834	0.5858	0.5882	0.5906	0.5930
0.5954	0.5978	0.6001	0.6025	0.6049
0.6959	0.7656	0.8581	0.9238	1.0000

Transect Ch 1000
Area:

0.0043	0.0107	0.0174	0.0245	0.0319
0.0397	0.0478	0.0562	0.0649	0.0740
0.0834	0.0931	0.1032	0.1137	0.1245
0.1356	0.1471	0.1589	0.1711	0.1837
0.1967	0.2100	0.2238	0.2380	0.2525
0.2675	0.2828	0.2985	0.3146	0.3310
0.3478	0.3649	0.3824	0.4029	0.4258
0.4511	0.4788	0.5090	0.5411	0.5749
0.6103	0.6474	0.6862	0.7267	0.7685
0.8117	0.8566	0.9031	0.9509	1.0000

Hrad:

0.0256	0.0611	0.0949	0.1273	0.1583
0.1882	0.2172	0.2453	0.2727	0.2994
0.3253	0.3503	0.3749	0.3992	0.4231
0.4466	0.4696	0.4924	0.5142	0.5347
0.5548	0.5750	0.5953	0.6156	0.6357
0.6557	0.6757	0.6969	0.7183	0.7396
0.7608	0.7818	0.7891	0.8178	0.8420
0.8614	0.8765	0.8883	0.8990	0.9089
0.9180	0.9267	0.9351	0.9427	0.9527
0.9614	0.9699	0.9797	0.9897	1.0000

Width:

0.1260	0.1325	0.1390	0.1456	0.1522
0.1589	0.1656	0.1722	0.1789	0.1855
0.1923	0.1994	0.2063	0.2133	0.2202

0.2272	0.2342	0.2412	0.2486	0.2566
0.2647	0.2727	0.2805	0.2884	0.2963
0.3042	0.3120	0.3193	0.3263	0.3334
0.3405	0.3475	0.3609	0.4367	0.4842
0.5325	0.5821	0.6284	0.6613	0.6947
0.7288	0.7623	0.7949	0.8308	0.8504
0.8850	0.9199	0.9466	0.9733	1.0000

Transect Ch 1050
Area:

0.0132	0.0266	0.0403	0.0543	0.0686
0.0831	0.0979	0.1129	0.1283	0.1439
0.1597	0.1759	0.1923	0.2089	0.2259
0.2431	0.2605	0.2783	0.2963	0.3145
0.3330	0.3518	0.3709	0.3902	0.4098
0.4296	0.4497	0.4701	0.4907	0.5116
0.5328	0.5542	0.5758	0.5978	0.6200
0.6425	0.6652	0.6882	0.7114	0.7350
0.7588	0.7828	0.8071	0.8317	0.8565
0.8816	0.9070	0.9326	0.9585	1.0000

Hrad:

0.0305	0.0603	0.0896	0.1182	0.1463
0.1738	0.2009	0.2275	0.2537	0.2795
0.3049	0.3300	0.3547	0.3791	0.4031
0.4269	0.4504	0.4737	0.4967	0.5195
0.5421	0.5644	0.5865	0.6084	0.6301
0.6516	0.6729	0.6941	0.7151	0.7359
0.7565	0.7770	0.7974	0.8176	0.8377
0.8576	0.8775	0.8972	0.9168	0.9362
0.9556	0.9749	0.9940	1.0131	1.0320
1.0509	1.0697	1.0884	1.1070	1.0000

Width:

0.1729	0.1763	0.1797	0.1832	0.1867
0.1902	0.1937	0.1972	0.2007	0.2042
0.2077	0.2111	0.2146	0.2181	0.2216
0.2250	0.2285	0.2319	0.2353	0.2387
0.2422	0.2456	0.2490	0.2524	0.2558
0.2592	0.2626	0.2661	0.2695	0.2729
0.2763	0.2797	0.2831	0.2865	0.2899
0.2934	0.2968	0.3002	0.3036	0.3070
0.3104	0.3138	0.3173	0.3207	0.3241
0.3275	0.3309	0.3343	0.3377	1.0000

Transect Ch 1100
Area:

0.0046	0.0094	0.0146	0.0200	0.0257
0.0316	0.0379	0.0444	0.0512	0.0584
0.0659	0.0738	0.0820	0.0905	0.0993
0.1085	0.1181	0.1281	0.1384	0.1491
0.1602	0.1716	0.1835	0.1957	0.2082
0.2212	0.2363	0.2653	0.2952	0.3253
0.3556	0.3861	0.4169	0.4478	0.4790
0.5103	0.5420	0.5741	0.6065	0.6390
0.6717	0.7047	0.7378	0.7711	0.8047
0.8384	0.8737	0.9132	0.9553	1.0000

Hrad:

0.0387	0.0749	0.1090	0.1414	0.1723
0.2019	0.2300	0.2571	0.2835	0.3035
0.3284	0.3528	0.3766	0.4000	0.4203
0.4405	0.4606	0.4806	0.5005	0.5202
0.5399	0.5596	0.5791	0.5986	0.6181
0.6375	0.6567	0.6153	0.6074	0.6079
0.6142	0.6244	0.6373	0.6525	0.6694
0.6870	0.7058	0.7182	0.7406	0.7636
0.7870	0.8108	0.8350	0.8595	0.8842
0.9090	0.9337	0.9584	0.9804	1.0000

Width:

0.1026	0.1086	0.1145	0.1205	0.1265
0.1325	0.1389	0.1452	0.1515	0.1611
0.1678	0.1745	0.1812	0.1880	0.1961
0.2042	0.2123	0.2205	0.2286	0.2367
0.2448	0.2530	0.2611	0.2692	0.2773
0.2854	0.4633	0.6475	0.6520	0.6564

0.6608	0.6654	0.6701	0.6749	0.6797
0.6851	0.6937	0.7006	0.7050	0.7093
0.7137	0.7181	0.7224	0.7268	0.7312
0.7355	0.8310	0.8871	0.9436	1.0000

Transect Ch 1150
Area:

0.0081	0.0164	0.0249	0.0337	0.0428
0.0521	0.0617	0.0715	0.0816	0.0919
0.1024	0.1133	0.1243	0.1356	0.1472
0.1591	0.1712	0.1835	0.1962	0.2091
0.2222	0.2356	0.2493	0.2632	0.2773
0.2916	0.3062	0.3210	0.3361	0.3513
0.3668	0.3825	0.3984	0.4146	0.4310
0.4476	0.4644	0.4909	0.5259	0.5616
0.5980	0.6352	0.6731	0.7118	0.7516
0.7943	0.8405	0.8902	0.9433	1.0000

Hrad:

0.0375	0.0736	0.1086	0.1425	0.1754
0.2074	0.2387	0.2691	0.2989	0.3280
0.3566	0.3846	0.4121	0.4389	0.4651
0.4909	0.5164	0.5415	0.5662	0.5907
0.6149	0.6388	0.6638	0.6885	0.7130
0.7373	0.7613	0.7851	0.8090	0.8327
0.8562	0.8795	0.9027	0.9256	0.9484
0.9711	0.9935	0.9959	0.9874	0.9840
0.9844	0.9876	0.9930	1.0003	1.0061
1.0073	1.0071	1.0056	1.0032	1.0000

Width:

0.1401	0.1444	0.1487	0.1530	0.1573
0.1616	0.1659	0.1702	0.1745	0.1788
0.1831	0.1874	0.1917	0.1961	0.2006
0.2050	0.2095	0.2140	0.2185	0.2229
0.2274	0.2319	0.2358	0.2398	0.2437
0.2476	0.2516	0.2555	0.2593	0.2632
0.2670	0.2708	0.2746	0.2785	0.2823
0.2861	0.2899	0.5922	0.6049	0.6175
0.6302	0.6429	0.6556	0.6682	0.7001
0.7608	0.8206	0.8804	0.9402	1.0000

Transect Ch 1200
Area:

0.0057	0.0179	0.0312	0.0448	0.0588
0.0732	0.0880	0.1034	0.1191	0.1352
0.1517	0.1685	0.1856	0.2030	0.2207
0.2387	0.2571	0.2757	0.2947	0.3140
0.3336	0.3536	0.3738	0.3944	0.4153
0.4365	0.4580	0.4798	0.5020	0.5244
0.5472	0.5701	0.5930	0.6160	0.6390
0.6621	0.6852	0.7083	0.7315	0.7548
0.7784	0.8021	0.8261	0.8503	0.8747
0.8994	0.9242	0.9493	0.9745	1.0000

Hrad:

0.0134	0.0359	0.0596	0.0836	0.1072
0.1283	0.1498	0.1710	0.1916	0.2130
0.2344	0.2554	0.2761	0.2965	0.3167
0.3365	0.3562	0.3756	0.3947	0.4137
0.4325	0.4511	0.4694	0.4876	0.5057
0.5235	0.5412	0.5588	0.5760	0.5924
0.6130	0.6374	0.6617	0.6859	0.7101
0.7343	0.7584	0.7825	0.8050	0.8232
0.8413	0.8593	0.8771	0.8949	0.9127
0.9303	0.9478	0.9653	0.9827	1.0000

Width:

0.4398	0.5089	0.5261	0.5384	0.5508
0.5728	0.5899	0.6069	0.6239	0.6371
0.6494	0.6618	0.6741	0.6865	0.6988
0.7112	0.7235	0.7359	0.7482	0.7606
0.7729	0.7853	0.7976	0.8100	0.8223
0.8347	0.8472	0.8596	0.8722	0.8860
0.8934	0.8951	0.8967	0.8984	0.9001
0.9017	0.9034	0.9051	0.9084	0.9167
0.9251	0.9334	0.9417	0.9500	0.9584

0.9667	0.9750	0.9833	0.9917	1.0000

Transect Ch 1250
Area:

0.0099	0.0202	0.0308	0.0415	0.0525
0.0638	0.0752	0.0869	0.0987	0.1107
0.1228	0.1352	0.1477	0.1604	0.1733
0.1864	0.1996	0.2130	0.2267	0.2404
0.2544	0.2685	0.2828	0.2972	0.3118
0.3272	0.3447	0.3629	0.3816	0.4010
0.4209	0.4414	0.4625	0.4847	0.5081
0.5326	0.5583	0.5850	0.6127	0.6414
0.6710	0.7017	0.7337	0.7675	0.8030
0.8396	0.8772	0.9156	0.9543	1.0000

Hrad:

0.0516	0.1026	0.1524	0.2010	0.2484
0.2949	0.3412	0.3872	0.4323	0.4767
0.5204	0.5634	0.6058	0.6475	0.6887
0.7293	0.7693	0.8087	0.8476	0.8869
0.9259	0.9644	1.0025	1.0401	1.0774
0.9937	0.9845	1.0048	1.0254	1.0455
1.0661	1.0869	1.1002	1.0947	1.0902
1.0907	1.0995	1.1103	1.1223	1.1359
1.1503	1.1652	1.1816	1.1956	1.2276
1.2648	1.1882	1.2266	1.2643	1.0000

Width:

0.1962	0.2007	0.2052	0.2097	0.2141
0.2186	0.2224	0.2259	0.2293	0.2327
0.2362	0.2396	0.2431	0.2465	0.2499
0.2534	0.2568	0.2603	0.2639	0.2670
0.2702	0.2734	0.2765	0.2797	0.2829
0.3234	0.3445	0.3556	0.3668	0.3781
0.3895	0.4009	0.4154	0.4381	0.4618
0.4845	0.5043	0.5237	0.5430	0.5620
0.5811	0.6002	0.6339	0.6705	0.6939
0.7133	0.7355	0.7428	0.7503	1.0000

Transect Ch 1300
Area:

0.0107	0.0220	0.0336	0.0455	0.0578
0.0703	0.0832	0.0963	0.1098	0.1236
0.1376	0.1520	0.1667	0.1817	0.1970
0.2126	0.2285	0.2448	0.2613	0.2781
0.2952	0.3127	0.3304	0.3485	0.3668
0.3855	0.4045	0.4238	0.4433	0.4632
0.4834	0.5039	0.5247	0.5458	0.5672
0.5890	0.6110	0.6333	0.6560	0.6790
0.7023	0.7259	0.7499	0.7742	0.7989
0.8281	0.8706	0.9133	0.9564	1.0000

Hrad:

0.0292	0.0584	0.0869	0.1147	0.1419
0.1684	0.1944	0.2199	0.2449	0.2695
0.2937	0.3175	0.3410	0.3641	0.3869
0.4094	0.4316	0.4536	0.4753	0.4967
0.5179	0.5389	0.5597	0.5802	0.6006
0.6209	0.6409	0.6608	0.6806	0.7002
0.7196	0.7390	0.7582	0.7772	0.7961
0.8149	0.8336	0.8521	0.8704	0.8883
0.9055	0.9226	0.9397	0.9567	0.9736
0.9692	0.9734	0.9806	0.9897	1.0000

Width:

0.2494	0.2563	0.2632	0.2701	0.2770
0.2839	0.2908	0.2977	0.3046	0.3115
0.3183	0.3252	0.3320	0.3388	0.3456
0.3525	0.3593	0.3661	0.3729	0.3797
0.3866	0.3934	0.4003	0.4071	0.4139
0.4208	0.4276	0.4345	0.4413	0.4481
0.4550	0.4618	0.4687	0.4755	0.4824
0.4893	0.4962	0.5031	0.5101	0.5173
0.5249	0.5324	0.5400	0.5476	0.5552
0.9462	0.9525	0.9590	0.9656	1.0000

Transect Ch 1350

Area:

0.0059	0.0123	0.0190	0.0259	0.0337
0.0421	0.0506	0.0593	0.0681	0.0772
0.0863	0.0957	0.1052	0.1149	0.1248
0.1348	0.1450	0.1554	0.1659	0.1766
0.1874	0.1984	0.2096	0.2210	0.2325
0.2442	0.2561	0.2681	0.2803	0.2926
0.3051	0.3178	0.3307	0.3437	0.3569
0.3704	0.3992	0.4297	0.4613	0.4943
0.5328	0.5731	0.6153	0.6608	0.7103
0.7631	0.8184	0.8764	0.9369	1.0000

Hrad:

0.0484	0.0946	0.1399	0.1849	0.2041
0.2492	0.2933	0.3363	0.3782	0.4193
0.4595	0.4990	0.5378	0.5759	0.6134
0.6503	0.6866	0.7224	0.7577	0.7925
0.8268	0.8607	0.8942	0.9273	0.9601
0.9925	1.0246	1.0563	1.0878	1.1189
1.1497	1.1803	1.2107	1.2407	1.2706
1.2587	0.6550	0.6796	0.7042	0.7288
0.7530	0.7782	0.8050	0.8397	0.8698
0.8982	0.9254	0.9513	0.9761	1.0000

Width:

0.0957	0.1018	0.1064	0.1097	0.1288
0.1313	0.1337	0.1362	0.1388	0.1414
0.1440	0.1466	0.1492	0.1518	0.1544
0.1569	0.1595	0.1621	0.1647	0.1673
0.1699	0.1725	0.1751	0.1776	0.1802
0.1828	0.1854	0.1880	0.1905	0.1931
0.1957	0.1983	0.2009	0.2035	0.2060
0.2161	0.4645	0.4824	0.5003	0.5522
0.6147	0.6388	0.6761	0.7381	0.7973
0.8395	0.8796	0.9197	0.9599	1.0000

Transect Ch 1400

Area:

0.0071	0.0143	0.0217	0.0291	0.0367
0.0443	0.0521	0.0600	0.0680	0.0760
0.0842	0.0925	0.1010	0.1095	0.1181
0.1268	0.1357	0.1446	0.1536	0.1628
0.1720	0.1814	0.1909	0.2004	0.2101
0.2198	0.2297	0.2397	0.2640	0.2933
0.3230	0.3533	0.3840	0.4153	0.4470
0.4792	0.5120	0.5452	0.5790	0.6133
0.6481	0.6836	0.7197	0.7572	0.7957
0.8350	0.8751	0.9160	0.9576	1.0000

Hrad:

0.0431	0.0852	0.1265	0.1669	0.2066
0.2455	0.2837	0.3212	0.3582	0.3945
0.4302	0.4653	0.5000	0.5341	0.5678
0.6011	0.6340	0.6666	0.6987	0.7305
0.7619	0.7929	0.8235	0.8539	0.8839
0.9136	0.9430	0.9721	0.3869	0.4226
0.4579	0.4927	0.5271	0.5612	0.5948
0.6281	0.6610	0.6936	0.7255	0.7558
0.7858	0.8156	0.8450	0.8478	0.8736
0.8991	0.9245	0.9498	0.9750	1.0000

Width:

0.1676	0.1702	0.1727	0.1752	0.1777
0.1802	0.1827	0.1853	0.1878	0.1903
0.1928	0.1953	0.1978	0.2003	0.2028
0.2053	0.2077	0.2101	0.2125	0.2150
0.2174	0.2198	0.2222	0.2246	0.2270
0.2295	0.2319	0.2343	0.6776	0.6892
0.7009	0.7126	0.7243	0.7359	0.7476
0.7593	0.7710	0.7826	0.7948	0.8084
0.8220	0.8356	0.8492	0.8914	0.9095
0.9276	0.9457	0.9638	0.9819	1.0000

Transect Ch 1450

Area:

0.0009	0.0042	0.0080	0.0125	0.0184
0.0254	0.0331	0.0412	0.0497	0.0585

0.0676	0.0771	0.0869	0.0971	0.1078
0.1188	0.1302	0.1419	0.1539	0.1663
0.1789	0.1918	0.2050	0.2192	0.2343
0.2505	0.2677	0.2859	0.3052	0.3256
0.3471	0.3697	0.3935	0.4184	0.4447
0.4725	0.5016	0.5329	0.5681	0.6062
0.6445	0.6831	0.7219	0.7609	0.8001
0.8396	0.8794	0.9193	0.9595	1.0000

Hrad:

0.0162	0.0576	0.0949	0.1258	0.1399
0.1684	0.2049	0.2440	0.2827	0.3199
0.3561	0.3910	0.4231	0.4519	0.4849
0.5187	0.5496	0.5819	0.6155	0.6486
0.6812	0.7134	0.7376	0.7517	0.7734
0.7935	0.8103	0.8249	0.8389	0.8522
0.8642	0.8751	0.8864	0.8977	0.9084
0.9175	0.9271	0.9186	0.7185	0.7615
0.8040	0.8460	0.8877	0.9291	0.9702
1.0109	1.0515	1.0917	1.1317	1.0000

Width:

0.0596	0.0747	0.0873	0.1024	0.1354
0.1553	0.1662	0.1736	0.1803	0.1873
0.1943	0.2016	0.2099	0.2196	0.2270
0.2338	0.2415	0.2486	0.2547	0.2609
0.2671	0.2733	0.2824	0.3068	0.3277
0.3487	0.3704	0.3928	0.4153	0.4381
0.4614	0.4854	0.5094	0.5359	0.5649
0.5948	0.6247	0.6878	0.7947	0.7993
0.8040	0.8090	0.8139	0.8189	0.8239
0.8289	0.8338	0.8388	0.8438	1.0000

Transect Ch 1500 / 1550

Area:

0.0035	0.0075	0.0121	0.0172	0.0228
0.0290	0.0357	0.0429	0.0506	0.0588
0.0674	0.0765	0.0862	0.0963	0.1069
0.1180	0.1295	0.1416	0.1541	0.1671
0.1806	0.1952	0.2105	0.2259	0.2419
0.2610	0.2838	0.3074	0.3316	0.3566
0.3823	0.4088	0.4359	0.4638	0.4924
0.5218	0.5519	0.5827	0.6142	0.6465
0.6794	0.7128	0.7470	0.7820	0.8172
0.8527	0.8885	0.9246	0.9611	1.0000

Hrad:

0.0345	0.0651	0.0928	0.1179	0.1418
0.1649	0.1878	0.2106	0.2328	0.2545
0.2757	0.2965	0.3170	0.3372	0.3572
0.3770	0.3967	0.4165	0.4362	0.4558
0.4681	0.4672	0.4954	0.5233	0.5336
0.4271	0.4571	0.4860	0.5140	0.5411
0.5675	0.5932	0.6183	0.6428	0.6668
0.6904	0.7134	0.7361	0.7584	0.7803
0.8027	0.8245	0.8453	0.8673	0.8901
0.9130	0.9361	0.9591	0.9821	1.0000

Width:

0.0845	0.0960	0.1077	0.1200	0.1323
0.1442	0.1556	0.1665	0.1773	0.1881
0.1989	0.2098	0.2207	0.2316	0.2425
0.2534	0.2643	0.2749	0.2856	0.2962
0.3118	0.3381	0.3432	0.3484	0.3659
0.5018	0.5181	0.5344	0.5507	0.5670
0.5833	0.5996	0.6158	0.6321	0.6484
0.6647	0.6810	0.6973	0.7136	0.7296
0.7414	0.7562	0.7746	0.7847	0.7912
0.7978	0.8044	0.8111	0.8179	1.0000

Transect Ch 1600

Area:

0.0068	0.0154	0.0243	0.0334	0.0429
0.0527	0.0628	0.0733	0.0840	0.0950
0.1063	0.1179	0.1299	0.1421	0.1547
0.1675	0.1807	0.1941	0.2079	0.2220
0.2364	0.2510	0.2660	0.2814	0.2970

0.3129	0.3292	0.3458	0.3627	0.3799
0.3975	0.4168	0.4368	0.4571	0.4778
0.4989	0.5203	0.5421	0.5643	0.5868
0.6098	0.6418	0.6838	0.7265	0.7701
0.8144	0.8596	0.9056	0.9524	1.0000

Hrad:

0.0292	0.0629	0.0958	0.1276	0.1585
0.1885	0.2176	0.2461	0.2739	0.3011
0.3277	0.3538	0.3795	0.4047	0.4295
0.4539	0.4780	0.5018	0.5252	0.5484
0.5713	0.5937	0.6159	0.6379	0.6597
0.6814	0.7028	0.7240	0.7452	0.7661
0.7674	0.7390	0.7605	0.7820	0.8033
0.8245	0.8455	0.8665	0.8868	0.9069
0.9270	0.9218	0.9243	0.9301	0.9383
0.9483	0.9598	0.9723	0.9858	1.0000

Width:

0.1739	0.1819	0.1882	0.1946	0.2009
0.2073	0.2136	0.2200	0.2263	0.2327
0.2390	0.2454	0.2517	0.2581	0.2644
0.2708	0.2771	0.2835	0.2898	0.2962
0.3026	0.3091	0.3157	0.3222	0.3288
0.3353	0.3419	0.3485	0.3551	0.3618
0.3782	0.4124	0.4199	0.4274	0.4350
0.4425	0.4501	0.4576	0.4655	0.4733
0.4812	0.8653	0.8820	0.8987	0.9155
0.9322	0.9490	0.9660	0.9830	1.0000

Transect Ch 1650

Area:

0.0022	0.0048	0.0079	0.0114	0.0153
0.0196	0.0244	0.0296	0.0352	0.0413
0.0477	0.0547	0.0620	0.0698	0.0780
0.0866	0.0957	0.1052	0.1151	0.1261
0.1406	0.1557	0.1716	0.1880	0.2052
0.2229	0.2414	0.2605	0.2802	0.3006
0.3216	0.3433	0.3657	0.3887	0.4123
0.4366	0.4616	0.4872	0.5135	0.5428
0.5782	0.6170	0.6594	0.7033	0.7483
0.7942	0.8417	0.8910	0.9437	1.0000

Hrad:

0.0406	0.0749	0.1054	0.1335	0.1599
0.1853	0.2098	0.2337	0.2572	0.2803
0.3031	0.3257	0.3480	0.3702	0.3923
0.4142	0.4357	0.4572	0.4786	0.3997
0.4061	0.4307	0.4551	0.4791	0.5030
0.5266	0.5501	0.5734	0.5966	0.6196
0.6426	0.6654	0.6881	0.7107	0.7333
0.7557	0.7781	0.8005	0.8226	0.8275
0.8442	0.8572	0.8675	0.8793	0.8926
0.9114	0.9372	0.9614	0.9821	1.0000

Width:

0.0417	0.0488	0.0560	0.0634	0.0708
0.0782	0.0856	0.0929	0.1003	0.1077
0.1151	0.1225	0.1299	0.1373	0.1446
0.1520	0.1595	0.1670	0.1746	0.2320
0.2550	0.2662	0.2774	0.2886	0.2998
0.3110	0.3223	0.3335	0.3447	0.3559
0.3671	0.3783	0.3895	0.4007	0.4119
0.4231	0.4344	0.4455	0.4568	0.5798
0.6363	0.6986	0.7461	0.7639	0.7808
0.8008	0.8307	0.8719	0.9359	1.0000

Transect Ch 400

Area:

0.0006	0.0024	0.0048	0.0079	0.0115
0.0158	0.0206	0.0260	0.0321	0.0387
0.0460	0.0537	0.0617	0.0699	0.0782
0.0868	0.0956	0.1045	0.1137	0.1231
0.1327	0.1424	0.1524	0.1626	0.1730
0.1835	0.1943	0.2052	0.2164	0.2277
0.2392	0.2706	0.3083	0.3462	0.3844
0.4230	0.4618	0.5010	0.5404	0.5802

0.6204	0.6608	0.7015	0.7425	0.7837
0.8253	0.8672	0.9093	0.9526	1.0000

Hrad:

0.0290	0.0645	0.1012	0.1348	0.1667
0.1976	0.2279	0.2578	0.2873	0.3166
0.3466	0.3866	0.4284	0.4712	0.5128
0.5534	0.5921	0.6298	0.6666	0.7027
0.7380	0.7727	0.8068	0.8413	0.8751
0.9084	0.9413	0.9736	1.0055	1.0371
1.0682	0.9141	0.8652	0.8409	0.8311
0.8296	0.8358	0.8476	0.8636	0.8828
0.9054	0.9303	0.9566	0.9841	1.0125
1.0417	1.0716	1.1020	1.1321	1.0000

Width:

0.0216	0.0373	0.0478	0.0582	0.0687
0.0792	0.0897	0.1002	0.1106	0.1211
0.1312	0.1369	0.1413	0.1446	0.1479
0.1511	0.1546	0.1581	0.1617	0.1652
0.1688	0.1723	0.1758	0.1792	0.1825
0.1858	0.1891	0.1924	0.1957	0.1990
0.2023	0.6552	0.6596	0.6640	0.6687
0.6744	0.6800	0.6856	0.6912	0.6969
0.7021	0.7071	0.7121	0.7171	0.7221
0.7272	0.7322	0.7372	0.7913	1.0000

Transect CH 450

Area:

0.0062	0.0131	0.0203	0.0280	0.0361
0.0447	0.0537	0.0631	0.0729	0.0833
0.0940	0.1053	0.1170	0.1291	0.1417
0.1547	0.1682	0.1821	0.1964	0.2112
0.2265	0.2422	0.2583	0.2749	0.2920
0.3103	0.3297	0.3498	0.3709	0.3928
0.4156	0.4395	0.4647	0.4909	0.5178
0.5453	0.5735	0.6024	0.6319	0.6620
0.6927	0.7240	0.7559	0.7884	0.8215
0.8551	0.8892	0.9239	0.9592	1.0000

Hrad:

0.0366	0.0715	0.1042	0.1353	0.1650
0.1941	0.2216	0.2477	0.2731	0.2978
0.3220	0.3458	0.3693	0.3925	0.4153
0.4377	0.4599	0.4819	0.5036	0.5251
0.5464	0.5675	0.5885	0.6093	0.6282
0.6092	0.6234	0.6343	0.6458	0.6570
0.6678	0.6719	0.6733	0.6933	0.7137
0.7340	0.7543	0.7745	0.7947	0.8163
0.8378	0.8592	0.8806	0.9025	0.9248
0.9470	0.9690	0.9895	0.9996	1.0000

Width:

0.1013	0.1080	0.1148	0.1215	0.1282
0.1344	0.1410	0.1480	0.1550	0.1620
0.1690	0.1760	0.1828	0.1897	0.1965
0.2034	0.2102	0.2171	0.2239	0.2307
0.2376	0.2444	0.2513	0.2581	0.2658
0.2919	0.3030	0.3163	0.3296	0.3434
0.3575	0.3761	0.3973	0.4077	0.4177
0.4278	0.4378	0.4479	0.4580	0.4671
0.4761	0.4852	0.4943	0.5030	0.5114
0.5197	0.5280	0.5373	0.5525	1.0000

Transect Ch 500

Area:

0.0092	0.0189	0.0287	0.0387	0.0489
0.0593	0.0700	0.0809	0.0920	0.1033
0.1149	0.1266	0.1386	0.1507	0.1631
0.1757	0.1885	0.2016	0.2149	0.2287
0.2427	0.2571	0.2718	0.2869	0.3023
0.3189	0.3364	0.3546	0.3735	0.3932
0.4137	0.4349	0.4569	0.4797	0.5033
0.5278	0.5531	0.5792	0.6064	0.6343
0.6631	0.6928	0.7234	0.7550	0.7877
0.8216	0.8641	0.9090	0.9541	1.0000

Hrad:

0.0395	0.0790	0.1175	0.1549	0.1902
0.2246	0.2580	0.2907	0.3231	0.3549
0.3859	0.4164	0.4462	0.4755	0.5043
0.5326	0.5604	0.5854	0.6075	0.6294
0.6511	0.6726	0.6939	0.7151	0.7376
0.7117	0.7213	0.7317	0.7422	0.7533
0.7651	0.7774	0.7889	0.8004	0.8122
0.8246	0.8373	0.8461	0.8589	0.8729
0.8870	0.9013	0.9112	0.9214	0.9298
0.9291	0.9269	0.9495	0.9735	1.0000

Width:

0.1423	0.1446	0.1469	0.1492	0.1528
0.1563	0.1599	0.1634	0.1665	0.1697
0.1728	0.1759	0.1791	0.1822	0.1854
0.1885	0.1917	0.1957	0.2008	0.2059
0.2109	0.2160	0.2210	0.2260	0.2305
0.2537	0.2646	0.2755	0.2868	0.2980
0.3092	0.3204	0.3323	0.3444	0.3567
0.3689	0.3812	0.3958	0.4086	0.4211
0.4337	0.4463	0.4615	0.4769	0.4937
0.5318	0.6645	0.6677	0.6708	1.0000

Transect Ch 550

Area:

0.0091	0.0221	0.0352	0.0484	0.0618
0.0753	0.0889	0.1027	0.1166	0.1307
0.1449	0.1592	0.1737	0.1883	0.2031
0.2180	0.2330	0.2483	0.2637	0.2793
0.2952	0.3112	0.3274	0.3439	0.3605
0.3773	0.3944	0.4116	0.4290	0.4466
0.4644	0.4824	0.5006	0.5189	0.5375
0.5563	0.5753	0.5945	0.6140	0.6341
0.6560	0.6807	0.7088	0.7401	0.7745
0.8122	0.8531	0.8972	0.9446	1.0000

Hrad:

0.0263	0.0627	0.0984	0.1334	0.1678
0.2015	0.2347	0.2673	0.2993	0.3308
0.3618	0.3924	0.4225	0.4521	0.4813
0.5101	0.5379	0.5641	0.5901	0.6156
0.6409	0.6658	0.6905	0.7149	0.7390
0.7633	0.7877	0.8118	0.8357	0.8594
0.8829	0.9062	0.9293	0.9522	0.9742
0.9953	1.0163	1.0372	1.0576	1.0771
1.0921	1.1015	1.1053	1.1042	1.0977
1.0885	1.0776	1.0655	1.0517	1.0000

Width:

0.1898	0.1918	0.1939	0.1959	0.1979
0.2000	0.2020	0.2040	0.2061	0.2082
0.2102	0.2123	0.2143	0.2164	0.2184
0.2205	0.2229	0.2258	0.2288	0.2318
0.2347	0.2377	0.2406	0.2436	0.2465
0.2494	0.2522	0.2550	0.2579	0.2607
0.2635	0.2663	0.2691	0.2720	0.2750
0.2784	0.2817	0.2851	0.2886	0.3077
0.3412	0.3903	0.4369	0.4837	0.5312
0.5787	0.6263	0.6738	0.7218	1.0000

Transect Ch 600

Area:

0.0070	0.0141	0.0214	0.0289	0.0365
0.0443	0.0522	0.0602	0.0684	0.0768
0.0852	0.0938	0.1026	0.1114	0.1204
0.1295	0.1388	0.1484	0.1583	0.1686
0.1792	0.1902	0.2015	0.2132	0.2252
0.2376	0.2504	0.2634	0.2768	0.2906
0.3047	0.3191	0.3338	0.3502	0.3807
0.4142	0.4480	0.4823	0.5179	0.5549
0.5932	0.6329	0.6740	0.7164	0.7602
0.8054	0.8519	0.8998	0.9491	1.0000

Hrad:

0.0459	0.0901	0.1327	0.1739	0.2137
0.2523	0.2899	0.3266	0.3624	0.3972
0.4312	0.4644	0.4969	0.5286	0.5598

0.5903	0.6175	0.6362	0.6551	0.6743
0.6936	0.7130	0.7324	0.7518	0.7716
0.7917	0.8117	0.8317	0.8516	0.8715
0.8913	0.9111	0.9308	0.8144	0.7319
0.7444	0.7607	0.7791	0.7976	0.8159
0.8343	0.8528	0.8714	0.8901	0.9089
0.9278	0.9468	0.9657	0.9843	1.0000

Width:

0.1360	0.1391	0.1421	0.1451	0.1481
0.1511	0.1540	0.1566	0.1591	0.1617
0.1643	0.1668	0.1694	0.1720	0.1746
0.1771	0.1807	0.1876	0.1944	0.2012
0.2081	0.2149	0.2217	0.2286	0.2352
0.2418	0.2483	0.2549	0.2614	0.2680
0.2746	0.2811	0.2877	0.4080	0.6437
0.6479	0.6521	0.6731	0.6991	0.7253
0.7516	0.7778	0.8041	0.8303	0.8566
0.8828	0.9091	0.9357	0.9651	1.0000

Transect Ch 650

Area:

0.0075	0.0181	0.0297	0.0421	0.0548
0.0678	0.0811	0.0948	0.1091	0.1239
0.1390	0.1545	0.1703	0.1864	0.2028
0.2194	0.2363	0.2535	0.2709	0.2885
0.3065	0.3246	0.3430	0.3617	0.3805
0.4003	0.4208	0.4417	0.4629	0.4846
0.5067	0.5293	0.5524	0.5758	0.5995
0.6236	0.6480	0.6728	0.6979	0.7235
0.7493	0.7755	0.8020	0.8288	0.8559
0.8832	0.9107	0.9382	0.9659	1.0000

Hrad:

0.0218	0.0478	0.0721	0.0973	0.1238
0.1497	0.1751	0.1971	0.2165	0.2394
0.2631	0.2860	0.3083	0.3313	0.3544
0.3774	0.4001	0.4225	0.4446	0.4661
0.4877	0.5096	0.5313	0.5527	0.5740
0.5661	0.5837	0.6003	0.6176	0.6340
0.6490	0.6639	0.6811	0.6999	0.7176
0.7353	0.7529	0.7705	0.7879	0.8055
0.8232	0.8413	0.8593	0.8771	0.8964
0.9194	0.9421	0.9645	0.9867	1.0000

Width:

0.2586	0.2827	0.3067	0.3216	0.3289
0.3362	0.3436	0.3563	0.3731	0.3829
0.3907	0.3990	0.4078	0.4151	0.4218
0.4282	0.4347	0.4411	0.4476	0.4545
0.4610	0.4670	0.4730	0.4790	0.4851
0.5177	0.5276	0.5383	0.5483	0.5590
0.5710	0.5831	0.5931	0.6014	0.6106
0.6197	0.6288	0.6379	0.6470	0.6558
0.6644	0.6727	0.6810	0.6893	0.6960
0.6990	0.7021	0.7052	0.7084	1.0000

Transect Ch 700

Area:

0.0061	0.0124	0.0189	0.0258	0.0328
0.0401	0.0476	0.0554	0.0635	0.0717
0.0802	0.0890	0.0980	0.1072	0.1167
0.1263	0.1365	0.1476	0.1591	0.1709
0.1831	0.1957	0.2086	0.2218	0.2355
0.2494	0.2637	0.2784	0.2934	0.3088
0.3245	0.3406	0.3570	0.3845	0.4189
0.4538	0.4890	0.5248	0.5609	0.5973
0.6340	0.6710	0.7085	0.7466	0.7854
0.8248	0.8648	0.9058	0.9506	1.0000

Hrad:

0.0460	0.0897	0.1313	0.1710	0.2091
0.2457	0.2811	0.3153	0.3484	0.3807
0.4121	0.4427	0.4731	0.5035	0.5331
0.5621	0.5446	0.5695	0.5941	0.6184
0.6425	0.6664	0.6901	0.7136	0.7370
0.7602	0.7832	0.8062	0.8290	0.8517

0.8742	0.8966	0.9198	0.9007	0.8781
0.8660	0.8604	0.8597	0.8690	0.8814
0.9003	0.9155	0.9228	0.9324	0.9439
0.9571	0.9718	0.9872	0.9979	1.0000

Width:

0.1198	0.1246	0.1293	0.1340	0.1387
0.1434	0.1481	0.1528	0.1575	0.1622
0.1669	0.1716	0.1762	0.1804	0.1848
0.1892	0.2119	0.2187	0.2255	0.2324
0.2392	0.2460	0.2528	0.2596	0.2664
0.2733	0.2801	0.2869	0.2937	0.3005
0.3074	0.3142	0.3207	0.6608	0.6690
0.6771	0.6859	0.6950	0.7013	0.7075
0.7116	0.7184	0.7308	0.7431	0.7554
0.7677	0.7800	0.8230	0.9097	1.0000

Transect Ch 750

Area:

0.0089	0.0184	0.0281	0.0380	0.0481
0.0585	0.0690	0.0799	0.0909	0.1021
0.1135	0.1252	0.1371	0.1491	0.1614
0.1739	0.1866	0.1995	0.2127	0.2260
0.2395	0.2533	0.2673	0.2814	0.2958
0.3107	0.3262	0.3426	0.3597	0.3776
0.3964	0.4159	0.4362	0.4575	0.4796
0.5023	0.5257	0.5498	0.5746	0.6000
0.6262	0.6531	0.6816	0.7131	0.7484
0.7916	0.8425	0.8940	0.9459	1.0000

Hrad:

0.0476	0.0953	0.1416	0.1864	0.2301
0.2726	0.3140	0.3546	0.3946	0.4336
0.4719	0.5095	0.5463	0.5825	0.6181
0.6530	0.6875	0.7214	0.7548	0.7877
0.8203	0.8524	0.8841	0.9154	0.9463
0.9497	0.9537	0.9565	0.9612	0.9676
0.9754	0.9844	0.9947	0.9923	1.0121
1.0317	1.0510	1.0685	1.0867	1.1055
1.1235	1.1412	1.0871	1.0383	0.9998
0.9186	0.9199	0.9507	0.9826	1.0000

Width:

0.1327	0.1358	0.1389	0.1421	0.1453
0.1485	0.1517	0.1548	0.1578	0.1608
0.1638	0.1668	0.1697	0.1727	0.1757
0.1787	0.1817	0.1847	0.1877	0.1906
0.1936	0.1966	0.1996	0.2026	0.2056
0.2157	0.2261	0.2373	0.2486	0.2598
0.2710	0.2823	0.2935	0.3092	0.3181
0.3272	0.3364	0.3464	0.3562	0.3660
0.3762	0.3866	0.4253	0.4677	0.5511
0.6912	0.7278	0.7330	0.7382	1.0000

Transect Ch 800

Area:

0.0133	0.0279	0.0426	0.0575	0.0725
0.0876	0.1030	0.1185	0.1341	0.1499
0.1659	0.1820	0.1983	0.2148	0.2314
0.2481	0.2650	0.2821	0.2993	0.3167
0.3343	0.3520	0.3698	0.3878	0.4060
0.4243	0.4428	0.4615	0.4803	0.4992
0.5183	0.5376	0.5570	0.5766	0.5963
0.6162	0.6363	0.6565	0.6769	0.6974
0.7181	0.7389	0.7599	0.7811	0.8024
0.8238	0.8455	0.8738	0.9314	1.0000

Hrad:

0.0270	0.0559	0.0843	0.1123	0.1400
0.1673	0.1943	0.2210	0.2473	0.2734
0.2991	0.3246	0.3498	0.3747	0.3995
0.4239	0.4482	0.4721	0.4959	0.5195
0.5428	0.5659	0.5889	0.6116	0.6341
0.6565	0.6787	0.7007	0.7225	0.7442
0.7657	0.7871	0.8083	0.8294	0.8503
0.8711	0.8918	0.9123	0.9327	0.9529
0.9731	0.9931	1.0130	1.0328	1.0525

1.0720	1.0915	1.0620	1.0345	1.0000

Width:

0.1942	0.1963	0.1983	0.2004	0.2025
0.2046	0.2067	0.2089	0.2110	0.2131
0.2153	0.2174	0.2195	0.2216	0.2237
0.2259	0.2280	0.2301	0.2322	0.2343
0.2364	0.2385	0.2406	0.2427	0.2448
0.2469	0.2490	0.2511	0.2532	0.2553
0.2574	0.2595	0.2616	0.2637	0.2658
0.2680	0.2701	0.2722	0.2743	0.2764
0.2785	0.2806	0.2827	0.2848	0.2869
0.2890	0.2911	0.6756	0.8143	1.0000

Transect Ch 850

Area:

0.0048	0.0098	0.0152	0.0209	0.0268
0.0331	0.0397	0.0466	0.0538	0.0613
0.0692	0.0773	0.0856	0.0943	0.1032
0.1123	0.1217	0.1314	0.1413	0.1515
0.1620	0.1728	0.1840	0.1955	0.2073
0.2200	0.2337	0.2483	0.2651	0.2856
0.3077	0.3314	0.3569	0.3841	0.4129
0.4436	0.4759	0.5100	0.5457	0.5832
0.6215	0.6602	0.6992	0.7387	0.7786
0.8189	0.8596	0.9007	0.9453	1.0000

Hrad:

0.0447	0.0864	0.1257	0.1630	0.1986
0.2323	0.2644	0.2957	0.3264	0.3563
0.3860	0.4154	0.4447	0.4734	0.5016
0.5292	0.5564	0.5832	0.6096	0.6356
0.6578	0.6792	0.7005	0.7218	0.7372
0.7238	0.7187	0.7155	0.7091	0.6995
0.7152	0.7291	0.7416	0.7531	0.7638
0.7741	0.7840	0.7939	0.8037	0.8147
0.8306	0.8483	0.8674	0.8876	0.9081
0.9294	0.9513	0.9742	0.9931	1.0000

Width:

0.0823	0.0873	0.0923	0.0973	0.1023
0.1075	0.1129	0.1182	0.1233	0.1285
0.1332	0.1378	0.1422	0.1466	0.1509
0.1553	0.1597	0.1640	0.1684	0.1728
0.1782	0.1838	0.1895	0.1952	0.2026
0.2201	0.2363	0.2532	0.3183	0.3578
0.3827	0.4114	0.4402	0.4690	0.4978
0.5266	0.5554	0.5842	0.6129	0.6371
0.6437	0.6503	0.6569	0.6636	0.6705
0.6774	0.6844	0.6911	0.8309	1.0000

Transect Ch 900

Area:

0.0070	0.0163	0.0259	0.0357	0.0458
0.0561	0.0666	0.0773	0.0883	0.0995
0.1109	0.1226	0.1345	0.1466	0.1590
0.1716	0.1844	0.1975	0.2108	0.2243
0.2381	0.2520	0.2662	0.2806	0.2951
0.3099	0.3249	0.3401	0.3555	0.3711
0.3869	0.4029	0.4191	0.4356	0.4522
0.4690	0.4881	0.5119	0.5393	0.5705
0.6043	0.6401	0.6780	0.7179	0.7599
0.8038	0.8498	0.8979	0.9479	1.0000

Hrad:

0.0267	0.0607	0.0938	0.1261	0.1577
0.1886	0.2189	0.2485	0.2776	0.3062
0.3343	0.3619	0.3890	0.4158	0.4422
0.4682	0.4939	0.5192	0.5442	0.5690
0.5943	0.6195	0.6444	0.6691	0.6936
0.7178	0.7417	0.7655	0.7890	0.8124
0.8355	0.8585	0.8813	0.9040	0.9265
0.9488	0.9715	0.9879	0.9968	0.9994
1.0004	1.0008	1.0008	1.0005	1.0002
0.9998	0.9995	0.9994	0.9996	1.0000

Width:

0.1738	0.1782	0.1826	0.1870	0.1913

```
            0.1957     0.2001     0.2045     0.2088     0.2132
            0.2176     0.2220     0.2264     0.2307     0.2351
            0.2395     0.2439     0.2482     0.2526     0.2570
            0.2609     0.2648     0.2687     0.2725     0.2764
            0.2803     0.2842     0.2881     0.2919     0.2958
            0.2997     0.3036     0.3075     0.3114     0.3153
            0.3191     0.4127     0.4826     0.5521     0.6179
            0.6561     0.6943     0.7325     0.7707     0.8090
            0.8472     0.8854     0.9236     0.9618     1.0000

Transect Ch 950
Area:
            0.0089     0.0223     0.0390     0.0557     0.0725
            0.0893     0.1062     0.1232     0.1402     0.1573
            0.1744     0.1917     0.2095     0.2273     0.2453
            0.2633     0.2814     0.2997     0.3179     0.3363
            0.3546     0.3731     0.3915     0.4100     0.4286
            0.4473     0.4663     0.4856     0.5052     0.5251
            0.5453     0.5658     0.5866     0.6078     0.6292
            0.6510     0.6731     0.6955     0.7182     0.7412
            0.7645     0.7881     0.8121     0.8363     0.8609
            0.8857     0.9114     0.9389     0.9681     1.0000
Hrad:
            0.0305     0.0459     0.0777     0.1104     0.1428
            0.1749     0.2067     0.2383     0.2696     0.3006
            0.3314     0.3618     0.3818     0.4116     0.4412
            0.4706     0.4997     0.5287     0.5580     0.5872
            0.6162     0.6451     0.6737     0.7021     0.7304
            0.7503     0.7700     0.7889     0.8077     0.8262
            0.8446     0.8629     0.8812     0.8993     0.9174
            0.9354     0.9533     0.9712     0.9890     1.0067
            1.0243     1.0419     1.0595     1.0769     1.0944
            1.1117     1.1281     1.1422     1.1543     1.0000
Width:
            0.2529     0.4143     0.4214     0.4229     0.4244
            0.4258     0.4273     0.4288     0.4303     0.4318
            0.4333     0.4461     0.4500     0.4522     0.4543
            0.4565     0.4587     0.4607     0.4621     0.4633
            0.4644     0.4655     0.4666     0.4676     0.4687
            0.4759     0.4832     0.4909     0.4986     0.5064
            0.5143     0.5221     0.5299     0.5378     0.5456
            0.5534     0.5613     0.5691     0.5769     0.5847
            0.5926     0.6004     0.6082     0.6161     0.6239
            0.6317     0.6705     0.7147     0.7589     1.0000


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......        60.578        29.556
Continuity Error (%) .....         0.752


**************************        Volume        Volume
Flow Routing Continuity        hectare-m       Mliters
**************************     ---------     ---------
External Inflow ..........         0.000         0.000
External Outflow .........        15.104       151.038
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.002         0.024
Continuity Error (%) .....        -0.005


**************************************
Runoff Coefficient Computations Report
**************************************


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Subbasin Catch-A3
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                                                          Area          Soil       Runoff
Soil/Surface Description                                   (ha)         Group       Coeff.
-------------------------------------------------------------------------------------------
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-	42.08	-	0.25
Composite Area & Weighted Runoff Coeff.	42.08		0.25

Subbasin Catch-B1

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	44.21	-	0.25
Composite Area & Weighted Runoff Coeff.	44.21		0.25

Subbasin Ext-A

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	24.27	-	0.25
Composite Area & Weighted Runoff Coeff.	24.27		0.25

Subbasin Ext-B

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	30.42	-	0.25
Composite Area & Weighted Runoff Coeff.	30.42		0.25

Subbasin Ext-C

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	99.71	-	0.25
Composite Area & Weighted Runoff Coeff.	99.71		0.25

Subbasin Ext-D

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	99.71	-	0.25
Composite Area & Weighted Runoff Coeff.	99.71		0.25

Subbasin Ext-E

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	51.56	-	0.25
Composite Area & Weighted Runoff Coeff.	51.56		0.25

Subbasin Ext-F

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	80.41	-	0.25
Composite Area & Weighted Runoff Coeff.	80.41		0.25

Subbasin Ext-G

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	117.35	-	0.25

Composite Area & Weighted Runoff Coeff.	117.35		0.25

Subbasin Ext-H

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	41.74	-	0.25
Composite Area & Weighted Runoff Coeff.	41.74		0.25

Subbasin Ext-I

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	137.91	-	0.25
Composite Area & Weighted Runoff Coeff.	137.91		0.25

Subbasin Ext-J

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	69.04	-	0.25
Composite Area & Weighted Runoff Coeff.	69.04		0.25

Subbasin Ext-K

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	80.14	-	0.25
Composite Area & Weighted Runoff Coeff.	80.14		0.25

Subbasin Ext-L

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	51.91	-	0.25
Composite Area & Weighted Runoff Coeff.	51.91		0.25

Subbasin Ext-M

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	109.11	-	0.25
Composite Area & Weighted Runoff Coeff.	109.11		0.25

Subbasin Ext-O

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	124.44	-	0.25
Composite Area & Weighted Runoff Coeff.	124.44		0.25

Subbasin Ext-P

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	95.51	-	0.25
Composite Area & Weighted Runoff Coeff.	95.51		0.25

Subbasin Ext-R

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	26.26	-	0.25
Composite Area & Weighted Runoff Coeff.	26.26		0.25

Subbasin Ext-S

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	104.52	-	0.25
Composite Area & Weighted Runoff Coeff.	104.52		0.25

Subbasin Ext-T

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	91.62	-	0.25
Composite Area & Weighted Runoff Coeff.	91.62		0.25

Subbasin Ext-U

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	121.39	-	0.25
Composite Area & Weighted Runoff Coeff.	121.39		0.25

Subbasin Ext-W

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	62.67	-	0.25
Composite Area & Weighted Runoff Coeff.	62.67		0.25

Subbasin Ext-X

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	41.25	-	0.25
Composite Area & Weighted Runoff Coeff.	41.25		0.25

Subbasin Ext-Y

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	38.05	-	0.25
Composite Area & Weighted Runoff Coeff.	38.05		0.25

Subbasin Ext-Z

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	33.92	-	0.25
Composite Area & Weighted Runoff Coeff.	33.92		0.25

Subbasin Sub-24

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	107.45	-	0.25
Composite Area & Weighted Runoff Coeff.	107.45		0.25

Subbasin Sub-25

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	32.35	-	0.25
Composite Area & Weighted Runoff Coeff.	32.35		0.25

Subbasin Sub-28

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	22.31	-	0.25
Composite Area & Weighted Runoff Coeff.	22.31		0.25

Subbasin Sub-30

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	52.37	-	0.25
Composite Area & Weighted Runoff Coeff.	52.37		0.25

Subbasin Sub-31

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	28.78	-	0.25
Composite Area & Weighted Runoff Coeff.	28.78		0.25

Subbasin Sub-32

Soil/Surface Description	Area (ha)	Soil Group	Runoff Coeff.
-	5.00	-	0.72
Composite Area & Weighted Runoff Coeff.	5.00		0.72

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Subbasin Runoff Summary
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Subbasin ID	Accumulated Precip mm	Rainfall Intensity mm/hr	Total Runoff mm	Peak Runoff cms	Weighted Runoff Coeff	Time of Concentration days	hh:mm:ss
Catch-A3	36.92	43.43	9.23	1.26	0.250	0	00:51:00
Catch-B1	36.92	43.43	9.23	1.32	0.250	0	00:51:00
Ext-A	20.20	80.79	5.05	1.35	0.250	0	00:15:00
Ext-B	18.76	86.58	4.69	1.81	0.250	0	00:13:00
Ext-C	32.16	50.56	8.04	3.47	0.250	0	00:38:07
Ext-D	22.62	72.72	5.66	4.10	0.250	0	00:18:39
Ext-E	19.64	83.16	4.91	2.95	0.250	0	00:14:07
Ext-F	21.94	74.52	5.49	4.13	0.250	0	00:17:43
Ext-G	27.80	59.21	6.95	4.79	0.250	0	00:28:06
Ext-H	20.20	80.79	5.05	2.32	0.250	0	00:15:00

Ext-I	29.98	54.52	7.50	5.18	0.250	0	00:33:00
Ext-J	23.79	69.06	5.95	3.28	0.250	0	00:20:43
Ext-K	24.96	66.07	6.24	3.65	0.250	0	00:22:37
Ext-L	22.89	71.67	5.72	2.56	0.250	0	00:19:13
Ext-M	21.57	76.14	5.39	5.72	0.250	0	00:16:57
Ext-O	36.07	44.47	9.02	3.81	0.250	0	00:48:44
Ext-P	29.19	56.19	7.30	3.70	0.250	0	00:31:08
Ext-R	20.31	80.36	5.08	1.45	0.250	0	00:15:10
Ext-S	32.06	50.63	8.02	3.64	0.250	0	00:38:01
Ext-T	38.27	41.75	9.57	2.63	0.250	0	00:55:00
Ext-U	33.26	48.68	8.32	4.07	0.250	0	00:41:00
Ext-W	36.22	44.35	9.05	1.91	0.250	0	00:49:00
Ext-X	37.41	42.76	9.35	1.21	0.250	0	00:52:33
Ext-Y	29.98	54.52	7.50	1.43	0.250	0	00:33:00
Ext-Z	29.98	54.52	7.50	1.27	0.250	0	00:33:00
Sub-24	34.03	47.48	8.51	3.51	0.250	0	00:43:00
Sub-25	31.26	52.10	7.81	1.16	0.250	0	00:36:00
Sub-28	31.67	51.36	7.92	0.79	0.250	0	00:37:00
Sub-30	40.20	39.54	10.05	1.43	0.250	0	01:01:00
Sub-31	31.79	51.09	7.95	1.01	0.250	0	00:37:22
Sub-32	0.00	0.00	0.00	0.00	0.720	0	00:00:00

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Node Depth Summary
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Node ID	Average Depth Attained m	Maximum Depth Attained m	Maximum HGL Attained m	Time of Max Occurrence days	Time of Max Occurrence hh:mm	Total Flooded Volume ha-mm	Total Time Flooded minutes	Retention Time hh:mm:ss
Jun-01	0.00	0.00	440.00	0	00:00	0	0	0:00:00
Jun-02	0.00	0.00	360.00	0	00:00	0	0	0:00:00
Jun-03	0.00	0.00	360.00	0	00:00	0	0	0:00:00
Jun-04	0.00	0.00	380.00	0	00:00	0	0	0:00:00
Jun-05	0.00	0.00	440.00	0	00:00	0	0	0:00:00
Jun-06	0.00	0.00	360.00	0	00:00	0	0	0:00:00
Jun-07	0.00	0.00	330.00	0	00:00	0	0	0:00:00
Jun-08	0.00	0.00	330.00	0	00:00	0	0	0:00:00
Jun-09	0.00	0.00	340.00	0	00:00	0	0	0:00:00
Jun-10	0.00	0.00	320.00	0	00:00	0	0	0:00:00
Jun-11	0.00	0.00	340.00	0	00:00	0	0	0:00:00
Jun-12	0.00	0.00	300.00	0	00:00	0	0	0:00:00
Jun-13	0.00	0.00	290.00	0	00:00	0	0	0:00:00
Jun-14	0.00	0.00	280.00	0	00:00	0	0	0:00:00
Jun-15	0.00	0.00	260.00	0	00:00	0	0	0:00:00
Jun-16	0.00	0.00	250.00	0	00:00	0	0	0:00:00
Jun-17	0.00	0.00	240.00	0	00:00	0	0	0:00:00
Jun-18	0.00	0.00	240.00	0	00:00	0	0	0:00:00
Jun-19	0.00	0.00	245.00	0	00:00	0	0	0:00:00
Jun-20	0.00	0.00	280.00	0	00:00	0	0	0:00:00
Jun-22	0.19	2.06	231.40	0	00:18	0	0	0:00:00
Jun-23	0.25	2.16	220.96	0	00:27	0	0	0:00:00
Jun-24	0.00	0.00	500.00	0	00:00	0	0	0:00:00
Jun-25	0.00	0.00	500.00	0	00:00	0	0	0:00:00
Jun-26	0.00	0.00	435.00	0	00:00	0	0	0:00:00
Jun-27	0.00	0.00	500.00	0	00:00	0	0	0:00:00
Jun-28	0.00	0.00	500.00	0	00:00	0	0	0:00:00
Jun-29	0.00	0.00	440.00	0	00:00	0	0	0:00:00
Jun-30	0.00	0.00	340.00	0	00:00	0	0	0:00:00
Jun-31	0.00	0.00	390.00	0	00:00	0	0	0:00:00
Jun-32	0.00	0.00	350.00	0	00:00	0	0	0:00:00
Jun-33	0.00	0.00	350.00	0	00:00	0	0	0:00:00
Jun-34	0.00	0.00	350.00	0	00:00	0	0	0:00:00
Jun-35	0.00	0.00	320.00	0	00:00	0	0	0:00:00
Jun-36	0.00	0.00	278.00	0	00:00	0	0	0:00:00
Jun-38	0.00	0.00	235.00	0	00:00	0	0	0:00:00
Jun-39	0.00	0.00	260.00	0	00:00	0	0	0:00:00
Jun-41	0.04	0.39	240.39	0	00:52	0	0	0:00:00
Jun-42	0.00	0.00	0.00	0	00:00	0	0	0:00:00

Jun-43	0.00	0.00	234.00	0	00:00	0	0	0:00:00
Jun-44	0.00	0.00	0.00	0	00:00	0	0	0:00:00
Jun-45	0.00	0.00	234.00	0	00:00	0	0	0:00:00
Jun-46	0.00	0.00	0.00	0	00:00	0	0	0:00:00
Jun-47	0.00	0.00	234.00	0	00:00	0	0	0:00:00
Jun-48	0.00	0.00	220.00	0	00:00	0	0	0:00:00
Jun-49	0.00	0.00	221.00	0	00:00	0	0	0:00:00
Jun-50	0.00	0.00	222.00	0	00:00	0	0	0:00:00
Jun-51	0.00	0.00	221.00	0	00:00	0	0	0:00:00
Jun-52	0.00	0.00	228.00	0	00:00	0	0	0:00:00
Jun-53	0.00	0.00	228.00	0	00:00	0	0	0:00:00
Jun-54	0.00	0.00	228.00	0	00:00	0	0	0:00:00
Jun-55	0.00	0.00	0.00	0	00:00	0	0	0:00:00
Jun-56	0.08	0.41	228.41	0	01:14	0	0	0:00:00
Jun-57	0.08	0.41	227.66	0	01:15	0	0	0:00:00
Jun-58	0.07	0.40	227.48	0	01:15	0	0	0:00:00
Jun-59	0.07	0.40	226.68	0	01:15	0	0	0:00:00
Jun-60	0.08	0.42	226.50	0	01:15	0	0	0:00:00
Jun-61	0.16	1.32	226.42	0	00:22	0	0	0:00:00
Jun-62	0.20	2.20	231.20	0	00:19	0	0	0:00:00
Jun-64	0.20	2.20	230.95	0	00:19	0	0	0:00:00
Jun-65	0.16	2.06	229.06	0	00:20	0	0	0:00:00
Jun-66	0.16	1.94	230.44	0	00:19	0	0	0:00:00
Jun-67	0.19	2.33	230.58	0	00:20	0	0	0:00:00
Jun-68	0.19	2.33	230.31	0	00:20	0	0	0:00:00
Jun-69	0.14	1.78	229.28	0	00:20	0	0	0:00:00
Jun-70	0.16	2.06	228.76	0	00:21	0	0	0:00:00
Jun-71	0.17	1.89	228.14	0	00:21	0	0	0:00:00
Jun-72	0.17	1.89	227.89	0	00:22	0	0	0:00:00
Jun-73	0.15	1.69	227.19	0	00:22	0	0	0:00:00
Jun-74	0.13	1.32	226.32	0	00:22	0	0	0:00:00
Jun-75	0.16	1.52	226.12	0	00:23	0	0	0:00:00
Jun-76	0.16	1.53	225.88	0	00:23	0	0	0:00:00
Jun-77	0.18	1.68	225.78	0	00:23	0	0	0:00:00
Jun-78	0.18	1.68	225.58	0	00:24	0	0	0:00:00
Jun-79	0.15	1.48	224.98	0	00:24	0	0	0:00:00
Jun-80	0.16	1.81	224.91	0	00:24	0	0	0:00:00
Jun-81	0.16	1.81	224.61	0	00:25	0	0	0:00:00
Jun-82	0.10	1.07	223.32	0	00:25	0	0	0:00:00
Jun-83	0.14	1.43	223.18	0	00:25	0	0	0:00:00
Jun-84	0.18	1.56	222.72	0	00:25	0	0	0:00:00
Jun-85	0.00	0.00	0.00	0	00:00	0	0	0:00:00
Jun-86	0.18	1.56	222.06	0	00:26	0	0	0:00:00
Jun-87	0.15	1.44	221.44	0	00:26	0	0	0:00:00
Jun-88	0.15	1.44	221.04	0	00:26	0	0	0:00:00
Jun-89	0.28	2.37	221.37	0	00:26	0	0	0:00:00
Jun-90	0.28	2.37	221.27	0	00:27	0	0	0:00:00
Out-01	0.00	0.00	210.00	0	00:00	0	0	0:00:00
Out-02	0.00	0.00	0.00	0	00:00	0	0	0:00:00

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Node Flow Summary
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Node ID	Element Type	Maximum Lateral Inflow cms	Peak Inflow cms	Time of Peak Inflow Occurrence days	hh:mm	Maximum Flooding Overflow cms	Time of Peak Flooding Occurrence days	hh:mm
Jun-01	JUNCTION	0.000	1.814	0	00:13	0.00		
Jun-02	JUNCTION	2.562	6.256	0	00:15	0.00		
Jun-03	JUNCTION	3.647	9.117	0	00:18	0.00		
Jun-04	JUNCTION	2.953	6.113	0	00:18	0.00		
Jun-05	JUNCTION	0.000	1.351	0	00:15	0.00		
Jun-06	JUNCTION	0.000	4.127	0	00:17	0.00		
Jun-07	JUNCTION	0.000	6.934	0	00:17	0.00		
Jun-08	JUNCTION	0.000	9.117	0	00:18	0.00		
Jun-09	JUNCTION	5.721	11.967	0	00:17	0.00		
Jun-10	JUNCTION	0.000	20.797	0	00:17	0.00		
Jun-11	JUNCTION	0.000	4.786	0	00:28	0.00		
Jun-12	JUNCTION	0.000	14.910	0	00:20	0.00		

Jun-13	JUNCTION	0.000	35.302	0	00:17	0.00
Jun-14	JUNCTION	0.000	3.697	0	00:31	0.00
Jun-15	JUNCTION	0.000	3.812	0	00:48	0.00
Jun-16	JUNCTION	0.000	3.812	0	00:48	0.00
Jun-17	JUNCTION	0.000	3.812	0	00:48	0.00
Jun-18	JUNCTION	0.000	41.981	0	00:18	0.00
Jun-19	JUNCTION	4.070	6.034	0	00:41	0.00
Jun-20	JUNCTION	0.000	35.302	0	00:17	0.00
Jun-22	JUNCTION	0.000	45.291	0	00:18	0.00
Jun-23	JUNCTION	0.000	49.124	0	00:27	0.00
Jun-24	JUNCTION	1.814	1.814	0	00:13	0.00
Jun-25	JUNCTION	1.351	1.351	0	00:15	0.00
Jun-26	JUNCTION	3.472	4.250	0	00:15	0.00
Jun-27	JUNCTION	4.098	4.098	0	00:18	0.00
Jun-28	JUNCTION	4.127	4.127	0	00:17	0.00
Jun-29	JUNCTION	4.786	4.786	0	00:28	0.00
Jun-30	JUNCTION	5.178	9.490	0	00:28	0.00
Jun-31	JUNCTION	2.323	2.323	0	00:15	0.00
Jun-32	JUNCTION	3.284	6.934	0	00:17	0.00
Jun-33	JUNCTION	3.697	3.697	0	00:31	0.00
Jun-34	JUNCTION	3.812	3.812	0	00:48	0.00
Jun-35	JUNCTION	1.454	1.454	0	00:15	0.00
Jun-36	JUNCTION	3.644	39.234	0	00:18	0.00
Jun-38	JUNCTION	1.914	45.291	0	00:18	0.00
Jun-39	JUNCTION	2.635	2.635	0	00:55	0.00
Jun-41	JUNCTION	1.215	1.215	0	00:52	0.00
Jun-42	JUNCTION	1.274	1.274	0	00:33	0.00
Jun-43	JUNCTION	0.000	1.274	0	00:33	0.00
Jun-44	JUNCTION	1.161	1.161	0	00:36	0.00
Jun-45	JUNCTION	0.000	1.161	0	00:36	0.00
Jun-46	JUNCTION	3.514	3.514	0	00:43	0.00
Jun-47	JUNCTION	0.000	3.514	0	00:43	0.00
Jun-48	JUNCTION	0.000	6.570	0	00:43	0.00
Jun-49	JUNCTION	0.000	2.094	0	00:36	0.00
Jun-50	JUNCTION	0.789	0.789	0	00:37	0.00
Jun-51	JUNCTION	0.000	2.822	0	00:37	0.00
Jun-52	JUNCTION	1.426	4.520	0	00:43	0.00
Jun-53	JUNCTION	1.323	2.094	0	00:36	0.00
Jun-54	JUNCTION	1.259	2.088	0	00:33	0.00
Jun-55	JUNCTION	1.013	1.013	0	00:37	0.00
Jun-56	JUNCTION	0.000	0.973	0	01:14	0.00
Jun-57	JUNCTION	0.000	0.973	0	01:15	0.00
Jun-58	JUNCTION	0.000	0.973	0	01:15	0.00
Jun-59	JUNCTION	0.000	0.973	0	01:15	0.00
Jun-60	JUNCTION	0.000	0.973	0	01:15	0.00
Jun-61	JUNCTION	1.429	46.158	0	00:22	0.00
Jun-62	JUNCTION	0.000	45.268	0	00:19	0.00
Jun-64	JUNCTION	0.000	45.259	0	00:19	0.00
Jun-65	JUNCTION	0.000	45.227	0	00:20	0.00
Jun-66	JUNCTION	0.000	45.253	0	00:19	0.00
Jun-67	JUNCTION	0.000	45.244	0	00:20	0.00
Jun-68	JUNCTION	0.000	45.234	0	00:20	0.00
Jun-69	JUNCTION	0.000	45.230	0	00:20	0.00
Jun-70	JUNCTION	0.000	45.207	0	00:21	0.00
Jun-71	JUNCTION	0.000	45.200	0	00:21	0.00
Jun-72	JUNCTION	0.000	45.192	0	00:22	0.00
Jun-73	JUNCTION	0.000	45.188	0	00:22	0.00
Jun-74	JUNCTION	0.000	46.158	0	00:22	0.00
Jun-75	JUNCTION	0.000	46.153	0	00:23	0.00
Jun-76	JUNCTION	0.000	46.143	0	00:23	0.00
Jun-77	JUNCTION	0.000	46.132	0	00:23	0.00
Jun-78	JUNCTION	0.000	46.125	0	00:24	0.00
Jun-79	JUNCTION	0.000	46.121	0	00:24	0.00
Jun-80	JUNCTION	0.000	46.118	0	00:24	0.00
Jun-81	JUNCTION	0.000	46.118	0	00:25	0.00
Jun-82	JUNCTION	0.000	46.110	0	00:25	0.00
Jun-83	JUNCTION	0.000	46.106	0	00:25	0.00
Jun-84	JUNCTION	0.000	46.103	0	00:25	0.00
Jun-85	JUNCTION	0.000	0.000	0	00:00	0.00
Jun-86	JUNCTION	0.000	46.098	0	00:26	0.00
Jun-87	JUNCTION	0.000	46.095	0	00:26	0.00
Jun-88	JUNCTION	0.000	46.100	0	00:26	0.00
Jun-89	JUNCTION	0.000	46.095	0	00:26	0.00

Jun-90	JUNCTION	0.000	46.089	0	00:27	0.00
Out-01	OUTFALL	0.000	49.124	0	00:27	0.00
Out-02	OUTFALL	0.000	6.570	0	00:43	0.00

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Outfall Loading Summary
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Outfall Node ID	Flow Frequency (%)	Average Flow cms	Peak Inflow cms
Out-01	99.98	3.015	49.124
Out-02	16.94	2.848	6.570
System	58.46	5.862	53.616

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Link Flow Summary
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Link ID	Element Type	Time of Peak Flow Occurrence days hh:mm	Maximum Velocity Attained m/sec	Length Factor	Peak Flow during Analysis cms	Design Flow Capacity cms	Ratio of Maximum /Design Flow	Ratio of Maximum Flow	Total Reported Time Condition minutes
Link-01	DIRECT	0 00:15			1.351				
Link-02	DIRECT	0 00:13			1.814				
Link-03	DIRECT	0 00:18			4.098				
Link-04	DIRECT	0 00:15			1.351				
Link-05	DIRECT	0 00:13			1.814				
Link-06	DIRECT	0 00:15			4.250				
Link-07	DIRECT	0 00:18			6.113				
Link-08	DIRECT	0 00:17			4.127				
Link-09	DIRECT	0 00:28			4.786				
Link-10	DIRECT	0 00:15			2.323				
Link-11	DIRECT	0 00:28			4.786				
Link-12	DIRECT	0 00:28			9.490				
Link-13	DIRECT	0 00:18			9.117				
Link-14	DIRECT	0 00:17			4.127				
Link-15	DIRECT	0 00:17			6.934				
Link-16	DIRECT	0 00:15			6.256				
Link-17	DIRECT	0 00:17			11.967				
Link-18	DIRECT	0 00:18			9.117				
Link-19	DIRECT	0 00:17			20.797				
Link-20	DIRECT	0 00:17			35.302				
Link-21	DIRECT	0 00:20			14.910				
Link-22	DIRECT	0 00:31			3.697				
Link-23	DIRECT	0 00:48			3.812				
Link-24	DIRECT	0 00:15			1.454				
Link-25	DIRECT	0 00:31			3.697				
Link-26	DIRECT	0 00:17			35.302				
Link-27	DIRECT	0 00:18			39.234				
Link-28	DIRECT	0 00:48			3.812				
Link-29	DIRECT	0 00:48			3.812				
Link-30	DIRECT	0 00:55			2.635				
Link-31	DIRECT	0 00:41			6.034				
Link-32	DIRECT	0 00:48			3.812				
Link-33	DIRECT	0 00:18			41.981				
Link-34	CHANNEL	0 00:19	2.68	1.00	45.268	94.329	0.48	0.78	0 Calculated

```
  Link-35              CHANNEL      0  00:22      2.52    1.00      46.158      52.274
0.88      0.95           0  Calculated
  Link-36              DIRECT       0  00:18                        45.291
  Link-37              CHANNEL      0  01:14      1.85    1.00       0.973      73.557
0.01      0.16           0  Calculated
  Link-39              DIRECT       0  00:27                        49.124
  Link-40              DIRECT       0  00:17                         6.934
  Link-42              DIRECT       0  00:33                         1.274
  Link-43              DIRECT       0  00:36                         1.161
  Link-44              DIRECT       0  00:43                         3.514
  Link-45              DIRECT       0  00:33                         1.274
  Link-46              DIRECT       0  00:36                         1.161
  Link-47              DIRECT       0  00:43                         3.514
  Link-48              DIRECT       0  00:43                         4.520
  Link-49              DIRECT       0  00:36                         2.094
  Link-50              DIRECT       0  00:33                         2.088
  Link-51              DIRECT       0  00:37                         0.789
  Link-52              DIRECT       0  00:37                         2.822
  Link-53              DIRECT       0  00:36                         2.094
  Link-54              DIRECT       0  00:43                         6.570
  Link-55              DIRECT       0  00:37                         1.013
  Link-56              CHANNEL      0  01:15      1.12    1.00       0.973       1.582
0.62      0.82           0  Calculated
  Link-57              CONDUIT      0  01:15      2.28    1.00       0.973       1.002
0.97      0.79           0  Calculated
  Link-58              CONDUIT      0  01:15      2.59    1.00       0.973       6.300
0.15      0.27           0  Calculated
  Link-59              CONDUIT      0  01:15      2.33    1.00       0.973       1.032
0.94      0.77           0  Calculated
  Link-60              CHANNEL      0  01:17      1.06    1.00       0.973       1.475
0.66      0.84           0  Calculated
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0.59      0.83           0  Calculated
  Link-62              CHANNEL      0  00:19      2.06    1.00      45.253      50.417
0.90      0.97           0  Calculated
  Link-63              CHANNEL      0  00:21      2.65    1.00      45.207     128.597
0.35      0.69           0  Calculated
  Link-64              CHANNEL      0  00:20      2.53    1.00      45.244      56.276
0.80      0.89           0  Calculated
  Link-65              CHANNEL      0  00:20      2.16    1.00      45.234     101.420
0.45      0.78           0  Calculated
  Link-66              CHANNEL      0  00:20      2.37    1.00      45.230     108.215
0.42      0.65           0  Calculated
  Link-67              CHANNEL      0  00:20      3.24    1.00      45.227     167.157
0.27      0.59           0  Calculated
  Link-68              CHANNEL      0  00:21      2.80    1.00      45.200      57.823
0.78      0.94           0  Calculated
  Link-69              CHANNEL      0  00:22      1.94    1.00      45.192      53.357
0.85      0.95           0  Calculated
  Link-70              CHANNEL      0  00:22      2.55    1.00      45.188      75.024
0.60      0.84           0  Calculated
  Link-71              CHANNEL      0  00:22      2.69    1.00      45.183      55.430
0.82      0.93           0  Calculated
  Link-72              CHANNEL      0  00:23      2.25    1.00      46.153      96.096
0.48      0.61           0  Calculated
  Link-73              CHANNEL      0  00:23      1.93    1.00      46.143      48.047
0.96      0.99           0  Calculated
  Link-74              CHANNEL      0  00:23      1.90    1.00      46.132      47.113
0.98      0.99           0  Calculated
  Link-75              CHANNEL      0  00:24      1.74    1.00      46.125      60.132
0.77      0.91           0  Calculated
  Link-76              CHANNEL      0  00:24      2.25    1.00      46.121      86.326
0.53      0.80           0  Calculated
  Link-77              CHANNEL      0  00:24      1.90    1.00      46.118     102.703
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  Link-78              CHANNEL      0  00:25      1.82    1.00      46.118      47.564
0.97      0.92           0  Calculated
  Link-79              CHANNEL      0  00:25      2.60    1.00      46.110      51.593
0.89      0.96           0  Calculated
  Link-80              CHANNEL      0  00:25      2.49    1.00      46.106      49.043
0.94      0.98           0  Calculated
  Link-81              CHANNEL      0  00:25      3.01    1.00      46.103      88.014
0.52      0.81           0  Calculated
```

```
  Link-82              CHANNEL      0  00:26      2.79    1.00      46.098      73.570
0.63      0.85           0  Calculated
  Link-83              CHANNEL      0  00:26      2.76    1.00      46.095     125.382
0.37      0.69           0  Calculated
  Link-84              CHANNEL      0  00:26      2.56    1.00      46.100     113.041
0.41      0.72           0  Calculated
  Link-85              CHANNEL      0  00:26      2.86    1.00      46.095      59.293
0.78      0.92           0  Calculated
  Link-86              CHANNEL      0  00:27      1.61    1.00      46.089      59.265
0.78      0.93           0  Calculated
  Link-87              CHANNEL      0  00:27      2.06    1.00      46.088      79.412
0.58      0.85           0  Calculated


  ********************************
  Highest Flow Instability Indexes
  ********************************
  All links are stable.

  WARNING 004 : Minimum elevation drop used for Conduit Link-11.

  Analysis began on:  Fri Jul 23 10:35:55 2021
  Analysis ended on:  Fri Jul 23 10:36:01 2021
  Total elapsed time: 00:00:06
```

ENGINEERING SERVICES REPORT

APPENDIX E

STORMWATER INFRASTRUCTURE MAINTENANCE

SWALES & FILTER STRIPS

Operation & Maintanence Guide

STORMWATER DEVICE INFORMATION SERIES

Auckland Council

Te Kaunihera o Tāmaki Makaurau

What are swales and filter strips?

Swales, also known as bioretention, filter or infiltration strips, are broad, grass channels used to treat stormwater runoff. They direct and slow stormwater across grass or similar ground cover and through the soil. Swales also help filter sediments, nutrients and contaminants from incoming stormwater before discharging to downstream stormwater system or waterways. Some swales have liners to direct filtered runoff, or rocky linings to slow fast flows. Swales are simple to maintain and can fit well in urban design.

Fig.1 Swale in Waitakere City

Seven key components of swales and filter strips

1. Inflow points

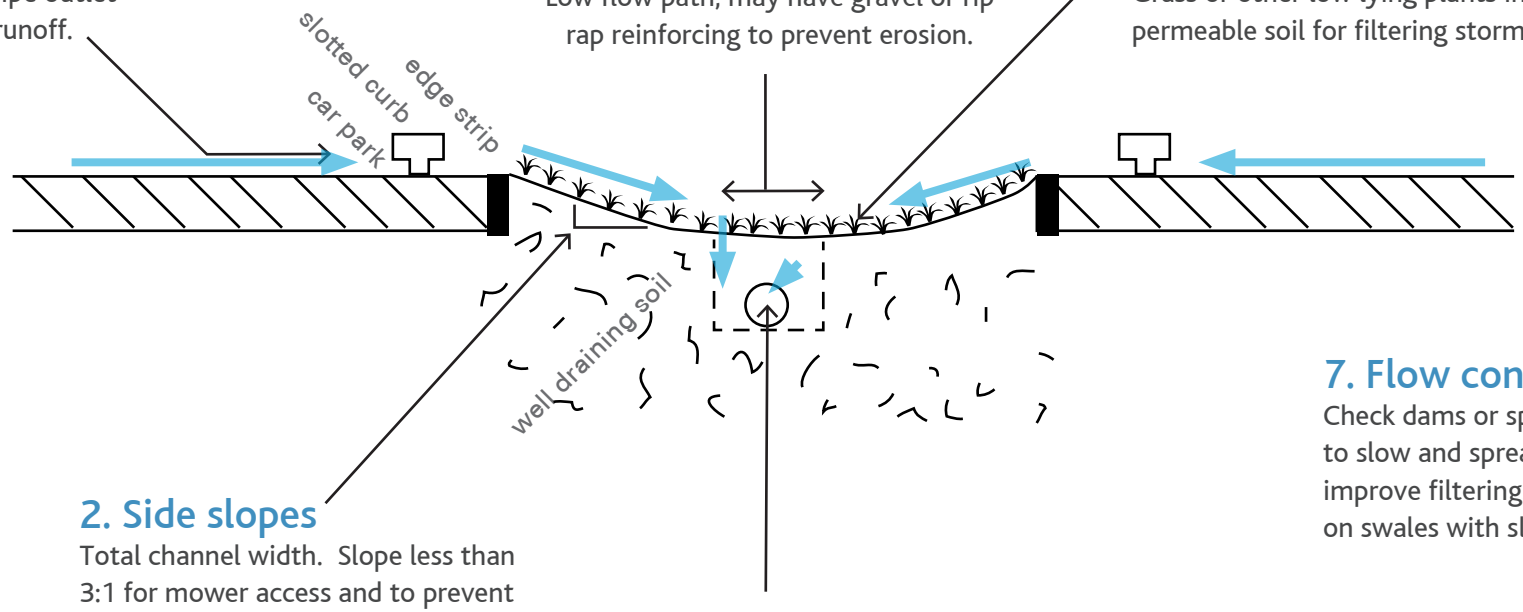
Stormwater flow entry, via pipe outlet or surface runoff.

3. Channel base

Low flow path, may have gravel or rip rap reinforcing to prevent erosion.

5. Plants and soil

Grass or other low lying plants in permeable soil for filtering stormwater.



7. Flow controls

Check dams or spreaders, used to slow and spread flows to improve filtering. Often used on swales with slopes over 5%.

2. Side slopes

Total channel width. Slope less than 3:1 for mower access and to prevent scour.

4. Underdrain (if present)

Usually perforated pipe, buried under channel to capture filtered flow and connected to stormwater system.

6. Outlet

Discharge point for filtered stormwater.

Fig.2 Waitakere City Hospital car park swale

- Slotted kerbs not too close to edge of swale.
- Sign post in centre of swale are compromising underdrain.

Fig.3 Henderson Valley Road – newly constructed road side swales

- Geotextile used to protect catchpit (swale outlet) during construction.
- Dish channels for each driveway controls flows and allow high flows to pass above.

Fig.4 Manawa Wetland vegetated swale

- Native vegetated swale following contours and overland flow paths.
- Check dams used to slow flow and allow for filtration.

MAINTENANCE SCHEDULE

TIMING	COMPONENT	ACTION
Following storms	Inflow points	• Check for scouring, channelling and erosion, and repair as necessary.
	Side slopes	• Check for scouring, channelling and erosion, and repair by adding soil and replanting as necessary.
	Channel base	• Check for scouring, channelling and erosion, and repair by adding soil and replanting as necessary.
	Plants and soil	• Check stormwater is filtering though soil following storm runoff. • Remove weeds.
Monthly	Outlet	• Check outlet for scouring or erosion and repair to suit.
	Inflow points	• Remove rubbish and debris.
	Channel base	• If grassed, mow channel no shorter than 150mm length. • Use catcher and remove clippings. • Re-seed bare patches of grass and water in dry conditions to establish.
	Plants and soil	• If planted, check plants are healthy and growth is dense. • Remove weeds. • Replant gaps and water new plants in dry conditions until established.
Two yearly	Outlet	• Remove rubbish and debris from outlet grate or catchpit.
	Channel base	• Check for boggy patches and ponding water. • Check soil is not compacted, and aerate surface or top up dips to repair.
	Grass, plants and soil	• Remove weeds, rubbish and debris. • Replant gaps and re-seed bare patches, and water if required to establish. • Aerate soil to prevent natural compaction, similar to coring sportsfields and lawn bowls greens. • Check stormwater is filtering though soil, by either monitoring after storm runoff or by running water across swale.

TROUBLESHOOTING

SYMPTOM	POSSIBLE PROBLEMS	SOLUTION
Water not draining. Ponding	Soil compacted	• Aerate soil with rotating aerator or core, as for sports fields.
	Soil clogged with fine sediments	• Remove top layer of soil and replace, turning soil.
	Underdrain, if present, may be blocked – check for discharge at outlet.	• Re build underdrain.
Water flowing straight to outlet	Soil not free-draining.	• See above - aerate soil, replace top layer of soil, replace soil with free draining mix.
	Swale slope too steep.	• If slope over 5%, construct check dams to slow flows.
	Plants or grass not dense enough.	• Leave grass longer, and re-seed to increase density. Mow less frequently during dry periods.
Scouring / Channels appearing	Inflow concentrated at inlets.	• Remove blockages including rubbish, debris and sediment build up. • Fill channels as necessary, replanting.

Quick maintenance check

- ✓ Maintain grass length to between 50-150mm.

Avoid

- ✗ On roadside swales, keep plant height below line-of-sight for motorists .

Auckland Regional Council TE RAUHITANGA TAIAO	**STORMWATER COMPLIANCE INSPECTION ADVICE** **(Under Section 332 of the Resource Management Act 1991)**	Investigating Officer: Date: Time: Weather: Rainfall over previous 2-3 days? Person contacted during visit: Page 1 of 2

Site Name:		File No:	
Consent Holder:		Consent No:	
Engineer:		Catchment:	

SEDIMENT / STORMWATER MANAGEMENT DRY WELL CONSTRUCTION CHECKLIST	:	Needs immediate attention	V	Okay	;	Clarification Required
	9	Not Applicable				

Pond Components:

Items Inspected	Checked		Satisfactory	Unsatisfactory		Checked		Satisfactory	Unsatisfactory
PRE-CONSTRUCTION					10. Clean / washed material	Y	N		
1. Runoff diverted	Y	N			11. Placed properly	Y	N		
2. Area stabilised	Y	N			**OBSERVATION WELL/ROOF LEADER**				
EXCAVATION									
3. Size & Location	Y	N			12. Pipe size	Y	N		
4. Side slope stable	Y	N			13. Removable cap/footplate	Y	N		
5. Soil Permeability	Y	N			14. Initial depth = _____m	Y	N		
6. Groundwater / Bedrock	Y	N			**FINAL INSPECTION**				
FILTER FABRIC PLACEMENT					15. Pretreatment facility in place	Y	N		
7. Fabric specification	Y	N			16. Debris / gutter screens	Y	N		
8. Placed on bottom, sides, & top	Y	N			17. Stabilisation	Y	N		
AGGREGATE MATERIAL					18. Outlet	Y	N		
9. Size as specifed	Y	N							

OFFICERS REMARKS:

Auckland Regional Council TE RAUHITANGA TAIAO	**STORMWATER COMPLIANCE INSPECTION ADVICE** (Under Section 332 of the Resource Management Act 1991)	Investigating Officer:
		Date:
		Time:
		Weather: Rainfall over previous 2-3 days?
		Person contacted during visit:
		Page 1 of 2

Site Name:		File No:	
Consent Holder:		Consent No:	
Engineer:		Catchment:	

INFILTRATION TRENCH CONSTRUCTION INSPECTION FORM	: 9	Needs immediate attention Not Applicable	V	Okay	;	Clarification Required

Infiltration Trench Components:

Items Inspected	Checked		Satisfactory	Unsatisfactory		Checked		Satisfactory	Unsatisfactory
PRE-CONSTRUCTION					10. Clean / washed material	Y	N		
1. Runoff diverted	Y	N			11. Placed properly	Y	N		
2. Area stabilised	Y	N			**OBSERVATION WELL**				
EXCAVATION					12. Pipe size	Y	N		
3. Size & location	Y	N			13. Removable cap / footplate	Y	N		
4. Side slope stable	Y	N			14. Initial depth = _____m	Y	N		
5. Soil Permeability	Y	N			**FINAL INSPECTION**				
6. Groundwater / Bedrock	Y	N			15. Pretreatment facility in place	Y	N		
FILTER FABRIC PLACEMENT					16. Stabilisation	Y	N		
7. Fabric specification	Y	N			17. Outlet	Y	N		
8. Placed on bottom, sides, & top	Y	N							
AGGREGATE MATERIAL									
9. Size as specified	Y	N							

OFFICERS REMARKS:

ENGINEERING SERVICES REPORT

APPENDIX F

CONCEPT CIVIL PLANS

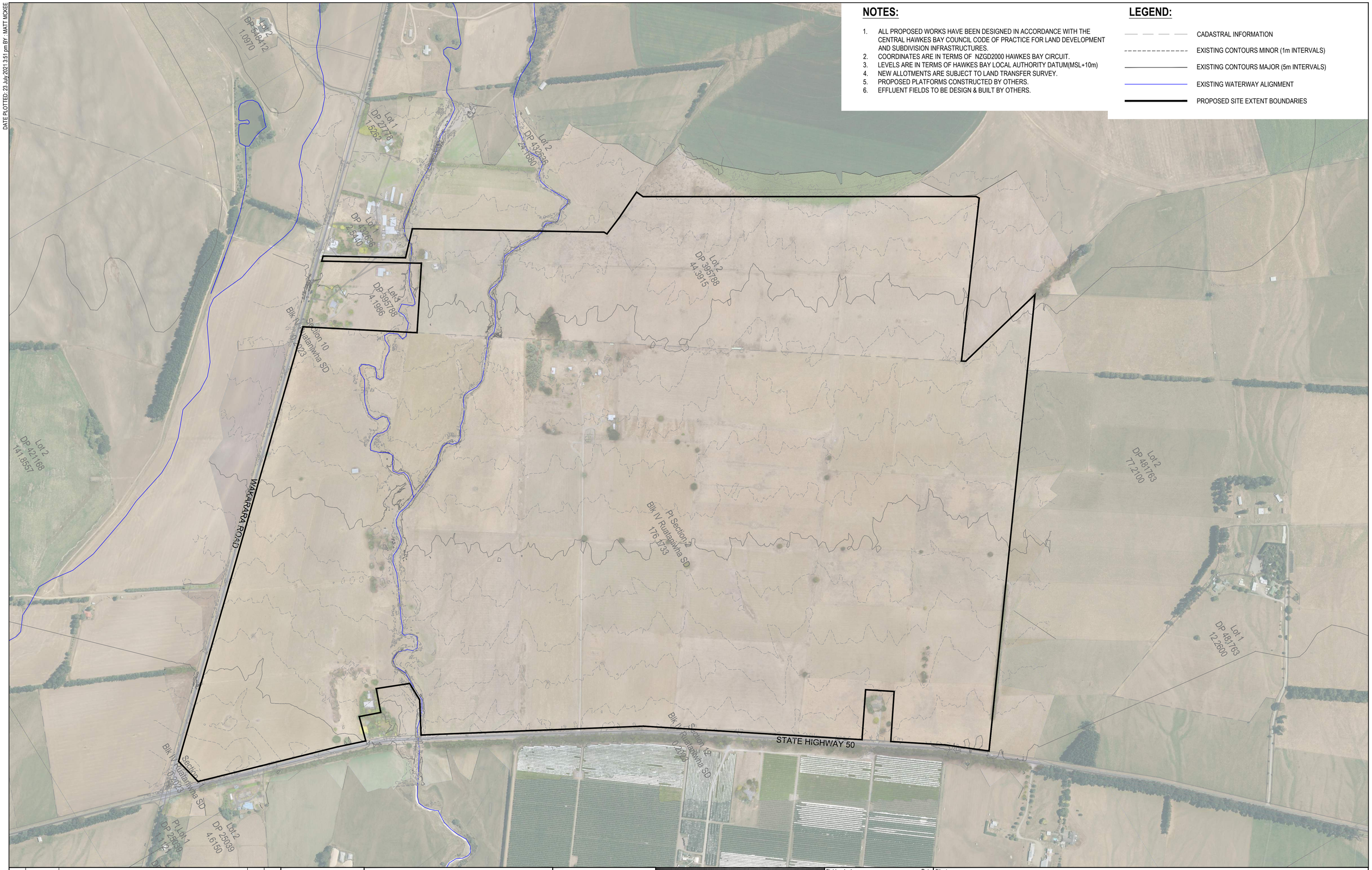
DATE PLOTTED: 23 July 2021 3:51 pm BY: MATT MCKEE

NOTES:

1. ALL PROPOSED WORKS HAVE BEEN DESIGNED IN ACCORDANCE WITH THE CENTRAL HAWKES BAY COUNCIL CODE OF PRACTICE FOR LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURES.
2. COORDINATES ARE IN TERMS OF NZGD2000 HAWKES BAY CIRCUIT.
3. LEVELS ARE IN TERMS OF HAWKES BAY LOCAL AUTHORITY DATUM(MSL+10m)
4. NEW ALLOTMENTS ARE SUBJECT TO LAND TRANSFER SURVEY.
5. PROPOSED PLATFORMS CONSTRUCTED BY OTHERS.
6. EFFLUENT FIELDS TO BE DESIGN & BUILT BY OTHERS.

LEGEND:

- CADASTRAL INFORMATION
- EXISTING CONTOURS MINOR (1m INTERVALS)
- EXISTING CONTOURS MAJOR (5m INTERVALS)
- EXISTING WATERWAY ALIGNMENT
- PROPOSED SITE EXTENT BOUNDARIES



Rev.	Date	Description	Appd.	Issued
1	14/04/2021	FOR APPROVAL	DS	MP

CAD File: H20210003-RC.dwg

NORTH

0 100 200 300 400m
SCALE 1:4000 @A1

DEVELOPMENT NOUS
SURVEYING • URBAN DESIGN • ENGINEERING • TOWN PLANNING
ENVIRONMENTAL • LANDSCAPE ARCHITECTURE

		Date
Fieldworked	MV	19/03/2021
Drawn	TB	26/03/2021
Checked	KC	08/04/2021
Designed	MP	22/03/2021
Approved	DS	

Client: SPRINGHILL FARM HOLDINGS

Project: SPRINGHILL FARM LIFESTYLE DEVELOPMENT

Title: EXISTING SITE PLAN

Status: FOR RESOURCE CONSENT
NOT TO BE USED FOR CONSTRUCTION PURPOSES

Datum	Council Ref.	Scale	Size
HB2000		1:4000	A1

Drawing Number: H20210003-RC-C300

Revision: 1

DATE PLOTTED: 23 July 2021 3:51 pm BY: MATT MCKEE

NOTES:

1. ALL PROPOSED WORKS HAVE BEEN DESIGNED IN ACCORDANCE WITH THE CENTRAL HAWKES BAY COUNCIL CODE OF PRACTICE FOR LAND DEVELOPMENT AND SUBDIVISION INFRASTRUCTURES.
2. COORDINATES ARE IN TERMS OF NZGD2000 HAWKES BAY CIRCUIT.
3. LEVELS ARE IN TERMS OF HAWKES BAY LOCAL AUTHORITY DATUM(MSL+10m)
4. NEW ALLOTMENTS ARE SUBJECT TO LAND TRANSFER SURVEY.
5. PROPOSED PLATFORMS CONSTRUCTED BY OTHERS.
6. EFFLUENT FIELDS TO BE DESIGN & BUILT BY OTHERS.

LEGEND:

- LOT BOUNDARIES
- CADASTRAL INFORMATION
- EXISTING CONTOURS MINOR (1m INTERVALS)
- EXISTING CONTOURS MAJOR (5m INTERVALS)
- EXISTING WATERWAY ALIGNMENT
- PROPOSED SITE EXTENT BOUNDARIES

Rev.	Date	Description	Appd.	Issued
1	14/04/2021	FOR APPROVAL	DS	MP

CAD File: H20210003-RC.dwg

NORTH

0 100 200 300 400m
SCALE 1:4000 @A1

DEVELOPMENT NOUS
SURVEYING • URBAN DESIGN • ENGINEERING • TOWN PLANNING
ENVIRONMENTAL • LANDSCAPE ARCHITECTURE

Fieldworked MV	Date 19/03/2021	Client SPRINGHILL FARM HOLDINGS
Drawn TB	Date 26/03/2021	Project SPRINGHILL FARM LIFESTYLE DEVELOPMENT
Checked KC	Date 08/04/2021	Status FOR RESOURCE CONSENT — NOT TO BE USED FOR CONSTRUCTION PURPOSES
Designed MP	Date 22/03/2021	Title EXISTING SITE WITH PROPOSED DEVELOPMENT PLAN
Approved DS	Date	Datum HB2000 · Council Ref. · Scale 1:4000 · Size A1
		Drawing Number H20210003-RC-C301 · Revision 1