

CONTRACT NO: VR032/05

VREDENBURG / LOUWVILLE BASIN STORMWATER MASTER PLAN



DOCUMENT NO: VR032/05/01/OD/001

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REVISION SUMMARY

Project Name: VREDENBURG / LOUWVILLE BASIN STORMWATER MASTER PLAN

Contract No: VR032/05

This document has gone through a line of checking procedure, which forms part of our Quality Management System.

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Signature of Project Leader

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REV	DATE	BY	DESCRIPTION OF REVISION
0A	29/06/2012	CRS	For information

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1 INTRODUCTION

1.1 BRIEF

Nadeson Consulting Services were appointed by the Saldanha Bay Municipality to implement stormwater master planning in the Vredenburg / Louwville district. The report must address issues and problems associated with growing development and degraded infrastructure currently experienced in the area.

The municipality requires a tool for stormwater management which provides a basis for directing investment and administrative decisions by the various departments within the municipality.

1.2 OBJECTIVES

The purposes of the stormwater Master Plan is to facilitate the accomplishment of the client's objective. The plan must not be limited to stormwater related issues only, but must consider the impact on both the public and the environment.

The stormwater Master Plan for the Vredenburg / Louwville Basin has the following objectives.

1. To identify the tributary drainage area and discharge route.
2. To collect "as-built" system data and conduct site investigations.
3. To obtain historical records through consultation with the municipality and desk-top research.
4. To develop a hydrologic model for the basin incorporating the most current information available.
5. To identify shortcomings of the existing system by means of model assessment.
6. To evaluate negative impacts on health, welfare and safety to the public.
7. To protect properties from flood damage.
8. To reduce channel and channel bank erosion.
9. To comply with the guiding principles of Water Sensitive Urban Design (WSUD).
10. To provide recommendations for future upgrades including cost estimation.

1.3 MASTER PLANNING PHILOSOPHY

Major planning is predominantly concerned with the major system. The major system is the trunk system that receives discharge from the minor system and includes watercourses, large conduits, roads, attenuation devices (ponds), wetlands and open spaces.

Conveyance culverts, conduits (pipes), channels and related facilities are considered as minor system components and are assumed to be flowing full during a major storm event.

The selection of recurrence interval for a major flood event is based on the minimizing of risk to property and human life. During major storm events disruption to the traffic function of lower order roads is acceptable.

The minor system provides for convenience to pedestrian and traffic flow by removing runoff caused by relatively frequent events. The determination of the storm event depends on the land use of the focus area (residential, institutional, commercial or industrial).

Design periods for culverts and bridges crossing roadways are related to different road classes. Where the potential damage and the impact of disruption because of failure of the structure are high, the design period should be enlarged.

Scouring and erosion of channel banks, particularly where unlined, is reduced by ensuring the bottom formalized conduit is capable of conveying the runoff generated under more frequent storm events.

The master planning philosophy incorporates these principles in achieving the reports objectives.

Table 1.1 provides guidelines according to which compliance to the principles are measured.

Table 1.1 Flood Frequencies for system components

System Component	Recurrence Interval	Objective
Major System (water courses, ponds)	50 years	Protect Flood Plain Developments, Human Life
Road Structure (box culvert / Pipe)	20 years	Protect against damage to structure
Channel (lined Bank)	20 years	Protect stability of channel banks
Channel (Unlined Bank)	2 years	Protect against bank erosion
Minor system (internal infrastructure)	2 years	Ensure convenience to public.

2 BASIN EVALUATION

2.1

CATCHMENT AREA DESCRIPTION

The Vredenburg / Louwville Basin area includes approximately 1050 hectares located on the eastern side of the town of Vredenburg. The main drainage route begins near the commercial district of Vredenburg, north of the R399 and flows 4 kilometers eastward, terminating at the dam north of the George Kerridge development.

A second drainage route begins in Marais Industria, flowing between Louwville and Witteklip, intersecting the main drainage route south of Ongegund at the Southern Bypass Street crossing.

Two detention ponds, dealing with runoff generated by both minor and major storms attenuate flow along the drainage route. The first south of Ruthfirst has been recently

constructed. The second falling north of George Kerridge, shows signs of distress and will most likely require upgrading.

Notable suburbs within the catchment area are:

- Vredenburg
- Louwville
- Witteklip
- Ongegend
- George Kerridge
- Wesbank

The catchment location is shown on drawing VR032/C0050 (Annexure A). A summary of the catchment hydrological characteristics for both existing and future scenarios are indicated in Table 2.1.

Topography of the site is varying, with Vredenburg and Witteklip tending to be steeper due to the developments on the mountain slopes. The main drainage route is well graded with an average slope of over 2%.

VREDENBURG / LOUWILLE BASIN STORMWATER MASTER PLAN

Table 2.1 : Catchment Hydrological Characteristics

Node Name	Catchment Name	Area ha	Existing		Future						
			Paved Area %	Supplementary Area %	Paved Area %	Paved Entry Time min	Paved Storage mm	Supplementary Area %	Grass Entry Time min	Grass Storage mm	Soil Type
10	C290	8.584	70	20	70	25	2	20	20	8	C
100	C230	5.519	30	10	30	20	2	10	20	8	B
110	C510	18.383	8	5	8	30	2	5	20	8	B
120	C220	2.66	18	25	18	20	2	25	20	8	B
130	C490	3.382	18	22	18	20	2	22	20	8	A/B
140	C200	2.546	18	25	18	20	2	25	20	8	B
150	C210	2.42	5	0	60	20	2	20	20	8	B/C
160	C310	20.581	70	20	70	30	2	20	20	8	C
20	C280	2.04	70	20							
20	C300	9.143			70	25	2	20	0	8	C
210	C530	18.794	10	6	10	30	2	6	20	8	B
220	C520	2.921	70	20	70	25	2	20	20	8	C
250	C430	7.782	18	22	18	25	2	22	20	8	A/B
260	C540	6.663	25	8	25	25	2	8	20	8	B
270	C500	6.781	18	22	18	25	2	22	20	8	A/B
280	C590	7.906	8	0	8	25	2	0	20	8	B
290	C190	2.265	0	0	60	20	0	20	20	0	B/C
30	C300	9.143	70	20							
30	C289	2.04			70	20	2	20	20	8	C
300	C480	4.656	18	22	18	20	2	22	20	8	B
340	C470	17.284	18	22	18	25	2	22	20	8	A/B
350	C550	8.314	18	22	18	25	2	22	20	8	A/B
360	C560	12.178	18	22	18	25	2	22	20	8	A/B

VREDENBURG / LOUWVILLE BASIN STORMWATER MASTER PLAN

Node Name	Catchment Name	Area ha	Existing		Future						
			Paved Area %	Supplementary Area %	Paved Area %	Paved Entry Time min	Paved Storage mm	Supplementary Area %	Grass Entry Time min	Grass Storage mm	Soil Type
380	C570	6.428	5	28	5	25	2	28	20	8	B/C
390	C580	13.115	5	8	5	25	2	8	20	8	B/C
40	C260	3.935	18	25	18	20	2	25	20	8	B
410	C450	4.841	18	22	18	25	2	22	20	8	A/B
430	C435	2.547	18	22	18	20	2	22	20	8	A/B
440	C440	14.416	18	22	18	25	2	22	20	8	A/B
450	C460	7.948	15	14	15	25	2	14	20	8	B/C
470	C620	10.78	18	22	18	25	2	22	20	8	B
480	C630	2.813	10	12	10	20	2	12	20	8	B/C
490	C600	24.84	18	22	18	30	2	22	20	8	A/B
500	C610	4.245	10	0	10	25	2	0	20	8	B
515	C641	5.901	18	22	18	25	2	22	20	8	A/B
520	C710	32.992	18	22	18	30	2	22	20	8	B
530	C650	23.464	18	22	18	30	2	22	20	8	A/B
540	C180	5.686	20	15	20	25	2	15	20	8	B/C
545	C170	5.853	5	10	60	25	2	20	20	8	B/C
550	C150	9.785	0	0	60	25	2	20	20	8	B/C
560	C160	17.865	10	10	10	30	2	10	20	8	B/C
590	C140	9.49	5	0	50	25	2	20	20	8	B
60	C270	8.641	70	20	70	25	2	20	20	8	C
630	C145	10.33	5	0	5	25	2	0	20	8	B
640	C330	42.638	0	0	4	30	2	6	20	8	B
650	C340	55.081	0	0	4	30	2	6	20	8	B
660	C350	22.534	0	0	4	30	2	6	20	8	B

VREDENBURG / LOUWVILLE BASIN STORMWATER MASTER PLAN

Node Name	Catchment Name	Area ha	Existing		Future						
			Paved Area %	Supplementary Area %	Paved Area %	Paved Entry Time min	Paved Storage mm	Supplementary Area %	Grass Entry Time min	Grass Storage mm	Soil Type
690	C425	8.746	12	18	12	25	2	18	20	8	A/B
700	C420	9.447	12	18	12	25	2	18	20	8	A/B
710	C640	5.593	18	22	18	25	2	22	20	8	A/B
720	C130	8.901	8	3	30	25	2	25	20	8	C
730	C100	25.985	7	0	30	30	2	0	20	8	C
740	C110	8.906	30	12	30	25	2	12	20	8	B/C
760	C120	5.888	20	25	20	25	2	25	20	8	B
770	C320	56.192	0	0	4	25	2	6	20	8	B
80	C250	6.986	30	20	30	25	2	20	20	8	B
800	C400	10.898	12	18	12	25	2	18	20	8	A/B
810	C410	12.309	12	18	12	25	2	18	20	8	A/B
820	C360	10.613	12	18	12	25	2	18	20	8	A/B
830	C370	9.278	12	18	12	25	2	18	20	8	A/B
840	C380	10.725	12	18	12	25	2	18	20	8	A/B
850	C390	7.375	12	18	12	25	2	18	20	8	A/B
870	C660	57.072	5	5	8	30	2	10	20	0	B
880	C690	20.925	12	18	12	30	2	18	20	8	A/B
90	C240	5.498	18	25	18	20	2	25	20	8	B
900	C670	136.639	2	5	6	60	2	10	20	8	B
910	C700	4.97	5	5	5	20	2	5	20	8	B
930	C680	101.446	2	4	6	60	2	10	20	8	B

2.2 HYDROLOGY

2.2.1 Land Use

Land use has direct implications on the hydrology of a catchment. Currently 80% of the basin is urbanised with more homes and businesses being built every year. As urbanisation increases, so do runoff rates typically increase due to the increased impervious areas.

Spatial Development Plans, indicated in Annexure A, show future subsidised housing in the vicinity of Witteklip and George Kerridge. The resulting increase in runoff volumes, may cause additional problems or exacerbate existing problems in the stormwater drainage system. The increased possibility of flooding and damage to conveyance systems must form part of the master plan assessment.

The spatial development plan (Plan No. 19.1) shows the spatial distribution of December 2003 with the general spatial needs identified at the time.

2.2.2 Hydrological Soil Groups

The type of soil encountered affects the rate of infiltration which ultimately determines the amount of precipitation that becomes runoff.

Natural Resources Conservation Services (NRCS) have classified soils into 4 hydrological soil groups according to their saturated hydraulic conductivity (infiltration rate).

Group A soils have a low runoff potential and high infiltration rates. They consist of typically coarse textured soils, i.e. sands and gravels.

Group B soils have a moderate infiltration rate where permeability is slightly restricted. They consist of moderately fine to moderately coarse textured soils.

Group C soils have a slow infiltration rate and consist of soils that impedes downward movement of water.

Group D soils have high runoff rate with severely restricted permeability. They typically consist of clay soils with a permanently high water table.

In addition to the four main groups, three intermediate soil groups (A/B, B/C and C/D) are considered, providing for increased diversity.

Trial holes excavated with the catchment area indicate a sandy soil generally underlain by a clayey material. No soils within the extremes of Group A or Group D are expected. Soil classifications between Group A/B and Group C have been identified, with a less permeable soil attributed to the more mountainous areas.

2.2.3 Precipitation

The use of design storms is a widely utilised and accepted practice for stormwater management. The intensity of a design storm increases as the recurrence period increases and the storm duration decreases.

The intensity is also related to the mean annual precipitation and to the rainfall region. Two methods have been used to derive the intensity for the basin, namely the Chicago Storm regionalised IDF curve and the modified recalibrated Hershfield equation. Both methods require representative rainfall station information provided by the South African Weather Services.

Rainfall station Vredenburg (Pol), SAWB number 0060864 W is the closest station to our catchment. A Mean Annual Precipitation (MAP) value of 275 mm and the 2 - year return period daily rainfall of 34,6 mm are extracted from the rainfall station information shown in Annexure B.

3 PRELIMINARY ASSESSMENT

Prior to the development of system model, preliminary assessments were conducted in order to identify problem areas within the system. This assessment took the form of several site inspections covering all sub-catchments within the greater basin.

The findings of the preliminary investigations were as follows:

- Regular flooding of roadways in the Vredenburg Commercial district due to inadequately sized infrastructure.
- Erosion and damage to grass block channels running parallel to Kooijeskloof Street.
- Deposition of waste products in earth channels south of Ongegund, leading to detrimental ecological conditions, a potential danger to human life and a hazardous environmental situation.
- Generally poor maintenance of conveyance systems, with overgrown vegetation causing siltation and disruption of flow.
- Ponding of low lying sections of roads during heavy rainfalls, preventing access to properties.
- Inadequate capacity of detention pond at George Kerridge causing occasional flooding on the Hopefield Road (R45)
- Earthdams eastward of Louwville and running parallel to the Transnet railway line have disintegrated and no longer perform a conveyance function.

4 STORMWATER MODEL

An overall stormwater systems model has been developed to determine peak flows and flood levels against which both existing and proposed infrastructure can be evaluated. The detailed analysis will be used to assess flow conditions at specific locations such as road culverts or where properties are adjacent to the 1 in 50 year flood line.

Similarly, proposed infrastructure will be designed according to 1 in 2 year return period peak flows ensuring channels can adequately accommodate 1 in 20 year return period flows.

4.1 MODELING SOFTWARE

Two software packages were selected to model the Vredenburg / Louwville basin. Civil Designer "Storm" was used to simulate the surface runoff incorporating the

interconnected system of hydrologic and hydraulic components. The Illudus Time – Area method is used for estimation of runoff from a uniformly distributed design storm. HEC-RAS, river analysis system software, performs a one-dimensional steady flow calculation which is used to generate water surface profiles needed for the 1 in 50 year return period flood lines.

4.2

MODEL PARAMETERS

Parameters used in the model are based on accepted norms and sound engineering judgment. Where possible a desk-top study has been conducted to ascertain the accuracy of the values asserted.

The following are parameters used in the model:

- Storm duration of 210 min for the minor storm and 1050 min for the major storm, based on Manning and Kerby equations
- Ratio of the time to peak vs storm duration of 0.38 for a minor storm and 0.6 for a major storm.
- Land use in terms of paved, supplementary and grassed are based on land use and representative calculations. These will vary for existing and future models in line with SDF projected growth patterns.
- A "coastal" climate region in accordance with the SCS storm distribution area map. The type 1 distribution applies to coastal areas with winter rainfall or rainfall through the year.

The parameters relating to soil types and rainfalls have been clarified earlier in this report.

4.3

DESCRIPTION OF MODEL

Delineation of the catchment area was accomplished using topographical contour mapping data and a substantial database of topographical survey information procured from previous SBM contracts.

In addition to this, two location specific surveys were conducted for the purposes of the report and will be used in the future detail design.

GIS information and as-built drawings were obtained and used in the development of the system network.

Detailed information on the network showing conveyance type and size for both existing and proposed systems are provided in Table 4.1. The link invert levels and lengths are indicative and will be adjusted in the final design.

Photographs of the various system components are provided to illustrate the current condition of each element and are referenced on the catchment layout.

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Table 4.1 : Conveyance System Properties (Existing and Future)

Link Name	Link Type	Existing System			Future System			
		Fixed Size	Length m	Fixed In Level m	Link Type	Fixed Size	Length m	Fixed In Level m
10	Concrete Pipe	450	105.328	123.41	100D Concrete	675	77.624	124.95
100	Concrete Pipe	525	135.302	96.375	100D Concrete	525	135.302	96.375
1000	WEIR 1	5200 x 400	8.564	41.8	WEIR 1	5200 x 800	8.564	41.8
1010	Drains	Open field	25.495	41.359	MP SW CH	Overland wide	25.495	41.359
110	Concrete Pipe	1350	178.992	88.6	100D Concrete	1350	178.992	88.6
120	Concrete Pipe	375	370.806	125.721	100D Concrete	375	370.806	125.721
130	Concrete Pipe	525	43.479	99.97	50D Concrete	525	43.479	99.97
140	MP SW CH	Overland Ch	165.652	127.847	MP SW CH	Overland Ch	165.652	127.847
150	Concrete Pipe	450	200.795	110.75	50D Concrete	450	200.795	110.75
160	Concrete Pipe	825	106.645	118.296	50D Concrete	825	106.645	118.296
170	MP SW CH	TYPE CC-1	258.441	110.36	MP SW CH	TYPE CC-1	258.441	110.36
180	Concrete Pipe	1350	61.916	85.145	100D Concrete	1350	61.916	85.145
190	Concrete Pipe	1350	122.158	82.74	100D Concrete	1350	122.158	82.74
20	Concrete Pipe	675	80.201	122.102	100D Concrete	675	91.81	124.37
200	Concrete Pipe	1350	15.27	79.62	100D Concrete	1350	15.27	79.62
210	Concrete Pipe	1350	238.317	79.44	100D Concrete	1350	238.317	79.44
220	Concrete Pipe	450	304.652	117.868	100D Concrete	450	304.652	117.868
230	Concrete Pipe	600	290.063	94.989	100D Concrete	600	290.063	94.989
240	Concrete Pipe	600	115.826	87.483	100D Concrete	600	115.826	87.483
250	Concrete Pipe	1350	18.787	70.591	100D Concrete	1350	18.787	70.591
260	MP SW CH	TYPE CC-1	435.126	70.415	100D Concrete	1350	435.126	70.415
270	Concrete Pipe	1050	460.979	81.01	100D Concrete	1050	460.979	81.01

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Link Name	Existing System				Future System			
	Link Type	Fixed Size	Length m	Fixed In Level m	Link Type	Fixed Size	Length m	Fixed In Level m
280	MP SW CH	TYPE CC-2	251.331	60.536	100D Concrete	1350	251.331	60.536
290	Concrete Pipe	300	438.386	113.856	100D Concrete	300	438.386	113.856
30	Concrete Pipe	675	108.257	121.582	100D Concrete	675	108.257	121.582
300	Concrete Pipe	375	54.326	85.61	100D Concrete	375	54.326	85.61
310	Concrete Pipe	450	50.006	84.23	100D Concrete	450	50.006	84.23
320	Concrete Pipe	525	197.604	82.85	100D Concrete	525	197.604	82.85
330	Concrete Pipe	750	52.423	80.17	100D Concrete	750	52.423	80.17
340	Concrete Pipe	825	377.304	79.6	100D Concrete	825	377.304	79.6
350	Concrete Pipe	1050	66.544	68.92	100D Concrete	1050	66.544	68.92
360	Concrete Pipe	1200	46.364	68.47	100D Concrete	1200	46.364	68.47
370	Concrete Pipe	1350	116.068	68.23	100D Concrete	1350	116.068	68.23
380	MP SW CH	TYPE CC-2	263.769	67.337	MP SW CH	TYPE CC-2	263.769	67.337
390	MP SW CH	TYPE CC-2	143.082	63.11	MP SW CH	TYPE CC-2	143.082	63.11
40	Concrete Pipe	375	244.652	124.642	50D Concrete	375	244.652	124.642
400	Box Culvert	2 x 2100 x 900	25.642	60.836	Box Culvert	2 x 2100 x 900	25.642	60.836
410	Concrete Pipe	525	190.467	89.757	100D Concrete	525	190.467	89.757
420	Concrete Pipe	600	121.754	84.25	100D Concrete	600	121.754	84.25
430	Concrete Pipe	450	389.445	90.296	100D Concrete	450	389.445	90.296
440	Concrete Pipe	525	240.227	83.188	100D Concrete	525	240.227	83.188
450	Concrete Pipe	600	98.095	79.608	100D Concrete	600	98.095	79.608
460	Concrete Pipe	600	359.703	77.496	100D Concrete	600	359.703	77.496
470	Portal Culvert	2100 x 1200	25.454	56.844	Portal Culvert	2100 x 1200	25.454	56.844
480	MP SW CH	TYPE CC-3	163.895	56.613	100D Concrete	1350	163.895	56.613

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Link Name	Existing System				Future System			
	Link Type	Fixed Size	Length m	Fixed In Level m	Link Type	Fixed Size	Length m	Fixed In Level m
490	Concrete Pipe	825	92.616	57.714	100D Concrete	825	92.616	57.714
50	Concrete Pipe	750	78.936	118.5	100D Concrete	750	78.936	118.5
500	Concrete Pipe	825	26.655	57.346	100D Concrete	825	26.655	57.346
510	MP SW CH	TYPE CC-1	54.806	57.216	MP SW CH	TYPE CC-1	54.806	57.216
515	MP SW CH	TYPE CC-3	55.943	54.6	100D Concrete	1350	55.943	54.6
520	MP SW CH	TYPE CC-4	205.906	53.97	100D Concrete	1350	205.906	53.97
525	MP SW CH	TYPE CC-4	59.965	0	100D Concrete	1350	59.965	51.5
530	Box Culvert	2 x 2100 x 900	22.018	50.043	Box Culvert	2 x 2100 x 900	22.018	50.643
540	MP SW CH	Overland Ch	263.481	127.07	MP SW CH	Overland Ch	263.481	127.07
545	MP SW CH	TYPE GB-1	363.236	104.55	100D Concrete	525	363.236	104.55
550	Concrete Pipe	1050	130.282	98.5	100D Concrete	1050	130.282	98.5
560	Drains	Earth Drain	283.402	120.36	100D Concrete	900	283.402	120.36
570	Concrete Pipe	1050	63.509	95.868	100D Concrete	1050	63.509	95.868
580	100D Concrete	1200	21.163	94.622	100D Concrete	1200	21.163	94.622
590	Reservoir	Ruthfirst Pond	124.225	94.409	Reservoir	Ruthfirst Pond	124.225	94.409
60	Concrete Pipe	825	136.915	116.509	100D Concrete	825	136.915	116.509
600	Concrete Pipe	600	67.213	92.7	100D Concrete	600	67.213	92.7
610	Concrete Pipe	1050	20.796	90.657	100D Concrete	1050	20.796	90.657
620	Concrete Pipe	600	50.506	90.6	100D Concrete	600	50.506	90.6
630	MP SW CH	TYPE ED-1	94.578	90.475	MP SW CH	TYPE CC-N1	94.578	90.475
640	MP SW CH	TYPE ED-1	587.612	90.03	MP SW CH	TYPE CC-N1	587.612	90.03
650	MP SW CH	TYPE ED-1	258.887	82.5	MP SW CH	TYPE CC-N2	258.887	82.5
660	MP SW CH	TYPE SP-1	193.23	82.024	100D Concrete	750	193.23	82.024

VREDENBURG / LOUUVILLE BASIN STORMWATER MASTER PLAN

Link Name	Existing System				Future System			
	Link Type	Fixed Size	Length m	Fixed In Level m	Link Type	Fixed Size	Length m	Fixed In Level m
670	Box Culvert	1200 x 600	15.465	79.283	Box Culvert	1200 x 600	15.465	79.283
680	MP SW CH	TYPE SP-1	489.352	79.152	100D Concrete	750	489.352	79.152
690	MP SW CH	TYPE SP-2	422.563	72.257	100D Concrete	750	422.563	72.257
70	Concrete Pipe	1050	149.606	110.13	100D Concrete	1050	149.606	110.13
700	Concrete Pipe	825	365.267	65.672	100D Concrete	825	365.267	65.672
710	Concrete Pipe	375	97.559	52.401	100D Concrete	375	97.559	52.401
720	MP SW CH	Overland Ch	238.914	115.18	MP SW CH	Overland Ch	238.914	115.18
730	MP SW CH	Overland Ch	366.958	111.24	MP SW CH	Overland Ch	366.958	111.24
740	Concrete Pipe	825	47.267	94.96	100D Concrete	825	47.267	94.96
750	Concrete Pipe	900	72.31	94.839	100D Concrete	900	72.31	94.839
760	Concrete Pipe	600	90.54	95.54	100D Concrete	600	90.54	95.54
770	Concrete Pipe	1200	156.054	94.654	100D Concrete	1200	156.054	94.654
780	Concrete Pipe	1200	93.671	94.232	100D Concrete	1200	93.671	94.232
790	MP SW CH	TYPE ED-1	190.769	94	MP SW CH	TYPE ED-1	190.769	94
80	Concrete Pipe	1050	195.984	99.69	100D Concrete	1050	195.984	99.69
800	Concrete Pipe	375	236.413	82.795	100D Concrete	375	236.413	82.795
810	Concrete Pipe	600	103.834	75.698	100D Concrete	600	103.834	75.698
820	Concrete Pipe	300	103.67	99.876	100D Concrete	300	103.67	99.876
830	Concrete Pipe	450	356.097	95.664	100D Concrete	450	356.097	95.664
840	Concrete Pipe	450	170.884	83.932	100D Concrete	450	170.884	83.932
850	Concrete Pipe	525	251.053	75.395	100D Concrete	525	251.053	75.395
860	MP SW CH	TYPE ED-2	258.22	48.72	Box Culvert	1500 x 1200	258.22	48.72
870	MP SW CH	TYPE ED-3	266.18	46.87	Box Culvert	1500 x 1200	266.18	46.87

VREDENBURG / LOUWVILLE BASIN STORMWATER MASTER PLAN

Link Name	Existing System				Future System			
	Link Type	Fixed Size	Length m	Fixed In Level m	Link Type	Fixed Size	Length m	Fixed In Level m
880	MP SW CH	TYPE ED-4	111.817	45.079	Box Culvert	1500 x 1200	111.817	45.079
890	Portal Culvert	4 x 1200 x 600	18.739	44.033	Portal Culvert	2 x 1500 x 1200	18.739	44.033
90	Concrete Pipe	450	328.251	121.302	100D Concrete	450	328.251	121.302
900	MP SW CH	TYPE ED-5	121.21	43.885	Box Culvert	1800 x 1500	121.21	43.885
910	Portal Culvert	2 x 1500 x 1200	9.012	43.495	Portal Culvert	2 x 1500 x 1200	9.012	43.495
920	MP SW CH	TYPE ED-6	182.126	43.142	MP SW CH	TYPE GBC -1	182.126	43.142
930	MP SW CH	TYPE ED-6	27.224	42.5	MP SW CH	TYPE GBC -1	27.224	42.5
940	Reservoir	George Ker Pond	94.327	42.4	Reservoir	George Ker Pond	94.327	42.4
95	Concrete Pipe	450	185.189	0	100D Concrete	450	185.189	0

SIMULATION ASSESSMENT

In order to detect inadequacies in the existing system, the network was simulated under both major and minor storm conditions. These results were then assessed and the necessary upgrades, in line with prescribed criteria, applied to the model.

The output from the "storm" model includes the calculated inflow generated by the sub-catchments, the capacity of the conveyance link, the velocity under inflow conditions, the flow depth, over-flow exceeding the link capacity and storage requirements. Flow velocities must be limited to the criteria set out in Table 5.1. High flow velocities can cause damage to the conduits, particularly at joints where pulsating pressure change at joints may cause pieces to break away.

Table 5.1 : Maximum Velocities in Conduits

Conduit	Recommended Maximum (M/S)	Absolute Maximum
Precast Concrete Pipe	3,5	8
Precast Box Culverts	3,5	8
Rip/Rap & Gabions	3	7
In-situ Concrete	6	8
Hard Packed Rock (300mm)	6	8
Grass	1,5	1,8
Gravelly Soil	1,3	1,8
Open Concrete Channel	8	12
Concrete Blocks (depending on depth)	4	6

Where the velocity of flow exceeds these values energy dissipaters must be considered.

To avoid siltation and settlement of fine sand particles, velocities under minor storm conditions should exceed 0,5 m/s. This will promote self cleansing and reduce the impacts of concentrated flow.

EXISTING SYSTEM ASSESSMENT

5.1

Simulation results for the existing system subjected to a 1 in 2 year storm event are shown in Annexure D.

These results have been evaluated against the prescribed criteria. Where non compliance has been identified these figures have been highlighted.

Compliance of the road cross section and formalized overhead flow conveyance system has been evaluated under a 1 in 20 year storm event. The results not meeting the criteria are shown in Table 5.2. Brief assessments leading to system improvements are provided.

Flood line determination and the evaluation of detention facilities are presented under the improved system assessment and therefore not included in the existing system assessment.

The deficiencies within the existing system are summarized as follows:

Simulated minor storm event:

- Inadequately sized pipes within the commercial district (Nodes 10).
- Potential channel bank erosion where capacities exceed of concrete structures adjacent to Kooijieskloof Street (Nodes 260, 280, 480, 515, 520, 525).
- Insufficient capacity in the informal earthdrains running parallel to the Transnet railway line (Node 650).

Simulated major storm event:

- Road crossing structure (4 No 1200 x 600 BC) not accommodating 1 in 20 year and will require enlargement (Node 890).
- Inability of the overgrown earth drain to deal with peak flows (Nodes 900, 920 & 930).

The hydraulic analysis together with preliminary assessments have been used in determining where existing elements of the stormwater system are inadequate and how the problems can best be addressed. Improvements also take into account sensitive social and environmental considerations.

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Table 5.2 : Evaluation of Overflow Capacity on 20 year RI Storm (Existing)

Link Name	Next Link Name	Overflow Node	Inflow m^3/s	Capacity m^3/s	Overflow m^3/s	Overflow Capacity m^3/s	Flow Surplus m^3/s	Assessment
890	900	900	8.906	7.1899	1.716	0.614	1.102	4 No 1200 x 600 - Upgrade required on Infrastructure

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Table 5.3 : Evaluation of Overflow Capacity on 20 year RI Storm (Proposed)

Link Name	Next Link Name	Inflow m^3/s	Capacity m^3/s	Overflow m^3/s	Overflow Capacity m^3/s	Flow Surplus m^3/s	Assessment
10	20	0.6803	0.604	0.0763	1.357	-1.281	All overflows picked up in formalised overland system
250	260	4.7464	4.6758	0.0706	0.614	-0.543	
280	470	6.4612	5.8551	0.6061	6.361	-5.755	
30	50	1.5714	1.4413	0.1302	2.203	-2.073	
480	515	6.3992	5.3538	1.0453	4.254	-3.209	
50	60	1.6375	1.3509	0.2865	4.302	-4.016	
515	520	7.0769	5.1265	1.9504	7.739	-5.789	
520	525	7.5167	5.291	2.2257	6.081	-3.855	
525	530	10.5653	5.7752	4.7901	6.163	-1.373	
620	630	0.7852	0.3093	0.4759	0.417	0.059	
660	670	2.3569	1.3365	1.0204	3.224	-2.204	
680	690	2.3538	1.332	1.0217	3.179	-2.157	
690	700	2.6197	1.325	1.2948	4.393	-3.098	
700	525	3.0486	2.7103	0.3383	3.757	-3.419	
750	770	1.2716	1.2653	0.0063	4.200	-4.194	
760	750	1.0888	0.9874	0.1014	0.633	-0.531	
840	850	0.3068	0.2805	0.0262	1.952	-1.926	
860	870	10.9588	8.272	2.6868	6.390	-3.703	
870	880	11.4106	8.0164	3.3942	5.910	-2.516	
880	890	11.5965	9.4521	2.1444	6.130	-3.986	
900	910	12.0581	9.4874	2.5707	4.513	-1.942	

5.2 IMPROVED SYSTEM ASSESSMENT

In general, conveyance system improvements are proposed where restrictions or deficiencies cause overflowing of infrastructure, where severe channel instability exists or where flooding hazards occur.

The simulation results for the proposed system subjected to the three storms (1 in 2, 1 in 20 and 1 in 50) as shown in Annexure E.

In order to evaluate the impact of flooding on adjacent properties, the capacity of the overland conveyance system has been deducted from the calculated overflow, the resultant thereof representing flows exceeding formalized systems. Table 5.3 and 5.4 shows the results of this evaluation which will to be used in determining water cross section profiles in HEC-RAS.

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Table 5.4 : Evaluation of Overflow Capacity on 50 Year RI Storm (Proposed)

Link Name	Next Link Name	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Overflow Capacity m ³ /s	Flow Surplus m ³ /s	Comment
10	20	0.9185	0.604	0.604	0.3145	1.357	-1.043	
100	110	1.105	1.0555	1.0555	0.0495	2.143	-2.094	
110	180	6.8928	6.7117	6.7117	0.1811	1.182	-1.001	
180	190	6.8928	6.8928	9.521	0	1.287	-1.287	
190	200	6.8759	6.8759	7.7205	0	1.413	-1.413	
20	30	1.8969	1.4886	1.4886	0.4083	5.500	-5.092	
200	210	6.8324	5.245	5.245	1.5875	0.352	1.236	Check Flood lines
210	250	7.4003	7.4003	9.3089	0	1.440	-1.440	
220	230	0.3126	0.3126	0.4788	0	1.577	-1.577	
230	240	0.302	0.302	0.4396	0	1.688	-1.688	
240	210	0.2825	0.2825	1.6384	0	3.423	-3.423	
250	260	7.5814	4.6758	4.6758	2.9057	0.614	2.292	Check Flood lines
260	280	8.0499	7.2791	7.2791	0.7708	1.377	-0.606	
270	260	0.2235	0.2235	3.7924	0	1.377	-1.377	
280	470	11.7297	5.8551	5.8551	5.8746	6.361	-0.486	
290	300	0.3857	0.2609	0.2609	0.1248	2.203	-2.078	
30	50	2.1441	1.4413	1.4413	0.7028	7.550	-6.847	
300	310	0.6045	0.29	0.29	0.3145	1.097	-0.782	
310	320	0.6045	0.498	0.498	0.1065	1.282	-1.176	
320	330	0.6045	0.4479	0.4479	0.1566	1.214	-1.057	
330	340	0.6045	0.6045	0.7935	0	0.614	-0.614	
340	350	1.331	1.331	2.2531	0	1.347	-1.347	
350	360	2.5231	2.0571	2.0571	0.466	1.301	-0.835	
360	370	2.9246	2.5705	2.5705	0.3541	0.833	-0.479	

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Link Name	Next Link Name	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Overflow Capacity m ³ /s	Flow Surplus m ³ /s	Comment
370	380	2.9246	2.9246	4.2374	0	7.237	-7.237	
380	390	3.2329	2.7224	2.7224	0.5105	7.616	-7.106	
390	400	3.6038	2.7112	2.7112	0.8927	7.237	-6.344	
40	50	0.1983	0.1983	0.2661	0	1.418	-1.418	
400	280	3.6038	3.6038	22.9324	0	1.033	-1.033	
410	420	0.1596	0.1596	0.7487	0	1.418	-1.418	
420	340	0.1597	0.1597	1.1145	0	1.494	-1.494	
430	440	0.096	0.096	0.3922	0	1.102	-1.102	
440	450	0.5687	0.4236	0.4236	0.1451	0.938	-0.793	
450	460	0.9316	0.5896	0.5896	0.3421	1.219	-0.877	
460	350	0.9316	0.9149	0.9149	0.0168	1.324	-1.308	
470	480	12.1742	12.1742	12.8831	0	0.614	-0.614	
480	515	13.0535	5.3538	5.3538	7.6997	4.254	3.446	Check Flood lines
490	500	0.7358	0.7358	0.8673	0	1.031	-1.031	
50	60	2.3466	1.3509	1.3509	0.9957	4.302	-3.306	
500	510	0.7874	0.7874	0.9609	0	1.739	-1.739	
510	480	0.7868	0.7868	0.9409	0	14.693	-14.693	
515	520	13.2481	5.1265	5.1265	8.1215	7.739	0.382	Check Flood lines
520	525	14.471	5.291	5.291	9.18	6.081	3.099	Check Flood lines
525	530	20.7705	5.7752	5.7752	14.9953	6.163	8.832	Check Flood lines
530	860	21.6501	21.6501	53.1356	0	0.998	-0.998	
540	545	0.2968	0.2968	1.7218	0	1.050	-1.050	
545	550	0.8807	0.5276	0.5276	0.3531	1.480	-1.127	
550	570	2.4372	2.4372	3.5556	0	1.300	-1.300	
560	550	0.5727	0.5727	4.91	0	0.913	-0.913	
570	580	2.4337	2.4337	2.6948	0	0.506	-0.506	

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Link Name	Next Link Name	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Overflow Capacity m ³ /s	Flow Surplus m ³ /s	Comment
580	590	2.4299	2.4299	3.5843	0	1.525	-1.525	
590	600	3.1944	3.1955	1.633	0			Ruthfirst Pond
60	70	3.2712	2.97	2.97	0.3012	0.803	-0.502	
600	610	1.0028	0.8249	0.8249	0.1779	0.000	0.178	Stored in Ruthfirst Pond
610	620	0.8249	0.8249	1.3096	0	0.309	-0.309	
620	630	0.826	0.3093	0.3093	0.5167	0.417	0.100	Stored in Ruthfirst Pond
630	640	4.4782	4.4782	7.16	0	1.221	-1.221	
640	650	4.7826	4.7826	9.6576	0	1.365	-1.365	
650	660	4.8356	4.8356	6.0036	0	1.817	-1.817	
660	670	4.6694	1.3365	1.3365	3.3329	3.224	0.109	Ruthfirst Canal - flows along track
670	680	4.6694	2.6997	2.6997	1.9697	0.067	1.903	Ruthfirst Canal - flows along track
680	690	4.6694	1.332	1.332	3.3374	3.179	0.158	Ruthfirst Canal - flows along track
690	700	5.3286	1.325	1.325	4.0036	4.393	-0.389	
70	80	3.2712	3.2712	6.6082	0	2.306	-2.306	
700	525	6.2995	2.7103	2.7103	3.5892	3.757	-0.168	
710	530	0.1844	0.1844	0.2442	0	8.019	-8.019	
720	730	0.7342	0.4202	0.4202	0.3141	0.589	-0.275	
730	760	2.2375	1.2182	1.2182	1.0192	1.218	-0.199	
740	750	0.5305	0.5305	0.6962	0	0.614	-0.614	
750	770	3.046	1.2653	1.2653	1.7807	1.221	0.559	Acceptable - drains to Ruthfirst Pond
760	750	2.5138	0.9874	0.9874	1.5264	0.633	0.894	Acceptable - drains to Ruthfirst Pond
770	780	3.5919	1.8579	1.8579	1.734	4.200	-2.466	
780	790	3.5919	1.778	1.778	1.8138	4.200	-2.386	
790	630	3.5919	1.9679	1.9679	1.624	4.200	-2.576	
80	110	3.6276	3.6276	5.9506	0	1.393	-1.393	
800	810	0.2257	0.2257	0.3152	0	1.391	-1.391	

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Link Name	Next Link Name	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Overflow Capacity m ³ /s	Flow Surplus m ³ /s	Comment
810	690	0.4789	0.4789	1.1319	0	0.693	-0.693	
820	830	0.2198	0.2074	0.2074	0.0124	1.870	-1.857	
830	840	0.412	0.3418	0.3418	0.0702	0.811	-0.740	
840	850	0.6341	0.2805	0.2805	0.3536	1.952	-1.599	
850	700	0.7869	0.7869	0.8241	0	1.424	-1.424	
860	870	21.6376	8.272	8.272	13.3656	6.390	6.976	Check Flood lines
870	880	23.8314	8.0164	8.0164	15.815	5.910	9.905	Check Flood lines
880	890	24.2209	9.4521	9.4521	14.7687	6.130	8.639	Check Flood lines
890	900	24.2209	14.9525	14.9525	9.2684	0.614	8.655	Check Flood lines
90	95	0.2771	0.2771	0.6351	0	1.549	-1.549	
900	910	25.4705	9.4874	9.4874	15.9831	4.513	11.470	Check Flood lines
910	920	25.5271	25.5271	33.2991	0	4.500	-4.500	
920	930	25.5169	24.1417	24.1417	1.3752	1.397	-0.022	
930	940	25.8621	24.644	24.644	1.2181	0.657	0.561	Check Flood lines
940	1000	25.778	25.8621	4.374	0			George Kerridge Pond
95	130	0.2834	0.2834	0.5661	0	1.873	-1.873	

6	SEGMENTAL SYSTEM IMPROVEMENTS	
6.1	SEGMENT 1 : VREDENBURG COMMERCIAL DISTRICT	Segment 1 includes the north-east commercial district of Vredenburg north of the R45 Hopefield Road and west of the R399 Veldrif Road. Improvements to undersized infrastructure have previously been reported on by Nadeson Consulting Services under their former name ASCH Consulting Services. Reference can be made to this report, "Report on Upgrade to School Street Upgrade – Doc No VR032/1/OD/003" for a detailed summation of the necessary improvements.
6.2	SEGMENT 2 : RUTHFIRST UPGRADES	Segment 2 includes the tributary leading up to the Ruthfirst Detention Facility. This system has been reported on by Nadeson Consulting Services in the report "Report on Stormwater, Upgrade to College Site – Doc No VR032/1/OD/004" compiled in May 2010. Recommendations coming out of this report have resulted in the Phase 1 construction of the Ruthfirst Detention Pond with contributing infrastructure along Bergsig Street. Phase 2 improvements have been included in the "proposed stormwater" system model. Deficiencies within the system are brought about by future development of the open area west of Bergsig Street.
6.3	SEGMENT 3 : RUTHFIRST / WITTEKLIP CHANNEL	Segment 3 includes the drainage route beginning at the Ruthfirst Pond outlet structure, running parallel to the railway line, and terminating north of Witteklip at Southern Bypass Street. In general the use of open channels is promoted as an alternative to a network of pipelines. The disadvantage, as is evident throughout the catchment, is that open channels are prone to illegal dumping by local residents and require a high degree of maintenance. Following consultation with the municipality it was agreed that where a minor conveyance system borders a residential area, the use of a piped system would be better suited to that of an open channel. Open channels may be introduced to serve as a cut-off drain and accommodate overflow conditions. In remote areas a lined open channel may be considered as an alternative where earth drains no longer perform adequately. In the open field between nodes 630 and 660 an trapezoidal lined channel is recommended. The channel should have a concrete lined base to accommodate minor storms and provide rapid removal of runoff. The upper side banks will be stone pitched to assist in retarding flows during major storm events. Between nodes 660 and 700, a 750 mm diameter concrete pipe offset from the property boundary is proposed. The existing concrete channel appears to fall within the residential properties and should to be demolished and removed off site. Precast

manhole structures are to be constructed at bends and where the internal reticulation intersects the proposed line.

The location of the approximate 1000m channel and 1200m of pipework are shown in drawings found in Annexure F.

6.4 SEGMENT 4 : KOOTJIESKLOOF COLLECTOR

Segment 4 includes the conveyance system running parallel to Kootjieskloof Street between nodes 260 and 530.

Deficiencies in the system are related to the inadequate capacity of the concrete lined channel under minor flow conditions. The interpretation of results is circumspect. Although there is little evidence of bank instability, the system is integral units were improvements to an upstream component will impact the performance of another.

The improvements are not highlighted as a priority upgrade but must be included in future planning. Of higher priority is the section between nodes 520 and 530 where the reduction in channel width has caused flow concentration and damage to the grass blocked slopes. Layouts of the existing and proposed system within this segment can be found in Annexure G.

The proposed improvements can be summarized as follows:

- Continuation of the 1350 mm diam pipe from node 260 to node 530.
- Construction of a informal depression serving as an overland flow route.

6.5 SEGMENT 5 : ONGEGUND / GEORGE KERRIDGE SYSTEM

Segment 5 includes the system running between the townships of Ongegund and George Kerridge. It consists of a wide overgrown earth channel which begins at the Southern Bypass Street (Node 530) crossing and terminates at the crossing just before the George Kerridge Pond component (Node 910). The two road crossing at Southern Bypass Street (2 No. 2100 x 900 box culverts) and Toermalyn Street (4 No. 2100 x 600 box culverts) are included under this segment.

The earth channel, as reported in the preliminary assessment, has become hazardous due to the deposition of waste products. The trend current exercised by the local residents is unlikely to improve. Proposed improvements are therefore aimed at removing the convenience of the open channel as a dump site by constructing a closed system.

The proposed improvements within this segment can be summarized as follows:

- Replacement of the earth channel with a box culvert, 1500 mm wide and 1200 high, between nodes 860 and 890.
- Demolishing of the existing 4 No. 1200 mm x 600mm box culvert upgrading to 2 No. 1500 mm x 1200mm box culvert and reinstate of roadway.
- New 1800 mm x 1500 mm box culvert between nodes 900 and 920.
- Construction of brick access chambers at all connections and deviations in existing channel route.

Layouts showing both the existing and improved systems are shown in Annexure H.

6.6 SEGMENT 6 : GEORGE KERRIDGE POND

An accurate estimation on the capacity of the existing pond is difficult due to the ever present ground water in the pond. The exact level of the water table in unknown and can only be estimates. Preliminary calculation indicate a capacity in the region of 30-000 m³ when assuming a high water level 41,9 m MSL.

Simulation results show a storage capacity requirement of over 150 000 m³ under major storm (1 in 50 year) conditions. This requirement is based on a maximum inflow rate of 26 m³/s with a maximum discharge rate of 3,2 m³/s.

Further investigation and consultation with the municipality must be held prior to proceeding with the final design. Land availability and an accepted discharge rate are issues to be discussed.

Based on the preliminary investigations, the following segmental improvements are recommended:

- All accumulated soil sediment be removed and the full extent of the site be made available.
- The capacity of the pond be increase to 100 000 m³ by raising embankments.
- The outlet structure be upgraded to allow for the agreed rate of discharge.
- The site be fenced off with concrete palisading in order to prevent illegal dumping and provide additional safety.
- Construct grass block channel at entrance control device with possible energy dissipaters.

7

FLOODLINES

All elements of the built and natural environment must be able to withstand the effects of a 1 in 50 year storm event with significant loss and risk to property and life.

HEC-RAS provides a graphical interface that displays the extent of the reach subject to flooding. Information shown in Table 5.3 was transferred to the digital topographical mapping using straight – line interpolation to determine the water surface elevations.

Flood prone areas along the tributaries to the main drainage route have been mapped. A detailed 50 year floodline plan (VR032/05/C0060) and profile sheets are included in Annexure I.

Encroaching of the floodlines within the development of George Kerridge is evident. This would be expected where the overflow routes are inadequate in capacity and in such close proximity to residential developments.

Two remedial measures are to be considered in addressing this problem, namely:

- Introducing a levee or raised embankment allowing for the protection of developed properties.
- Bulk filling over undeveloped areas raising the erven above the 50 year flood line.

The details of improvements required are not included in this report but must form part of future appointments involving the development of George Kerridge. Investigations conducted purely highlight the inefficiencies of the system and the need for further studies.

8 COST ESTIMATION

The cost estimation presented in Table 8.1 indicates a segmental breakdown of improvements recommended in this report.

Where possible contractors have been contracted to establish indicative rates for the less common items. Other rates used have been based on tenders received for similarly related projects.

For a further breakdown of the values shown in Table 8.1 a schedule of quantities has been provided in Annexure J.

VREDENBURG / LOUWVILLE BASIN STORMWATER MASTER PLAN

Table 8.1 Cost Estimate

VR032/05: VREDENBURG/LOUWVILLE STORMWATER MASTERPLAN						
CIVIL ENGINEERING SERVICES ESTIMATE						
1 Construction						
Section	Description	Segment 3	Segment 4	Segment 5	Segment 6	
A	Preliminary and General	R 837,673.75	R 1,250,636.25	R 1,440,466.00	R 1,546,185.75	
B	Site Clearance	R 129,000.00	R 85,500.00	R 174,830.00	R 213,000.00	
C	Earthworks	R 226,200.00	R 138,000.00	R 540,000.00	R 120,700.00	
D	Stormwater	R 3,427,625.00	R 5,239,075.00	R 5,661,610.00	R 6,814,205.00	
	Sub-Total	R 4,620,498.75	R 6,713,211.25	R 7,816,906.00	R 8,694,090.75	
	Escalation 10%	R 462,049.88	R 671,321.13	R 781,690.60	R 869,409.08	
	Total	R 5,082,548.63	R 7,384,532.38	R 8,598,596.60	R 9,563,499.83	
	Contingencies 10%	R 508,254.86	R 738,453.24	R 859,859.66	R 956,349.98	
	Total Estimated Civil Construction (excl VAT)	R 5,590,803.49	R 8,122,985.61	R 9,458,456.26	R 10,519,849.81	
2 Professional Fees						
	Civil Engineering Fees (8%)	R 447,264.28	R 649,838.85	R 756,676.50	R 841,587.98	
	Total Fee Estimate	R 447,264.28	R 649,838.85	R 756,676.50	R 841,587.98	
	TOTAL CIVIL COMPONENT (EXCL VAT)	R 6,038,067.77	R 8,772,824.46	R 10,215,132.76	R 11,361,437.79	

ANNEXURES

ANNEXURE A

SUPPORTING PLANS / FIGURES

PROJECT: SALAMBA BAY WASTE WATER TREATMENT PLANT
 CLIENT: SALAMBA BAY MUNICIPALITY
 DRAWING NO: C0050-04
 DATE: 2014

PROJECT NAME: SALAMBA BAY WASTE WATER TREATMENT PLANT
 PROJECT NO: C0050-04
 PROJECT DATE: 2014

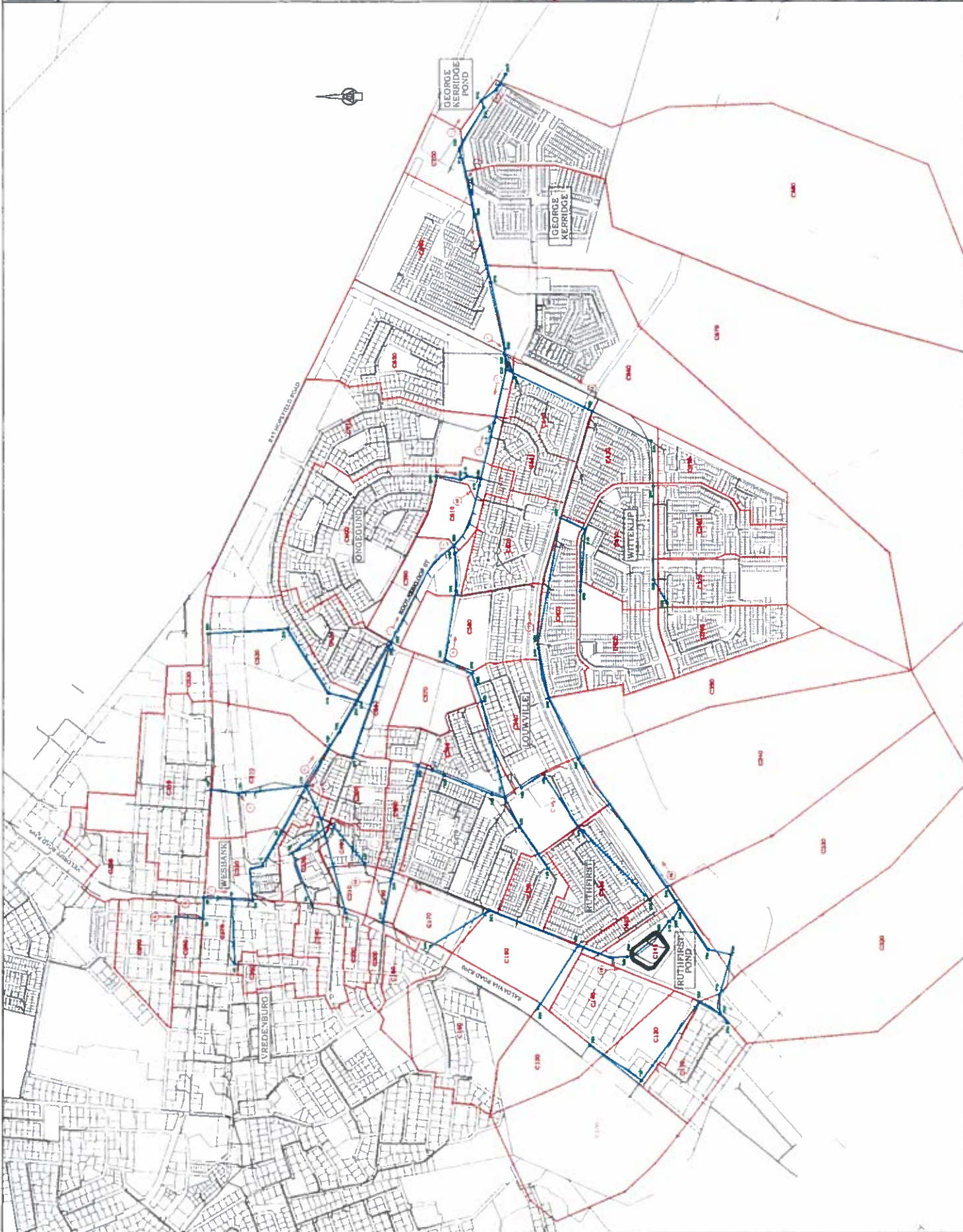
NADESON
 CONSULTING SERVICES

SALAMBA BAY MUNICIPALITY

WASTE WATER / WASTE WATER
 STORMWATER WASTEWATER

STORMWATER CATCHMENTS

DRAWING NO: C0050-04



Sewer Master Plan Saldanha

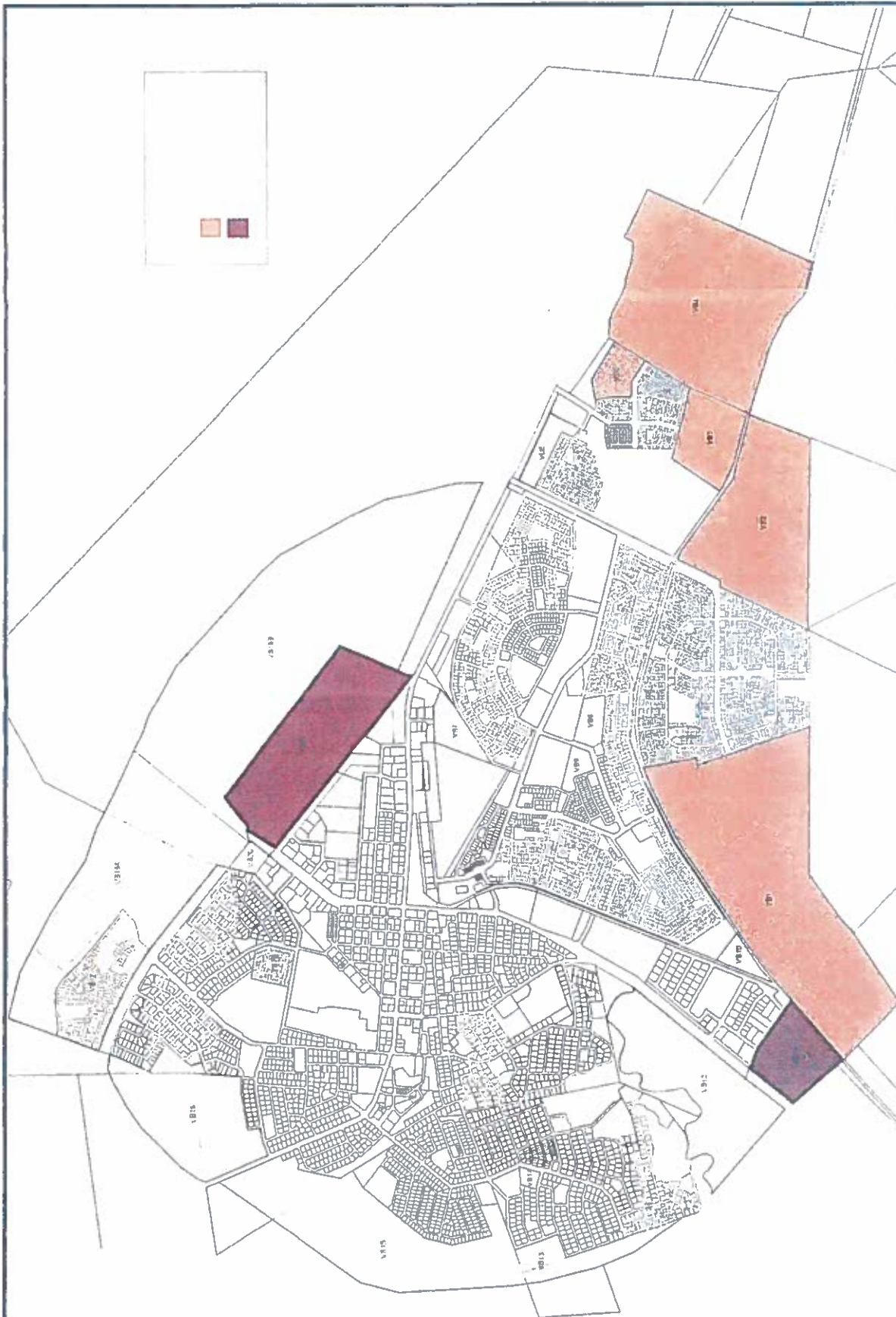
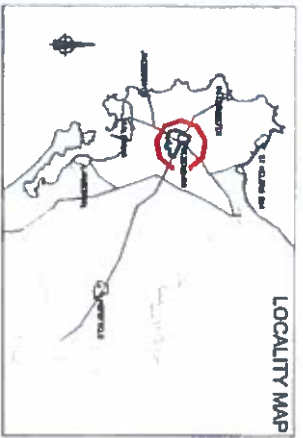


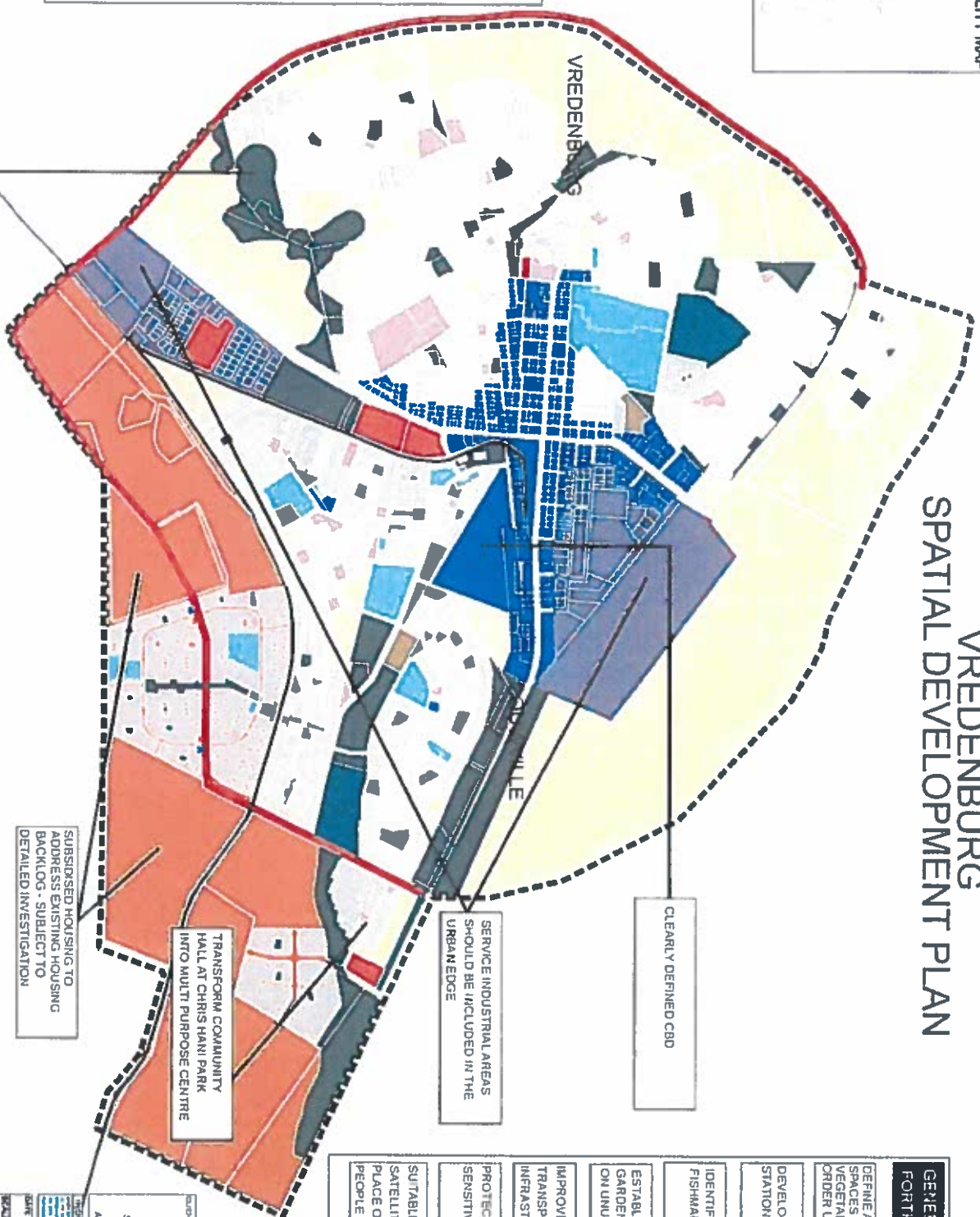
Figure SBS 4.1(f)
Potential future developments
(land use) - Vredenburg

CS



VREDENBURG SPATIAL DEVELOPMENT PLAN

- RESIDENTIAL
- SUBSIDISED RESIDENTIAL
- BUSINESS
- SERVICE INDUSTRIES
- COMMUNITY USE
- EDUCATION
- GOVERNMENT USE
- OPEN SPACE
- CEMETERY
- SPORTSFIELDS AND RECREATION
- PROPOSED URBAN EDGE
- PROPOSED ROADS
- RAILWAY LINE



CLEARLY DEFINED CBD

SERVICE INDUSTRIAL AREAS SHOULD BE INCLUDED IN THE URBAN EDGE

TRANSFORM COMMUNITY HALL AT CHRIS HANI PARK INTO MULTI PURPOSE CENTRE

SUBSIDISED HOUSING TO ADDRESS EXISTING HOUSING BACKLOG - SUBJECT TO DETAILED INVESTIGATION

PROTECT AREAS WITH SENSITIVE VEGETATION

- GENERAL SPATIAL NEEDS FORTHCOMING FROM IDP
- DEFINE A HIERARCHY OF OPEN SPACES AND ESTABLISH VEGETABLE GARDENS ON LOWER ORDER UNUTILISED OPEN SPACES
- DEVELOP SATELLITE POLICE STATION AT CHRIS HANI PARK
- IDENTIFY LOCATION FOR FISHMARKET AT LOUWVILLE
- ESTABLISH VEGETABLE GARDENS IN LOUWVILLE ON UNUTILISED OPEN SPACE
- IMPROVE PUBLIC TRANSPORT AND TRANSPORT INFRASTRUCTURE
- PROTECT AREAS WITH SENSITIVE VEGETATION
- SUITABLE LOCATION FOR SATELLITE POLICE STATION AND PLACE OF CARE FOR DISABLED PEOPLE

SA DABHA BAY MUNICIPALITY
DEPARTMENT OF ECONOMIC AND DEVELOPMENT PLANNING

DATE: DECEMBER 2003
SCALE: N.T.S.
YEAR: 191

191

ANNEXURE B

SAWB RAINFALL DATA

DESIGN RAINFALL DEPTHS AT SELECTED STATIONS IN SOUTH AFRICA

SAWB NUMBER	Station Name	Latitude (°)'(')	Longitude (°)'(')	MAP (mm)	Altitude (m)	Years (days)	Return Period (years)																						
							2		5		10		20		50		100		200										
0059722 AVEAST LONDON-QUEENS PARK		33	1	27 54	828	68	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D	L	D					
							75	75	76	111	111	112	138	139	140	167	169	171	210	214	217	247	252	258	286	295	304		
							104	105	106	156	157	157	194	196	198	233	238	244	290	301	312	337	354	372	390	413	440		
							3	113	114	115	168	170	170	209	212	215	252	258	265	314	326	340	364	384	406	419	448	482	
							4	119	120	121	178	179	180	221	224	227	267	273	280	334	346	360	389	408	430	449	478	512	
							5	125	126	127	185	187	188	230	234	238	277	285	293	345	360	377	400	424	452	462	496	538	
							6	130	131	133	193	194	196	239	243	247	287	295	304	357	373	392	415	440	469	476	514	560	
7	134	136	137	198	200	201	245	249	253	294	302	311	365	381	398	423	448	477	484	523	567								
0059722 W EAST LONDON -SIGNAL STN		33	1	27 54	873	40	99	1	69	69	69	101	102	102	126	127	128	153	155	156	192	196	199	226	231	236			
							2	90	91	92	134	135	136	167	170	172	202	206	211	251	260	270	291	306	321	337	357	380	
							3	99	100	101	148	149	150	183	186	189	221	227	232	275	286	298	319	337	356	367	393	423	
							4	105	106	107	157	158	159	196	199	201	237	242	247	295	306	319	344	362	381	397	423	453	
							5	112	113	114	166	167	168	206	209	213	248	255	262	309	322	338	358	380	404	413	444	482	
							6	117	118	120	174	175	176	215	219	222	258	266	274	322	336	353	374	396	422	429	463	504	
							7	121	122	123	178	179	180	220	224	227	264	271	279	327	342	357	379	402	428	435	469	509	
0060620 W CAPE COLUMBINE (VRT)		32	49	17 51	210	18	39	1	22	23	23	30	30	31	35	35	36	39	40	42	44	46	49	47	51	55			
							2	29	29	30	38	38	39	43	44	46	48	50	52	53	57	60	57	62	66	60	67	73	
							3	31	31	32	41	42	42	47	48	50	51	54	56	57	61	65	61	66	71	65	71	78	
							4	33	33	34	44	45	46	50	52	54	56	59	61	62	67	72	66	73	79	70	79	87	
							5	35	35	36	46	47	48	53	55	56	59	62	64	65	70	74	70	76	82	74	82	90	
							6	37	37	38	49	50	50	57	58	58	63	65	66	71	74	76	70	76	80	83	80	86	90
							7	40	40	41	53	54	54	61	62	63	67	70	72	75	80	83	76	80	86	80	86	91	100
0060620 A CAPE COLUMBINE VRT 6		32	50	17 51	248	50	41	1	21	21	22	28	28	29	32	33	34	36	38	39	41	43	46	44	48	51			
							2	27	28	28	36	36	37	41	42	43	45	47	49	50	54	57	54	59	63	57	63	69	
							3	30	30	31	40	40	41	45	47	48	50	52	55	55	59	63	59	64	69	63	69	76	
							4	33	34	34	44	45	46	50	52	54	56	59	62	62	67	72	66	73	80	71	79	87	
							5	35	35	36	46	47	48	53	55	56	59	61	64	65	70	74	69	76	82	74	82	89	
							6	37	37	37	49	49	49	56	57	57	62	64	65	69	72	75	74	79	82	79	85	89	
							7	39	39	39	51	52	53	59	60	61	65	68	70	72	77	80	77	84	88	82	90	96	
0060780 W SALDAHINA BAY (CUSTOMS)		33	1	17 56	402	10	59	1	33	33	34	44	45	45	51	52	54	57	59	61	64	68	72	69	75	81			
							2	41	42	42	54	55	56	62	64	66	68	72	75	76	82	87	82	89	96	87	96	105	
							3	46	47	48	61	62	63	69	72	74	77	81	84	85	91	97	91	99	107	96	106	116	
							4	49	50	51	65	67	68	75	78	80	83	88	91	92	100	107	99	109	118	105	118	130	
							5	52	53	54	69	70	72	79	82	84	87	92	96	97	105	111	103	114	122	110	123	134	
							6	55	55	56	73	74	75	84	86	87	94	96	98	105	110	113	112	119	124	120	128	134	
							7	58	59	59	77	78	79	88	90	92	98	102	105	109	116	121	117	126	133	124	136	145	
0060864 W VREDENBURG (POL)		32	54	17 59	275	138	71	1	26	26	27	35	35	36	40	41	42	45	47	48	51	54	57	55	59	64			
							2	34	35	35	45	46	47	51	53	55	57	59	62	63	68	72	68	74	79	72	80	87	
							3	39	39	40	51	52	53	58	60	62	64	67	70	71	76	81	76	83	89	81	89	97	
							4	43	43	44	57	58	59	65	67	70	72	76	80	80	87	93	86	95	103	91	103	113	
							5	46	47	47	61	62	63	70	72	74	77	81	84	86	92	98	91	100	108	97	108	118	
							6	49	49	49	65	65	66	74	75	76	83	85	86	92	96	99	99	105	109	105	113	118	
							7	52	52	53	69	70	71	79	81	83	88	91	94	97	104	108	104	113	119	111	121	130	
0061256 W LAIRPLEK (POL)		32	46	18 9	279	8	27	1	23	23	24	31	31	32	36	37	38	40	41	43	45	48	51	49	53	57			
							2	29	29	30	38	39	40	44	45	46	48	51	53	54	58	61	58	63	68	61	68	74	
							3	32	32	33	42	43	43	48	49	51	53	55	57	58	63	66	62	68	73	66	73	80	
							4	34	35	35	45	46	47	52	54	56	58	61	64	67	68	73	78	73	80	86	77	86	
							5	36	37	38	49	49	50	56	57	59	61	64	67	68	73	78	73	80	86	77	86	94	
							6	38	38	39	51	51	52	58	59	60	65	67	68	72	76	78	78	82	85	83	88	93	
							7	41	41	42	54	55	56	62	64	65	69	72	74	76	81	85	82	88	93	87	95	102	

ANNEXURE C

EXISTING NETWORK PHOTOGRAPHS

Photo 5: Stilling basin
(Node 110)



Photo 6: Overland/Cut – off channel
(Node 180 to 200)



Photo 3: Overland route at Wesbank



Photo 4: Start of concrete channel
(Node 170)



Photo 1: Ponding on the Riebeeck St



Photo 2: Veldrif Rd – facing south



Photo 11: Channel down Suikerbos Avenue
(Node 510)

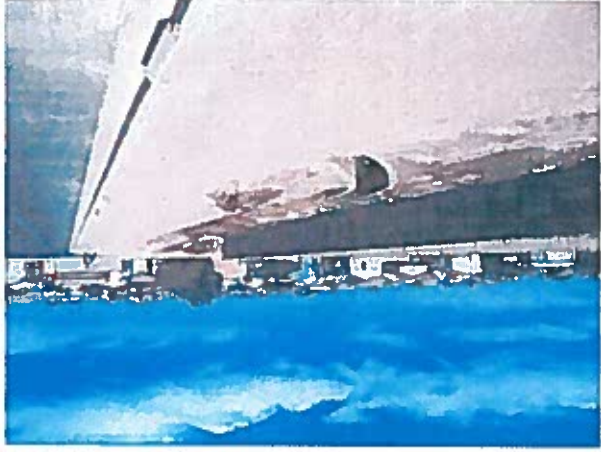


Photo 9: Concrete channel near Macdon St
(Node 380)



Photo 7: Concrete channel on Kootjieskloof St
(Node 260)



Photo 12: Reduced channel along Kootjieskloof
(Node 520)



Photo 10: Concrete channel on Kootjieskloof St
(Node 480)



Photo 8: Concrete channel on Kootjieskloof St
(Node 280)





Photo 13: Open earth channel, north of Bergsig St (Node 140)



Photo 14: New constructed grass block channel along Bergsig (Node 545)

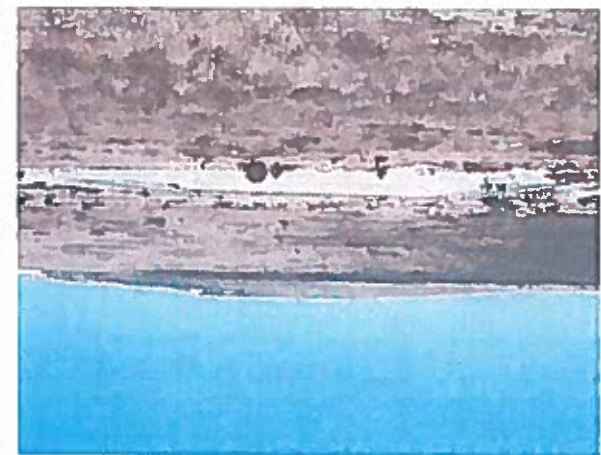


Photo 15: Ruthfirst Pond



Photo 16: Overgrown channel along railway line (Node 640)



Photo 17: Stone pitched channel, south of Witteklip (Node 680)

Photo 18: Stone pitched channel along Southern Bypass St (Node 700)



Photo 19: Transition at reduced concrete channel (Node 515)



Photo 21: Open channel, south of Ongegund (Node 870)



Photo 23: George Kerridge Road



Photo 20: Road crossing on Southern Bypass St (Node 530)



Photo 22: Road crossing on Toermalyn St (Node 890)

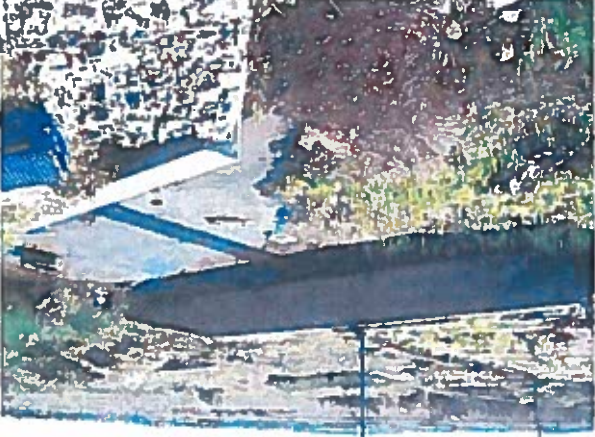


Photo 24: George Kerridge pond weir structure

ANNEXURE D

EXISTING SYSTEM : SIMULATION RESULTS

Vredenburgh Masterplan 2 yr RI (Existing)

Results Summary

File Name: R:\VR032\StormwaterMaster Plan\STORMWATER MP Existing 5 year.slw

Inflow Calculation Method = Illudas
Number of Nodes analyzed = 101

Subnetwork 1

Outfall Data
Outfall Node = OUT
Outlet Level = 40.183 m
Design Flow = 0.016 m³/s

Storm Data

File Name: R:\VR032\StormwaterMaster Plan\Vredenburgh 2 year - MAP 275 - 210min Coastal.slm

Chicago Storm Coastal Region

Vredenburgh 2 year - MAP 275 - 210min

Mean Annual Precipitation

Return Period

Duration

Time Step

Ratio of Peak to Duration

Factors:

A = 256 B = 11.9 C = 0.748

Total Depth

= 275 mm
= 2 years
= 210 min
= 15 min
= 0.38
= 14.6 mm

Antecedent Moisture Condition = Rather Wet (3)
Routing Method = Continuity

Accuracy Check

Volume of Inflow

Volume at outfall

Percentage Error

= 14915.5 m³
= 13844.7 m³
= 7.18 %

Vredenburg Masterplan 2 yr RI (Existing)

Illudas Runoff Analysis

Node Name	Next Node Name	Runoff m ³ /s	Surface Inflow m ³ /s	Paved Area Volume m ³	Grass Area Volume m ³	Total Volume m ³
10	20	0.3833	0.3833	759.616	56.305	815.9
100	110	0.1003	0.1003	209.309	0.000	209.3
1000	1010	0.0000	0.0000	0.000	0.000	0.0
1010	CUT	0.0000	0.0000	0.000	0.000	0.0
110	180	0.0891	0.0891	185.914	0.000	185.9
120	100	0.0290	0.0290	60.529	0.000	60.5
130	180	0.0369	0.0369	76.958	0.000	77.0
140	290	0.0278	0.0278	57.934	0.000	57.9
150	130	0.0073	0.0073	15.296	0.000	15.3
160	170	0.9302	0.9302	1821.255	134.996	1956.3
170	110	0.0000	0.0000	0.000	0.000	0.0
180	190	0.0000	0.0000	0.000	0.000	0.0
190	200	0.0000	0.0000	0.000	0.000	0.0
20	30	0.0926	0.0926	180.524	13.361	193.9
200	210	0.0000	0.0000	0.000	0.000	0.0
210	250	0.1139	0.1139	237.589	0.000	237.6
220	230	0.1322	0.1322	258.485	19.160	277.6
230	240	0.0000	0.0000	0.000	0.000	0.0
240	210	0.0000	0.0000	0.000	0.000	0.0
250	260	0.0849	0.0849	177.080	0.000	177.1
260	280	0.1009	0.1009	210.579	0.000	210.6
270	260	0.0740	0.0740	154.302	0.000	154.3
280	470	0.0383	0.0383	79.956	0.000	80.0
290	300	0.0000	0.0000	0.000	0.000	0.0
30	50	0.3346	0.3346	809.083	59.971	869.1
300	310	0.0508	0.0508	105.948	0.000	105.9
310	320	0.0000	0.0000	0.000	0.000	0.0
320	330	0.0000	0.0000	0.000	0.000	0.0
330	340	0.0000	0.0000	0.000	0.000	0.0
340	350	0.1885	0.1885	393.299	0.000	393.3
350	360	0.0907	0.0907	189.186	0.000	189.2
360	370	0.1028	0.1028	277.112	0.000	277.1
370	380	0.0000	0.0000	0.000	0.000	0.0
380	390	0.0195	0.0195	40.630	0.000	40.6
390	400	0.0397	0.0397	82.898	0.000	82.9
40	50	0.0429	0.0429	89.541	0.000	89.5
400	280	0.0000	0.0000	0.000	0.000	0.0
410	420	0.0528	0.0528	110.157	0.000	110.2
420	340	0.0000	0.0000	0.000	0.000	0.0
430	440	0.0278	0.0278	57.957	0.000	58.0
440	450	0.1573	0.1573	328.038	0.000	328.0
450	460	0.0722	0.0722	150.715	0.000	150.7

Vredenburg Masterplan 2 yr RI (Existing)

Node Name	Next Node Name	Runoff m ³ /s	Surface Inflow m ³ /s	Paved Area Volume m ³	Grass Area Volume m ³	Total Volume m ³
460	350	0.0000	0.0000	0.000	0.000	0.0
470	480	0.1176	0.1176	245.300	0.000	245.3
480	515	0.0170	0.0170	35.561	0.000	35.6
490	500	0.2589	0.2589	565.237	0.000	565.2
50	60	0.0000	0.0000	0.000	0.000	0.0
500	510	0.0257	0.0257	53.664	0.000	53.7
510	480	0.0000	0.0000	0.000	0.000	0.0
515	520	0.0644	0.0644	134.278	0.000	134.3
520	525	0.3439	0.3439	750.736	0.000	750.7
525	530	0.0000	0.0000	0.000	0.000	0.0
530	860	0.2560	0.2560	533.926	0.000	533.9
540	545	0.0689	0.0689	143.762	0.000	143.8
545	550	0.0177	0.0177	36.996	0.000	37.0
550	570	0.0000	0.0000	0.000	0.000	0.0
560	550	0.1083	0.1083	225.844	0.000	225.8
570	580	0.0000	0.0000	0.000	0.000	0.0
580	590	0.0000	0.0000	0.000	0.000	0.0
590	600	0.0288	0.0288	59.985	0.000	60.0
60	70	0.3878	0.3878	764.660	56.679	821.3
600	610	0.0000	0.0000	0.000	0.000	0.0
610	620	0.0000	0.0000	0.000	0.000	0.0
620	630	0.0000	0.0000	0.000	0.000	0.0
630	640	0.0313	0.0313	65.294	0.000	65.3
640	650	0.0000	0.0000	0.000	0.000	0.0
650	660	0.0000	0.0000	0.000	0.000	0.0
660	670	0.0000	0.0000	0.000	0.000	0.0
670	680	0.0000	0.0000	0.000	0.000	0.0
680	690	0.0000	0.0000	0.000	0.000	0.0
690	700	0.0636	0.0636	132.677	0.000	132.7
70	80	0.0000	0.0000	0.000	0.000	0.0
700	525	0.0687	0.0687	143.312	0.000	143.3
710	530	0.0610	0.0610	127.269	0.000	127.3
720	730	0.0432	0.0432	90.019	0.000	90.0
730	760	0.1102	0.1102	229.947	0.000	229.9
740	750	0.1619	0.1619	337.762	0.000	337.8
750	770	0.0000	0.0000	0.000	0.000	0.0
760	750	0.0714	0.0714	148.869	0.000	148.9
770	780	0.0000	0.0000	0.000	0.000	0.0
780	790	0.0000	0.0000	0.000	0.000	0.0
790	630	0.0000	0.0000	0.000	0.000	0.0
80	110	0.1270	0.1270	264.945	0.000	264.9
800	810	0.0793	0.0793	165.323	0.000	165.3
810	690	0.0895	0.0895	186.728	0.000	186.7
820	830	0.0772	0.0772	161.000	0.000	161.0

Vredenburg Masterplan 2 yr RI (Existing)

Node Name	Next Node Name	Runoff m ³ /s	Surface Inflow m ³ /s	Paved Area Volume m ³	Grass Area Volume m ³	Total Volume m ³
830	840	0.0675	0.0675	140.748	0.000	140.7
840	850	0.0780	0.0780	162.699	0.000	162.7
850	700	0.0536	0.0536	111.879	0.000	111.9
860		0.0000	0.0000	0.000	0.000	0.0
870	880	0.1729	0.1729	360.744	0.000	360.7
880	890	0.1522	0.1522	317.434	0.000	317.4
890	900	0.0000	0.0000	0.000	0.000	0.0
90	95	0.0600	0.0600	125.108	0.000	125.1
900	910	0.1656	0.1656	345.470	0.000	345.5
910	920	0.0151	0.0151	31.415	0.000	31.4
920	930	0.0000	0.0000	0.000	0.000	0.0
930	940	0.1230	0.1230	256.490	0.000	256.5
940	1000	0.0000	0.0000	0.000	0.000	0.0
95	130	0.0000	0.0000	0.000	0.000	0.0
OUT		0.0000	0.0000	0.000	0.000	0.0

Flow Analysis

Link Name	Next Link Name	Number Link Type of Links	Calculated Size	Flow m ³ /s	Capacity m ³ /s	Velocity m/s	Flow Depth %
10	20	1 100D Concrete	450	0.3165	0.3165	2.308	100.000
100	110	1 100D Concrete	525	0.2199	1.0555	3.996	30.000
1000	1010	1 WEIR 1	5200 x 400	0.0159	11.8001	1.664	1.000
1010	OUT	1 Drains	Earth Drain	0.0159	0.6682	0.342	13.000
110	180	1 100D Concrete	1350	2.4754	6.7117	4.930	41.000
120	100	1 100D Concrete	375	0.0290	0.5118	2.515	15.000
130	100	1 50D Concrete	525	0.0944	1.2940	3.384	18.000
140	290	1 MP SW CH	Overland Ch	0.0278	1.7116	0.664	10.000
150	130	1 50D Concrete	450	0.0073	0.6412	1.407	6.000
160	170	1 50D Concrete	825	0.9302	3.5312	5.497	34.000
170	110	1 MP SW CH	TYPE CC-1	0.9257	3.8611	4.685	48.000
180	190	1 100D Concrete	1350	2.4132	9.5210	6.345	34.000
190	200	1 100D Concrete	1350	2.3961	7.7205	5.426	37.000
20	30	1 100D Concrete	675	0.4759	0.6878	2.166	60.000
200	210	1 100D Concrete	1350	2.3539	5.2450	4.079	46.000
210	250	1 100D Concrete	1350	2.5580	9.3089	6.294	35.000
220	230	1 100D Concrete	450	0.1322	0.4788	2.581	34.000
230	240	1 100D Concrete	600	0.1232	0.4396	1.330	32.000
240	210	1 100D Concrete	600	0.1010	1.6384	3.371	16.000
250	260	1 100D Concrete	1350	2.5606	4.6758	3.820	52.000
260	280	1 MP SW CH	TYPE CC-1	1.8888	1.8888	3.286	100.000
270	260	1 100D Concrete	1050	0.0740	3.7924	1.896	8.000

Vredenburg Masterplan 2 yr RI (Existing)

Link Name	Next Link Name	Number Link Type of Links	Calculated Size	Flow	Capacity	Velocity	Flow Depth
280	470	1 MP SW CH	TYPE CC-2	m ³ /s	m ³ /s	m/s	%
290	300	1 100D Concrete	300	0.026	0.2609	2.227	18.000
30	50	1 100D Concrete	675	0.8006	1.4413	4.322	52.000
300	310	1 100D Concrete	375	0.0690	0.2900	2.218	32.000
310	320	1 100D Concrete	450	0.0680	0.4980	2.233	24.000
320	330	1 100D Concrete	525	0.0669	0.4479	1.500	24.000
330	340	1 100D Concrete	750	0.0593	0.7935	1.105	17.000
340	350	1 100D Concrete	825	0.2924	2.2531	3.112	23.000
350	360	1 100D Concrete	1050	0.5561	2.0571	2.272	35.000
360	370	1 100D Concrete	1200	0.6446	2.5705	2.135	33.000
370	380	1 100D Concrete	1350	0.6323	4.2374	2.403	25.000
380	390	1 MP SW CH	TYPE CC-2	0.6226	2.7224	2.286	48.000
390	400	1 MP SW CH	TYPE CC-2	0.6057	2.7112	2.323	50.000
40	50	1 50D Concrete	375	0.0429	0.2661	1.781	25.000
400	280	2 Box Culvert	2 x 2100 x 900	0.6392	10.6007	1.307	13.000
410	420	1 100D Concrete	525	0.0528	0.7487	2.065	17.000
420	340	1 100D Concrete	600	0.0498	1.145	2.081	13.000
430	440	1 100D Concrete	450	0.0278	0.3922	1.368	15.000
440	450	1 100D Concrete	525	0.1792	0.4236	1.911	43.000
450	460	1 100D Concrete	600	0.2357	0.5896	2.053	43.000
460	350	1 100D Concrete	600	0.2273	0.9149	2.731	31.000
470	480	1 Portal Culvert	2100 x 1200	2.9894	9.5627	4.042	28.000
480	515	1 MP SW CH	TYPE CC-3	2.6134	2.6134	2.372	100.000
490	500	1 100D Concrete	825	0.2589	0.8673	1.539	36.000
50	60	1 100D Concrete	750	0.8280	1.3509	3.378	56.000
500	510	1 100D Concrete	825	0.2756	0.9609	1.699	36.000
510	480	1 MP SW CH	TYPE CC-1	0.2729	0.9409	1.200	53.000
515	520	1 MP SW CH	TYPE CC-3	2.2744	2.2744	2.090	100.000
520	525	1 MP SW CH	TYPE CC-4	0.2233	0.2233	1.493	100.000
525	530	1 MP SW CH	TYPE CC-4	0.3808	0.3808	2.547	100.000
530	860	2 Box Culvert	2 x 2100 x 900	4.1093	10.6007	2.272	47.000
540	545	1 MP SW CH	Overland Ch	0.0689	1.7056	0.901	16.000
545	550	1 MP SW CH	TYPE GB-1	0.0727	1.4799	0.672	15.000
550	570	1 100D Concrete	1050	0.1300	3.5556	2.274	13.000
560	550	1 Drains	Earth Drain	0.1083	0.9131	0.708	27.000
570	580	1 100D Concrete	1050	0.1359	2.6946	1.862	15.000
580	590	1 100D Concrete	1200	0.1388	3.5843	1.764	13.000
590	600	1 Reservoir	Rudhirst Pond	0.1475	1.6330	0.000	0.000
60	70	1 100D Concrete	825	1.2031	2.9700	5.752	43.000
600	610	1 100D Concrete	600	0.0656	0.8249	1.842	18.000
610	620	1 100D Concrete	1050	0.0654	1.3096	0.895	15.000
620	630	1 100D Concrete	600	0.0653	0.3093	0.914	31.000
630	640	1 MP SW CH	TYPE ED-1	0.3503	1.2076	0.572	53.000
640	650	1 MP SW CH	TYPE ED-1	0.3505	1.5286	0.624	40.000

Vredenburg Masterplan 2 yr RI (Existing)

Link Name	Next Link Name	Number of Links	Link Type	Calculated Size	Flow m ³ /s	Capacity m ³ /s	Velocity m/s	Flow Depth %
650	660	1	MP SW CH	TYPE ED-1	0.2681	0.7550	0.362	54.000
660	670	1	MP SW CH	TYPE SP-1	0.2297	3.2440	1.242	29.000
670	680	1	Box Culvert	1200 x 600	0.2360	1.8552	1.522	21.000
680	690	1	MP SW CH	TYPE SP-1	0.2362	3.1790	1.213	29.000
690	700	1	MP SW CH	TYPE SP-2	0.2575	4.3932	1.256	26.000
70	80	1	1000 Concrete	1050	1.1860	6.6082	6.541	28.000
700	525	1	1000 Concrete	825	0.4533	2.6783	3.993	26.000
710	530	1	1000 Concrete	375	0.0610	0.2610	1.980	32.000
720	730	1	MP SW CH	Overland Ch	0.0432	0.5890	0.352	20.000
730	760	1	MP SW CH	Overland Ch	0.1343	1.2182	0.861	27.000
740	750	1	1000 Concrete	825	0.1619	0.6962	1.158	32.000
750	770	1	1000 Concrete	900	0.3136	0.9035	1.389	39.000
760	750	1	1000 Concrete	600	0.1625	0.5471	1.754	36.000
770	780	1	1000 Concrete	1200	0.3001	1.8579	1.325	25.000
780	790	1	1000 Concrete	1200	0.2668	1.7780	1.286	26.000
790	630	1	MP SW CH	TYPE ED-1	0.2677	1.9679	0.764	37.000
80	110	1	1000 Concrete	1050	1.2954	5.9506	6.203	31.000
800	810	1	1000 Concrete	375	0.0793	0.3152	2.416	33.000
810	690	1	1000 Concrete	600	0.1640	1.0836	2.895	25.000
820	830	1	1000 Concrete	300	0.0772	0.2074	2.743	41.000
830	840	1	1000 Concrete	450	0.1432	0.3418	2.027	41.000
840	850	1	1000 Concrete	450	0.2026	0.2805	1.932	59.000
850	700	1	1000 Concrete	525	0.2413	0.8241	3.390	35.000
860	870	1	MP SW CH	TYPE ED-2	4.0617	24.3047	0.905	39.000
870	880	1	MP SW CH	TYPE ED-3	4.2391	18.2911	0.830	44.000
880	890	1	MP SW CH	TYPE ED-4	4.1661	13.9523	1.005	50.000
890	900	4	Portal Culvert	4 x 1200 x 600	4.0496	7.1899	2.656	51.000
90	95	1	1000 Concrete	450	0.0600	0.6351	2.503	19.000
900	910	1	MP SW CH	TYPE ED-5	4.0783	11.5324	0.691	54.000
910	920	2	Portal Culvert	2 x 1500 x 1200	3.7381	33.2991	9.911	10.000
920	930	1	MP SW CH	TYPE ED-6	3.7347	8.9497	0.708	63.000
930	940	1	MP SW CH	TYPE ED-6	3.9617	9.1359	0.722	63.000
940	1000	1	Reservoir	George Ker Pond	3.9617	4.3740	0.000	0.000
95	130	1	1000 Concrete	450	0.0548	0.5661	2.260	20.000
OUT		1	500 Concrete	300	0.0159	0.0672	0.000	0.000

Vredenburg Masterplan 2 yr RI (Existing)

Illudas Overflow Analysis

Link Name	Next Link Name	Overflow Node	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Storage m ³	Inflow Storage m ³
10	20	20	0.3833	0.3165	0.3165	0.0668	0.0	0.0
100	110	110	0.2199	0.2199	1.0555	0.0000	0.0	0.0
1000	1010		0.0159	0.0159	11.8001	0.0000	0.0	0.0
1010	OUT		0.0159	0.0159	0.6882	0.0000	0.0	0.0
110	180	180	2.4754	2.4754	6.7117	0.0000	0.0	0.0
120	100	100	0.0290	0.0290	0.5118	0.0000	0.0	0.0
130	100	100	0.0944	0.0944	1.2940	0.0000	0.0	0.0
140	290	290	0.0278	0.0278	1.7116	0.0000	0.0	0.0
150	130	130	0.0073	0.0073	0.6412	0.0000	0.0	0.0
160	170	170	0.9302	0.9302	3.5312	0.0000	0.0	0.0
170	110	110	0.9257	0.9257	3.8611	0.0000	0.0	0.0
180	190	190	2.4132	2.4132	9.5210	0.0000	0.0	0.0
190	200	200	2.3961	2.3961	7.7205	0.0000	0.0	0.0
20	30	30	0.4759	0.4759	0.6878	0.0000	0.0	0.0
200	210	210	2.3539	2.3539	5.2450	0.0000	0.0	0.0
210	250	250	2.5580	2.5580	9.3089	0.0000	0.0	0.0
220	230	230	0.1322	0.1322	0.4788	0.0000	0.0	0.0
230	240	240	0.1232	0.1232	0.4386	0.0000	0.0	0.0
240	210	210	0.1010	0.1010	1.6384	0.0000	0.0	0.0
250	260	260	2.5606	2.5606	4.6758	0.0000	0.0	0.0
260	280	280	2.7106	1.8888	1.8888	0.8218	0.0	0.0
270	260	260	0.0740	0.0740	3.7924	0.0000	0.0	0.0
280	470	470	3.0941	2.6065	2.6065	0.4876	0.0	0.0
290	300	300	0.0226	0.0226	0.2609	0.0000	0.0	0.0
30	50	50	0.8006	0.8006	1.4413	0.0000	0.0	0.0
300	310	310	0.0680	0.0680	0.2900	0.0000	0.0	0.0
310	320	320	0.0680	0.0680	0.4980	0.0000	0.0	0.0
320	330	330	0.0669	0.0669	0.4479	0.0000	0.0	0.0
330	340	340	0.0593	0.0593	0.7935	0.0000	0.0	0.0
340	350	350	0.2924	0.2924	2.2531	0.0000	0.0	0.0
350	360	360	0.5561	0.5561	2.0571	0.0000	0.0	0.0
360	370	370	0.6446	0.6446	2.5705	0.0000	0.0	0.0
370	380	380	0.6323	0.6323	4.2374	0.0000	0.0	0.0
380	390	390	0.6226	0.6226	2.7224	0.0000	0.0	0.0
390	400	400	0.6057	0.6057	2.7112	0.0000	0.0	0.0
40	50	50	0.0429	0.0429	0.2661	0.0000	0.0	0.0
400	280	280	0.6392	0.6392	10.6007	0.0000	0.0	0.0
410	420	420	0.0528	0.0528	0.7487	0.0000	0.0	0.0
420	340	340	0.0498	0.0498	1.1145	0.0000	0.0	0.0
430	440	440	0.0278	0.0278	0.3922	0.0000	0.0	0.0
440	450	450	0.1792	0.1792	0.4236	0.0000	0.0	0.0
450	460	460	0.2357	0.2357	0.5896	0.0000	0.0	0.0

Vredenburg Masterplan 2 yr RI (Existing)

Link Name	Next Link Name	Overflow Node	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Storage m ³	Inflow Storage m ³
460	350	350	0.2273	0.2273	0.9149	0.0000	0.0	0.0
470	480	480	2.9894	2.9894	9.5627	0.0000	0.0	0.0
480	515	515	3.2392	2.6134	2.6134	0.6257	0.0	0.0
490	500	500	0.2589	0.2589	0.8673	0.0000	0.0	0.0
50	60	60	0.8280	0.8280	1.3509	0.0000	0.0	0.0
500	510	510	0.2756	0.2756	0.9609	0.0000	0.0	0.0
510	480	480	0.2729	0.2729	0.9409	0.0000	0.0	0.0
515	520	520	3.1049	2.2744	2.2744	0.8305	0.0	0.0
520	525	525	3.3808	0.2233	0.2233	3.1576	0.0	0.0
525	530	530	3.7939	0.3808	0.3808	3.4131	0.0	0.0
530	860	860	4.1093	4.1093	10.6007	0.0000	0.0	0.0
540	545	545	0.0689	0.0689	1.7056	0.0000	0.0	0.0
545	550	550	0.0727	0.0727	1.4799	0.0000	0.0	0.0
550	570	570	0.1300	0.1300	3.5556	0.0000	0.0	0.0
560	550	550	0.1083	0.1083	0.9131	0.0000	0.0	0.0
570	580	580	0.1359	0.1359	2.6948	0.0000	0.0	0.0
580	590	590	0.1388	0.1388	3.5843	0.0000	0.0	0.0
590	600	600	0.1486	0.1475	1.6330	0.0000	0.0	0.0
60	70	70	1.2031	1.2031	2.9700	0.0000	0.0	0.0
600	610	610	0.0656	0.0656	0.8249	0.0000	0.0	0.0
610	620	620	0.0654	0.0654	1.3096	0.0000	0.0	0.0
620	630	630	0.0653	0.0653	0.3093	0.0000	0.0	0.0
630	640	640	0.3503	0.3503	1.2078	0.0000	0.0	0.0
640	650	650	0.3505	0.3505	1.5288	0.0000	0.0	0.0
650	660	660	0.2681	0.2681	0.7550	0.0000	0.0	0.0
660	670	670	0.2297	0.2297	3.2440	0.0000	0.0	0.0
670	680	680	0.2360	0.2360	1.8552	0.0000	0.0	0.0
680	690	690	0.2362	0.2362	3.1790	0.0000	0.0	0.0
690	700	700	0.2675	0.2675	4.3932	0.0000	0.0	0.0
70	80	80	1.1860	1.1860	6.6082	0.0000	0.0	0.0
700	525	525	0.4533	0.4533	2.6783	0.0000	0.0	0.0
710	530	530	0.0610	0.0610	0.2610	0.0000	0.0	0.0
720	730	730	0.0432	0.0432	0.5890	0.0000	0.0	0.0
730	760	760	0.1343	0.1343	1.2182	0.0000	0.0	0.0
740	750	750	0.1619	0.1619	0.6962	0.0000	0.0	0.0
750	770	770	0.3136	0.3136	0.9035	0.0000	0.0	0.0
760	750	750	0.1625	0.1625	0.5471	0.0000	0.0	0.0
770	780	780	0.3001	0.3001	1.8579	0.0000	0.0	0.0
780	790	790	0.2668	0.2668	1.7780	0.0000	0.0	0.0
790	630	630	0.2677	0.2677	1.9579	0.0000	0.0	0.0
80	110	110	1.2954	1.2954	5.9506	0.0000	0.0	0.0
800	810	810	0.0793	0.0793	0.3152	0.0000	0.0	0.0
810	690	690	0.1640	0.1640	1.0636	0.0000	0.0	0.0
820	830	830	0.0772	0.0772	0.2074	0.0000	0.0	0.0

Vredenburgh Masterplan 2 yr RI (Existing)

Link Name	Next Link Name	Overflow Node	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Storage m ³	Inflow Storage m ³
830	840	840	0.1432	0.1432	0.3418	0.0000	0.0	0.0
840	850	850	0.2026	0.2026	0.2805	0.0000	0.0	0.0
850	700	700	0.2413	0.2413	0.8241	0.0000	0.0	0.0
860	870	870	4.0617	4.0617	24.3047	0.0000	0.0	0.0
870	880	880	4.2391	4.2391	18.2911	0.0000	0.0	0.0
880	890	890	4.1661	4.1661	13.9523	0.0000	0.0	0.0
890	900	900	4.0496	4.0496	7.1899	0.0000	0.0	0.0
90	95	95	0.0600	0.0600	0.6351	0.0000	0.0	0.0
900	910	910	4.0783	4.0783	11.5324	0.0000	0.0	0.0
910	920	920	3.7381	3.7381	33.2991	0.0000	0.0	0.0
920	930	930	3.7347	3.7347	8.9497	0.0000	0.0	0.0
930	940	940	3.9617	3.9617	9.1359	0.0000	0.0	0.0
940	1000		4.0069	3.9617	4.3740	0.0000	0.0	0.0
95	130	130	0.0548	0.0548	0.5661	0.0000	0.0	0.0
OUT			0.0159	0.0159	0.0672	0.0000	0.0	0.0

ANNEXURE E

IMPROVED SYSTEM : SIMULATION RESULTS

Vredenburg Masterplan 2 yr RI (Proposed)

Results Summary

File Name: R:\VR032\StormwaterMaster Plan\STORMWATER MP Proposed 5 year.siw

Inflow Calculation Method = Illudas
Number of Nodes analyzed = 101

Subnetwork 1

Outfall Data
Outfall Node = OUT
Outlet Level = 41.104 m
Design Flow = 0.022 m3/s

Storm Data

File Name: R:\VR032\StormwaterMaster Plan\Vredenburg 2 year - MAP 275 - 210mm Coastal.stm
Chicago Storm Coastal Region

Vredenburg 2 year - MAP 275 - 210mm

Mean Annual Precipitation = 275 mm

Return Period = 2 years

Duration = 210 min

Time Step = 15 min

Ratio of Peak to Duration = 0.38

Factors:

A = 256 B = 11.9 C = 0.748

Total Depth = 14.6 mm

Antecedent Moisture Condition = Rather Wet (3)
Routing Method = Continuity

Accuracy Check
Volume of Inflow = 20293.1 m3
Volume at outfall = 19477.9 m3
Percentage Error = 4.02 %

Vredenburg Masterplan 2 yr RI (Proposed)

Illudas Runoff Analysis

Node Name	Next Node Name	Runoff m ³ /s	Surface Inflow m ³ /s	Paved Area Volume m ³	Grass Area Volume m ³	Total Volume m ³
10	20	0.2790	0.2790	759.616	56.305	815.9
100	110	0.0825	0.0825	209.309	0.000	209.3
1000	1010	0.0000	0.0000	0.000	0.000	0.0
1010	OUT	0.0000	0.0000	0.000	0.000	0.0
110	180	0.0580	0.0580	185.914	0.000	185.9
120	100	0.0239	0.0239	60.529	0.000	60.5
130	100	0.0303	0.0303	76.958	0.000	77.0
140	290	0.0228	0.0228	57.934	0.000	57.9
150	130	0.0724	0.0724	183.558	0.000	183.6
160	170	0.6123	0.6123	1821.255	134.996	1956.3
170	110	0.0000	0.0000	0.000	0.000	0.0
180	190	0.0000	0.0000	0.000	0.000	0.0
190	200	0.0000	0.0000	0.000	0.000	0.0
20	30	0.2971	0.2971	809.118	59.974	869.1
200	210	0.0000	0.0000	0.000	0.000	0.0
210	250	0.0742	0.0742	237.589	0.000	237.6
220	230	0.0949	0.0949	258.485	19.160	277.6
230	240	0.0000	0.0000	0.000	0.000	0.0
240	210	0.0000	0.0000	0.000	0.000	0.0
250	260	0.0608	0.0608	177.080	0.000	177.1
260	280	0.0723	0.0723	210.579	0.000	210.6
270	260	0.0529	0.0529	154.302	0.000	154.3
280	470	0.0274	0.0274	79.956	0.000	80.0
290	300	0.0706	0.0706	198.981	5.686	204.7
30	50	0.0761	0.0761	180.524	13.381	193.9
300	310	0.0418	0.0418	105.948	0.000	105.9
310	320	0.0000	0.0000	0.000	0.000	0.0
320	330	0.0000	0.0000	0.000	0.000	0.0
330	340	0.0000	0.0000	0.000	0.000	0.0
340	350	0.1350	0.1350	393.299	0.000	393.3
350	360	0.0649	0.0649	189.186	0.000	189.2
360	370	0.0951	0.0951	277.112	0.000	277.1
370	380	0.0000	0.0000	0.000	0.000	0.0
380	390	0.0139	0.0139	40.630	0.000	40.6
390	400	0.0284	0.0284	82.898	0.000	82.9
40	50	0.0353	0.0353	89.541	0.000	89.5
400	280	0.0000	0.0000	0.000	0.000	0.0
410	420	0.0378	0.0378	110.157	0.000	110.2
420	340	0.0000	0.0000	0.000	0.000	0.0
430	440	0.0228	0.0228	57.957	0.000	58.0
440	450	0.1126	0.1126	328.038	0.000	328.0
450	460	0.0517	0.0517	150.715	0.000	150.7

Vredenburgh Masterplan 2 yr RI (Proposed)

Node Name	Next Node Name	Runoff m3/s	Surface Inflow m3/s	Paved Area Volume m3	Grass Area Volume m3	Total Volume m3
460	350	0.0000	0.0000	0.000	0.000	0.0
470	480	0.0842	0.0842	245.300	0.000	245.3
480	515	0.0140	0.0140	35.561	0.000	35.6
490	500	0.1764	0.1764	565.237	0.000	565.2
50	60	0.0000	0.0000	0.000	0.000	0.0
500	510	0.0184	0.0184	53.664	0.000	53.7
510	480	0.0000	0.0000	0.000	0.000	0.0
515	520	0.0461	0.0461	134.278	0.000	134.3
520	525	0.2344	0.2344	750.736	0.000	750.7
525	530	0.0000	0.0000	0.000	0.000	0.0
530	860	0.1667	0.1667	533.926	0.000	533.9
540	545	0.0493	0.0493	143.762	0.000	143.8
545	550	0.1523	0.1523	443.952	0.000	444.0
550	570	0.2547	0.2547	742.196	0.000	742.2
560	550	0.0705	0.0705	225.844	0.000	225.8
570	580	0.0000	0.0000	0.000	0.000	0.0
580	590	0.0000	0.0000	0.000	0.000	0.0
590	600	0.2058	0.2058	599.850	0.000	599.9
60	70	0.2808	0.2808	764.660	56.679	821.3
600	610	0.0000	0.0000	0.000	0.000	0.0
610	620	0.0000	0.0000	0.000	0.000	0.0
620	630	0.0000	0.0000	0.000	0.000	0.0
630	640	0.0224	0.0224	65.294	0.000	65.3
640	650	0.0673	0.0673	215.607	0.000	215.6
650	660	0.0869	0.0869	278.527	0.000	278.5
660	670	0.0356	0.0356	113.947	0.000	113.9
670	680	0.0000	0.0000	0.000	0.000	0.0
680	690	0.0000	0.0000	0.000	0.000	0.0
690	700	0.0455	0.0455	132.677	0.000	132.7
70	80	0.0000	0.0000	0.000	0.000	0.0
700	525	0.0492	0.0492	143.312	0.000	143.3
710	530	0.0437	0.0437	127.269	0.000	127.3
720	730	0.1158	0.1158	337.572	0.000	337.6
730	760	0.3076	0.3076	985.485	0.000	985.5
740	750	0.1159	0.1159	337.762	0.000	337.8
750	770	0.0000	0.0000	0.000	0.000	0.0
760	750	0.0511	0.0511	148.869	0.000	148.9
770	780	0.0975	0.0975	284.145	0.000	284.1
780	790	0.0000	0.0000	0.000	0.000	0.0
790	80	0.0000	0.0000	0.000	0.000	0.0
80	110	0.0909	0.0909	264.945	0.000	264.9
800	810	0.0567	0.0567	165.323	0.000	165.3
810	690	0.0641	0.0641	186.728	0.000	186.7
820	830	0.0552	0.0552	161.000	0.000	161.0

Vredenburg Masterplan 2 yr RI (Proposed)

Node Name	Next Node Name	Runoff m ³ /s	Surface Inflow m ³ /s	Paved Area Volume m ³	Grass Area Volume m ³	Total Volume m ³
830	840	0.0483	0.0483	140.748	0.000	140.7
840	850	0.0558	0.0558	162.699	0.000	162.7
850	700	0.0384	0.0384	111.879	0.000	111.9
860	870	0.0000	0.0000	0.000	0.000	0.0
870	880	0.1802	0.1802	577.191	0.000	577.2
880	890	0.0991	0.0991	317.434	0.000	317.4
890	900	0.0000	0.0000	0.000	0.000	0.0
90	95	0.0493	0.0493	125.108	0.000	125.1
900	910	0.2207	0.2207	1036.411	0.000	1036.4
910	920	0.0124	0.0124	31.415	0.000	31.4
920	930	0.0000	0.0000	0.000	0.000	0.0
930	940	0.1639	0.1639	769.471	0.000	769.5
940	1000	0.0000	0.0000	0.000	0.000	0.0
95	130	0.0000	0.0000	0.000	0.000	0.0
OUT		0.0000	0.0000	0.000	0.000	0.0

Flow Analysis

Link Name	Next Link Name	Number Link Type of Links	Calculated Size	Flow m ³ /s	Capacity m ³ /s	Velocity m/s	Flow Depth %
10	20	1 100D Concrete	675	0.2790	0.6040	1.724	46.000
100	110	1 100D Concrete	525	0.2421	1.0555	4.107	32.000
1000	1010	1 WEIR 1	5200 x 800	0.0221	27.9730	2.393	0.000
1010	OUT	1 MP SW CH	Overland wide	0.0221	1.7272	0.254	8.000
110	180	1 100D Concrete	1350	1.8487	6.7117	4.623	36.000
120	100	1 100D Concrete	375	0.0239	0.5118	2.381	13.000
130	100	1 50D Concrete	525	0.1397	1.2940	3.787	21.000
140	290	1 MP SW CH	Overland Ch	0.0228	1.7116	0.626	8.000
150	130	1 50D Concrete	450	0.0724	0.6412	2.705	21.000
160	170	1 50D Concrete	825	0.6123	3.5312	4.922	28.000
170	110	1 MP SW CH	TYPE CC-1	0.6194	3.8611	4.250	40.000
180	190	1 100D Concrete	1350	1.9026	9.5210	5.956	30.000
190	200	1 100D Concrete	1350	1.9171	7.7205	5.149	34.000
20	30	1 100D Concrete	675	0.5685	1.4886	4.060	42.000
200	210	1 100D Concrete	1350	1.9489	5.2450	3.890	42.000
210	250	1 100D Concrete	1350	2.1252	9.3089	6.083	32.000
220	230	1 100D Concrete	450	0.0949	0.4788	2.347	28.000
230	240	1 100D Concrete	600	0.0875	0.4396	1.311	31.000
240	210	1 100D Concrete	600	0.0958	1.6384	3.367	16.000
250	260	1 100D Concrete	1350	2.2261	4.6758	3.697	48.000
260	280	1 100D Concrete	1350	2.3426	7.2791	5.240	39.000
270	260	1 100D Concrete	1050	0.0529	3.7924	1.826	7.000

Vredenburg Masterplan 2 yr RI (Proposed)

Link Name	Next Link Name	Number Link Type of Links	Calculated Size	Flow m ³ /s	Capacity m ³ /s	Velocity m/s	Flow Depth %
280	470	1 100D Concrete	1350	3.1523	5.8551	4.786	52.000
290	300	1 100D Concrete	300	0.0886	0.2609	3.284	37.000
30	50	1 100D Concrete	675	0.6368	1.4413	4.078	46.000
300	310	1 100D Concrete	375	0.1209	0.2900	2.578	44.000
310	320	1 100D Concrete	450	0.1189	0.4980	2.621	32.000
320	330	1 100D Concrete	525	0.1170	0.4479	1.788	33.000
330	340	1 100D Concrete	750	0.1100	0.7935	1.346	25.000
340	350	1 100D Concrete	825	0.2699	2.2531	3.159	23.000
350	360	1 100D Concrete	1050	0.5177	2.0571	2.256	34.000
360	370	1 100D Concrete	1200	0.6044	2.5705	2.117	33.000
370	380	1 100D Concrete	1350	0.6129	4.2374	2.433	25.000
380	390	1 MP SW CH	TYPE CC-2	0.6392	2.7224	2.353	50.000
390	400	1 MP SW CH	TYPE CC-2	0.6842	2.7112	2.376	52.000
40	50	1 50D Concrete	375	0.0353	0.2661	1.679	23.000
400	280	2 Box Culvert	2 x 2100 x 900	0.6927	22.9324	2.236	8.000
410	420	1 100D Concrete	525	0.0378	0.7487	1.846	14.000
420	430	1 100D Concrete	600	0.0347	1.1145	1.927	12.000
430	440	1 100D Concrete	450	0.0228	0.3922	1.291	14.000
440	450	1 100D Concrete	525	0.1300	0.4236	1.771	36.000
450	460	1 100D Concrete	600	0.1667	0.5896	1.905	36.000
460	470	1 100D Concrete	600	0.1719	0.9149	2.666	30.000
470	480	1 Portal Culvert	2100 x 1200	3.2677	12.8831	5.446	23.000
480	515	1 100D Concrete	1350	3.4868	5.3538	4.566	59.000
490	500	1 100D Concrete	825	0.1764	0.8673	1.414	31.000
50	60	1 100D Concrete	750	0.6571	1.3509	3.192	48.000
500	510	1 100D Concrete	825	0.1990	0.9609	1.561	31.000
510	480	1 MP SW CH	TYPE CC-1	0.2013	0.9409	1.122	47.000
515	520	1 100D Concrete	1350	3.5517	5.1265	4.427	61.000
520	525	1 100D Concrete	1350	3.7950	5.2910	4.606	62.000
525	530	1 100D Concrete	1350	4.8858	5.7752	5.178	70.000
530	860	2 Box Culvert	2 x 2100 x 900	5.0892	53.1356	7.587	17.000
540	545	1 MP SW CH	Overland Ch	0.0493	1.7218	0.860	15.000
545	550	1 100D Concrete	525	0.1886	0.5276	2.339	41.000
550	570	1 100D Concrete	1050	0.4804	3.5556	3.263	24.000
560	550	1 100D Concrete	900	0.0705	4.9100	3.132	8.000
570	580	1 100D Concrete	1050	0.4870	2.6948	2.695	28.000
580	590	1 100D Concrete	1200	0.4956	3.5843	2.530	25.000
590	600	1 Reservoir	Ruifirst Pond	0.6628	1.6330	0.000	0.000
60	70	1 100D Concrete	825	0.9260	2.9700	5.359	37.000
600	610	1 100D Concrete	600	0.3124	0.8249	2.859	42.000
610	620	1 100D Concrete	1050	0.3124	1.3096	1.410	33.000
620	630	1 100D Concrete	600	0.3093	0.3093	1.308	100.000
630	640	1 MP SW CH	TYPE CC-N1	0.9442	1.9669	2.028	70.000
640	650	1 MP SW CH	TYPE CC-N1	0.9995	2.4897	2.422	63.000

Vredenburg Masterplan 2 yr RI (Proposed)

Link Name	Next Link Name	Number of Links	Link Type	Calculated Size	Flow m ³ /s	Capacity m ³ /s	Velocity m/s	Flow Depth %
650	660	1	MP SW CH	TYPE CC-N2	0.9753	2.1072	1.458	71.000
660	670	1	100D Concrete	750	1.0422	1.3365	3.539	67.000
670	680	1	Box Culvert	1200 x 600	1.0563	2.6997	3.055	48.000
680	690	1	100D Concrete	750	1.0573	1.3320	3.542	68.000
690	700	1	100D Concrete	750	1.1331	1.3250	3.559	71.000
700	80	1	100D Concrete	1050	0.9090	6.6082	6.042	24.000
710	525	1	100D Concrete	825	1.2385	2.7103	5.443	47.000
720	530	1	100D Concrete	375	0.0437	0.2442	1.711	27.000
730	760	1	MP SW CH	Overland Ch	0.1158	0.5890	0.531	43.000
740	750	1	MP SW CH	Overland Ch	0.4173	1.2182	1.325	61.000
750	770	1	100D Concrete	825	0.1159	0.6962	1.051	27.000
760	780	1	100D Concrete	900	0.5854	0.9035	1.625	59.000
770	790	1	100D Concrete	600	0.4831	0.5471	2.299	73.000
780	790	1	100D Concrete	1200	0.6722	1.8579	1.725	42.000
790	630	1	100D Concrete	1200	0.6888	1.7780	1.674	43.000
80	110	1	MP SW CH	TYPE ED-1	0.6954	1.9679	0.978	58.000
810	810	1	100D Concrete	1050	0.9825	5.9506	5.759	27.000
820	830	1	100D Concrete	375	0.0567	0.3152	2.184	27.000
830	840	1	100D Concrete	600	0.1160	1.1319	2.699	21.000
840	850	1	100D Concrete	300	0.0552	0.2074	2.496	34.000
850	860	1	100D Concrete	450	0.1019	0.3418	1.904	36.000
860	870	1	100D Concrete	450	0.1442	0.2805	1.844	52.000
870	880	1	100D Concrete	525	0.1845	0.8241	3.248	32.000
880	890	1	Box Culvert	1500 x 1200	5.0923	8.2720	4.164	67.000
890	900	1	Box Culvert	1500 x 1200	5.2461	8.0164	4.085	70.000
90	95	2	Box Culvert	1500 x 1200	5.2936	9.4521	4.659	62.000
910	920	2	Box Culvert	2 x 1500 x 1200	5.2733	14.9525	4.451	32.000
920	930	1	100D Concrete	450	0.0493	0.6351	2.367	17.000
930	940	1	Box Culvert	1800 x 1500	5.4635	9.4874	3.135	64.000
940	1000	2	Box Culvert	2 x 1500 x 1200	5.4285	33.2891	9.911	15.000
95	OUT	1	MP SW CH	TYPE GBC -1	5.4246	24.1417	1.275	43.000
		1	MP SW CH	TYPE GBC -1	5.3460	24.6440	1.302	43.000
		1	Reservoir	George Ker Pond	5.3460	4.3740	0.000	0.000
		1	100D Concrete	450	0.0442	0.5661	2.127	17.000
		1	MP SW CH	Overland wide	0.0221	1.2213	0.000	0.000

Vredenburg Masterplan 2 yr RI (Proposed)

Illudas Overflow Analysis

Link Name	Next Link Name	Overflow Node	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Storage m ³	Inflow Storage m ³
10	20	20	0.2790	0.2790	0.6040	0.0000	0.0	0.0
100	110	110	0.2421	0.2421	1.0555	0.0000	0.0	0.0
1000	1010		0.0221	0.0221	27.9730	0.0000	0.0	0.0
1010	OUT		0.0221	0.0221	1.7272	0.0000	0.0	0.0
110	180	180	1.8487	1.8487	6.7117	0.0000	0.0	0.0
120	100	100	0.0239	0.0239	0.5118	0.0000	0.0	0.0
130	100	100	0.1397	0.1397	1.2940	0.0000	0.0	0.0
140	290	290	0.0228	0.0228	1.7116	0.0000	0.0	0.0
150	130	130	0.0724	0.0724	0.6412	0.0000	0.0	0.0
160	170	170	0.6123	0.6123	3.5312	0.0000	0.0	0.0
170	110	110	0.6194	0.6194	3.8611	0.0000	0.0	0.0
180	190	190	1.9026	1.9026	9.5210	0.0000	0.0	0.0
190	200	200	1.9171	1.9171	7.7205	0.0000	0.0	0.0
20	30	30	0.5685	0.5685	1.4886	0.0000	0.0	0.0
200	210	210	1.9489	1.9489	5.2450	0.0000	0.0	0.0
210	250	250	2.1252	2.1252	9.3089	0.0000	0.0	0.0
220	230	230	0.0949	0.0949	0.4786	0.0000	0.0	0.0
230	240	240	0.0875	0.0875	0.4396	0.0000	0.0	0.0
240	210	210	0.0958	0.0958	1.6384	0.0000	0.0	0.0
250	260	260	2.2261	2.2261	4.6758	0.0000	0.0	0.0
260	280	280	2.3426	2.3426	7.2791	0.0000	0.0	0.0
270	260	260	0.0529	0.0529	3.7924	0.0000	0.0	0.0
280	470	470	3.1523	3.1523	5.8551	0.0000	0.0	0.0
290	300	300	0.0886	0.0886	0.2609	0.0000	0.0	0.0
30	50	50	0.6368	0.6368	1.4413	0.0000	0.0	0.0
300	310	310	0.1209	0.1209	0.2900	0.0000	0.0	0.0
310	320	320	0.1189	0.1189	0.4980	0.0000	0.0	0.0
320	330	330	0.1170	0.1170	0.4479	0.0000	0.0	0.0
330	340	340	0.1100	0.1100	0.7935	0.0000	0.0	0.0
340	350	350	0.2699	0.2699	2.2531	0.0000	0.0	0.0
350	360	360	0.5177	0.5177	2.0571	0.0000	0.0	0.0
360	370	370	0.6044	0.6044	2.5705	0.0000	0.0	0.0
370	380	380	0.6129	0.6129	4.2374	0.0000	0.0	0.0
380	390	390	0.6392	0.6392	2.7224	0.0000	0.0	0.0
390	400	400	0.6842	0.6842	2.7112	0.0000	0.0	0.0
40	50	50	0.0353	0.0353	0.2661	0.0000	0.0	0.0
400	280	280	0.6927	0.6927	22.9324	0.0000	0.0	0.0
410	420	420	0.0378	0.0378	0.7487	0.0000	0.0	0.0
420	340	340	0.0347	0.0347	1.1145	0.0000	0.0	0.0
430	440	440	0.0228	0.0228	0.3922	0.0000	0.0	0.0
440	450	450	0.1300	0.1300	0.4236	0.0000	0.0	0.0
450	460	460	0.1667	0.1667	0.5896	0.0000	0.0	0.0

Vredenburg Masterplan 2 yr RI (Proposed)

Link Name	Next Link Name	Overflow Node	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Storage m ³	Inflow Storage m ³
460	350	350	0.1719	0.1719	0.9149	0.0000	0.0	0.0
470	480	480	3.2677	3.2677	12.8831	0.0000	0.0	0.0
480	515	515	3.4868	3.4868	5.3538	0.0000	0.0	0.0
490	500	500	0.1764	0.1764	0.8673	0.0000	0.0	0.0
50	60	60	0.6571	0.6571	1.3509	0.0000	0.0	0.0
500	510	510	0.1990	0.1990	0.9609	0.0000	0.0	0.0
510	480	480	0.2013	0.2013	0.9409	0.0000	0.0	0.0
515	520	520	3.5517	3.5517	5.1265	0.0000	0.0	0.0
520	525	525	3.7950	3.7950	5.2910	0.0000	0.0	0.0
525	530	530	4.8858	4.8858	5.7752	0.0000	0.0	0.0
530	860	860	5.0892	5.0892	53.1356	0.0000	0.0	0.0
540	545	545	0.0493	0.0493	1.7218	0.0000	0.0	0.0
545	550	550	0.1886	0.1886	0.5276	0.0000	0.0	0.0
550	570	570	0.4804	0.4804	3.5556	0.0000	0.0	0.0
560	550	550	0.0705	0.0705	4.9100	0.0000	0.0	0.0
570	580	580	0.4870	0.4870	2.6948	0.0000	0.0	0.0
580	590	590	0.4956	0.4956	3.5843	0.0000	0.0	0.0
590	600	600	0.6657	0.6657	1.6330	0.0000	0.0	0.0
60	70	70	0.9260	0.9260	2.9700	0.0000	0.0	0.0
600	610	610	0.3124	0.3124	0.8249	0.0000	0.0	0.0
610	620	620	0.3124	0.3124	1.3095	0.0000	0.0	0.0
620	630	630	0.3124	0.3093	0.3093	0.0031	0.0	0.0
630	640	640	0.9442	0.9442	1.9869	0.0000	0.0	0.0
640	650	650	0.9995	0.9995	2.4897	0.0000	0.0	0.0
650	660	660	0.9753	0.9753	2.1072	0.0000	0.0	0.0
660	670	670	1.0422	1.0422	1.3365	0.0000	0.0	0.0
670	680	680	1.0563	1.0563	2.6997	0.0000	0.0	0.0
680	690	690	1.0573	1.0573	1.3320	0.0000	0.0	0.0
690	700	700	1.1331	1.1331	1.3250	0.0000	0.0	0.0
70	80	80	0.9090	0.9090	6.6082	0.0000	0.0	0.0
700	525	525	1.2385	1.2385	2.7103	0.0000	0.0	0.0
710	530	530	0.0437	0.0437	0.2442	0.0000	0.0	0.0
720	730	730	0.1158	0.1158	0.5890	0.0000	0.0	0.0
730	760	760	0.4173	0.4173	1.2182	0.0000	0.0	0.0
740	750	750	0.1159	0.1159	0.6962	0.0000	0.0	0.0
750	770	770	0.5854	0.5854	0.9035	0.0000	0.0	0.0
760	750	750	0.4831	0.4831	0.5471	0.0000	0.0	0.0
770	780	780	0.6722	0.6722	1.8579	0.0000	0.0	0.0
780	790	790	0.6888	0.6888	1.7780	0.0000	0.0	0.0
790	630	630	0.6954	0.6954	1.9679	0.0000	0.0	0.0
80	110	110	0.9825	0.9825	5.9506	0.0000	0.0	0.0
800	810	810	0.0567	0.0567	0.3152	0.0000	0.0	0.0
810	690	690	0.1160	0.1160	1.1319	0.0000	0.0	0.0
820	830	830	0.0552	0.0552	0.2074	0.0000	0.0	0.0

Vredenburg Masterplan 2 yr RI (Proposed)

Link Name	Next Link Name	Overflow Node	Inflow m3/s	Design Flow m3/s	Capacity m3/s	Overflow m3/s	Storage m3	Inflow Storage m3
830	840	840	0.1019	0.1019	0.3418	0.0000	0.0	0.0
840	850	850	0.1442	0.1442	0.2805	0.0000	0.0	0.0
850	700	700	0.1845	0.1845	0.8241	0.0000	0.0	0.0
860	870	870	5.0923	5.0923	8.2720	0.0000	0.0	0.0
870	880	880	5.2461	5.2461	8.0164	0.0000	0.0	0.0
880	890	890	5.2936	5.2936	9.4521	0.0000	0.0	0.0
890	900	900	5.2733	5.2733	14.9525	0.0000	0.0	0.0
90	95	95	0.0493	0.0493	0.6351	0.0000	0.0	0.0
900	910	910	5.4635	5.4635	9.4874	0.0000	0.0	0.0
910	920	920	5.4265	5.4265	33.2991	0.0000	0.0	0.0
920	930	930	5.4246	5.4246	24.1417	0.0000	0.0	0.0
930	940	940	5.3460	5.3460	24.6440	0.0000	0.0	0.0
940	1000		5.3085	5.3460	4.3740	0.0000	0.0	0.0
95	130	130	0.0442	0.0442	0.5661	0.0000	0.0	0.0
OUT			0.0221	0.0221	1.2213	0.0000	0.0	0.0

Vredenburg Masterplan 20 yr RI (Proposed)

Results Summary

File Name: R:\VR032\StormwaterMaster Plan\STORMWATER MP Proposed 50 year.slw

Inflow Calculation Method = Illudax
Number of Nodes analyzed = 101

Subnetwork 1

Outfall Data
Outfall Node = OUT
Outlet Level = 41.104 m
Design Flow = 0.068 m³/s

Storm Data

File Name: R:\VR032\StormwaterMaster Plan\Vredenburg 20 year - MAP 275 - 210min Coastal.stm
Chicago Storm Coastal Region
Vredenburg 20 year - MAP 275 - 210min
Mean Annual Precipitation = 275 mm
Return Period = 20 years
Duration = 210 min
Time Step = 15 min
Ratio of Peak to Duration = 0.60
Factors: A = 515 B = 12.0 C = 0.750
Total Depth = 29.0 mm

Antecedent Moisture Condition = Rather Wet (3)
Routing Method = Continuity

Accuracy Check
Volume of Inflow = 46443.4 m³
Volume at outfall = 45277.0 m³
Percentage Error = 2.51 %

Vredenburg Masterplan 20 yr RI (Proposed)

Illudas Runoff Analysis

Node Name	Next Node Name	Runoff m ³ /s	Surface Inflow m ³ /s	Paved Area Volume m ³	Grass Area Volume m ³	Total Volume m ³
10	20	0.6803	0.6803	1624.257	411.550	2035.8
100	110	0.1689	0.1689	447.557	0.000	447.6
1000	1010	0.0000	0.0000	0.000	0.000	0.0
1010	OUT	0.0000	0.0000	0.000	0.000	0.0
110	180	0.1224	0.1224	397.533	0.000	397.5
120	100	0.0488	0.0488	129.426	0.000	129.4
130	100	0.0621	0.0621	164.556	0.000	164.6
140	290	0.0468	0.0468	123.879	0.000	123.9
150	130	0.1719	0.1719	392.495	57.122	449.6
160	170	1.4906	1.4906	3894.320	986.732	4881.1
170	110	0.0000	0.0000	0.000	0.000	0.0
180	190	0.0000	0.0000	0.000	0.000	0.0
190	200	0.0000	0.0000	0.000	0.000	0.0
20	30	0.7246	0.7246	1730.107	438.370	2168.5
200	210	0.0000	0.0000	0.000	0.000	0.0
210	250	0.1565	0.1565	508.026	0.000	508.0
220	230	0.2315	0.2315	552.709	140.044	692.8
230	240	0.0000	0.0000	0.000	0.000	0.0
240	210	0.0000	0.0000	0.000	0.000	0.0
250	260	0.1271	0.1271	378.644	0.000	378.6
260	280	0.1512	0.1512	450.274	0.000	450.3
270	260	0.1108	0.1108	329.939	0.000	329.9
280	470	0.0574	0.0574	170.968	0.000	171.0
290	300	0.1751	0.1751	394.536	89.703	484.2
30	50	0.1800	0.1800	386.007	97.805	483.8
300	310	0.0855	0.0855	226.544	0.000	226.5
310	320	0.0000	0.0000	0.000	0.000	0.0
320	330	0.0000	0.0000	0.000	0.000	0.0
330	340	0.0000	0.0000	0.000	0.000	0.0
340	350	0.2824	0.2824	840.977	0.000	841.0
350	360	0.1358	0.1358	404.529	0.000	404.5
360	370	0.1989	0.1989	592.537	0.000	592.5
370	380	0.0000	0.0000	0.000	0.000	0.0
380	390	0.0473	0.0473	86.879	48.850	135.7
390	400	0.0595	0.0595	177.258	0.000	177.3
40	50	0.0723	0.0723	191.463	0.000	191.5
400	280	0.0000	0.0000	0.000	0.000	0.0
410	420	0.0791	0.0791	235.545	0.000	235.5
420	340	0.0000	0.0000	0.000	0.000	0.0
430	440	0.0468	0.0468	123.928	0.000	123.9
440	450	0.2355	0.2355	701.430	0.000	701.4
450	460	0.1082	0.1082	322.267	0.000	322.3

Vredenburg Masterplan 20 yr RI (Proposed)

Node Name	Next Node Name	Runoff m ³ /s	Surface Inflow m ³ /s	Paved Area Volume m ³	Grass Area Volume m ³	Total Volume m ³
460	350	0.0000	0.0000	0.000	0.000	0.0
470	480	0.1761	0.1761	524.516	0.000	524.5
480	515	0.0287	0.0287	76.039	0.000	76.0
490	500	0.3723	0.3723	1208.624	0.000	1208.6
50	60	0.0000	0.0000	0.000	0.000	0.0
500	510	0.0385	0.0385	114.748	0.000	114.7
510	480	0.0000	0.0000	0.000	0.000	0.0
515	520	0.0964	0.0964	287.121	0.000	287.1
520	525	0.4944	0.4944	1605.271	0.000	1605.3
525	530	0.0000	0.0000	0.000	0.000	0.0
530	860	0.3516	0.3516	1141.673	0.000	1141.7
540	545	0.1032	0.1032	307.400	0.000	307.4
545	550	0.3699	0.3699	949.286	138.155	1087.4
550	570	0.6184	0.6184	1587.008	230.966	1818.0
560	550	0.1487	0.1487	482.914	0.000	482.9
570	580	0.0000	0.0000	0.000	0.000	0.0
580	590	0.0000	0.0000	0.000	0.000	0.0
590	600	0.4395	0.4395	1282.636	23.903	1306.5
60	70	0.6848	0.6848	1635.043	414.283	2049.3
600	610	0.0000	0.0000	0.000	0.000	0.0
610	620	0.0000	0.0000	0.000	0.000	0.0
620	630	0.0000	0.0000	0.000	0.000	0.0
630	640	0.0469	0.0469	139.617	0.000	139.6
640	650	0.1420	0.1420	461.024	0.000	461.0
650	660	0.1834	0.1834	595.565	0.000	595.6
660	670	0.0750	0.0750	243.649	0.000	243.6
670	680	0.0000	0.0000	0.000	0.000	0.0
680	690	0.0000	0.0000	0.000	0.000	0.0
690	700	0.0953	0.0953	283.699	0.000	283.7
70	80	0.0000	0.0000	0.000	0.000	0.0
700	525	0.1029	0.1029	306.438	0.000	306.4
710	530	0.0914	0.0914	272.135	0.000	272.1
720	730	0.3883	0.3883	721.817	404.112	1125.9
730	760	0.6490	0.6490	2107.226	0.000	2107.2
740	750	0.2425	0.2425	722.223	0.000	722.2
750	770	0.0000	0.0000	0.000	0.000	0.0
760	750	0.1069	0.1069	318.321	0.000	318.3
770	780	0.2040	0.2040	607.577	0.000	607.6
780	790	0.0000	0.0000	0.000	0.000	0.0
790	630	0.0000	0.0000	0.000	0.000	0.0
80	110	0.1902	0.1902	566.522	0.000	566.5
800	810	0.1187	0.1187	353.505	0.000	353.5
810	690	0.1341	0.1341	399.274	0.000	399.3
820	830	0.1156	0.1156	344.260	0.000	344.3

Vredenburg Masterplan 20 yr RI (Proposed)

Node Name	Next Node Name	Runoff m ³ /s	Surface Inflow m ³ /s	Paved Area Volume m ³	Grass Area Volume m ³	Total Volume m ³
830	840	0.1010	0.1010	300.956	0.000	301.0
840	850	0.1168	0.1168	347.893	0.000	347.9
850	700	0.0803	0.0803	239.227	0.000	239.2
860	870	0.0000	0.0000	0.000	0.000	0.0
870	880	0.4938	0.4938	1234.185	340.931	1575.1
880	890	0.2091	0.2091	678.756	0.000	678.8
890	900	0.0000	0.0000	0.000	0.000	0.0
90	95	0.1010	0.1010	267.513	0.000	267.5
900	910	0.4483	0.4483	2216.119	0.000	2216.1
910	920	0.0254	0.0254	67.173	0.000	67.2
920	930	0.0000	0.0000	0.000	0.000	0.0
930	940	0.3329	0.3329	1645.331	0.000	1645.3
940	1000	0.0000	0.0000	0.000	0.000	0.0
95	130	0.0000	0.0000	0.000	0.000	0.0
OUT		0.0000	0.0000	0.000	0.000	0.0

Flow Analysis

Link Name	Next Link Name	Number Link Type of Links	Calculated Size	Flow m ³ /s	Capacity m ³ /s	Velocity m/s	Flow Depth %
10	20	1 100D Concrete	675	0.6040	0.6040	2.008	100.000
100	110	1 100D Concrete	525	0.5283	1.0555	5.065	49.000
1000	1010	1 WEIR 1	5000 x 800	0.0677	27.9730	2.393	2.000
1010	OUT	1 MP SW CH	Overland wide	0.0678	1.7272	0.377	16.000
110	180	1 100D Concrete	1350	4.5160	6.7117	5.733	59.000
120	100	1 100D Concrete	375	0.0488	0.5118	2.936	19.000
130	100	1 50D Concrete	525	0.3169	1.2940	4.774	33.000
140	290	1 MP SW CH	Overland Ch	0.0468	1.7116	0.816	13.000
150	130	1 50D Concrete	450	0.1719	0.6412	3.467	34.000
160	170	1 50D Concrete	825	1.4906	3.5312	6.239	45.000
170	110	1 MP SW CH	TYPE CC-1	1.4799	3.8611	5.327	61.000
180	190	1 100D Concrete	1350	4.4334	9.5210	7.471	47.000
190	200	1 100D Concrete	1350	4.4121	7.7205	6.361	53.000
20	30	1 100D Concrete	675	1.4049	1.4886	4.957	76.000
200	210	1 100D Concrete	1350	4.3626	5.2450	4.688	69.000
210	250	1 100D Concrete	1350	4.7073	9.3089	7.428	49.000
220	230	1 100D Concrete	450	0.2315	0.4786	3.017	47.000
230	240	1 100D Concrete	600	0.2205	0.4396	1.614	48.000
240	210	1 100D Concrete	600	0.2083	1.6384	4.204	24.000
250	260	1 100D Concrete	1350	4.6758	4.6756	4.239	100.000
260	280	1 100D Concrete	1350	4.9921	7.2791	6.286	61.000
270	260	1 100D Concrete	1050	0.1108	3.7924	2.135	10.000

Vredenburg Masterplan 20 yr RI (Proposed)

Link Name	Next Link Name	Number Link Type of Links	Calculated Size	Flow	Capacity	Velocity	Flow Depth
280	470	1 100D Concrete	1350	m ³ /s	m ³ /s	m/s	%
290	300	1 100D Concrete	300	0.2156	0.2609	4.139	66.000
30	50	1 100D Concrete	675	1.4413	1.4413	4.792	100.000
300	310	1 100D Concrete	375	0.2900	0.2900	3.075	100.000
310	320	1 100D Concrete	450	0.2900	0.4980	3.316	54.000
320	330	1 100D Concrete	525	0.2673	0.4479	2.262	56.000
330	340	1 100D Concrete	750	0.2719	0.7935	1.710	39.000
340	350	1 100D Concrete	825	0.6205	2.2531	3.873	34.000
350	360	1 100D Concrete	1050	1.0356	2.0571	2.687	49.000
360	370	1 100D Concrete	1200	1.2157	2.5705	2.534	47.000
370	380	1 100D Concrete	1350	1.1993	4.2374	2.914	36.000
380	390	1 MP SW CH	TYPE CC-2	1.2331	2.7224	2.806	70.000
390	400	1 MP SW CH	TYPE CC-2	1.3312	2.7112	2.837	72.000
40	50	1 50D Concrete	375	0.0723	0.2661	2.066	33.000
400	280	2 Box Culvert	2 x 2100 x 900	1.3578	22.9324	2.798	12.000
410	420	1 100D Concrete	525	0.0791	0.7487	2.312	21.000
420	340	1 100D Concrete	600	0.0744	1.1145	2.347	16.000
430	440	1 100D Concrete	450	0.0468	0.3922	1.621	21.000
440	450	1 100D Concrete	525	0.2748	0.4236	2.130	55.000
450	460	1 100D Concrete	600	0.3604	0.5896	2.285	55.000
460	350	1 100D Concrete	600	0.3485	0.9149	3.164	42.000
470	480	1 Portal Culvert	2100 x 1200	6.5868	12.8831	5.446	47.000
480	515	1 100D Concrete	1350	5.3538	5.3536	4.854	100.000
490	500	1 100D Concrete	825	0.3723	0.8673	1.693	44.000
50	60	1 100D Concrete	750	1.3509	1.3509	3.663	100.000
500	510	1 100D Concrete	825	0.3859	0.9609	1.870	44.000
510	480	1 MP SW CH	TYPE CC-1	0.3915	0.9409	1.333	65.000
515	520	1 100D Concrete	1350	5.1265	5.1265	4.648	100.000
520	525	1 100D Concrete	1350	5.2910	4.797	100.000	
525	530	1 100D Concrete	1350	5.7752	5.7752	5.236	100.000
530	860	2 Box Culvert	2 x 2100 x 900	10.9479	53.1356	9.604	30.000
540	545	1 MP SW CH	Overland Ch	0.1032	1.7218	1.057	21.000
545	550	1 100D Concrete	525	0.4570	0.5276	2.827	67.000
550	570	1 100D Concrete	1050	1.1631	3.5556	4.171	39.000
560	570	1 100D Concrete	900	0.1487	4.9100	3.719	11.000
570	580	1 100D Concrete	1050	1.1642	2.6948	3.392	45.000
580	590	1 100D Concrete	1200	1.1520	3.5843	3.200	38.000
590	600	1 Reservoir	Ruhrstl Pond	1.5915	1.6330	0.000	0.000
60	70	1 100D Concrete	825	2.3223	2.9700	6.722	66.000
600	610	1 100D Concrete	600	0.7827	0.8249	3.490	77.000
610	620	1 100D Concrete	1050	0.7844	1.3096	1.792	55.000
620	630	1 100D Concrete	600	0.3093	0.3093	1.395	100.000
630	640	1 MP SW CH	TYPE CC-N1A	2.2733	7.1600	1.742	60.000
640	650	1 MP SW CH	TYPE CC-N1A	2.3940	9.6576	2.178	53.000

Vredenburg Masterplan 20 yr Ri (Proposed)

Link Name	Next Link Name	Number Link Type of Links	Calculated Size	Flow m ³ /s	Capacity m ³ /s	Velocity m/s	Flow Depth %
650	660	1 MP SW CH	TYPE CC-N2A	2.4267	6.0036	1.226	65.000
660	670	1 1000 Concrete	750	1.3365	1.3365	3.636	100.000
670	680	1 Box Culvert	1200 x 600	2.3569	2.6997	3.654	89.000
680	690	1 1000 Concrete	750	1.3320	1.3320	3.609	100.000
690	700	1 1000 Concrete	750	1.3250	1.3250	3.599	100.000
70	80	1 1000 Concrete	1050	2.2968	6.6082	7.855	40.000
700	525	1 1000 Concrete	825	2.7103	2.7103	6.309	100.000
710	530	1 1000 Concrete	375	0.0914	0.2442	2.101	41.000
720	730	1 MP SW CH	Overland Ch	0.3883	0.4320	0.586	91.000
730	760	1 MP SW CH	Overland Ch	0.9786	1.2182	1.658	91.000
740	750	1 1000 Concrete	825	0.2425	0.6962	1.290	40.000
750	770	1 1000 Concrete	1050	1.2653	1.2653	1.879	100.000
760	750	1 1000 Concrete	750	0.9874	0.9874	2.679	100.000
770	780	1 1000 Concrete	1200	1.4170	1.8579	2.063	66.000
780	790	1 1000 Concrete	1200	1.4637	1.7780	1.995	69.000
790	630	1 MP SW CH	TYPE ED-1	1.4854	1.9679	1.221	87.000
80	110	1 1000 Concrete	1050	2.4644	5.9506	7.400	44.000
800	810	1 1000 Concrete	375	0.1187	0.3152	2.693	40.000
810	690	1 1000 Concrete	600	0.2451	1.1319	3.345	31.000
820	830	1 1000 Concrete	300	0.1156	0.2074	3.036	52.000
830	840	1 1000 Concrete	450	0.2137	0.3418	2.256	53.000
840	850	1 1000 Concrete	450	0.2805	0.2805	2.050	100.000
850	700	1 1000 Concrete	525	0.3708	0.8241	3.827	45.000
860	870	1 Box Culvert	1500 x 1200	8.2720	8.2720	4.565	100.000
870	880	1 Box Culvert	1500 x 1200	8.0164	8.0164	4.426	100.000
880	890	1 Box Culvert	1500 x 1200	9.4521	9.4521	5.229	100.000
890	900	2 Portal Culvert	2 x 1500 x 1200	11.5965	14.9525	4.451	74.000
90	95	1 1000 Concrete	450	0.1010	0.6351	2.920	25.000
900	910	1 Box Culvert	1800 x 1500	9.4874	9.4874	3.497	100.000
910	920	2 Portal Culvert	2 x 1500 x 1200	12.0707	33.2991	9.911	33.000
920	930	1 MP SW CH	TYPE GBC -1	12.0732	24.1417	1.653	69.000
930	940	1 MP SW CH	TYPE GBC -1	12.5074	24.6440	1.691	69.000
940	1000	1 Reservoir	George Ker Pond	12.5074	4.3740	0.000	0.000
95	130	1 1000 Concrete	450	0.0927	0.5661	2.650	26.000
OUT		1 MP SW CH	Overland wide	0.0681	1.2213	0.000	0.000

Vredenburg Masterplan 20 yr RI (Proposed)

Illudas Overflow Analysis

Link Name	Next Link Name	Overflow Node	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Storage m ³	Inflow Storage m ³
10	20	20	0.6803	0.6040	0.6040	0.0763	0.0	0.0
100	110	110	0.5283	0.5283	1.0555	0.0000	0.0	0.0
1000	1010		0.0677	0.0677	27.9730	0.0000	0.0	0.0
1010	OUT		0.0678	0.0678	1.7272	0.0000	0.0	0.0
110	180	180	4.5160	4.5160	6.7117	0.0000	0.0	0.0
120	100	100	0.0488	0.0488	0.5118	0.0000	0.0	0.0
130	100	100	0.3169	0.3169	1.2940	0.0000	0.0	0.0
140	290	290	0.0468	0.0468	1.7116	0.0000	0.0	0.0
150	130	130	0.1719	0.1719	0.6412	0.0000	0.0	0.0
160	170	170	1.4906	1.4906	3.5312	0.0000	0.0	0.0
170	110	110	1.4799	1.4799	3.8611	0.0000	0.0	0.0
180	190	190	4.4334	4.4334	9.5210	0.0000	0.0	0.0
190	200	200	4.4121	4.4121	7.7205	0.0000	0.0	0.0
20	30	30	1.4049	1.4049	1.4886	0.0000	0.0	0.0
200	210	210	4.3626	4.3626	5.2450	0.0000	0.0	0.0
210	250	250	4.7073	4.7073	9.3089	0.0000	0.0	0.0
220	230	230	0.2315	0.2315	0.4788	0.0000	0.0	0.0
230	240	240	0.2205	0.2205	0.4396	0.0000	0.0	0.0
240	210	210	0.2083	0.2083	1.6384	0.0000	0.0	0.0
250	260	260	4.7464	4.6758	4.6758	0.0706	0.0	0.0
260	280	280	4.9921	4.9921	7.2791	0.0000	0.0	0.0
270	260	260	0.1108	0.1108	3.7924	0.0000	0.0	0.0
280	470	470	6.4612	5.8551	5.8551	0.6061	0.0	0.0
290	300	300	0.2156	0.2156	0.2609	0.0000	0.0	0.0
30	50	50	1.5714	1.4413	1.4413	0.1302	0.0	0.0
300	310	310	0.2900	0.2900	0.2900	0.0001	0.0	0.0
310	320	320	0.2900	0.2900	0.4980	0.0000	0.0	0.0
320	330	330	0.2873	0.2873	0.4479	0.0000	0.0	0.0
330	340	340	0.2719	0.2719	0.7935	0.0000	0.0	0.0
340	350	350	0.6205	0.6205	2.2531	0.0000	0.0	0.0
350	360	360	1.0356	1.0356	2.0571	0.0000	0.0	0.0
360	370	370	1.2157	1.2157	2.5705	0.0000	0.0	0.0
370	380	380	1.1993	1.1993	4.2374	0.0000	0.0	0.0
380	390	390	1.2331	1.2331	2.7224	0.0000	0.0	0.0
390	400	400	1.3312	1.3312	2.7112	0.0000	0.0	0.0
40	50	50	0.0723	0.0723	0.2661	0.0000	0.0	0.0
400	280	280	1.3578	1.3578	22.9324	0.0000	0.0	0.0
410	420	420	0.0791	0.0791	0.7487	0.0000	0.0	0.0
420	340	340	0.0744	0.0744	1.1145	0.0000	0.0	0.0
430	440	440	0.0468	0.0468	0.3922	0.0000	0.0	0.0
440	450	450	0.2748	0.2748	0.4236	0.0000	0.0	0.0
450	460	460	0.3604	0.3604	0.5896	0.0000	0.0	0.0

Vredenburg Masterplan 20 yr RI (Proposed)

Link Name	Next Link Name	Overflow Node	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Storage m ³	Inflow Storage m ³
460	350	350	0.3485	0.3485	0.9149	0.0000	0.0	0.0
470	480	480	6.5868	6.5868	12.8831	0.0000	0.0	0.0
480	515	515	7.0082	5.3538	5.3538	1.6543	0.0	0.0
490	500	500	0.3723	0.3723	0.8673	0.0000	0.0	0.0
50	60	60	1.6375	1.3509	1.3509	0.2865	0.0	0.0
500	510	510	0.3959	0.3959	0.9609	0.0000	0.0	0.0
510	480	480	0.3915	0.3915	0.9409	0.0000	0.0	0.0
515	520	520	7.0769	5.1265	5.1265	1.9504	0.0	0.0
520	525	525	7.5167	5.2910	5.2910	2.2257	0.0	0.0
525	530	530	10.5653	5.7752	5.7752	4.7901	0.0	0.0
530	860	860	10.9478	10.9479	53.1356	0.0000	0.0	0.0
540	545	545	0.1032	0.1032	1.7218	0.0000	0.0	0.0
545	550	550	0.4570	0.4570	0.5276	0.0000	0.0	0.0
550	570	570	1.1831	1.1831	3.5556	0.0000	0.0	0.0
560	550	550	0.1487	0.1487	4.9100	0.0000	0.0	0.0
570	580	580	1.1642	1.1642	2.6948	0.0000	0.0	0.0
580	590	590	1.1520	1.1520	3.5843	0.0000	0.0	0.0
590	600	600	1.5873	1.5915	1.6330	0.0000	0.0	0.0
60	70	70	2.3223	2.3223	2.9700	0.0000	0.0	0.0
600	610	610	0.7827	0.7827	0.8249	0.0000	0.0	0.0
610	620	620	0.7844	0.7844	1.3096	0.0000	0.0	0.0
620	630	630	0.7852	0.3093	0.3093	0.4759	0.0	0.0
630	640	640	2.2733	2.2733	7.1600	0.0000	0.0	0.0
640	650	650	2.3940	2.3940	9.6576	0.0000	0.0	0.0
650	660	660	2.4267	2.4267	6.0036	0.0000	0.0	0.0
660	670	670	2.3569	1.3365	1.3365	1.0204	0.0	0.0
670	680	680	2.3569	2.3569	2.6997	0.0000	0.0	0.0
680	690	690	2.3538	1.3320	1.3320	1.0217	0.0	0.0
690	700	700	2.6197	1.3250	1.3250	1.2948	0.0	0.0
70	80	80	2.2968	2.2968	6.6082	0.0000	0.0	0.0
700	525	525	3.0486	2.7103	2.7103	0.3383	0.0	0.0
710	530	530	0.0914	0.0914	0.2442	0.0000	0.0	0.0
720	730	730	0.3883	0.3883	0.4320	0.0000	0.0	0.0
730	760	760	0.9786	0.9786	1.2182	0.0000	0.0	0.0
740	750	750	0.2425	0.2425	0.6962	0.0000	0.0	0.0
750	770	770	1.2716	1.2653	1.2653	0.0063	0.0	0.0
760	750	750	1.0888	0.9874	0.9874	0.1014	0.0	0.0
770	780	780	1.4170	1.4170	1.8579	0.0000	0.0	0.0
780	790	790	1.4637	1.4637	1.7780	0.0000	0.0	0.0
790	630	630	1.4854	1.4854	1.9679	0.0000	0.0	0.0
80	110	110	2.4644	2.4644	5.9506	0.0000	0.0	0.0
800	810	810	0.1187	0.1187	0.3152	0.0000	0.0	0.0
810	690	690	0.2451	0.2451	1.1319	0.0000	0.0	0.0
820	830	830	0.1156	0.1156	0.2074	0.0000	0.0	0.0

Vredenburg Masterplan 20 yr RI (Proposed)

Link Name	Next Link Name	Overflow Node	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Storage m ³	Inflow Storage m ³
830	840	840	0.2137	0.2137	0.3418	0.0000	0.0	0.0
840	850	850	0.3068	0.2805	0.2805	0.0262	0.0	0.0
850	700	700	0.3708	0.3708	0.8241	0.0000	0.0	0.0
860	870	870	10.9588	8.2720	8.2720	2.6868	0.0	0.0
870	880	880	11.4106	8.0164	8.0164	3.3942	0.0	0.0
880	890	890	11.5965	9.4521	9.4521	2.1444	0.0	0.0
890	900	900	11.5965	11.5965	14.9525	0.0000	0.0	0.0
900	95	95	0.1010	0.1010	0.6351	0.0000	0.0	0.0
910	910	910	12.0581	9.4874	9.4874	2.5707	0.0	0.0
920	920	920	12.0707	12.0707	33.2991	0.0000	0.0	0.0
930	930	930	12.0732	12.0732	24.1417	0.0000	0.0	0.0
940	940	940	12.5074	12.5074	24.6440	0.0000	0.0	0.0
940	1000		12.5208	12.5074	4.3740	0.0000	0.0	0.0
95	130	130	0.0927	0.0927	0.5661	0.0000	0.0	0.0
OUT			0.0681	0.0681	1.2213	0.0000	0.0	0.0

Vredenburgh Masterplan 50 yr. RI (Proposed)

Results Summary

File Name: R:\VR032\StormwaterMaster Plan\STORMWATER MP Proposed 50 year.stw

Inflow Calculation Method = Illudax
Number of Nodes analyzed = 101

Subnetwork 1

Outfall Data
Outfall Node = OUT
Outlet Level = 41.232 m
Design Flow = 1.221 m3/s

Storm Data

File Name: R:\VR032\StormwaterMaster Plan\Vredenburgh 50 year - MAP 275 - 1050min Coast.stm
Chicago Storm Coastal Region
Vredenburgh 50 yr - MAP 275 - 1050min
Mean Annual Precipitation = 275 mm
Return Period = 50 years
Duration = 1050 min
Time Step = 20 min
Ratio of Peak to Duration = 0.60
Factors:
A = 678 B = 12.0 C = 0.750
Total Depth = 60.7 mm

Antecedent Moisture Condition = Rather Wet (3)
Routing Method = Continuity

Accuracy Check
Volume of Inflow = 130648.8 m3
Volume at outfall = 127957.3 m3
Percentage Error = 2.06 %

Vredenburgh Masterplan 50 yr RI (Proposed)

Illudas Runoff Analysis

Node Name	Next Node Name	Runoff m ³ /s	Surface Inflow m ³ /s	Paved Area Volume m ³	Grass Area Volume m ³	Total Volume m ³
10	20	0.9185	0.9185	3526.255	786.989	4313.2
100	110	0.2868	0.2868	971.645	132.189	1103.8
1000	1010	0.0000	0.0000	0.000	0.000	0.0
1010	OUT	0.0000	0.0000	0.000	0.000	0.0
110	180	0.2253	0.2253	863.043	194.999	1058.0
120	100	0.1341	0.1341	280.983	160.942	441.9
130	100	0.1275	0.1275	357.250	101.435	458.7
140	290	0.1283	0.1283	268.941	154.044	423.0
150	130	0.2712	0.2712	852.104	184.368	1036.5
160	170	2.0043	2.0043	8454.549	1886.884	10341.4
170	110	0.0000	0.0000	0.000	0.000	0.0
180	190	0.0000	0.0000	0.000	0.000	0.0
190	200	0.0000	0.0000	0.000	0.000	0.0
20	30	0.9784	0.9784	3756.053	838.275	4594.3
200	210	0.0000	0.0000	0.000	0.000	0.0
210	250	0.2881	0.2881	1102.923	249.539	1352.5
220	230	0.3126	0.3126	1199.929	267.800	1467.7
230	240	0.0000	0.0000	0.000	0.000	0.0
240	210	0.0000	0.0000	0.000	0.000	0.0
250	260	0.2565	0.2565	822.034	233.403	1055.4
260	280	0.2487	0.2487	977.543	125.331	1102.9
270	260	0.2235	0.2235	716.295	203.380	919.7
280	470	0.0768	0.0768	371.170	0.000	371.2
290	300	0.2538	0.2538	824.707	208.799	1033.5
30	50	0.2472	0.2472	838.020	187.029	1025.0
300	310	0.2188	0.2188	491.826	243.638	735.5
310	320	0.0000	0.0000	0.000	0.000	0.0
320	330	0.0000	0.0000	0.000	0.000	0.0
330	340	0.0000	0.0000	0.000	0.000	0.0
340	350	0.5697	0.5697	1825.756	518.394	2344.2
350	360	0.2741	0.2741	878.230	249.359	1127.6
360	370	0.4014	0.4014	1286.395	365.251	1651.6
370	380	0.0000	0.0000	0.000	0.000	0.0
380	390	0.3220	0.3220	188.613	763.962	952.6
390	400	0.3709	0.3709	384.826	786.502	1171.3
40	50	0.1983	0.1983	415.665	238.085	653.8
400	280	0.0000	0.0000	0.000	0.000	0.0
410	420	0.1596	0.1596	511.368	145.195	656.6
420	340	0.0000	0.0000	0.000	0.000	0.0
430	440	0.0960	0.0960	269.047	76.391	345.4
440	450	0.4752	0.4752	1522.801	432.375	1955.2
450	460	0.3629	0.3629	699.641	589.128	1288.8

Vredenburg Masterplan 50 yr RI (Proposed)

Node Name	Next Node Name	Runoff m ³ /s	Surface Inflow m ³ /s	Paved Area Volume m ³	Grass Area Volume m ³	Total Volume m ³
460	350	0.0000	0.0000	0.000	0.000	0.0
470	480	0.4445	0.4445	1138.721	564.092	1702.8
480	515	0.1210	0.1210	165.080	195.793	360.9
490	500	0.7358	0.7358	2623.917	745.018	3368.9
50	60	0.0000	0.0000	0.000	0.000	0.0
500	510	0.0515	0.0515	249.117	0.000	249.1
510	480	0.0000	0.0000	0.000	0.000	0.0
515	520	0.1945	0.1945	623.339	176.987	800.3
520	525	1.2230	1.2230	3485.035	1726.394	5211.4
525	530	0.0000	0.0000	0.000	0.000	0.0
530	860	0.6951	0.6951	2478.566	703.749	3182.3
540	545	0.2968	0.2968	667.364	428.592	1096.0
545	550	0.5764	0.5764	2060.894	445.911	2506.8
550	570	0.9637	0.9637	3445.367	745.471	4190.9
560	550	0.5727	0.5727	1048.405	1133.648	2182.1
570	580	0.0000	0.0000	0.000	0.000	0.0
580	590	0.0000	0.0000	0.000	0.000	0.0
590	600	0.7656	0.7656	2784.596	511.733	3296.3
60	70	0.9246	0.9246	3549.670	792.214	4341.9
600	610	0.0000	0.0000	0.000	0.000	0.0
610	620	0.0000	0.0000	0.000	0.000	0.0
620	630	0.0000	0.0000	0.000	0.000	0.0
630	640	0.0627	0.0627	303.107	0.000	303.1
640	650	0.3724	0.3724	1000.882	559.338	1560.2
650	660	0.4811	0.4811	1292.968	722.568	2015.5
660	670	0.1968	0.1968	528.962	295.608	824.6
670	680	0.0000	0.0000	0.000	0.000	0.0
680	690	0.0000	0.0000	0.000	0.000	0.0
690	700	0.1812	0.1812	615.909	145.074	761.0
70	80	0.0000	0.0000	0.000	0.000	0.0
700	525	0.1957	0.1957	665.275	156.702	822.0
710	530	0.1844	0.1844	590.804	167.749	758.6
720	730	0.7342	0.7342	1567.061	1234.432	2801.5
730	760	1.5032	1.5032	4574.777	1959.775	6534.6
740	750	0.5305	0.5305	1567.942	556.634	2124.6
750	770	0.0000	0.0000	0.000	0.000	0.0
760	750	0.2764	0.2764	691.073	360.142	1051.2
770	780	0.5459	0.5459	1319.047	737.143	2056.2
780	790	0.0000	0.0000	0.000	0.000	0.0
790	830	0.0000	0.0000	0.000	0.000	0.0
80	110	0.3769	0.3769	1229.917	330.571	1560.5
800	810	0.2257	0.2257	767.457	180.770	948.2
810	690	0.2550	0.2550	866.822	204.175	1071.0
820	830	0.2198	0.2198	747.387	176.043	923.4

Vredenburg Masterplan 50 yr RI (Proposed)

Node Name	Next Node Name	Runoff m ³ /s	Surface Inflow m ³ /s	Paved Area Volume m ³	Grass Area Volume m ³	Total Volume m ³
830	840	0.1922	0.1922	653.374	153.899	807.3
840	850	0.2221	0.2221	755.274	177.901	933.2
850	700	0.1528	0.1528	519.361	122.333	641.7
860	870	0.0000	0.0000	0.000	0.000	0.0
870	880	2.1938	2.1938	2679.409	5087.970	7767.4
880	890	0.3895	0.3895	1473.576	347.093	1820.7
890	900	0.0000	0.0000	0.000	0.000	0.0
90	95	0.2771	0.2771	580.789	332.653	913.4
900	910	1.2512	1.2512	4811.183	3211.997	8023.2
910	920	0.0566	0.0566	145.832	52.312	198.1
920	930	0.0000	0.0000	0.000	0.000	0.0
930	940	0.9289	0.9289	3572.006	2384.709	5956.7
940	1000	0.0000	0.0000	0.000	0.000	0.0
95	130	0.0000	0.0000	0.000	0.000	0.0
OUT		0.0000	0.0000	0.000	0.000	0.0

Flow Analysis

Link Name	Next Link Name	Number of Links	Link Type	Calculated Size	Flow m ³ /s	Capacity m ³ /s	Velocity m/s	Flow Depth %
10	20	1	1000D Concrete	675	0.6040	0.6040	2.008	100.000
100	110	1	1000D Concrete	525	1.0555	1.0555	5.769	100.000
1000	1010	1	WEIR 1	5000 x 800	3.1927	27.9730	6.227	22.000
1010	OUT	1	1MP SW CH	Overland wide	1.2213	1.2213	0.752	100.000
110	180	1	1000D Concrete	1350	6.7117	6.7117	6.085	100.000
120	100	1	1000D Concrete	375	0.1341	0.5118	4.058	35.000
130	100	1	150D Concrete	525	0.6811	1.2940	5.853	51.000
140	290	1	1MP SW CH	Overland Ch	0.1283	1.7116	1.189	27.000
150	130	1	150D Concrete	450	0.2712	0.6412	3.939	45.000
160	170	1	150D Concrete	825	2.0043	3.5312	6.725	53.000
170	110	1	1MP SW CH	TYPE CC-1	1.9936	3.8611	5.779	72.000
180	190	1	1000D Concrete	1350	6.8928	9.5210	8.289	62.000
190	200	1	1000D Concrete	1350	6.8759	7.7205	6.967	73.000
20	30	1	1000D Concrete	675	1.4886	1.4886	4.949	100.000
200	210	1	1000D Concrete	1350	5.2450	5.2450	4.755	100.000
210	250	1	1000D Concrete	1350	7.4003	9.3089	8.241	66.000
220	230	1	1000D Concrete	450	0.3126	0.4788	3.255	57.000
230	240	1	1000D Concrete	600	0.3020	0.4396	1.737	58.000
240	210	1	1000D Concrete	600	0.2825	1.6384	4.563	27.000
250	260	1	1000D Concrete	1350	4.6758	4.6758	4.239	100.000
260	280	1	1000D Concrete	1350	7.2791	7.2791	6.600	100.000
270	260	1	1000D Concrete	1050	0.2235	3.7924	2.726	16.000

Vredenburg Masterplan 50 yr RI (Proposed)

Link Name	Next Link Name	Number Link Type of Links	Calculated Size	Flow m ³ /s	Capacity m ³ /s	Velocity m/s	Flow Depth %
280	470	1 100D Concrete	1350	5.8551	5.8551	5.309	100.000
290	300	1 100D Concrete	300	0.2609	0.2609	4.242	100.000
30	50	1 100D Concrete	675	1.4413	1.4413	4.792	100.000
300	310	1 100D Concrete	375	0.2900	0.2900	3.075	100.000
310	320	1 100D Concrete	450	0.4980	0.4980	3.632	100.000
320	330	1 100D Concrete	525	0.4479	0.4479	2.448	100.000
330	340	1 100D Concrete	750	0.6045	0.7935	2.085	65.000
340	350	1 100D Concrete	825	1.3310	2.2531	4.799	54.000
350	360	1 100D Concrete	1050	2.0571	2.0571	3.055	100.000
360	370	1 100D Concrete	1200	2.5705	2.5705	2.922	100.000
370	380	1 100D Concrete	1350	2.9246	4.2374	3.650	60.000
380	390	1 MP SW CH	TYPE CC-2	2.7224	2.7224	2.953	100.000
390	400	1 MP SW CH	TYPE CC-2	2.7112	2.7112	3.033	100.000
40	50	1 50D Concrete	375	0.1983	0.2661	2.738	65.000
400	280	2 Box Culvert	2 x 2100 x 900	3.6038	22.9324	3.819	24.000
410	420	1 100D Concrete	525	0.1596	0.7487	2.874	31.000
420	430	1 100D Concrete	600	0.1597	1.1145	2.945	25.000
430	440	1 100D Concrete	450	0.0960	0.3922	2.072	33.000
440	450	1 100D Concrete	525	0.4236	0.4236	2.315	100.000
450	460	1 100D Concrete	600	0.5896	0.5896	2.477	100.000
460	470	1 100D Concrete	600	0.9149	0.9149	3.860	100.000
470	480	1 Portal Culvert	2100 x 1200	12.1742	12.8831	5.446	93.000
480	515	1 100D Concrete	1350	5.3538	5.3538	4.878	100.000
490	500	1 100D Concrete	825	0.7358	0.8673	1.995	70.000
50	60	1 100D Concrete	750	1.3509	1.3509	3.661	100.000
500	510	1 MP SW CH	TYPE CC-1	0.7874	0.9609	1.603	91.000
510	480	1 100D Concrete	825	0.7868	0.9409	1.603	91.000
515	520	1 100D Concrete	1350	5.1265	5.1265	4.648	100.000
520	525	1 100D Concrete	1350	5.2910	5.2910	4.819	100.000
525	530	1 100D Concrete	1350	5.7752	5.7752	5.236	100.000
530	545	2 Box Culvert	2 x 2100 x 900	21.6501	53.1356	11.565	49.000
540	545	1 MP SW CH	Overland Ch	0.2968	1.7218	1.530	42.000
545	550	1 100D Concrete	525	0.5276	0.5276	2.814	100.000
550	570	1 100D Concrete	1050	2.4372	3.5556	5.014	60.000
560	550	1 100D Concrete	900	0.5727	4.9100	5.615	23.000
570	580	1 100D Concrete	1050	2.4337	2.6948	3.994	74.000
580	590	1 100D Concrete	1200	2.4299	3.5843	3.860	60.000
590	600	1 Reservoir	Ruiflirst Pond	3.1955	1.6330	0.000	0.000
60	70	1 100D Concrete	825	2.9700	2.9700	6.907	100.000
600	610	1 100D Concrete	600	0.8249	0.8249	3.480	100.000
610	620	1 100D Concrete	1050	0.8249	1.3096	1.814	57.000
620	630	1 100D Concrete	600	0.3093	0.3093	1.305	100.000
630	640	1 MP SW CH	TYPE CC-N1A	4.4782	7.1600	2.060	81.000
640	650	1 MP SW CH	TYPE CC-N1A	4.7826	9.6576	2.569	71.000

Vredenburg Masterplan 50 yr RI (Proposed)

Link Name	Next Link Name	Number of Links	Link Type	Calculated Size	Flow m ³ /s	Capacity m ³ /s	Velocity m/s	Flow Depth %
650	660	1	MP SW CH	TYPE CC-N2A	4.8356	6.0036	1.452	88.000
660	670	1	100D Concrete	750	1.3365	1.3365	3.637	100.000
670	680	1	Box Culvert	1200 x 600	2.6997	2.6997	3.750	100.000
680	690	1	100D Concrete	750	1.3320	1.3320	3.611	100.000
690	700	1	100D Concrete	750	1.3250	1.3250	3.597	100.000
70	80	1	100D Concrete	1050	3.2712	6.6082	8.621	49.000
700	525	1	100D Concrete	825	2.7103	6.303	100.000	
710	530	1	100D Concrete	375	0.1844	0.2442	2.510	64.000
720	730	1	MP SW CH	Overland Ch	0.4202	0.4202	0.560	100.000
730	760	1	MP SW CH	Overland Ch	1.2182	1.2182	1.729	100.000
740	750	1	100D Concrete	825	0.5305	0.6962	1.572	65.000
750	770	1	100D Concrete	1050	1.2653	1.2653	1.887	100.000
760	750	1	100D Concrete	750	0.9874	0.9874	2.687	100.000
770	780	1	100D Concrete	1200	1.8579	1.8579	2.114	100.000
780	790	1	100D Concrete	1200	1.7780	1.7780	2.028	100.000
790	630	1	MP SW CH	TYPE ED-1	1.9679	1.9679	1.270	100.000
80	110	1	100D Concrete	1050	3.6276	5.9506	8.161	56.000
800	810	1	100D Concrete	375	0.2257	0.3152	3.199	62.800
810	690	1	100D Concrete	600	0.4789	1.1319	4.034	45.000
820	830	1	100D Concrete	300	0.2074	0.2074	3.373	100.000
830	840	1	100D Concrete	450	0.3418	0.3418	2.492	100.000
840	850	1	100D Concrete	450	0.2805	0.2805	2.052	100.000
850	700	1	100D Concrete	525	0.7869	0.8241	4.513	77.000
860	870	1	Box Culvert	1500 x 1200	8.2720	8.2720	4.596	100.000
870	880	1	Box Culvert	1500 x 1200	8.0164	8.0164	4.454	100.000
880	890	1	Box Culvert	1500 x 1200	9.4521	9.4521	5.251	100.000
890	900	2	Portal Culvert	2 x 1500 x 1200	14.9525	14.9525	4.451	100.000
90	95	1	100D Concrete	450	0.2771	0.6351	3.969	46.000
900	910	1	Box Culvert	1800 x 1500	9.4874	9.4874	3.514	100.000
910	920	2	Portal Culvert	2 x 1500 x 1200	25.5271	33.2991	9.911	73.000
920	930	1	MP SW CH	TYPE GBC-1	24.1417	24.1417	1.998	98.000
930	940	1	MP SW CH	TYPE GBC-1	24.6440	24.6440	2.052	99.000
940	1000	1	Reservoir	George Ker Pond	25.8621	4.3740	0.000	0.000
95	130	1	100D Concrete	450	0.2834	0.5661	3.648	50.000
OUT		1	MP SW CH	Overland wide	1.2213	1.2213	0.000	0.000

Vredenburg Masterplan 50 yr R1 (Proposed)

Illudas Overflow Analysis

Link Name	Next Link Name	Overflow Node	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Storage m ³	Inflow Storage m ³
10	20	20	0.9185	0.6040	0.6040	0.3145	0.0	0.0
100	110	110	1.1050	1.0555	1.0555	0.0495	0.0	0.0
1000	1010		3.1927	3.1927	27.9730	0.0000	0.0	0.0
1010	OUT		3.1940	1.2213	1.2213	1.9727	18125.4	0.0
110	180	180	6.8928	6.7117	6.7117	0.1811	0.0	0.0
120	100	100	0.1341	0.1341	0.5118	0.0000	0.0	0.0
130	100	100	0.6811	0.6811	1.2940	0.0000	0.0	0.0
140	290	290	0.1283	0.1283	1.7116	0.0000	0.0	0.0
150	130	130	0.2712	0.2712	0.6412	0.0000	0.0	0.0
160	170	170	2.0043	2.0043	3.5312	0.0000	0.0	0.0
170	110	110	1.9936	1.9936	3.8611	0.0000	0.0	0.0
180	190	190	6.8928	6.8928	9.5210	0.0000	0.0	0.0
190	200	200	6.8759	6.8759	7.7205	0.0000	0.0	0.0
20	30	30	1.8969	1.4886	1.4886	0.4083	0.0	0.0
200	210	210	6.8324	5.2450	5.2450	1.5875	0.0	0.0
210	250	250	7.4003	7.4003	9.3089	0.0000	0.0	0.0
220	230	230	0.3126	0.3126	0.4788	0.0000	0.0	0.0
230	240	240	0.3020	0.3020	0.4396	0.0000	0.0	0.0
240	210	210	0.2825	0.2825	1.6384	0.0000	0.0	0.0
250	260	260	7.5814	4.6758	4.6758	2.9057	0.0	0.0
260	280	280	8.0499	7.2791	7.2791	0.7708	0.0	0.0
270	260	260	0.2235	0.2235	3.7924	0.0000	0.0	0.0
280	470	470	11.7297	5.8551	5.8551	5.8746	0.0	0.0
290	300	300	0.3857	0.2609	0.2609	0.1248	0.0	0.0
30	50	50	2.1441	1.4413	1.4413	0.7028	0.0	0.0
300	310	310	0.6045	0.2900	0.2900	0.3145	0.0	0.0
310	320	320	0.6045	0.4980	0.4980	0.1065	0.0	0.0
320	330	330	0.6045	0.4479	0.4479	0.1566	0.0	0.0
330	340	340	0.6045	0.6045	0.7935	0.0000	0.0	0.0
340	350	350	1.3310	1.3310	2.2531	0.0000	0.0	0.0
350	360	360	2.5231	2.0571	2.0571	0.4660	0.0	0.0
360	370	370	2.9246	2.5705	2.5705	0.3541	0.0	0.0
370	380	380	2.9246	2.9246	4.2374	0.0000	0.0	0.0
380	390	390	3.2329	2.7224	2.7224	0.5105	0.0	0.0
390	400	400	3.6038	2.7112	2.7112	0.8927	0.0	0.0
40	50	50	0.1983	0.1983	0.2661	0.0000	0.0	0.0
400	280	280	3.6038	3.6038	22.9324	0.0000	0.0	0.0
410	420	420	0.1596	0.1596	0.7487	0.0000	0.0	0.0
420	340	340	0.1597	0.1597	1.1145	0.0000	0.0	0.0
430	440	440	0.0960	0.0960	0.3922	0.0000	0.0	0.0
440	450	450	0.5687	0.4236	0.4236	0.1451	0.0	0.0
450	460	460	0.9316	0.5896	0.5896	0.3421	0.0	0.0

Vredenburg Masterplan 50 yr RI (Proposed)

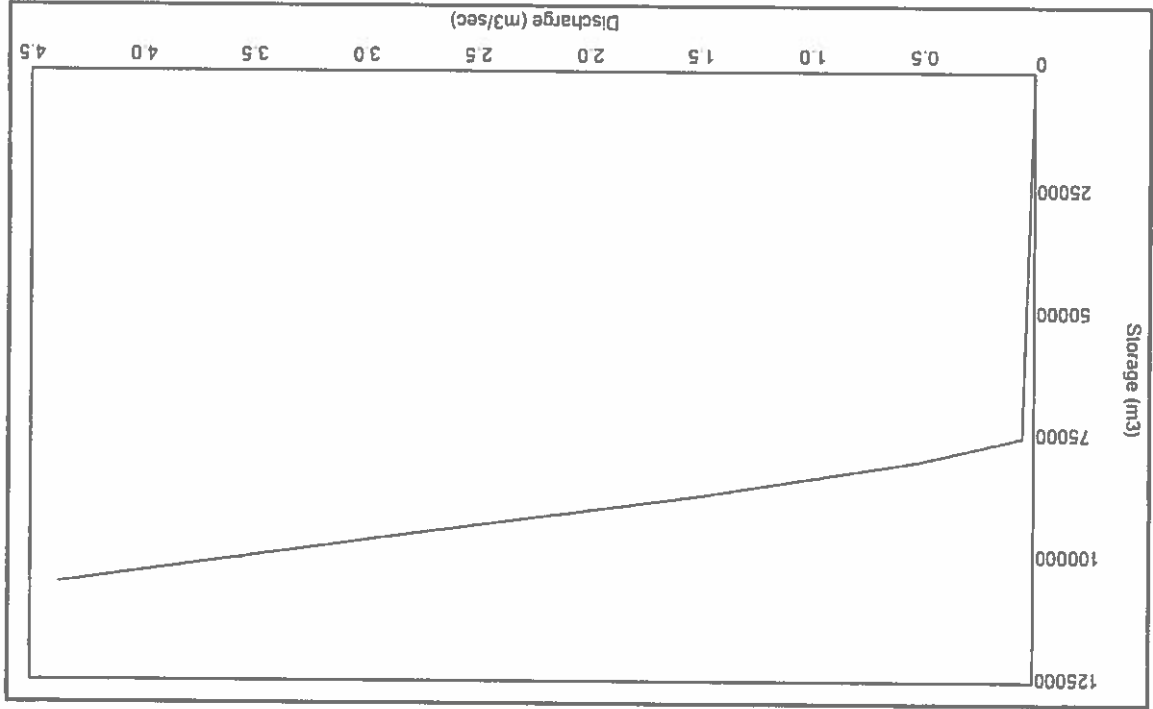
Link Name	Next Link Name	Overflow Node	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Storage m ³	Inflow Storage m ³
460	350	350	0.9316	0.9149	0.9149	0.0168	0.0	0.0
470	480	480	12.1742	12.1742	12.8631	0.0000	0.0	0.0
480	515	515	13.0535	5.3538	5.3538	7.6997	0.0	0.0
490	500	500	0.7358	0.7358	0.8673	0.0000	0.0	0.0
50	60	60	2.3466	1.3509	1.3509	0.9957	0.0	0.0
500	510	510	0.7874	0.7874	0.9609	0.0000	0.0	0.0
510	480	480	0.7868	0.7868	0.9409	0.0000	0.0	0.0
515	520	520	13.2481	5.1265	5.1265	8.1215	0.0	0.0
520	525	525	14.4710	5.2910	5.2910	9.1800	0.0	0.0
525	530	530	20.7705	5.7752	5.7752	14.9953	0.0	0.0
530	860	860	21.6501	21.6501	53.1356	0.0000	0.0	0.0
540	545	545	0.2968	0.2968	1.7218	0.0000	0.0	0.0
545	550	550	0.8807	0.5276	0.5276	0.3531	0.0	0.0
550	570	570	2.4372	2.4372	3.5556	0.0000	0.0	0.0
550	550	550	0.5727	0.5727	4.9100	0.0000	0.0	0.0
570	580	580	2.4337	2.4337	2.6948	0.0000	0.0	0.0
580	590	590	2.4299	2.4299	3.5843	0.0000	0.0	0.0
590	600	600	3.1944	3.1955	1.6330	0.0000	0.0	0.0
60	70	70	3.2712	2.9700	2.9700	0.3012	0.0	0.0
600	610	610	1.0028	0.8249	0.8249	0.1779	752.6	0.0
610	620	620	0.8249	0.8249	1.3096	0.0000	0.0	0.0
620	630	630	0.8260	0.8260	0.3093	0.5167	0.0	0.0
630	640	640	4.4782	4.4782	7.1600	0.0000	0.0	0.0
640	650	650	4.7826	4.7826	9.6576	0.0000	0.0	0.0
650	660	660	4.8356	4.8356	6.0036	0.0000	0.0	0.0
660	670	670	4.6694	1.3365	1.3365	3.3329	0.0	0.0
670	680	680	4.6694	2.6997	2.6997	1.9697	0.0	0.0
680	690	690	4.6694	1.3320	1.3320	3.3374	0.0	0.0
690	700	700	5.3286	1.3250	1.3250	4.0036	0.0	0.0
70	80	80	3.2712	3.2712	6.6082	0.0000	0.0	0.0
700	525	525	6.2995	2.7103	2.7103	3.5892	0.0	0.0
710	530	530	0.1844	0.1844	0.2442	0.0000	0.0	0.0
720	730	730	0.7342	0.4202	0.4202	0.3141	0.0	0.0
730	760	760	2.2375	1.2182	1.2182	1.0192	0.0	0.0
740	750	750	0.5305	0.5305	0.6962	0.0000	0.0	0.0
750	770	770	0.3460	1.2653	1.2653	1.7807	0.0	0.0
760	750	750	2.5138	0.9874	0.9874	1.5264	0.0	0.0
770	780	780	3.5919	1.8579	1.8579	1.7340	0.0	0.0
780	790	790	3.5919	1.7780	1.7780	1.8138	0.0	0.0
790	630	630	3.5919	1.9679	1.9679	1.6240	0.0	0.0
80	110	110	3.6276	3.6276	5.9506	0.0000	0.0	0.0
800	810	810	0.2257	0.2257	0.3152	0.0000	0.0	0.0
810	690	690	0.4789	0.4789	1.1319	0.0000	0.0	0.0
820	830	830	0.2198	0.2074	0.2074	0.0124	0.0	0.0

Vredenburg Masterplan 50 yr RI (Proposed)

Link Name	Next Link Name	Overflow Node	Inflow m ³ /s	Design Flow m ³ /s	Capacity m ³ /s	Overflow m ³ /s	Storage m ³	Inflow Storage m ³
830	840	840	0.4120	0.3418	0.3418	0.0702	0.0	0.0
840	850	850	0.6341	0.2805	0.2805	0.3536	0.0	0.0
850	700	700	0.7869	0.7869	0.8241	0.0000	0.0	0.0
860	870	870	21.6376	8.2720	8.2720	13.3656	0.0	0.0
870	880	880	23.8314	8.0164	8.0164	15.8150	0.0	0.0
880	890	890	24.2209	9.4521	9.4521	14.7687	0.0	0.0
890	900	900	24.2209	14.9525	14.9525	9.2684	0.0	0.0
90	95	95	0.2771	0.2771	0.6351	0.0000	0.0	0.0
900	910	910	25.4705	9.4674	9.4874	15.9831	0.0	0.0
910	920	920	25.5271	25.5271	33.2991	0.0000	0.0	0.0
920	930	930	25.5169	24.1417	24.1417	1.3752	0.0	0.0
930	940	940	25.8621	24.6440	24.6440	1.2181	0.0	0.0
940	1000		25.7780	25.8621	4.3740	0.0000	0.0	0.0
95	130	130	0.2834	0.2834	0.5661	0.0000	0.0	0.0
OUT			1.2213	1.2213	1.2213	0.0000	0.0	0.0

Reservoir Data

File Name: R:\VR032\Stormwater\College\George Kerridge Pond.rsr



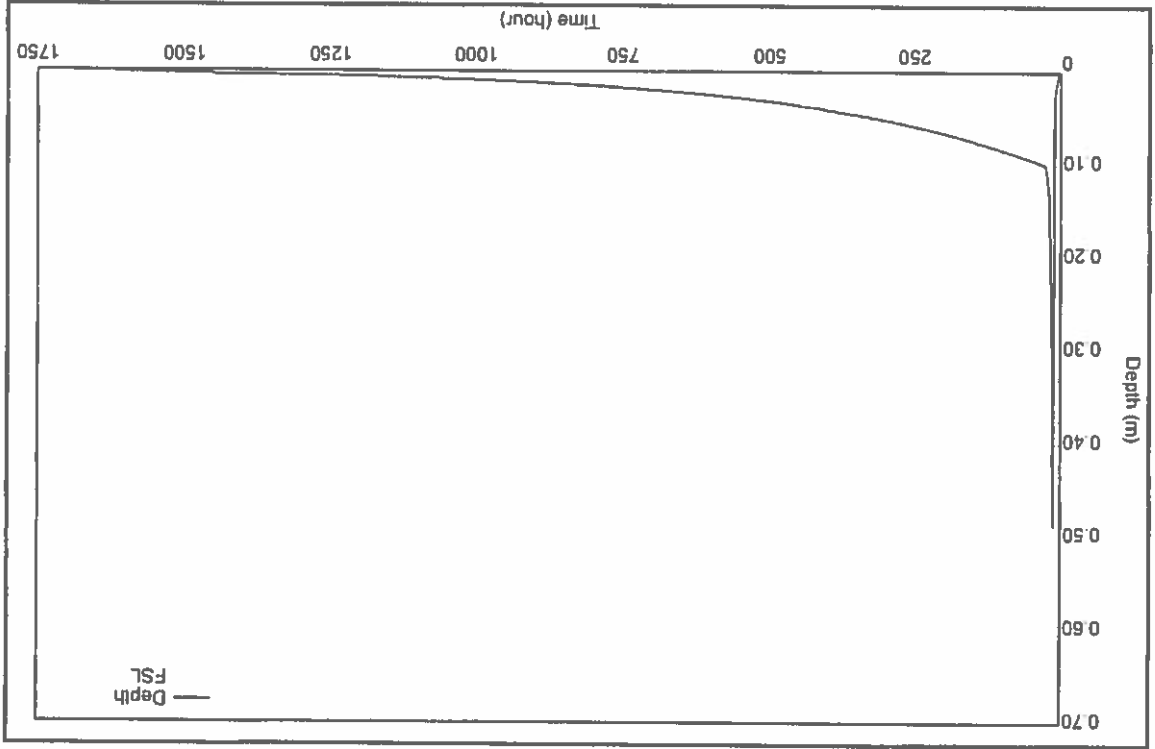
Reservoir Profile

Reservoir Routing Method = Continuity
Initial Water Level = 0.000 m

Depth (m)	Storage (m3)	Culvert Discharge (m3/s)	Weir Discharge (m3/s)	Total Discharge (m3/s)
0.000	0	0.000	0.000	0.000
0.100	75000	0.000	0.050	0.050
0.150	80000	0.000	0.520	0.520
0.300	87000	0.000	1.490	1.490
0.450	95000	0.000	2.790	2.790
0.600	105000	0.000	4.374	4.374

Reservoir Data

File Name: R:\VR032\stormwater\College\George Kerridge Pond.rsr



Summary

Node Name		940
Inflow Data		
Inflow Volume	129465 m3	
Maximum Inflow Rate	25.778 m3/s	
Time to Peak	640 min	
Outflow Data		
Outflow Volume	127963 m3	
Maximum Outflow Rate	3.193 m3/s	
Time to Peak	700 min	
Performance		
Maximum Storage Required	97533 m3	
Maximum Water Depth	0.488 m	
Flow Attenuation	87.61 %	
Lag Time	60 min	

ANNEXURE J

SCHEDULE OF QUANTITIES

CONTRACT NO : VR032
THE UPGRADE OF STORMWATER : SEGMENTS 3 To 5
SALDANHA BAY MUNICIPALITY

SECTION A: PRELIMINARY AND GENERAL

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
SECTION A: PRELIMINARY AND GENERAL											
PRELIMINARY AND GENERAL											
FIXED-CHARGE ITEMS											
A.1	Contractual Requirements	Sum						170227.13	245815.88	286939.80	321655.73
	Establish facilities on the site										
	<u>Facilities for Employee</u>										
A.2	a) Nameboards	No	2				4000	8000	8000	8000	8000
A.3	b) Telephone	Sum									
A.4	<u>Facilities for Contractor</u>	Sum									
A.5	(a) Offices and Storage sheds	Sum									
A.6	(b) Workshops	Sum									
A.7	(c) Laboratories	Sum									
A.8	(d) Living accommodation	Sum									
A.9	(e) Ablution and latrine facilities	Sum									
A.10	(f) Tools and Equipment	Sum									
A.11	(g) Water supplies, Electrical power and Communication facilities	Sum									
A.12	(h) Dealing with water	Sum									
A.13	Other fixed-charge obligations	Sum									
A.14	Removal of site establishment on completion of works	Sum									
TIME-RELATED ITEMS											
Total Carried Forward								178227.125	253815.875	294939.8	329655.725

CONTRACT NO : VR032
THE UPGRADE OF STORMWATER : SEGMENTS 3 To 5
SALDANHA BAY MUNICIPALITY

SECTION A: PRELIMINARY AND GENERAL

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
Brought Forward											
A.15	Contractual Requirements Operate and maintain services on site during construction <u>Facilities for Engineer for duration of Contract (SABS 1200 AB)</u>	Sum						397196.63	573570.38	669526.20	750530.03
A.16	(a) Telephone	Prov Sum	1	1	1	1	8000	8000	8000	8000	8000
A.17	(b) Nameboards	No									
A.18	<u>Facilities for the contractor for the duration of the contract</u>	Sum									
A.19	(a) Offices and Storage sheds	Sum									
A.20	(b) Workshops	Sum									
A.21	(c) Laboratories	Sum									
A.22	(d) Living Accomodation	Sum									
A.23	(e) Ablution and lairne facilities	Sum									
A.24	(f) Tools and equipment	Sum									
A.25	(g) Water supplies, Electrical power and Communication facilities	Sum									
A.26	(h) Dealing with water	Sum									
A.27	i) Access	Sum									
A.28	Supervision	Sum									
A.29	Company and Head Office overhead costs	Sum									
A.30	Other time-related obligations	Sum									
A.31	a) Plant	Sunday									
Total Carried Forward								583423.75	835386.25	972466	1088185.75

CONTRACT NO : VR032

**THE UPGRADING OF STORMWATER : SEGMENTS 3 To 5
SALDANHA BAY MUNICIPALITY**

SECTION A: PRELIMINARY AND GENERAL

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
Brought Forward								583423.75	835386.25	972466	1088185.75
A.32	b) Labour	Sum/day									
A.33	c) Other resources (to be specified by contractor)	Sum/day									
TEMPORARY WORKS											
A.34	Control of water inflow to stormwater system to be constructed for the duration of the project	Sum	0.3	0.7	0.8	1	200000	60000	140000	160000	200000
A.35	Accommodation of traffic and pedestrians plus everything necessary for duration of project	Sum	0.5	1	1	0.1	50000	25000	50000	50000	5000
PROVISIONAL SUMS STATED BY THE ENGINEER											
<u>Materials testing:</u>											
A.36	Provisional amount for materials testing as instructed by the Engineer (Only Engineers check testing paid for under this item)	Prov Sum	0.5	0.5	1	1	5000	2500	2500	5000	5000
A.37	Overheads, charges, attendance and profit for arranging the testing as required by the engineer	%	2500	2500	5000	5000	0.1	250	250	500	500
<u>Existing Services</u>											
A.38	Provisional Sum for cleaning and making repairs to existing services and deviating where required	Prov Sum	0.5	0.8	0.8	0.4	150000	75000	120000	120000	60000
A.39	Provisional Sum for locating existing services by specialist subcontractors	Prov Sum	0.6	1	1	1	25000	15000	25000	25000	25000
A.40	Overheads, charges, attendance and profit on selected subcontractor	%	15000	25000	25000	25000	0.1	1500	2500	2500	2500
Total Carried Forward								762673.75	1175636.25	1335466	1386185.75

CONTRACT NO : VR032

THE UPGRADE OF STORMWATER : SEGMENTS 3 To 5
SALDANHA BAY MUNICIPALITY

SECTION A: PRELIMINARY AND GENERAL

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
Brought Forward								762673.75	1175636.25	1335466	1386185.75
A-41	ANCILLARY ITEMS Cost of additional surveying requirements as instructed by the engineer OCCUPATIONAL HEALTH & SAFETY (PROVISIONAL)	Prov Sum	0.3	0.3	0.3	1	50000	15000	15000	15000	50000
A-42	Cost of health and safety measures in terms of the Construction Regulations (2003) of the Occupational Health and Safety Act	Sum	1	1	1	1	20000	20000	20000	20000	20000
A-43	Compilation and maintenance of a Health and Safety Plan, including Risk Assessments, Safe Works Procedures and Methods Statements	Sum	1	1	1	1	5000	5000	5000	5000	5000
A-44	Compilation and maintenance of the Health and Safety File ENVIRONMENTAL	Sum	1	1	1	1	5000	5000	5000	5000	5000
A-45	Compliance with environmental specifications	Sum	0.3	0.3	0.6	0.8	100000	30000	30000	60000	80000
Total Carried Forward To Summary								837673.75	1250636.25	1440466	1546185.75

CONTRACT NO : YR032
THE UPGRADING OF STORMWATER : SEGMENTS 3 TO 5
SALDANHA BAY MUNICIPALITY

SECTION B : SITE CLEARANCE

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
SECTION B : SITE CLEARANCE											
SITE CLEARANCE											
CLEAR SITE											
Clear and grub site complete and dispose of material including trees up to 2m diameter.											
B.1	a) Unsurfaced areas	ha	1.8	0.6	1	6	30000	54000	18000	30000	180000
B.2	Rehabilitation of existing earth channel	m	0	0	0	100	300	0	0	0	30000
B.3	Remove and dispose of existing structures	m²	500	450	50	20	150	75000	67500	7500	3000
B.4	Strip topsoil and stockpile only on instructions from Engineer	m³					8	0	0	0	0
B.5	Cut and remove existing premix and dispose of off site	m³	0	0	11	0	80	0	0	880	0
B.6	Excavate basecourse and subbase to temporary stockpile for later re-use as subbase	m³	0	0	110	0	70	0	0	7700	0
REINSTATEMENT OF ROAD LAYERWORKS											
Reinstate existing roads where crossed											
B.7	a) Subgrade - 300mm	m²	0	0	350	0	40	0	0	14000	0
B.8	b) G5 subbase - 150mm	m²	0	0	350	0	65	0	0	22750	0
B.9	c) G3 basecourse - 150mm	m²	0	0	350	0	80	0	0	28000	0
B.10	d) Asphalt - 40mm	m²	0	0	350	0	120	0	0	42000	0
B.11	e) Kerbing and channels	m	0	0	100	0	220	0	0	22000	0
Total Carried Forward To Summary								129000	85500	174830	213000

CONTRACT NO : VR032

THE UPGRADE OF STORMWATER : SEGMENTS 3 To 5
SALDANHA BAY MUNICIPALITY

SECTION C : EARTHWORKS

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
SECTION C : EARTHWORKS											
BULK EARTHWORKS											
EXCAVATION											
C.1	Excavate in rubble/rubbish material and remove off site to a dump chosen by the contractor (only if so instructed by Engineer)	m ³	20	50	1500	2000	60	1200	3000	90000	120000
C.2	Stabilisation using straw @ 1 bale per 20 sq metre	ha	0	0	0	4.1	7000	0	0	0	700
C.3	Import material for bulk filling from commercial sources (excluding pond)	m ³	2300	1500	5000	0	90	225000	135000	450000	0
Total Carried Forward To Summary								226200	138000	540000	120700

CONTRACT NO : VR032
THE UPGRADE OF STORMWATER : SEGMENTS 3 TO 5
SALDANHA BAY MUNICIPALITY

SECTION D : STORMWATER DRAINAGE

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
	SECTION D : STORMWATER DRAINAGE										
	EARTHWORKS (PIPE TRENCHES)										
	Excavate in all materials incl hard material for trenches, backfill and compact, incl. dispose surplus/unsuitable material, for pipes:										
	a) Up to 1200 mm diam. for depths:										
	Over and up to										
D.1	1.5 m 2.0 m	m	700	550	350	0	100	70000	55000	35000	0
D.2	2.0 m 2.5 m	m	500	750	550	0	120	60000	90000	66000	0
	Excavate and dispose of unsuitable material from trench bottom (provisional) in the following depth ranges:										
	Over and up to										
D.3	0.0 m 4.0 m	m³	420	350	400	0	25	10500	8750	10000	0
D.4	Excavation and backfilling by hand to expose existing services	m³	200	250	100	0	150	30000	37500	15000	0
	Make up deficiency in backfill material (provisional)										
D.5	a) Sand or suitable granular material from trenches or necessary excavations on site	m³	450	1200	850	0	20	9000	24000	17000	0
Total Carried Forward								179500	215250	143000	0

CONTRACT NO : VR032
THE UPGRADE OF STORMWATER : SEGMENTS 3 To 5
SALDANHA BAY MUNICIPALITY

SECTION D : STORMWATER DRAINAGE:

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
Brought Forward								179500	215250	143000	0
D.6	b) by importation from commercial or off-site sources selected by the Contractor										
	1) Sand to replace unsuitable material	m³	300	9600	6500	0	40	12000	384000	260000	0
D.7	2) 19mm stone below pipes (provisional)	m³	150	300	400	0	330	49500	99000	132000	0
	EXISTING SERVICES										
D.8	Services that intersect a trench										
	Underground cables and ducts										
D.9	a) Water erf connections	No.	5	5	2	1	75	375	375	150	75
	b) Stormwater	No.	5	5	2	1	130	650	650	260	130
D.10	c) Sewers up 200mm diam	No.	5	5	2	1	250	1250	1250	500	250
	d) Electrical cables	No.	5	5	2	1	250	1250	1250	500	250
D.12	Services that adjoin a trench										
	a) Sewers all sizes	m	400	400	200	0	25	10000	10000	5000	0
D.13	PIPES										
	Supply, handle, lay, bed (class C), concrete pipes with spigot and socket joints	m	100	0	30	0	280	28000	0	8400	0
Total Carried Forward								282525	711775	549810	705

CONTRACT NO : VR032

**THE UPGRADING OF STORMWATER : SEGMENTS 3 To 5
SALDANHA BAY MUNICIPALITY**

SECTION D : STORMWATER DRAINAGE

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
Brought Forward								282525	711775	549810	705
D.14	2) 600 mm diam. Class 100 D	m	20	0	20	0	800	16000	0	16000	0
D.15	2) 750 mm diam. Class 75 D	m	1200	0	0	0	1000	1200000	0	0	0
D.16	3) 1350 mm diam. Class 75 D	m	0	1200	0	0	3000	0	3600000	0	0
D.17	4) 1500 mm diam. Class 75 D RECTANGULAR CULVERTS Supply, handle, lay, bed (class C), concrete culvert including invert slabs	m	0	0	0	0	3500	0	0	0	0
D.18	1) 1500 mm wide x 1200mm high box culvert, class S	m	0	0	750	0	4800	0	0	3600000	0
D.19	1) 1500 mm wide x 1500mm high box culvert, class S	m	0	0	0	0	5200	0	0	0	0
D.20	1) 1800 mm wide x 1500mm high box culvert, class S	m	0	0	150	0	6000	0	0	900000	0
CONCRETE CHANNELS											
D.21	Precast 180mm thick concrete trench bottom channel Type CC - N1 to sid detail	m ¹	220	20	20	0	1400	308000	28000	28000	0
D.22	Precast 180mm thick concrete trench bottom channel Type CC - N2 to sid detail	m ¹	95	0	0	0	1400	133000	0	0	0
D.23	Stone Paving PROVISION OF BEDDING Provision of Bedding from trench excavation a) Suitable granular material from trenches or necessary excavations	m ²	3300	30	30	0	300	990000	9000	9000	0
D.24	1) Selected cradle material	m ³	600	200	30	0	20	12000	4000	600	0
D.25	2) Selected blanket material	m ³	700	400	40	0	20	14000	8000	800	0
Total Carried Forward								2955525	4360775	5104210	705

CONTRACT NO : VR032
THE UPGRADING OF STORMWATER : SEGMENTS 3 To 5
SALDANHA BAY MUNICIPALITY

SECTION D : STORMWATER DRAINAGE

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
Brought Forward								2955525	4360775	5104210	705
a) From commercial sources (Provisional)											
D.26	1) Selected cradle material	m³	400	800	60	0	80	32000	64000	4800	0
D.27	2) Selected blanket material	m²	500	1600	80	0	80	40000	128000	6400	0
Stormwater Access Chambers complete with cover and frame as per drawings VR032C0104											
(a) Structure 1 (1350/1500 diam pipes)											
		No	3	15	0	0	25000	75000	375000	0	0
D.28	(b) Structure 2 (at existing headwalls)	No	0	5	4	0	30000	0	150000	120000	0
D.29	(c) Structure 3 (at box culverts 1500 wide)	No	0	1	9	0	26000	0	26000	234000	0
D.30	(d) Structure 4 (at box culverts 1800 wide)	No	0	0	0	0	28000	0	0	0	0
D.31	(e) Structure 5	No	0	1	1	0	20000	0	20000	20000	0
MANHOLE, CATCHPITS ETC											
Supply and install manholes, catchpits and the like											
Manholes											
Precast manholes complete with Type 2A cover and frame (standard drawing)											
a) Pipe size < 1350mm, depths											
Total Carried Forward								3102525	5123775	5489410	705

CONTRACT NO : VR032
THE UPGRADE OF STORMWATER : SEGMENTS 3 TO 5
SALDANHA BAY MUNICIPALITY

SECTION D : STORMWATER DRAINAGE

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
Brought Forward								3102525	5123775	5489410	705
	Over and up to										
D.32	1.5 m 2.0 m	No.	6	0	2	0	9100	54600	0	18200	0
D.33	2.0 m 2.5 m	No.	10	0	0	0	9800	98000	0	0	0
	Inlet Structures										
D.34	a) Channel structures up to 5 m deep with gnd inlet headwalls	No.	1	0	0	0	6000	6000	0	0	0
D.35	a) For all pipes over 600mm and up to 1200mm diameter	No.	0	0	0	0	4500	0	0	0	0
	ANCILLARIES										
D.36	Terraforce wall as instructed by engineer. Kate inclusive of procuring material, selection, transport and complete laying of blocks with concrete infill.	m ²	50	50	50	200	350	17500	17500	17500	70000
	SUBSURFACE DRAINS (PROVISIONAL)										
	Excavation and backfilling for subsurface drains in the following depth ranges:										
	Over and up to										
D.37	1.5 m 2.0 m	m	150	150	100	0	90	13500	13500	9000	0
D.38	2.0 m 2.5 m	m	50	50	50	0	120	6000	6000	6000	0
D.39	Supply and install Type 1 subsurface drains complete with slotted 160mm diameter UPVC pipe, 19 mm stone & geofabric for 400 x 600 mm, X-section	m	200	200	150	0	240	48000	48000	36000	0
Total Carried Forward								3346125	5208775	5576110	70705

CONTRACT NO : VR032

**THE UPGRADING OF STORMWATER : SEGMENTS 3 To 5
SALDANHA BAY MUNICIPALITY**

SECTION D : STORMWATER DRAINAGE

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
Brought Forward								3346125	5208775	5576110	70705
D-40	Rodding eyes to standard detail	No.	5	5	5	0	1000	5000	5000	5000	0
D-41	Manhole/Access Chamber connections OPEN CHANNELS	No.	10	10	5	0	800	8000	8000	4000	0
D-42	Open trench for stormwater handling including sloping sides of trench Supply and install paving complete with 25 mm max bedding sand and including jointing sand	m²	0	0	0	800	40	0	0	0	32000
D-43	a) 100mm concrete grass blocks	m²	0	0	0	2500	165	0	0	0	412500
D-44	3 Bidium geotextile to underside of grass blocks	m²	6800	100	0	2900	10	68000	1000	0	29000
D-45	Connection to existing stormwater channel STORMWATER POND	No.	1	0	0	0	500	500	0	0	0
D-46	Excavate in granular material and place in fill compaction to 93% ModAASHTO (100% for sand) for pond embankment	m³	0	0	0	50000	40	0	0	0	2000000
D-47	Excavate in all materials and dispose of off site at a location of the contractors choice Extra over for :	m³	0	0	0	10000	50	0	0	0	500000
D-48	a) Excavation in hard shale material	m³	0	0	0	7000	50	0	0	0	350000
D-49	Extra over D-34 for importation of material from commercial sources	m³	0	0	0	10000	120	0	0	0	1200000
D-50	Hydroseeding with a mixed grass seed and mulch for stabilising pond embankments and covering of grass block channel Gabion Structures	m²	0	0	0	28000	10	0	0	0	280000
Total Carried Forward								3427625	5222775	5585110	4874205

CONTRACT NO : VR032
THE UPGRADE OF STORMWATER : SEGMENTS 3 To 5
SALDANHA BAY MUNICIPALITY

SECTION D : STORMWATER DRAINAGE

ITEM NO	DESCRIPTION	UNIT	QTY Segment 3	QTY Segment 4	QTY Segment 5	QTY Segment 6	Estimated RATE	AMOUNT Segment 3	AMOUNT Segment 4	AMOUNT Segment 5	AMOUNT Segment 6
Brought Forward								3427625	5222775	5585110	4874205
D.51	a) 2x1x1 gabions as protection at outlets	m³	0	10	20	120	1000	0	10000	20000	120000
D.52	b) 3x1x0.3 reno mattresses in stormwater outlets	m³	0	5	10	80	1200	0	6000	12000	96000
D.53	c) Bidum geotextile against gibbon or mattress exposed face <u>Stormwater Interceptor</u>	m²	0	30	50	500	10	0	300	500	5000
D.54	Provisional Sum for stormwater wter structure to be placed before the outlet into the pond	Prov	0	0	0	1	25000	0	0	0	25000
D.55	<u>ROAD CROSSING</u> Works by specialist contractor in accordance with the requirements of the relevant Authority	Prov Sum	0	0	1	0	40000	0	0	40000	0
D.56	Overheads, charges, attendance and profit on selected subcontractor	%	0	0	40000	0	0.1	0	0	4000	0
D.56	<u>FENCING</u> Palisade Fencing around Pond - 2.4m high, concrete type, complete with footing and posts.	m	0	0	0	1000	950	0	0	0	950000
D.57	<u>EMBANKMENT TREATMENT</u> Geosynthetic Clay Liner (Envirofix X1000) for use on pond embankments	m²	0	0	0	4900	60	0	0	0	294000
D.58	300mm clay layer above GLC	m³	0	0	0	1500	300	0	0	0	450000
Total Carried Forward To Summary								3427625	5239075	5661610	6814205

ANNEXURE F
SEGMENT 3 DRAWINGS

1. The purpose of this drawing is to show the
 location of the proposed stormwater
 management facilities in relation to the
 proposed development and the existing
 infrastructure.

SCALE: 1:500

1. Proposed	2. Existing
3. Boundary	4. Road

NADESONI
 CONSULTING SERVICES

1. Project Name
 2. Project Number
 3. Project Location

1. Date
 2. Drawn By
 3. Checked By

1. Project Name
 2. Project Number
 3. Project Location

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1. Project Name
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1. Date
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 2. Project Number
 3. Project Location

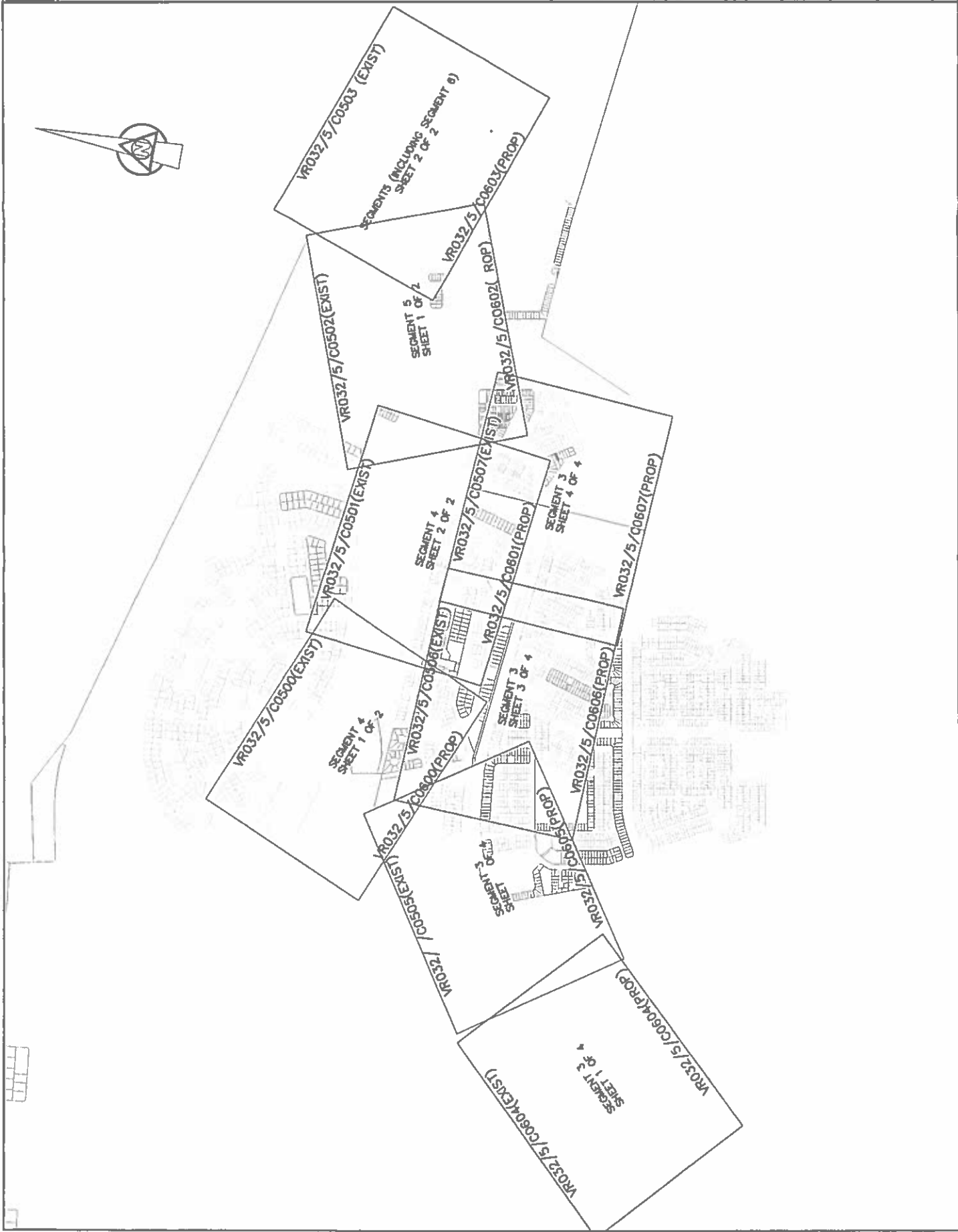
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 2. Project Number
 3. Project Location

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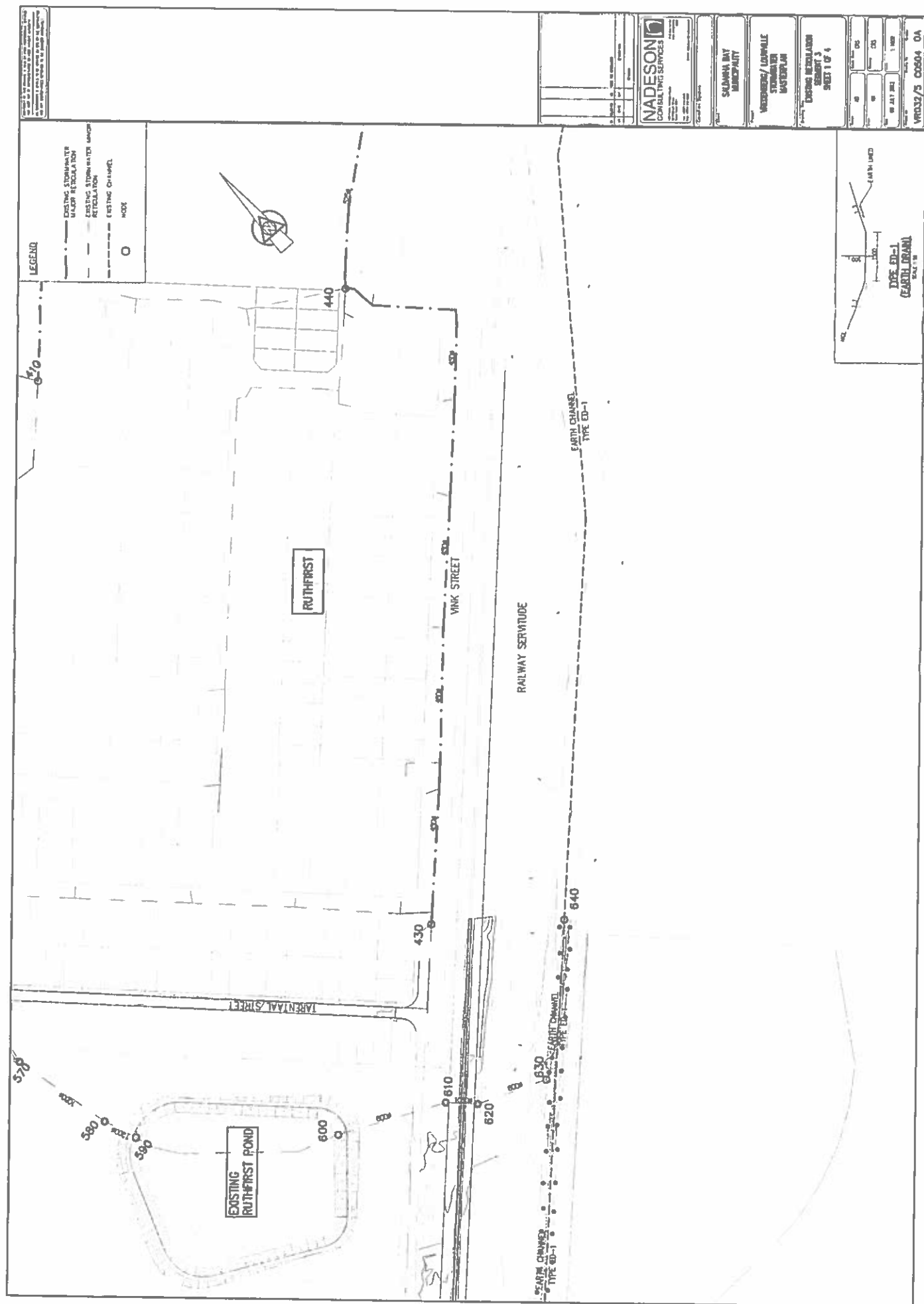
1. Project Name
 2. Project Number
 3. Project Location

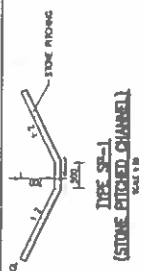
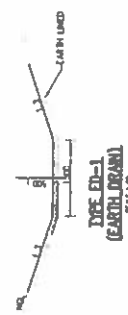
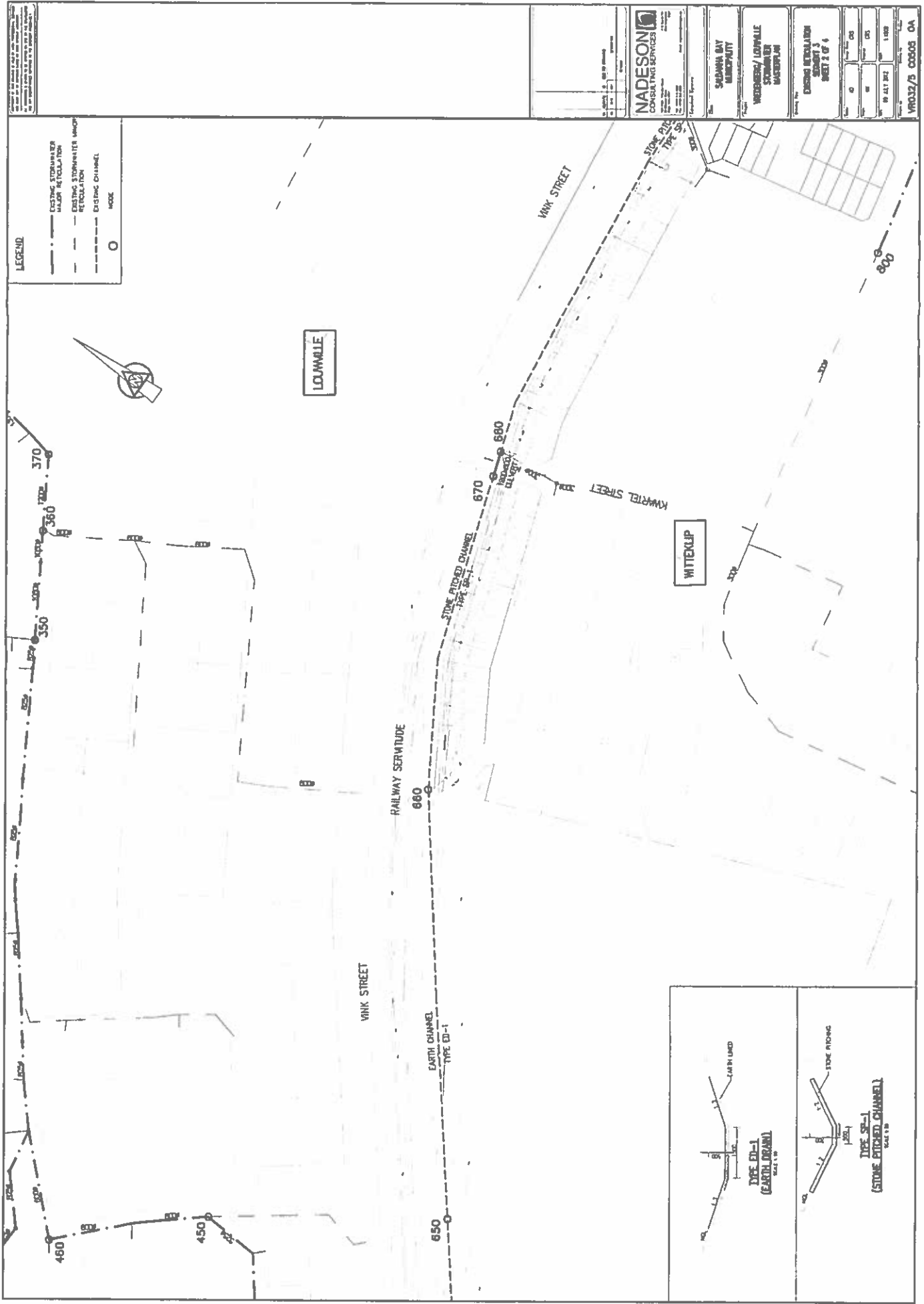
1. Date
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 3. Checked By



1. Project Name
 2. Project Number
 3. Project Location

1. Date
 2. Drawn By
 3. Checked By





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LOUNDALE

PETRIUS MEYER DRIVE

VANK STREET

RAILWAY SERVICE

RAILWAY SERVICE

STONE PITCHED CHANNEL

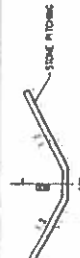
STONE PITCHED CHANNEL

LEGEND

- EXISTING STORMWATER MAJOR RETICULATION
- EXISTING STORMWATER MAJOR RETICULATION
- EXISTING DRAINAGE
- MAJOR



TYPE S-1
(STONE PITCHED CHANNEL)
SCALE 1:10



TYPE S-2
(STONE PITCHED CHANNEL)
SCALE 1:10

WITBOLD

800

810

690

300

300

300

300

300

300

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300

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NADESON
CONSULTING SERVICES

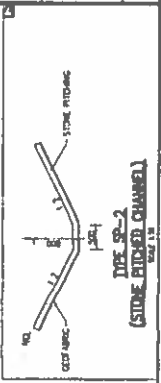
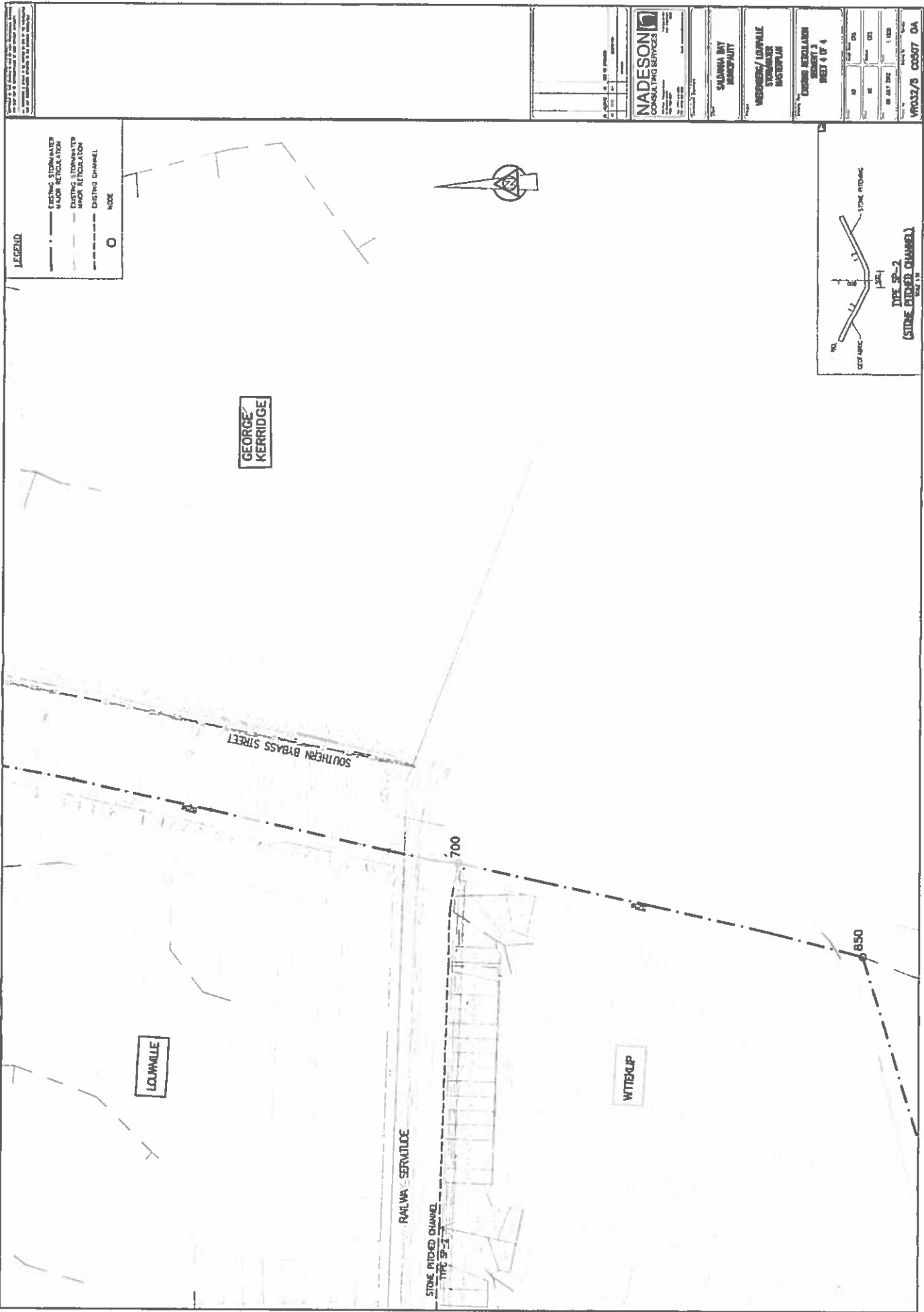
SIDEMAN BAY
MUNICIPALITY

WILDERESS/LOUNDALE
STORMWATER
MANAGEMENT

ENGINE REGISTRATION
SHEET 3 OF 4

DATE: 19 JAN 2017
BY: [Signature]

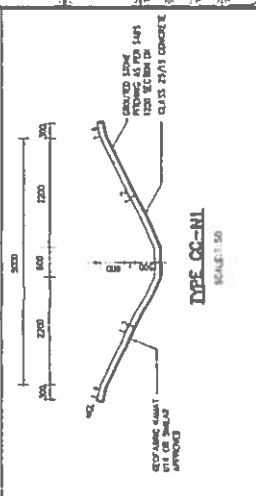
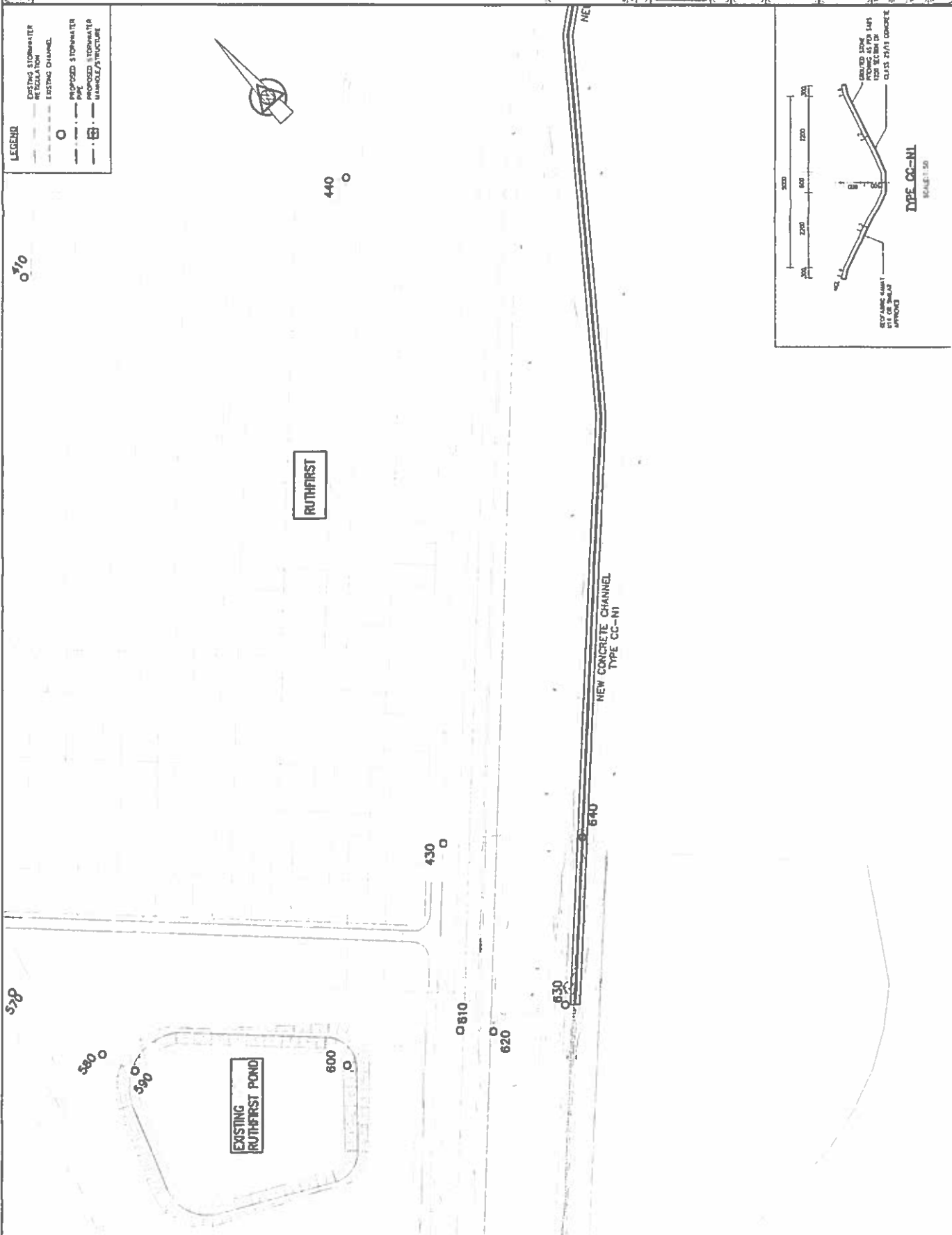
WML12/3 C0506 0A



NADESON CONSULTING SERVICES	
Project: SALAMBA BAY MUNICIPALITY	
Client: SALAMBA BAY MUNICIPALITY	
Project: WEDDERBURN / LOANVILLE STORMWATER RETICULATION	
Project: DRAINAGE REGULATION	
Project: SHEET 4 OF 4	
Drawn by: [Name]	Check by: [Name]
Date: 08 JUL 2002	Date: 11 DEC 2002
Scale: 1:1000	Scale: 1:1000
VNO32/3 CS007 DA	

LEGEND

EXISTING STORMWATER RETICULATION
 EXISTING CHANNEL
 PROPOSED STORMWATER PIPE
 PROPOSED STORMWATER MANHOLE/STRUCTURE



NADESON CONSULTING SERVICES

SALAMAN BAY MUNICIPALITY

WATERBURY/LUMPALE STORMWATER MASTERPLAN

EXISTING RETICULATION SHEET 3 OF 4

Project No: 2017-2018
 Date: 1/2018
 Scale: 1:50
 VRO32/3 00804 0A

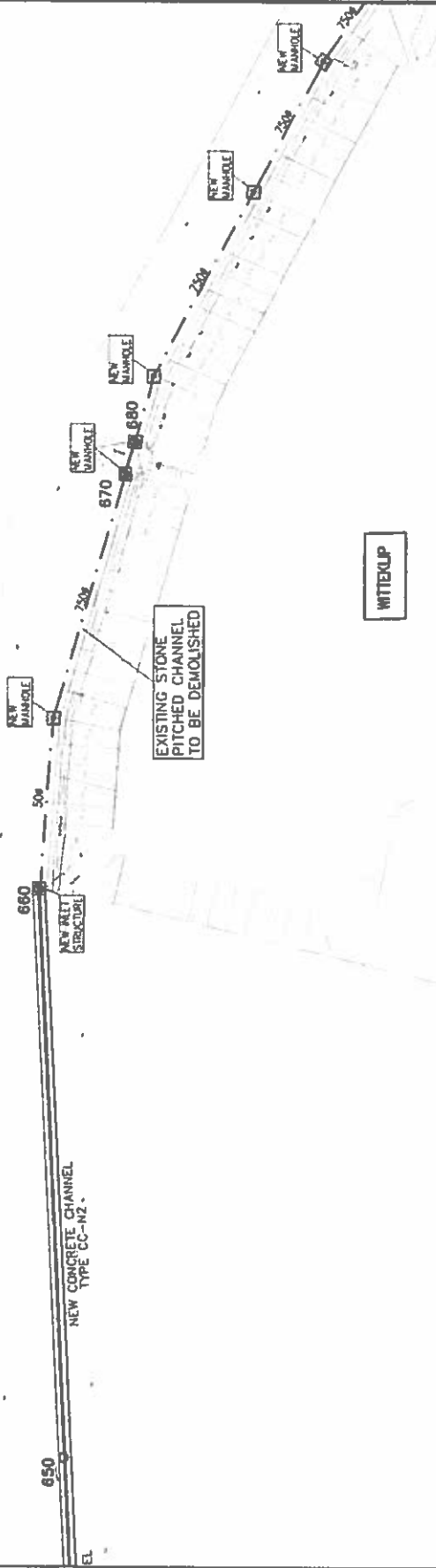
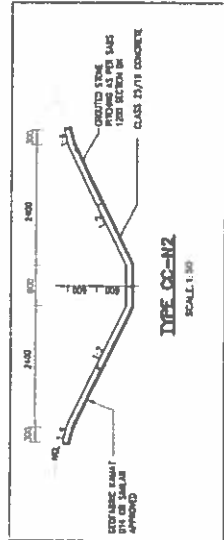
- LEGEND**
- EXISTING STORMWATER REGULATION
 - EXISTING CHANNEL
 - MODE
 - PROPOSED STORMWATER PIPE
 - PROPOSED STORMWATER MANHOLE/STRUCTURE



LOUWVILLE

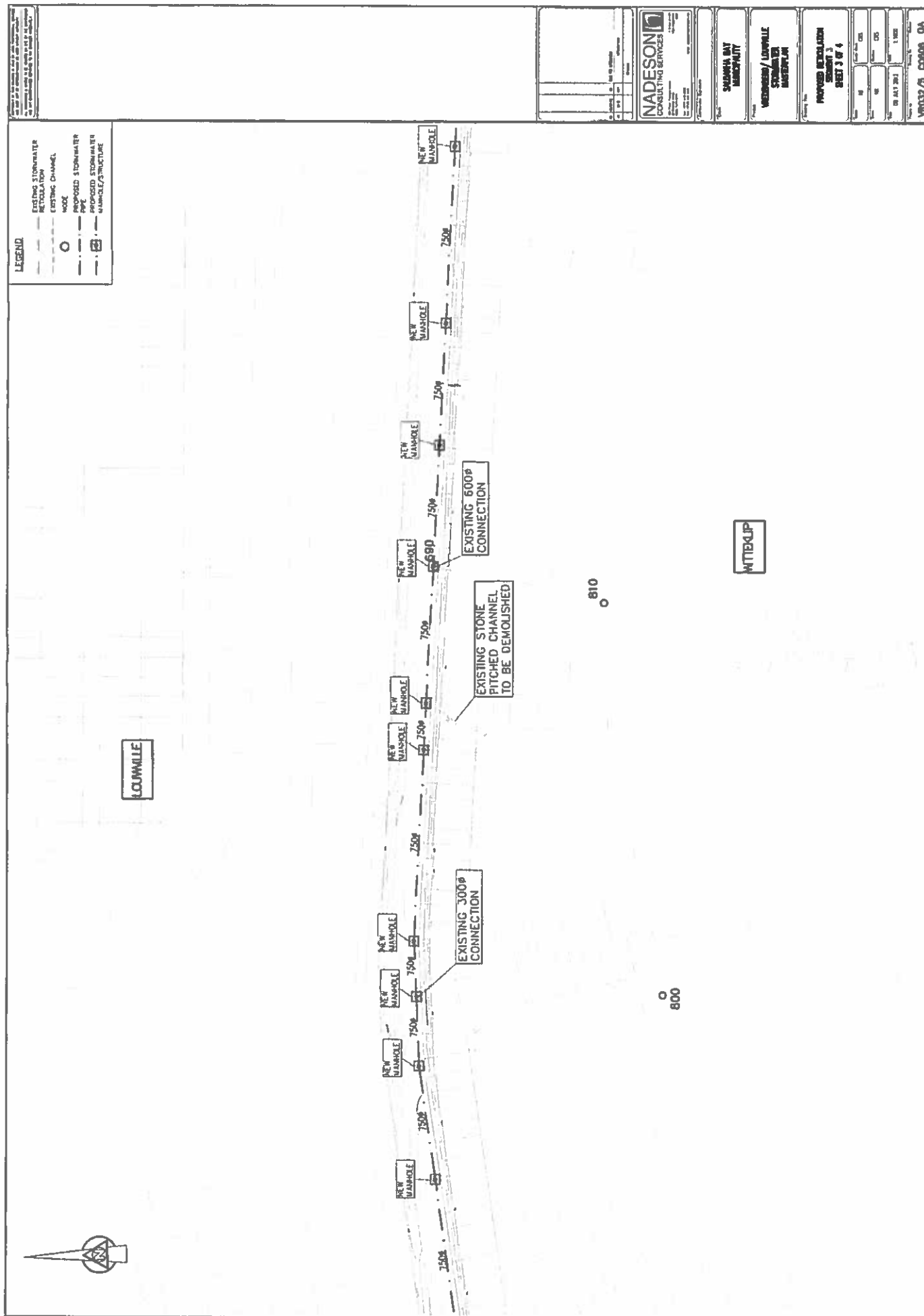
WITTEKOP

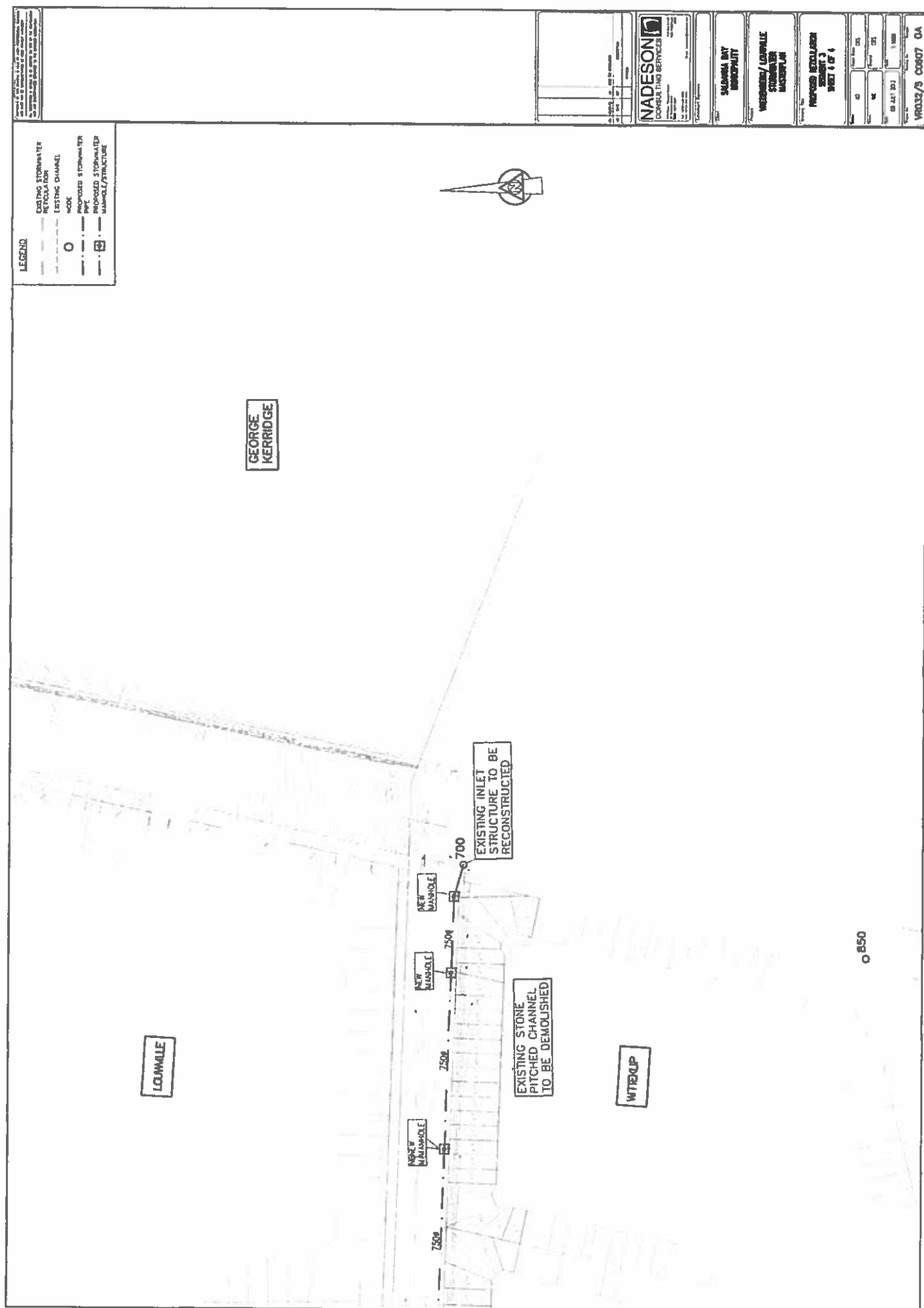
EXISTING STONE PITCHED CHANNEL TO BE DEMOLISHED



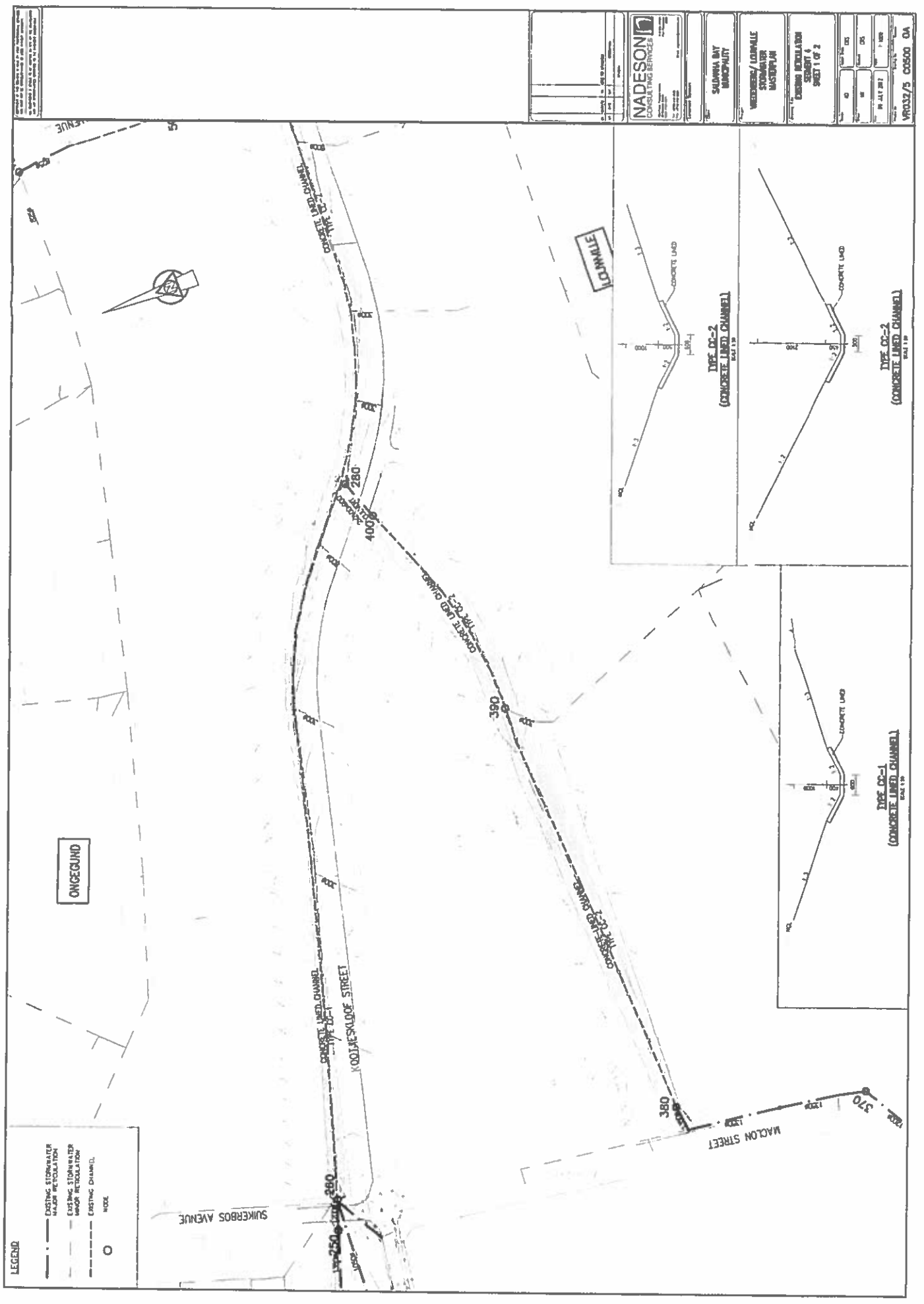
800

NADESON CONSULTING SERVICES		SALAMBA BAY BRICKPLOT
PROJECT: WITTEKOP / LOUWVILLE STORMWATER IMPROVEMENT		PROPOSED REGULATION SHEET 2 OF 4
DATE: 20 JUL 2010		DRAWN BY: [Name] CHECKED BY: [Name]
SCALE: 1:30		PROJECT NO: V1032/5 00005 0A





ANNEXURE G
SEGMENT 4 DRAWINGS



JONHALE



NADESONI CONSULTING SERVICES 101-103 Main Street, Suite 101 Cape Town, 7925 Tel: 021 461 1111 Fax: 021 461 1112 Email: info@nadesoni.co.za Website: www.nadesoni.co.za	
SALUBRA BY MUNICIPALITY	
WETLANDS/LOMPALE STORMWATER MASTERPLAN	
EXISTING RETICULATION SHEET 1 OF 2	
Date: 10 JUL 2012	Drawn: [Signature]
Checked: [Signature]	Approved: [Signature]
Project No: VR032/5 CS0500 OA	

- LEGEND**
- EXISTING STORMWATER RETENTION
 - EXISTING DRAINAGE
 - NOSE
 - PROPOSED STORMWATER PAV
 - PROPOSED STORMWATER MANHOLE/STRUCTURE

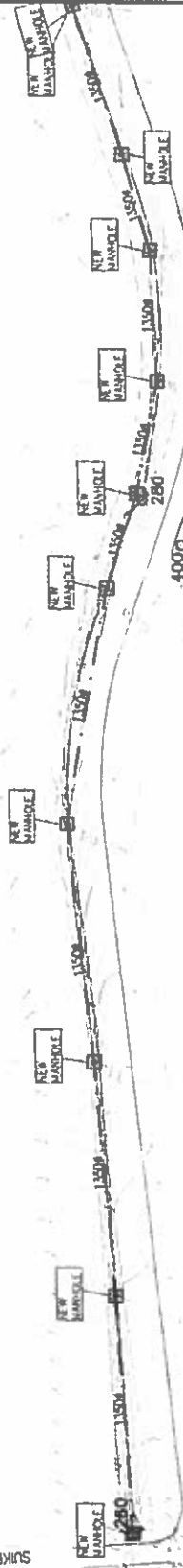
ONCEGUND

SUKERBOO AVENUE

MACDON STREET

LOUNALE

1500



NADESON CONSULTING SERVICES 1000 10th Avenue Suite 100 Victoria, BC V8W 2E1 Tel: 250-383-1111 Fax: 250-383-1112 Email: info@naleson.com		SALMON BAY MUNICIPALITY 1000 10th Avenue Suite 100 Victoria, BC V8W 2E1 Tel: 250-383-1111 Fax: 250-383-1112 Email: info@naleson.com	VICTORIA/LOUNALE STORMWATER MANAGEMENT 1000 10th Avenue Suite 100 Victoria, BC V8W 2E1 Tel: 250-383-1111 Fax: 250-383-1112 Email: info@naleson.com	PREPARED RETENTION SHEET 4 SHEET 1 OF 2 1000 10th Avenue Suite 100 Victoria, BC V8W 2E1 Tel: 250-383-1111 Fax: 250-383-1112 Email: info@naleson.com	1000 10th Avenue Suite 100 Victoria, BC V8W 2E1 Tel: 250-383-1111 Fax: 250-383-1112 Email: info@naleson.com
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VR032/3 0000 0A

ANNEXURE H

SEGMENT 5 AND 6 DRAWINGS



LEGEND

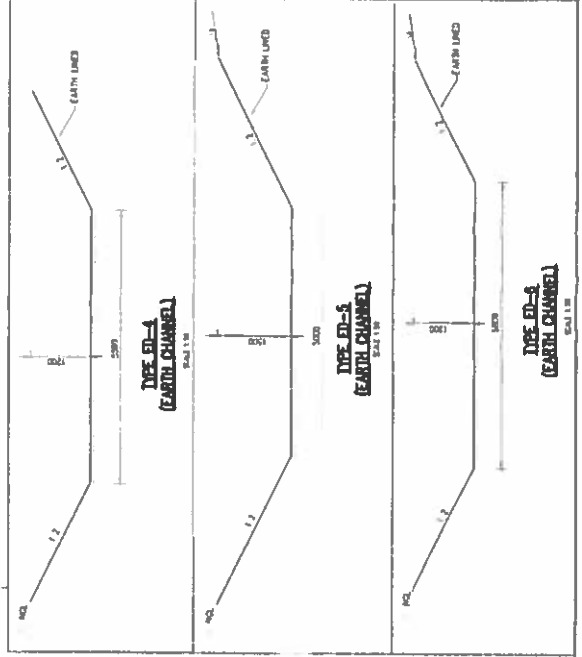
- EXISTING STORMWATER MAJOR RETICULATION
- EXISTING STORMWATER MINOR RETICULATION
- EXISTING CHANNEL
- NODE

HOPFIELD ROAD R44

JOHANNESBURG STREET

EXISTING WEIR STRUCTURE

GEORGE KERRIDGE



NADESON CONSULTING SERVICES

SANDHIA BAY MUNICIPALITY

WETLANDS/ WILDLIFE STORMWATER MASTERPLAN

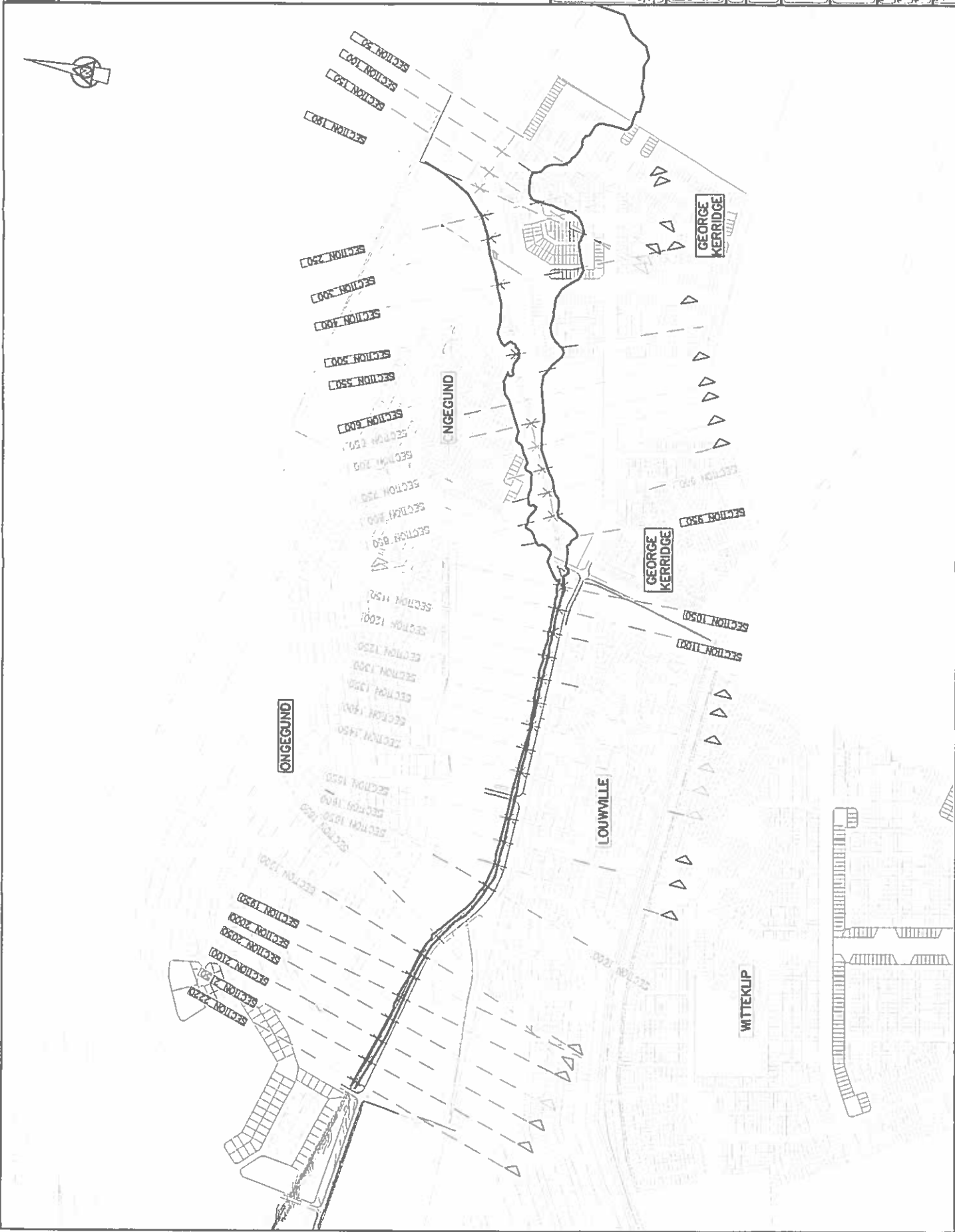
EXISTING RETICULATION

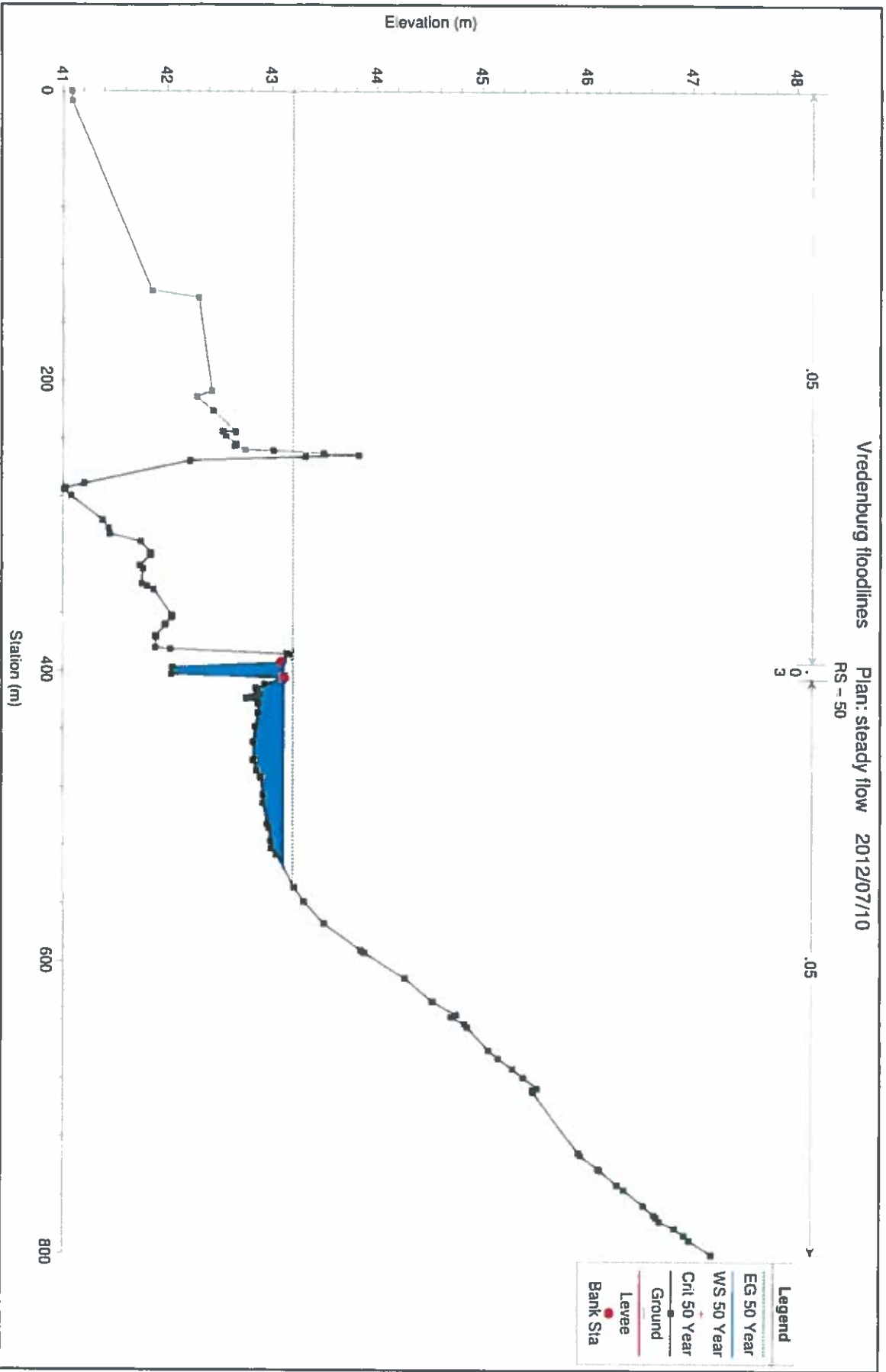
WETLANDS/ WILDLIFE STORMWATER MASTERPLAN

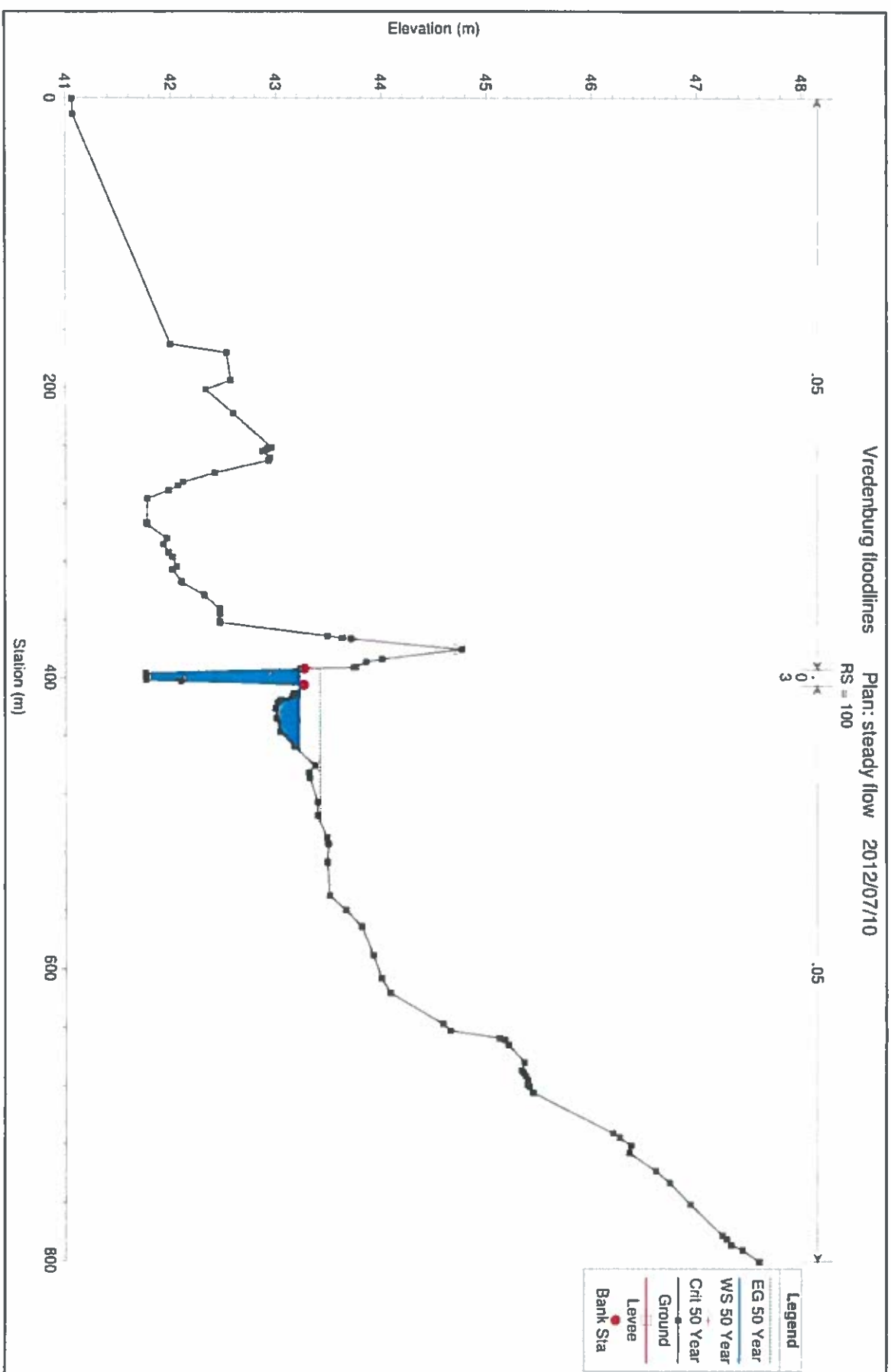
VR031/5 03503 OA

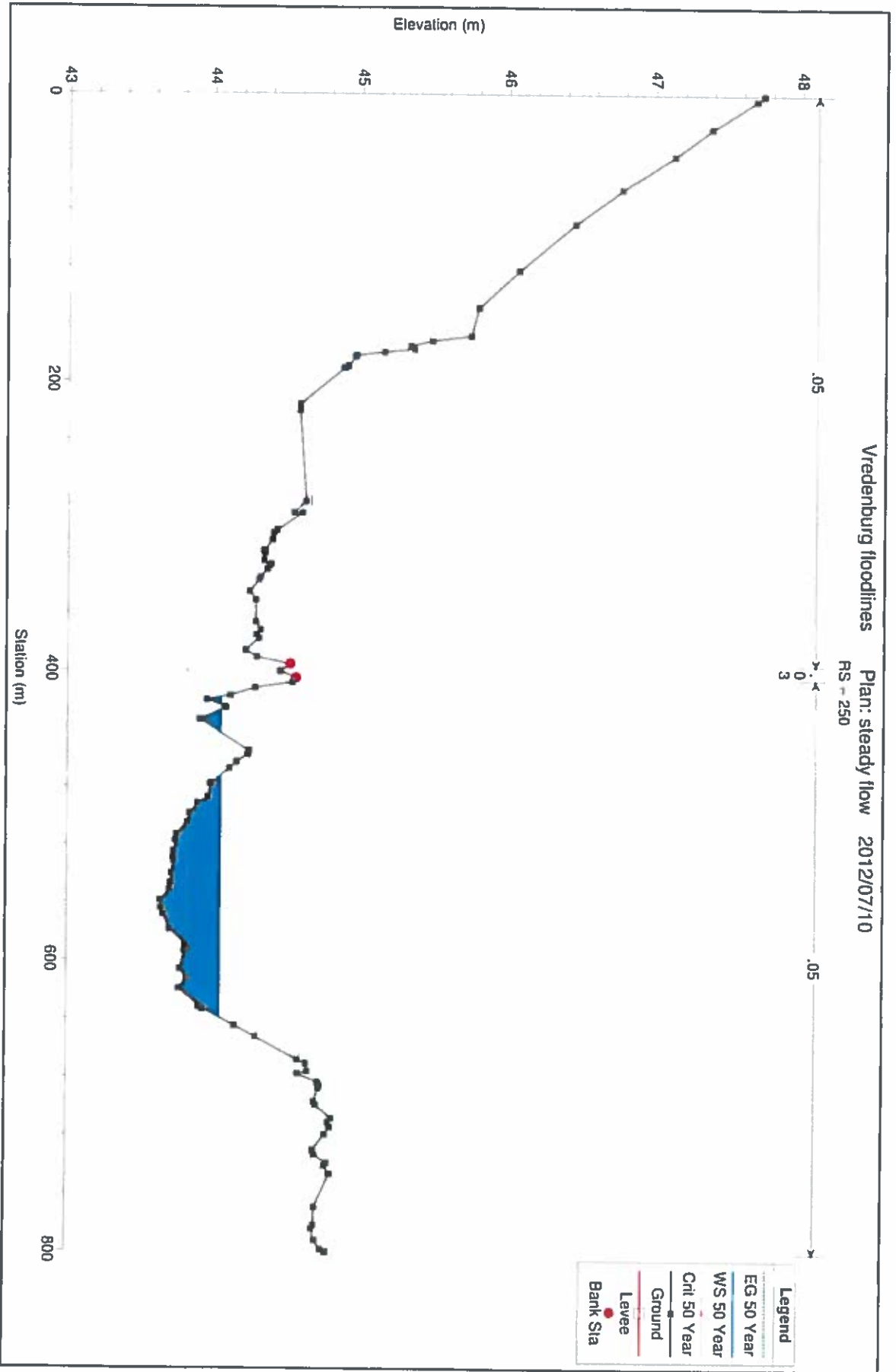
ANNEXURE I

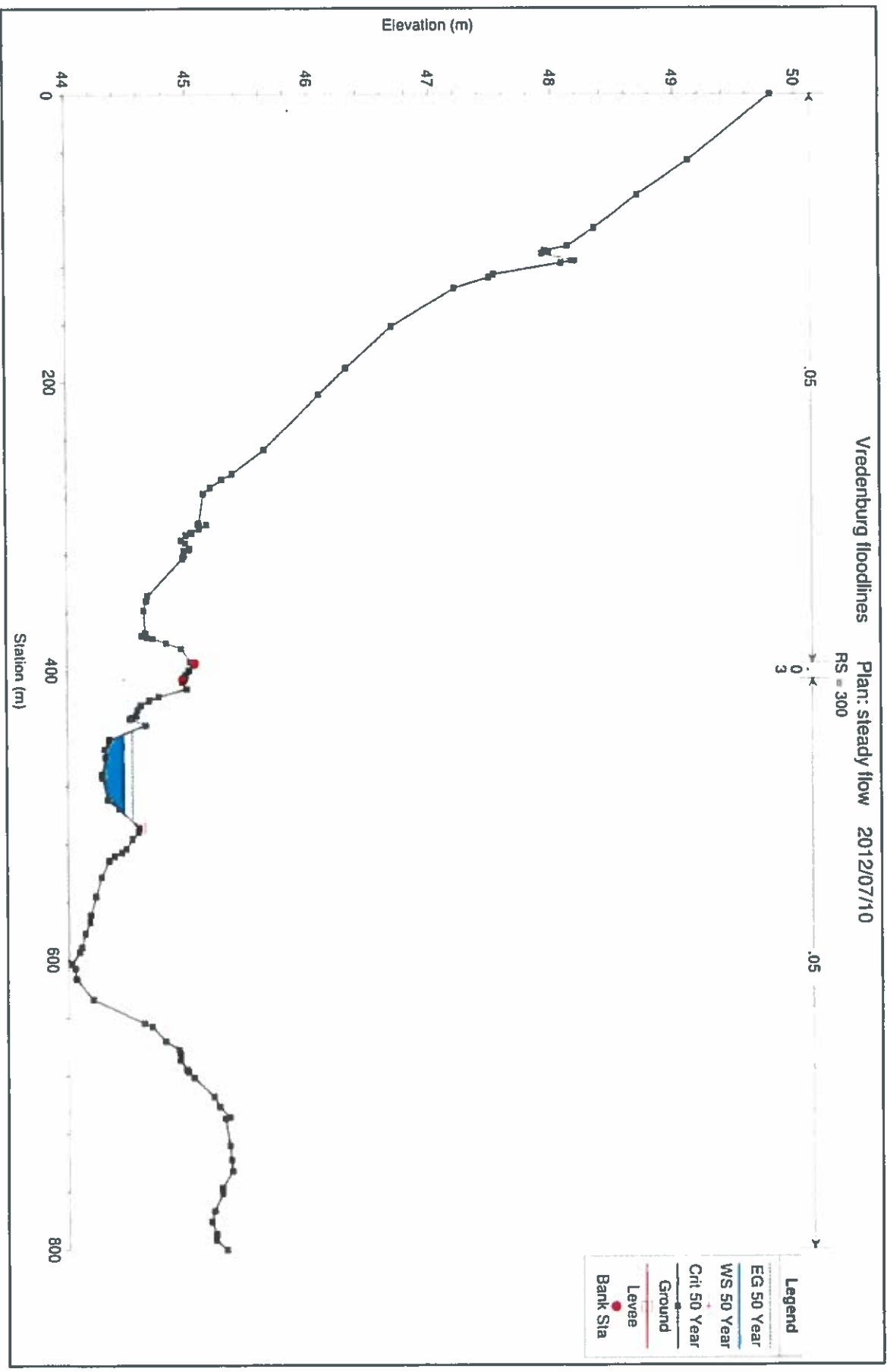
FLOODLINE MAPPING





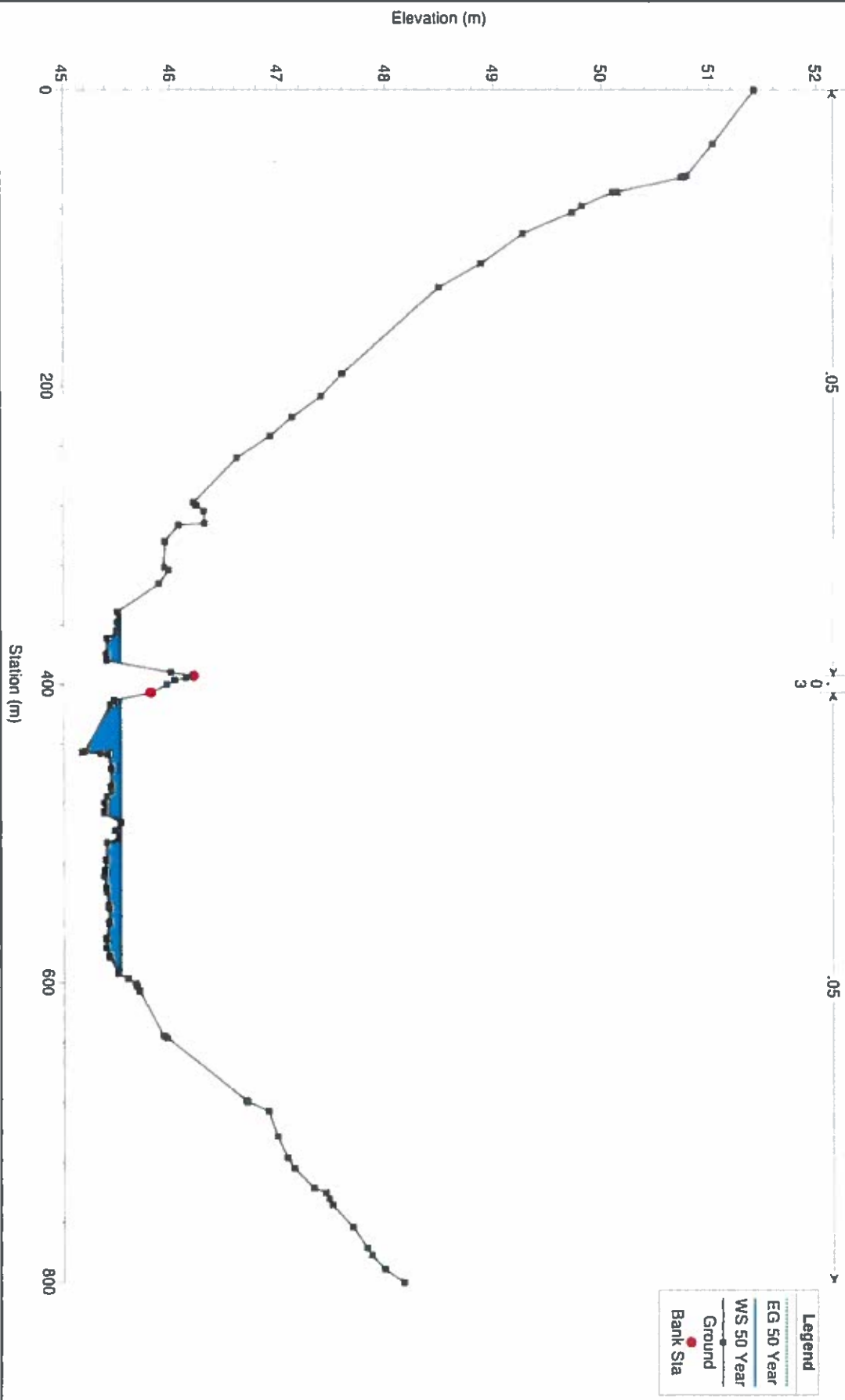


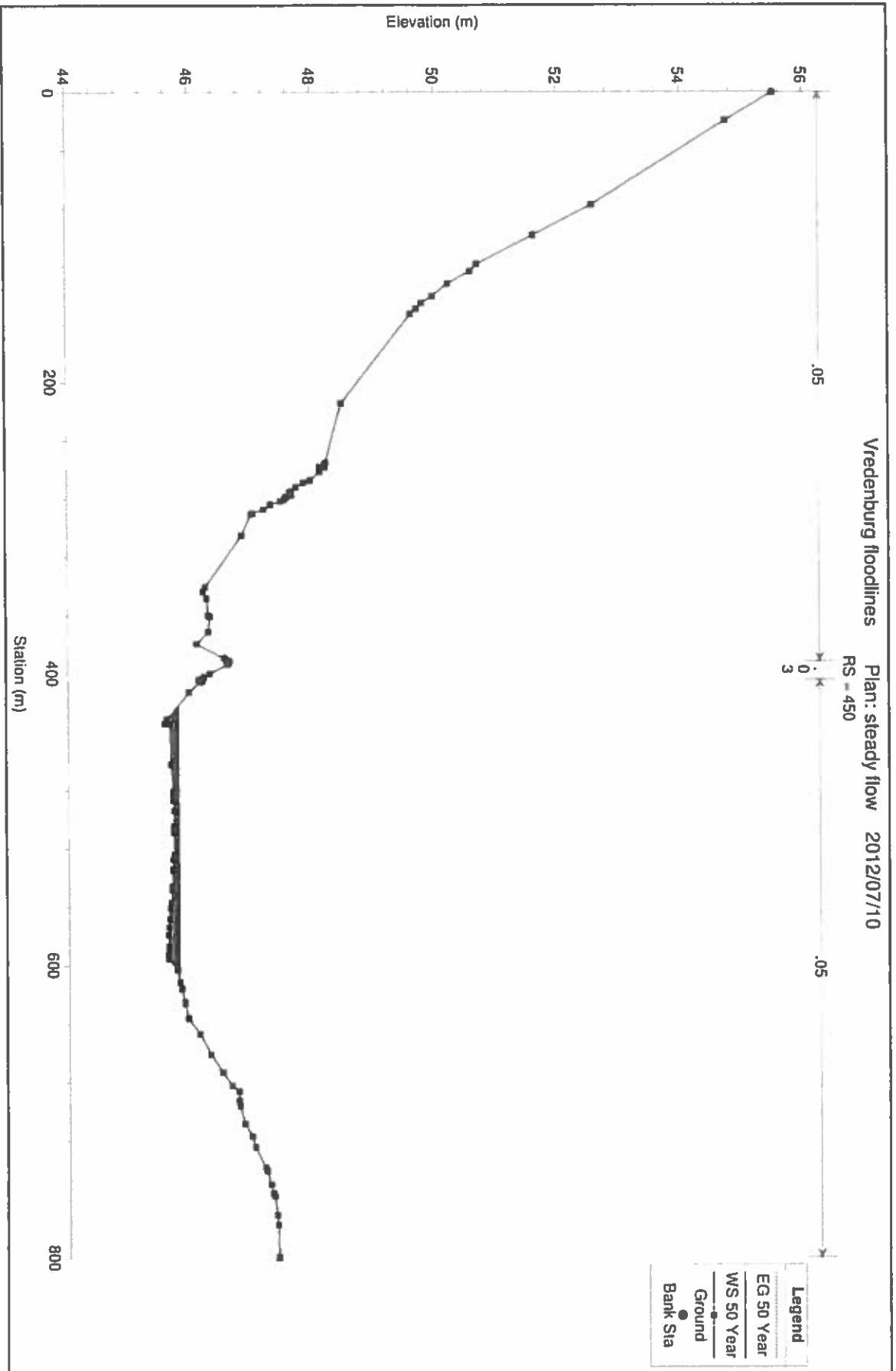


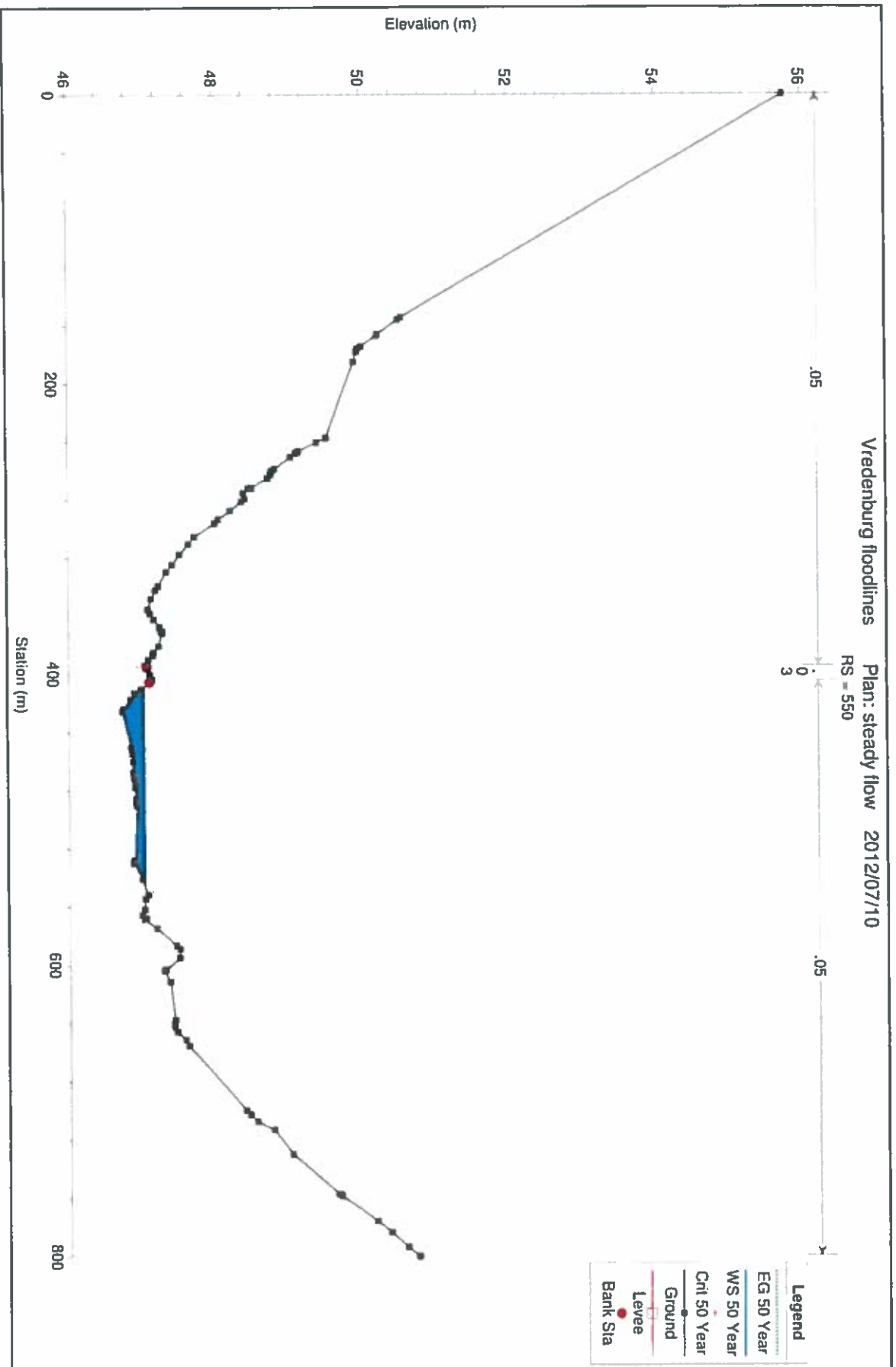


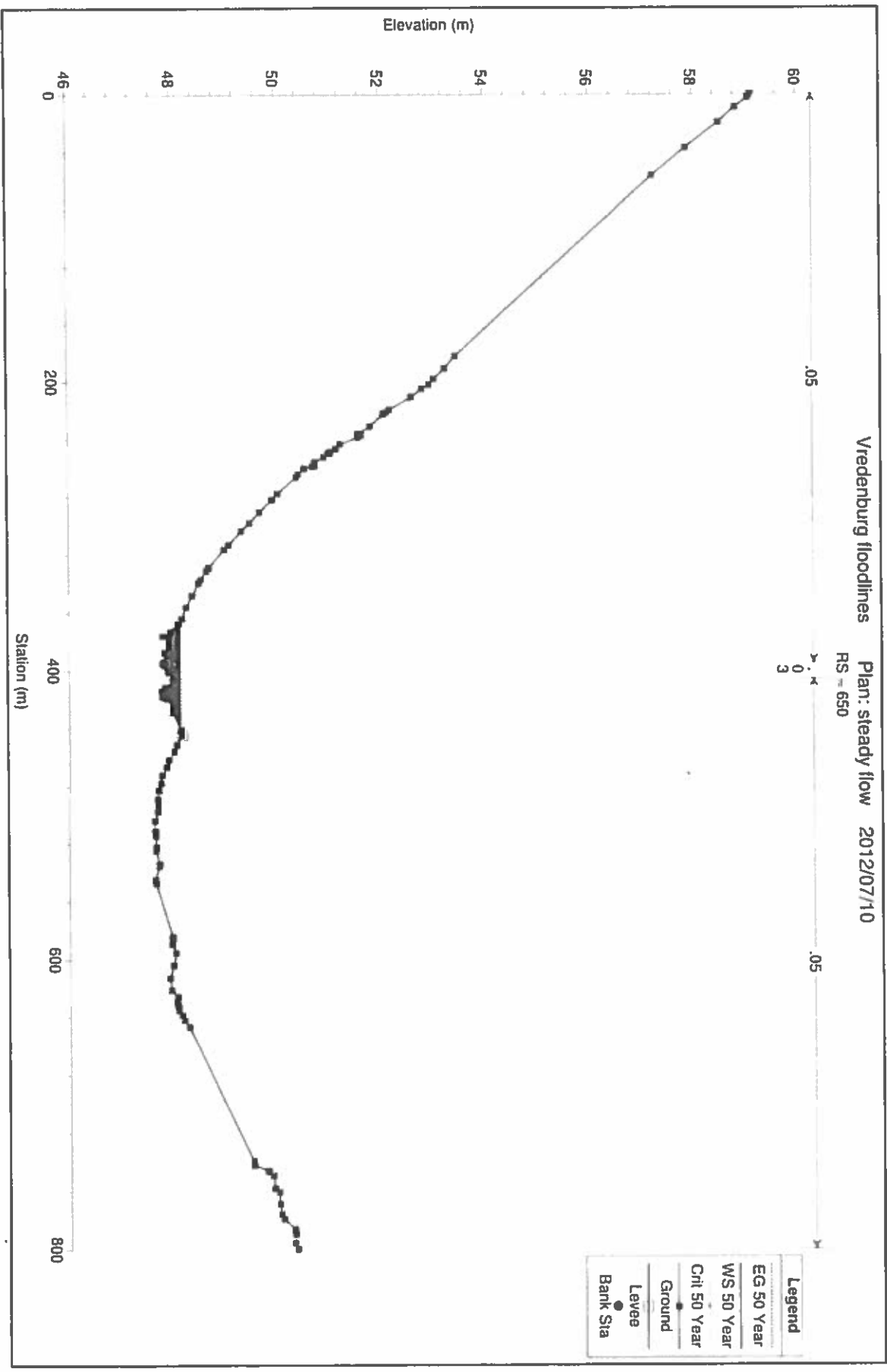
Vredenburgh floodlines

Plan: steady flow 2012/07/10
RS = 400









Vredenburg floodlines

Plan: steady flow 2012/07/10
RS = 750

0
3

.05

.05

Legend

- EG 50 Year
- WS 50 Year
- Crit 50 Year
- Ground
- Levee
- Bank Sta

