WYATT ENGINEERING

Rural Municipality of North Qu'Appelle No. 187
Box 99
136 Company Avenue South
Fort Qu'Appelle SK S0G 1S0

File: P2022-6701
Date: November 24, 2023

Attn: Gwen Lowe, Administrator

Re: Rural Municipality of North Qu'Appelle No. 187
Jasmin Development Drainage Study
FINAL Report

Dear Reeve and Council,

Wyatt Engineering Ltd. was retained by the Rural Municipality of North Qu'Appelle No. 187 (the RM; the Client) to complete the assessment and design for drainage improvements in the Jasmin Development on Echo Lake.

I am pleased to submit herewith the Final report for the above noted project with the RM's comments incorporated. Please do not hesitate to contact the undersigned with any questions or concerns.

Sincerely,

WYATT ENGINEERING LTD.

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Director of Civil Engineering
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WYATT ENGINEERING

FINAL REPORT | **Wyatt Engineering Ltd.**

Rural Municipality of North Qu'Appelle No. 187

Jasmin Development Drainage Study

RM of North Qu'Appelle No. 187 | November 24, 2023 | 2022-6701

Submitted to:
Gwen Lowe, Administrator

Wyatt Engineering Ltd.
Box 802
White City, SK S4L 5B1

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EXECUTIVE SUMMARY

Wyatt Engineering Ltd. (WE) was retained by the Rural Municipality of North Qu'Appelle No. 187 (the RM; the Client) to complete an assessment and design for drainage improvements in the Jasmin Development on Echo Lake. Jasmin Development is located on the north shoreline of Echo Lake, south of Highway 56 within SW 26-21-14 W2M (the Development; Jasmin; the Site). Jasmin contains 66 lots and is zoned as 'Resort Residential' (RR).

The objectives of this project are to:

- Review the drainage into the development and confirm whether the existing culverts are sized appropriately for expected flows;
- Review the drainage concerns that are negatively impacting [redacted] within Jasmin and provide:
  - Options available to resolve the identified drainage concern;
  - A Class "D" cost estimates for each option; and
  - A recommendation on the option which provides the best value.

A minor drainage system, which consists of catch basins, pipes and culverts are typically evaluated based on a 1:5 year, 24-hour event. The drainage into Jasmin is impacted by the culverts under the Highway, as it appears flow would be detained in this area (i.e., backup) and dissipate via the culverts over time.

In reviewing pre-development conditions and post development conditions, the northwest (North - 35%) 450 mm diameter culvert and southwest (west + north) 550 mm diameter culvert are both undersized for the anticipated design flow for a 1:5 year, 24-hour storm event. The remaining three culverts have sufficient capacity for the increased flows expected at full build-out of the Development.

There were also localized areas of concern related to drainage identified by the RM and local residents within the Development including:

- The turnaround on the west end of Pasqua Lake Road, has had lumber placed on the south side to prevent runoff from flowing into [redacted].
- The Northern 450 mm diameter culvert crossing beneath Highway 56 is clogged, causing water to flow across the Highway via the adjacent 1900 mm walkway, and into [redacted].
- The north ditch along Pasqua Lake Road, west of the intersection, has silted-over trapping and accumulating runoff until eventually flowing over the roadway and into [redacted].
- There is ponding on the southwest corner of [redacted]
- The 'drain box' receiving flow from the Central 450 mm diameter culvert between [redacted] backs up, and overflows through both lots. [redacted] has experienced significant erosion along the side yard, which the owners have indicated they have repaired on numerous occasions. [redacted] has a gravel pad in their side yard for parking that washes into the backyard and settles in the artificial grass.

- The eastern 600 mm dia. culvert is partially clogged with debris reducing the capacity of the culvert. No issues have been identified with the culvert backing up.

The recommendations provided to the RM include:

- The RM should be completing flushing of their culverts regularly to prevent build up of debris. If the RM does not already have a flushing program, this should be created to ensure all culverts are being flushed on rotation, and priority locations are being flushed regularly to prevent flooding due to blocked culverts either by wildlife or debris.
- The RM could reduce siltation in the upstream environment by reestablishing and reseeding the roadway ditches, which have been silted over or disturbed and not revegetated, resulting in eroded channels for drainage conveyance or blockages to the drainage. The RM may also want to require silt fence be installed at the time of new lot developments so as to reduce the influx of silts and sands to the drainage system by new builds.
- The RM should register drainage easements where the developments intended drainage runs through the lots. This is expected to include [redacted].
- Implement a swale with articulate blocking in [redacted] to manage storm water runoff downstream of the Central 450 mm diameter culvert. This option is expected to be a robust solution that will work well in the design flow as well as larger storm events. Following installation, this solution is the most 'hands-off' of the options reviewed for the RM, resulting in a one-time cost to resolve the issue.

Below is a summary of the recommendations with associated Class 5 cost estimates. A Class 5 cost estimate indicates that the design is between 0 and 2 percent complete and the estimate is based on limited information and has wide accuracy ranges. Consequently, the actual cost is expected to fall within a range of -30% to +50% of the cost estimate. Note that all costs are in 2023 dollars even though they may not be implemented for many years.

Section	Recommendation	Class 5 Cost Estimate ($)
	Mobilization	20,000
3.4.1	Replace 450 mm with two 600 mm culverts	17,000
3.4.2	Add one 550 mm culvert	8,500
4.1	Deepen Ditch and Repair Turnaround	4,000
4.3	Deepen Ditch and Remove Siltation	4,750
4.4	Fill Low Spot in Block 6, Lot 16	
4.2	Flush and Remove Debris from 450 mm Highway Culvert	2,000
4.5	Flush and Remove Debris from East 600 mm Culvert	
5.4	Add Swale with Articulate Blocking in Block 5, Lot 16	27,000
	Subtotal (exclusive of applicable taxes)	**83,250**
	Expected Range (-30%)	**58,275**
	Expected Range (+50%)	**124,875**

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APPENDICES

1 BACKGROUND INFORMATION

Wyatt Engineering Ltd. (WE) was retained by the Rural Municipality of North Qu'Appelle No. 187 (the RM; the Client) to complete an assessment and design for drainage improvements in the Jasmin Development on Echo Lake.

Jasmin Development is located on the north shoreline of Echo Lake, south of Highway No. 56 within SW 26-21-14 W2M (the Development; Jasmin; the Site). Jasmin contains 66 lots and is zoned as 'Resort Residential' (RR).

The development's drainage is managed by approximately 960 m of shallow ditches along rural roadways and five (5) culverts, intended to convey runoff from the northern higher ground southward to Echo Lake. The five culverts consist of two 450 mm (18 inch), one 550 mm (22 inch), one 600 mm (24 inch) and one lengthy 800 mm (32 inch); some of the culvert ends were fairly damaged, so the aforementioned sizing is expected to be a close approximate to the actual sizing and consistent with the analysis of this report. For simplicity and reference throughout this report, the culverts have been labelled CSP 1 through 5 as such:

- CSP 1 – 450 mm dia. on Aaron Court;
- CSP 2 – 550 mm dia. on Aaron Place;
- CSP 3 – 450 mm dia. on Aaron Drive (west);
- CSP 4 – 600 mm dia. on Aaron Drive (east); and
- CSP 5 – 800 mm dia. through [redacted].

For clarification on culverts within the Development, refer to Sheet 100 in Appendix A – Figures.

The RM has received complaints of inadequate drainage due to an increase in runoff with recent development within the RM. Jasmin is currently partially built-out; there is a concern that the issues identified will be exacerbated as the development reaches full build-out.

1.1 SITE OBSERVATIONS

On September 23, 2022 and again on May 5, 2023, WE representatives reviewed the existing drainage features at the site and concerns brought forward by the RM and local residents.

CSP 2 on Aaron Place visually appears to be adequately managing the storm water and outlets into the Municipal Reserve parcel (MR2), which has an adequate outlet to Echo Lake.

CSP 5 collects water from MR1, which is fed by a 600 mm diameter culvert under Highway No. 56. The culvert runs through a treed/shrubbed area between [redacted] to discharge into Echo Lake. There is no easement registered for this pipeline. There is a ditch block directly west of the CSP

5 inlet, directing flow from the northern lots towards CSP 4. CSP 4 has a much smaller catchment and does not have any visual indicators that the culvert is inadequate to service its catchment area.

The areas of concern identified by the RM and local residents included:

- The turnaround on the west end of Aaron Place, has had lumber placed on the south side to prevent runoff from flowing into [redacted]
- The 450 mm diameter culvert crossing beneath Highway 56 is clogged, causing water to flow across the Highway via the adjacent 1900 mm walkway, and into [redacted].
- The north ditch along Aaron Place, west of the intersection with Jasmin Place, has silted-over trapping and accumulating runoff until eventually flowing over the roadway and into [redacted].
- There is ponding on the southwest corner of [redacted]
- The 'drain box' receiving flow from CSP 3 between [redacted] backs up, and overflows through both lots. [redacted] has experienced significant erosion along the side yard, which the owners have indicated they have repaired on numerous occasions. [redacted] has a gravel pad in their side yard for parking that washes into the backyard and settles in the artificial grass.
- CSP 4 is partially clogged with debris reducing the capacity of the culvert. No issues have been identified with the culvert backing up.

Refer to Sheet 200 and 201 in Appendix A – Figures, for clarification on the locations of issues observed.

1.2 CLIENT OBJECTIVES

The objectives of this project are to:

- Review the drainage into the development and confirm whether the existing culverts are sized appropriately for expected flows;
- Review the drainage concerns that are negatively impacting [redacted] within Jasmin and provide:
  - Options available to resolve the identified drainage concern;
  - A Class "D" cost estimates for each option; and
  - A recommendation on the option which provides the best value.

2 REGIONAL CONDITIONS

2.1 TOPOGRAPHY AND REGIONAL DRAINAGE

The Government of Saskatchewan Ministry of Environment publishes interactive maps with broad contours throughout Saskatchewan[1] which were utilized to determine the overall drainage patterns for the region. The major drainage runs in the region consist of:

- Jumping Deer Creek, west of the Site, which runs southward and discharges into Pasqua Lake; and
- A major drainage tributary east of the Site running southward from east of Lipton to Fort San and discharging into Echo Lake.

The drainage runs through the Jasmin Development are considered minor drainage runs, carrying local runoff from within the northern half of the Development as well as water received from the northern higher ground, with flow directed towards Echo Lake. There are two culverts below Highway No. 65 with pass the northern flow into the Development, and consist of a 450 mm culvert, north of Aaron Court and a 600 mm culvert on the eastern extents of Jasmin. A catchment for the highway culverts cannot be clearly defined with the limited contours available and without incurring significant costs; however, it is assumed to be no more than two quarter sections of agriculture land (128 ha or 320 acres).

There are no other developments observed upstream of Jasmin that would be considered a major influence to storm water runoff beyond agricultural conditions, which will generate similar runoff to pre-development conditions. There is potential for a development site north of Highway No. 56, upstream of Jasmin; a detailed review of the regions drainage would need to be re-evaluated at that time, if development was ever pursued.

2.2 AIR PHOTOS & SATELLITE IMAGERY

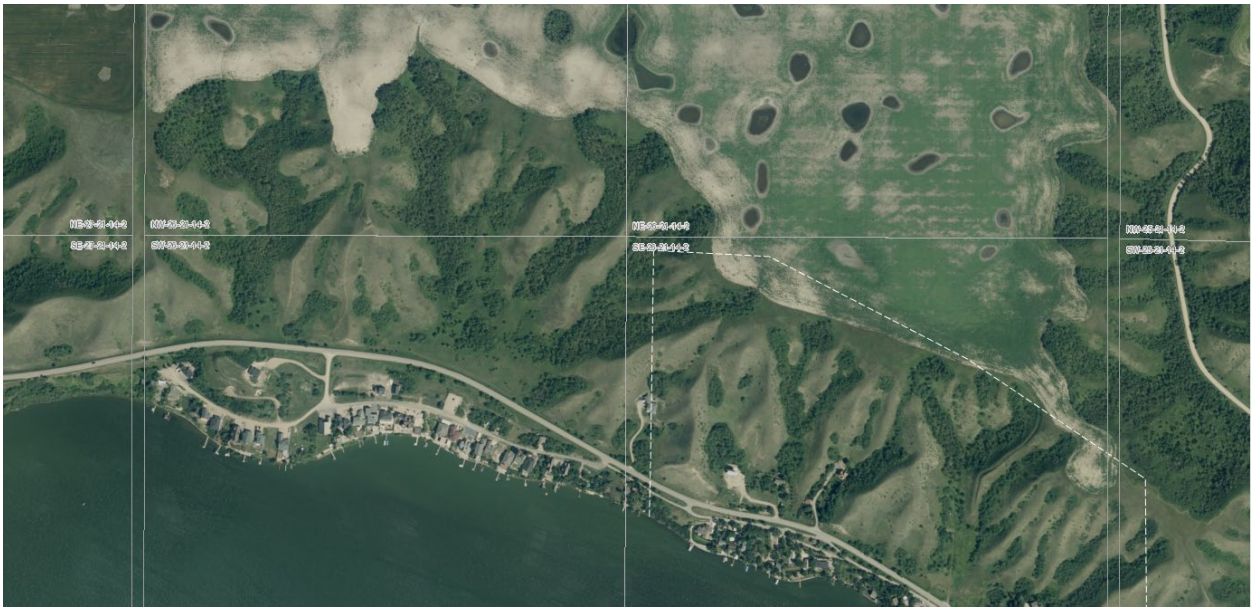
WE reviewed historical air photos[2] to gain an understanding of drainage in the region.

The northern higher ground is hummocky moraine, with numerous wetlands spread throughout the countryside. These wetlands can reduce the impacts of storm events by providing retention of localized storm water runoff. These become less effective when the groundwater is higher, leaving less available room for storage, as well as in major storm events when the ponds are full.

[1] Government of Saskatchewan. geohub.saskatchewan.ca. Reviewed September 21, 2023.
[2] Government of Saskatchewan. "Agricultural Drainage Application Mapping (ADAM)".

The catchment area north of Jasmin consists only of agricultural lands.

Figure 1 – Satellite Image of Jasmin[3]



The hillside directly upstream of the Jasmin Development consists of drainage channels, conveying water towards the lake from the higher northern ground.

2.3 REGIONAL GEOLOGY & HYDROGEOLOGY

The Saskatoon Group is the upper most group of sediments located at surface and consists of the Battleford Formation and a Floral Formation (Upper Floral Till Unit, Middle Member, and Lower Floral Till Unit).

The Battleford Formation is characterized by its soft consistency and is typically composed of soft, massive, oxidized till typically exhibiting a pre-consolidated pressure of 450-750 kPa. This unit is typically highly discontinuous and is rarely used as a water source[4].

The Floral Formation is the stratigraphic formation underlying the surficial deposits; it is within the Saskatoon stratigraphic grouping which consists of paleo-oxidized horizons and/or intertill stratified deposits. Floral formations are typically composed of till with underlain gravel, sand, silts or clays that are entrapped between an additional layer of till. The upper layer of the floral formation is typically composed of a strong oxidizing till containing high volumes of iron and magnesium[4]. The formation typically exhibits a pre-consolidated pressure of 1800 ± 200 kPa and is characterized by a hard, jointed and stained till[5].

[3] Government of Saskatchewan. "Agricultural Drainage Application Mapping (ADAM)".
[4] MDH Engineered Solutions. "Hydrogeology Mapping of NTS Mapsheet Regina 72I". May 2013.
[5] Christiansen, E.A. "Geology and Groundwater Resources of the Regina Area, Saskatchewan Research Council." 1961.

The Middle Floral Aquifer (Regina Aquifer) is one of the most utilized aquifers in the area, with both municipal and industrial users. Flow in this aquifer in the Regina area is considered to be relatively flat, with a minimal northern flow towards Wascana Creek, Boggy Creek, and the Qu'Appelle River. Recharge of groundwater flowing into the Regina Aquifer is typically from meteoric water such as rainfall, snowmelt and river systems. Water from this aquifer is calcium-sulfate type, with an average total dissolved solids concentration of 1,473 mg/L[6].

2.4 RAINFALL EVENTS

The closest Environment Canada monitoring station, which had an Intensity-Duration-Frequency (IDF) Curve available is in Indian Head, SK[7]. Using the IDF Curves, the expected depth of rainfall over the area for a 24-hour period, for varying rainfall events is presented in the table below.

Table 2-1: 24-hour Rainfall Data for Indian Head

24 Rainfall Event	
Probability in Any One Year	24 Hour Rainfall (mm)
1:2	42.4
1:5	57.8
1:10	68.0
1:25	80.9
1:50	90.5
1:100	100.0

[6] MDH Engineered Solutions. "Hydrogeology Mapping of NTS Mapsheet Regina 72I". May 2013.
[7] Government of Canada, Environment and Climate Change Canada. "Short Duration Rainfall Intensity-Duration-Frequency-Data." March 27, 2020.

3 IMPACTS OF DEVELOPMENT

3.1 UPSTREAM FLOWS

A minor drainage system, which consists of catch basins, pipes and culverts are typically evaluated based on a 1:5 year storm event. A major storm drainage system is typically evaluated on a 1:100 year storm event and would include considerations for overland flow once the minor system is overwhelmed, such as overtopping roads, channelization, and developing storm water retention to control the impacts of the regional drainage.

The major system for the region primarily consists of Jumping Deer Creek and the eastern tributary to the lakes. There was no evaluation of the major system as part of this study, as it is largely not related to the concerns brought forward, nor the typical drainage within Jasmin.

The minor system is being evaluated on a 1:5 year, 24-hour event. The drainage into Jasmin is impacted by the culverts under the Highway, as it appears flow would be detained in this area (i.e., backup) and dissipate via the culverts over time. In a 24-hour period, the retention may get as high as 1 m of head. This calculated value correlates nicely with the 1900 mm walking path 'culvert' being installed 1.2 m above the invert of the 450 mm invert of the drainage culvert. The calculated flow from these culverts will be used as the drainage 'inputs' into the development.

The RM also requested a review of a higher intensity, lower duration storm event. The 1:100 year, 15-minute event was agreed to be representative of the requested scenario.

3.1.1 Design Assumptions

Assuming there are two quarter sections of land (256 ha or 640 acres) that produce runoff to the development area, it is estimated that 65% of runoff is conveyed to the east side of the development toward the existing 600 mm diameter culvert below Highway 56, and the other 35% is received by the 450 mm diameter culvert below Highway 56, north of the cul-de-sac, Aaron Court. The 1900 mm 'culvert' at the west crossing is intended to allow for foot traffic below the Highway, and not for conveyance of stormwater and is therefore, not included in the evaluation of the minor drainage system.

Soils for the region are assumed to be a mix of sand and silt, with an average infiltration rate ranging between 3.75 mm/hr to 7.50 mm/hr. It is also assumed that there is approximately 5% coverage of wetlands, available to retain stormwater.

The maximum recommended run-length for sheet flow is 90 m (300 ft) for sheet flow, as it relates to the development of the 'time of concentration'. The time of concentration is the theoretical amount

of time for water to conglomerate into the flow received at the point of concern, typically the outlet. For this study, it is utilized in developing the flow being received at the Highway's east 600 mm corrugated steel pipe (CSP) culvert and west 450 mm CSP culvert.

3.1.2 1:5 Year, 24-hour Duration Storm Event

The calculated flow from the northern region is approximately 3.2 m^3/s for a 1:5, 24-hour duration storm event. With the two culverts below the Highway restricting flow entering Jasmin, the 450 mm culvert north of the cul-de-sac (Aaron Court) is expected to receive 35% of the incoming flow, with a flow of 0.70 m^3/s, at 1 m of head and the east 600 mm culvert is expected to receive 65% of the incoming flow, resulting in a flow into of 1.25 m^3/s, at 1 m of head.

3.1.3 1:100 Year, 15 Minute Duration Storm Event

The calculated flow from the northern region is approximately 0.96 m^3/s. Again, the two culverts below the Highway restrict the flow entering Jasmin. The west 450 mm culvert receives 35% of the incoming flow, resulting in a flow into Jasmin of 0.28 m^3/s, with 0.16 m of head. Similarly, the east 600 mm culvert is expected to receive 65% of the incoming flow, resulting in an estimated flow into Jasmin of 0.50 m^3/s, with 0.16 m of head.

3.2 PRE-DEVELOPMENT CONDITIONS

For the purpose of this study, predevelopment conditions will refer to development within Jasmin only. In other words, the northern lands are assumed to be agriculture and Highway No. 56, with its associated culverts, are assumed to be in place when considering the predevelopment conditions. This analysis is expected to address the concerns brought forward by the RM and Jasmin residents regarding their experiences of **increased** runoff with the increase in number of lots developed.

3.2.1 1:5 Year, 24-hour Duration Storm Event

There are five culverts within Jasmin, with associated catchments. A summary of the relative drainage information and expected flow utilizing the Rational Method can be found in the table below. The runoff coefficient ($C_{PREDEV.}$) utilized for Lawns – sandy soil, steep (>7%) ranges from 0.15 to 0.20[8]; to remain conservative, it is assumed the runoff coefficient for predevelopment is 0.15. Intensity (I) is determined using the IDF Curves and calculated time of concentration for each catchment.

[8] Ned H.C. Hwang & Robert J. Houghtalen "Fundamentals of Hydraulic Engineering Systems." Third Ed. New Jersey, USA. 1996.

Table 3-1: Pre-Development Flows for 1:5 Year, 24-hr Storm Event

Catchment Description	Area (ha)	Culvert Dia. (mm)	$C_{PREDEV.}$	I (mm/hr)	$Q_{CATCHMENT}$ (m^3/s)	Q_{NORTH} (m^3/s)	Q_{TOTAL} (m^3/s)
CSP 1	0.29	450	0.15	8.3	0.001	0.705	0.706
CSP 2	2.47	550	0.15	14.0	0.014	0.705	0.719
CSP 3	1.79	450	0.15	21.2	0.016	0.000	0.016
CSP 4	0.88	600	0.15	12.5	0.005	0.000	0.005
CSP 5	0.17	800	0.15	7.0	0.000	1.253	1.253
Total	**5.60**		**0.15**		**0.035**	**1.959**	**1.994**

Since there are no intentions to have on-site storage or retention of runoff, the capacity is the maximum flow achieved through the existing culverts via gravity. A comparison of the capacity to the expected flow in pre-development conditions is summarized in the table below.

Table 3-2: Capacity in Pre-development Conditions

Catchment Description	Area (ha)	Culvert Dia. (mm)	Q_{TOTAL} (m^3/s)	$Q_{CAPACITY}$ (m^3/s)	Deficiency (m^3/s)
CSP 1	0.29	450	0.706	0.159	-0.547
CSP 2	2.47	550	0.719	0.367	-0.352
CSP 3	1.79	450	0.016	0.202	0.186
CSP 4	0.88	600	0.005	0.427	0.422
CSP 5	0.17	800	1.253	1.803	0.550

In pre-development conditions, CSP 1, the northern 450 mm diameter culvert, and CSP 2, the southwestern 550 mm diameter culvert, are both undersized for the anticipated design flow for a 1:5 year, 24-hour storm event.

3.2.2 1:100 Year, 15-Minute Duration Storm Event

Using the same approach for a 1:100, 15 minute storm event, see the expectant flows and capacity deficiencies in Tables 3-3 and 3-4.

Table 3-3: Pre-Development Flows for 1:100 Year, 15-min Storm Event

Catchment Description	Area (ha)	Culvert Dia. (mm)	$C_{PREDEV.}$	I (mm/hr)	$Q_{CATCHMENT}$ (m^3/s)	Q_{NORTH} (m^3/s)	Q_{TOTAL} (m^3/s)
CSP 1	0.29	450	0.15	16.8	0.002	0.282	0.284
CSP 2	2.47	550	0.15	27.2	0.028	0.282	0.310
CSP 3	1.79	450	0.15	39.3	0.029	0.000	0.029
CSP 4	0.88	600	0.15	24.3	0.009	0.000	0.009
CSP 5	0.17	800	0.15	14.3	0.001	0.501	0.502
Total	**5.60**		**0.15**		**0.067**	**0.783**	**0.850**

Table 3-4: Capacity in Pre-development Conditions

Catchment Description	Area (ha)	Culvert Dia. (mm)	Q_{TOTAL} (m^3/s)	$Q_{CAPACITY}$ (m^3/s)	Deficiency (m^3/s)
CSP 1	0.29	450	0.284	0.159	-0.125
CSP 2	2.47	550	0.310	0.367	0.057
CSP 3	1.79	450	0.029	0.202	0.173
CSP 4	0.88	600	0.009	0.427	0.418
CSP 5	0.17	800	0.502	1.803	1.301

In pre-development conditions for the 1:100, 15-min storm event, only CSP 1 is expected to be undersized for the incoming flows.

3.3 POST DEVELOPMENT CONDITIONS

Post Development assumes all lots within Jasmin are fully developed. As such, the runoff coefficient needs to be revised to accurately reflect the decrease in permeable surface areas associated with rooftops, driveways and manicured landscaping which has a much lower permeability than pre-developed grasses. The runoff coefficient for residential – single family ranges from 0.30 to 0.50[9]; to be conservative, the 'worst-case' scenario of 0.50 is utilized in this analysis.

[9] Ned H.C. Hwang & Robert J. Houghtalen "Fundamentals of Hydraulic Engineering Systems." Third Ed. New Jersey, USA. 1996.

3.3.1 1:5 Year, 24-hour Duration Storm Event

Table 3-5 outlines the expected flows in post-development conditions for a 1:5 Year, 24-Hour Storm Event.

Table 3-5: Post Development Flows

Catchment Description	Area (ha)	Culvert Dia. (mm)	$C_{PREDEV.}$	I (mm/hr)	$Q_{CATCHMENT}$ (m^3/s)	Q_{NORTH} (m^3/s)	Q_{TOTAL} (m^3/s)
CSP 1	0.29	450	0.50	8.3	0.003	0.705	0.708
CSP 2	2.47	550	0.50	14.0	0.048	0.705	0.753
CSP 3	1.79	450	0.50	21.2	0.053	0.000	0.053
CSP 4	0.88	600	0.50	12.5	0.015	0.000	0.015
CSP 5	0.17	800	0.50	7.0	0.002	1.253	1.255
Total	**5.60**		**0.50**		**0.118**	**1.959**	**2.077**

Using the same analysis for capacity as for pre-development conditions, Table 3-6 summarizes the capacity of the culverts for each catchment and any shortfalls identified.

Table 3-6: Post Development Capacity

Catchment Description	Area (ha)	Culvert Dia. (mm)	Q_{TOTAL} (m^3/s)	$Q_{CAPACITY}$ (m^3/s)	Deficiency (m^3/s)
CSP 1	0.29	450	0.708	0.159	-0.549
CSP 2	2.47	550	0.753	0.367	-0.386
CSP 3	1.79	450	0.053	0.202	0.149
CSP 4	0.88	600	0.015	0.427	0.412
CSP 5	0.17	800	1.255	1.803	0.548

As with the pre-development conditions CSP 1 and CSP 2 are both undersized for the anticipated design flow for a 1:5 year, 24-hour storm event. The remaining three culverts have sufficient capacity for the increased flows expected at full build-out of the Development.

3.3.2 1:100 Year, 15-Minute Duration Storm Event

Table 3-7 and 3-8 provide the same analysis but for a 1:100, 15-Minute Storm Event.

Table 3-7: Post Development Flows

Catchment Description	Area (ha)	Culvert Dia. (mm)	$C_{PREDEV.}$	I (mm/hr)	$Q_{CATCHMENT}$ (m^3/s)	Q_{NORTH} (m^3/s)	Q_{TOTAL} (m^3/s)
CSP 1	0.29	450	0.50	16.8	0.007	0.282	0.289
CSP 2	2.47	550	0.50	27.2	0.093	0.282	0.375
CSP 3	1.79	450	0.50	39.3	0.098	0.000	0.098
CSP 4	0.88	600	0.50	24.3	0.030	0.000	0.030
CSP 5	0.17	800	0.50	14.3	0.003	0.501	0.504
Total	**5.60**		**0.50**		**0.224**	**0.783**	**1.007**

Table 3-8: Post Development Capacity

Catchment Description	Area (ha)	Culvert Dia. (mm)	Q_{TOTAL} (m^3/s)	$Q_{CAPACITY}$ (m^3/s)	Deficiency (m^3/s)
CSP 1	0.29	450	0.289	0.159	-0.130
CSP 2	2.47	550	0.375	0.367	-0.008
CSP 3	1.79	450	0.098	0.202	0.104
CSP 4	0.88	600	0.030	0.427	0.397
CSP 5	0.17	800	0.504	1.803	1.299

As is the case with all the scenarios, the CSP 1 appears to be undersized. In post-development conditions, CSP 2 would be considered 'borderline', as it is theoretically just over its maximum available capacity.

3.4 RECOMMENDATIONS

The recommendations provided are based on preliminary information only. The design is estimated to be between 0 and 2 percent complete; therefore, the associated cost estimates provided are based on limited information and have a wide range of accuracy. Consequently, the actual cost is expected to fall within a range of -30% to +50% of the cost estimate. Note that all costs are in 2023 dollars even though they may not be implemented for many years.

3.4.1 North Culvert

There have been no complaints for the two culverts (ie. CSP 1 and CSP 2) observed to be undersized. However, CSP 1 may not be receiving the full expected flow at this time due to upstream clogging. Refer to Section 4.2 – Flow Through Walking Path Culvert for further explanation on the issues observed.

Assuming the upstream issue is resolved, this culvert may need to be upsized to keep-up to the incoming flow from the north. Depending on the ability to increase cover on the road at this location, the RM could:

- replace the existing 450 mm culvert with one 800 mm culvert;
- replace the existing 450 mm culvert with two 600 mm culverts; or
- add four additional 450 mm culverts to the existing 450 mm culvert.

Although only a single pipe, the 800 mm culvert is expected to be more expensive than the two 600 mm culverts, particularly when considering the increased pipe cover requirements and need to adjust the road elevations. As such, the most economical solution is expected to be the replacement with two 600 mm culverts.

The cost for supply and installation of two new 600 m culvert is expected to be approximately **$17,000**, exclusive of applicable taxes and mobilization. The costs may be significantly reduced, if completed by the RM and not an external contractor.

Since the RM has not received any complaints at this location, and there were no reports of the culvert previously being overwhelmed, this may be a location which the RM should monitor, particularly with the clearing of the upstream culvert, to observe any changes. At this time, replacing this culvert is considered a low priority.

3.4.2 West Culvert

There have been no complaints for the capacity of CSP 2. It is expected that in higher flow events, the water backs up into the ditches until the culvert can 'catch up'. This may be attributing to the siltation observed in the north ditch; refer to Section 4.3 North Ditch Siltation.

The RM could resolve the undersized culvert by:

- replacing the existing 550 mm culvert with one 750 mm culvert; or
- add one additional 550 mm culvert to the existing 550 mm culvert.

Adding one 550 mm culvert is expected to be the best value solution for the RM.

The cost for supply and installation of a new 550 m culvert is expected to be approximately **$8,500**, exclusive of applicable taxes and mobilization. Again, the costs may be significantly reduced, if completed by the RM and not an external contractor.

Again, since the RM has not received any complaints at this location, and there were no reports of the culvert previously being overwhelmed, this may be a location which the RM should monitor, to observe any changes. At this time, adding a culvert at this location is considered a low priority.

4 LOCALIZED ISSUES

4.1 WEST TURNAROUND

The adjacent homeowner indicated that water has come pouring through his lot, [redacted], during spring runoff and larger storm events. The homeowner put logs across the south side of the turnaround to block runoff and redirect eastward into the roads south ditch; refer to Figure 2.

Figure 2 - Logs at West Turnaround on Pasqua Lake Road

Although the logs have been effectively redirecting the runoff, it is a significant safety concern, and prevents the turnaround from functioning as intended. Due to the placement and length of the logs, the radius remaining for the turnaround is too small for vehicles to actually complete a turnaround, resulting in three point turns in the road or using adjacent homeowner driveways.

4.1.1 Recommendation

WE recommends the ditch be deepened on the south side of the turnaround, preventing runoff from exiting the ditch. The design drawings were completed by WE, for execution by the RM to remove the logs and deepen the ditch at this location. Refer to Appendix B – Drawings. The redefined ditch should have a minimum of 100 mm of topsoil added after the new ditch is established and seeded. The turnaround is to be repaired on the south side and 50 mm of traffic gravel applied to the surface.

If the RM decided to have the works completed by a local contractor, the deepening of the ditch consists of removing approximately 40 m^3 of soil. It is assumed the in-situ material can be used to repair the turnaround and excess is blended into the embankments in the surrounding area (i.e., does not require hauling offsite). The cost is expected to be approximately **$4,000**, exclusive of applicable taxes and mobilization.

4.2 FLOW THROUGH WALKING PATH CULVERT

The 450 mm diameter culvert crossing Highway 56 has significant debris deposits, restricting flow. The area north of the Highway fills with water and spills to the south via the 1900 mm walkway culvert. The water from this culvert is directed over the road, Aaron Court and into [redacted], instead of being conveyed to the defined drainage ditch. Refer to Figures 3 and 4.

Figure 3 - 1900 mm and 450 mm Culverts North of Aaron Court

Figure 4 - Drainage from 1900 mm and 450 mm Highway Culverts

4.2.1 Recommendation

The RM should jet, flush and/or hydrovac the culvert to ensure it remains open and usable. The smaller diameter discharge will restrict flows to Aaron Courts ditch, preventing the flooding observed when being received by the 1900 mm culvert.

The cost for a hydrovac is expected to be approximately **$2,000** per day, exclusive of applicable taxes and mobilization. The RM could include this culvert flushing with others within the RM to optimize the value received for the cost.

4.3 NORTH DITCH SILTATION

The north ditch of Aaron Place has silted-over, west of the intersection with Jasmin Place, restricting the flow-through of runoff and eventually overtopping the road into [redacted].

Based on feedback of local residents, the partially developed lots cause significant runoff and washdown of silts and sands, as the natural vegetation which typically would hold the soils in place are stripped and removed. Once the landscaping for the lots is complete, this issue is expected to subside. However, with the development only being partially complete, this is anticipated to be an issue for the near future.

4.3.1 Recommendation

WE recommends the ditch be re-established and slightly deepened on the north side of the road and finished with topsoil and seeding. The grass will collect some silt and being deepened will allow for small amounts to accumulate within the ditch before requiring to be re-established again. The design drawings were completed by WE, for execution by the RM to deepen the ditch at this location. Refer to Appendix A – Drawings.

CSP 2 may also need to increase in capacity, allowing for solids to be carried downstream into the MR space. Refer to Section 3.4.2 West Culvert.

If the RM decided to have the works completed by a local contractor, the deepening of the ditch consists of removing approximately 45 m³ of soil. It is assumed the in-situ material can be blended into the embankments in the surrounding area (i.e., does not require hauling offsite). The cost is expected to be approximately **$4,750**, exclusive of applicable taxes and mobilization.

To reduce future siltation of the drainage ditches, the RM should include and enforce erosion control (typically via silt fence) for new building permits.

4.4 PONDING IN [redacted]

The RM indicated that there is pooling in the southwest corner of [redacted] near the large Recycling Bin, following rain events; refer to Figure 2. There is concern that the infiltration of the standing water will impact the adjacent road conditions.

4.4.1 Recommendation

There is adequate grade from the northwest to the southeast, along the ditch. There is a localized low-lying area observed that should be filled in to prevent ponding.

Cost efficiencies could be optimized if this work was to be completed in conjunction with the aforementioned ditch deepening, where this location could be used to blend excess material collected and have no additional costs associated with it. This work is also expected to be within the RM's capabilities and would have minimal cost implications (less than $1000) if completed by the RM, independent of the previous recommendations.

Figure 5 - Low Lying Area in [redacted]


[redacted]

4.5 SILTATION OF EAST 600 mm DIA. CULVERT

The eastern 600 mm dia. culvert has debris reducing the capacity of the culvert.

4.5.1 Recommendation

This culvert is expected to be oversized for the expected flows in a 1:5 year , 24-hour event; refer to Section 3.3 – Post Development Conditions. However, it is good practice to keep the culverts clear of debris.

The cost for a hydrovac is expected to be approximately **$2,000** per day, exclusive of applicable taxes and mobilization. The RM could include this culvert flushing with others within the RM to optimize the value received for the cost.

5 DRAIN BOX AT [redacted]

5.1 DESCRIPTION OF DRAINGE ISSUE

The following summary of the issues observed at [redacted] are based on discussions with the RM, discussions with the Owner's of [redacted], combined with WE's observations at the site walkthroughs.

Although CSP 3 is expected to be capable of adequately passing the incoming flow (refer to Section 3.3), there remains issues downstream of this culvert with the existing works.

Figure 6 - Runoff Collection Box

CSP 3 transfers water from the northern side of the road to the southern side of the road and into a wooden 'drain box'. The drain box collects runoff from the 450 mm diameter culvert, as well as the surficial runoff from the adjacent driveways and weeping tile line below the western driveway. This box had one 150 mm weeping tile outlet visible, however, the lot owner indicated there are two additional 100 mm weeping tile connections below the 150 mm line, but the box had been filled in with gravel/silt over time and the lines were no longer visible; refer to Figure 6.

The weeping tile discharges to a corrugated steel pipe vertical column, where the water drops to a small diameter HDPE outlet to Echo Lake. The HDPE line passes through an existing concrete retaining wall.

The lot owner indicated that the weeping tile lines out of the drain box are known to be clogged with debris. He indicated there has been a previous attempt to jet the weeping tile lines from the upstream and downstream ends with no success, rendering the pipes ineffective at passing flow.

With the weeping tile unable to adequately pass the incoming flows generated by the culvert and adjacent surficial runoff, the water flows overland and causes erosion and washout on [redacted] and [redacted] refer to Figure 7 and 8. According to the lot Owner, [redacted] is regraded several times a year. [redacted] has a gravel parking pad at the front of the lot; the gravel is washed down the side yard and deposits on the artificial turf in the backyard, which is a maintenance challenge for this homeowner.

According to the Owner of [redacted], this culvert and drain box provided sufficient drainage until the development of the northern lots ([redacted]) was initiated.

Figure 8 - Observed Erosion at [redacted]

Figure 7 - Observed Erosion [redacted]

This culvert does not currently have a downstream drainage easement nor an adequate outlet. As the development continues to progress towards full build out, this location will experience an increase in events that overwhelm the drainage box, due to the loss of permeable and vegetated surfaces being replaced with driveways, houses and garages. Based on the assessment of pre-development to post development, the flow at this location is anticipated to triple, to an ultimate design flow of 0.053 m^3/s for a 1:5 year, 24-hour storm event.

5.2 DRAIN BOX CAPACITY

The incoming 450 mm diameter culvert is anticipated to have a design flow of 0.053 m3/s or 53 L/s for a 1:5 year, 24-hour storm event. The incoming 150 mm weeping tile and surface drainage from the adjacent driveway is anticipated to have minimal impact, with the calculated flow of 0.9 L/s. If the three outlet pipes within the drain box were fully functioning, they would have a design flow of 69 L/s, which is greater than the incoming 54 L/s. However, with the two 100 mm weeping tile unable to pass the full flow, the 150 mm alone would theoretically convey 41 L/s.

The minimum size recommended for a centralized minor storm water management system is 250 mm (10 inch), which would also include catch basin(s) with a sump for collection of solids, to prevent debris build-up within the pipes. The catch basins are required to be cleaned out intermittently.

Additionally, weeping tile is a very flexible pipe, which is easily susceptible to having bends and sags within the pipe. These locations will be prone to collecting sediment and debris.

5.3 OPTIONS FOR REPAIR

Seeing that the lot Owners have made multiple attempts to jet and hydrovac the existing weeping tile lines, it is unlikely that the existing system can be rehabilitated to provide full flow. Since the current solution does not use recommended practices and cannot be rehabilitated, the most viable options for repair include:

- Surface Runoff
  - With Armouring (Option 1A)
  - With Landscaping (Option 1B)
- Minor Piped System
  - To Echo Lake (Option 2A)
  - To the Backyard (Option 2B)

With any of the options implemented, WE recommends the RM registers an easement in [redacted] for the drainage works.

5.3.1 Option 1A – Surface Runoff with Armouring

Option 1A – Surface Runoff with Armouring, includes removing the existing drain box and decommissioning the associated weeping tile connections, regrading the culvert outlet to directly discharge to a new swale through [redacted] complete with rip rap or articulate blocking, underlain with a geotextile matting. The rip rap or articulate blocking would typically retain the incoming siltation and debris and may need to get cleaned out from time to time, particularly in the interim while Jasmin is developing to full build-out.

Figure 10 –Articulate Blocking[10]

Figure 9 - Articulate Blocking[11]

The toe of the swale will terminate at the existing corrugated steel 'well' at the back of the lot, to discharge via the weeping tile connection through the retaining wall. The well must have a catch basin grate added for safety and to ensure animals do not become

[10] Shoreflex. "Roadside Channel. Killeen, Texas". www.shoreflex.com
[11] Belgard. "Turfstone™ Environmental". www.belgard.com

trapped within the well. The well is expected to backup due to the limited capacity of the existing 150 mm weeping tile connection to drain via gravity. However, when there is approximately 0.5 m of head within the well, the weeping tile connection is expected to flow beyond the design flow of 54 L/s.

The estimated costs for Option 1A are **$27,000** exclusive of applicable taxes and mobilization. It is highly recommended that the RM register an easement for the swale proposed within [redacted]

The benefits of Option 1A are:

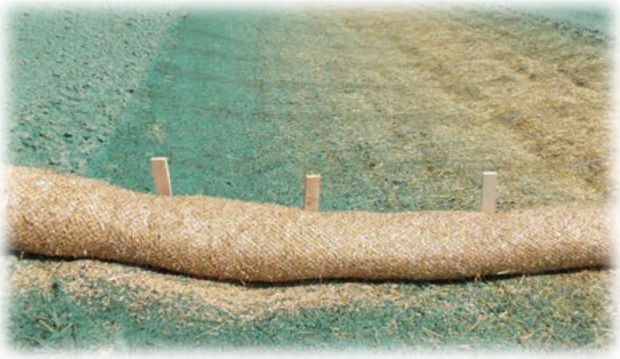
- Articulate blocking is robust solution expected to be aesthetic, functional and safe for a side yard. Rip rap would continue to be functional in a drainage application, but may cause frustrations for the homeowner, as it would significantly impact accessibility to the backyard through the side yard.
- It is expected to perform well at the design flow and larger storm events.
- Articulate blocking would require little to no maintenance. Rip rap would require clearing out debris, particularly while the lots are still being developed when siltation is high, and weed management; however, still relatively low maintenance option.
- It is simple to construct and install.
- It is somewhat cost effective in comparison to the other options.

The drawbacks of Option 1A are:

- It is still relatively expensive for the RM. It may be more cost effective if the RM were capable of completing the works in-house.
- The runoff and collected siltation will be surficial and visual to the homeowner.
- There would be restrictions for the landowner on landscaping or structures within the drainage area.

5.3.2 Option 1B – Surface Runoff with Landscaping

Figure 11 – Wattle[12]



Similarly, Option 1B – Surface Runoff with Landscaping, includes removing the existing drain box and decommissioning the associated weeping tile connections, regrading the culvert outlet to directly discharge to [redacted] side yard which has established vegetation. To ensure vegetation establishes, the initial construction would include the placement of coconut matting, which will naturally degrade over the course of a couple years, and placement of 150 mm (6 inches) of topsoil and grass seed. Wattles would be placed linearly, perpendicular to the flow along the side yard to dissipate incoming flow from the culvert, collect siltation and prevent erosion and washout of the topsoil and seed before the vegetation can establish. Once the vegetation is fully established (estimated to take 2 years), the wattles can be removed.[12]

[12] Miller Seed. Image Gallery. www.millerseed.com.

The estimated costs for Option 1B are **$11,750** exclusive of applicable taxes and mobilization.

The benefits of Option 1B are:
- Ultimately, it will be aesthetic, functional and safe for a side yard.
- Once vegetation establishes, it will require little to no maintenance.
- It is simple to construct and install.
- It is the most economical option by far.

The drawbacks of Option 1B are:
- The runoff and collected siltation will be surficial and visual to the homeowner. The siltation may need to be cleared intermittently, particularly until Jasmin is fully developed.
- There may be frustrations by the homeowner in its interim state, as it will restrict access from the front yard to the backyard.
- There would be restrictions for the landowner on landscaping or structures within the drainage area.
- It is expected to perform well for the design flow but may be susceptible to erosion for larger storm events, in which case, it will require repair and rehabilitation.
  - Depending on the frequency of the larger storm events, this cost may compound over time.

5.3.3 Option 2A – Minor Piped System to Echo Lake

Option 2A – Minor Piped System to Echo Lake, includes replacing the existing drain box with a catch basin and boring a pipe through the side and back yards, and through the existing retaining wall to discharge to Echo Lake.

The estimated costs for Option 2A are **$66,000** exclusive of applicable taxes and mobilization. The RM may be required to add an oil/grit separator due to the sensitivity of the receiving Echo Lake (dependent on Water Security Agency permitting requirements); this will **add $10,000** to the estimated costs.

The benefits of Option 2A are:
- It eliminates the interaction between the lot Owner and the storm water management system, which is expected to fully eliminate current challenges.
- There is no impact to accessibility for the homeowner.
- It is expected to perform well at the design flow and larger storm events.

The drawbacks of Option 2A are:
- The system would require intermittent cleaning via hydrovac and flushing.
- It requires expertise to install, and it is unlikely that the RM would be capable of completing the work in-house.
- It is significantly more costly than the other options.

5.3.4 Option 2B – Minor Piped System to Backyard

Option 2B– Minor Piped System to Backyard, includes replacing the existing drain box with a shallow catch basin and boring through the side yard with an outlet near mid lot. The outlet will have a rip rap or articulate blocking apron to prevent erosion at the outlet.

The estimated costs for Option 2B are **$38,500** exclusive of applicable taxes and mobilization.

The benefits of Option 2B are:

- It eliminates the potential for erosion of the side yard, where the slopes are the steepest.
- There is no impact to accessibility for the homeowner from the front to the back yard.
- It is expected to perform well at the design flow and larger storm events.

The drawbacks of Option 2B are:

- The system would require intermittent cleaning via hydrovac and flushing.
- It requires expertise to install, and it is unlikely that the RM would be capable of completing the work in-house.
- It remains on the higher side for costs of the options presented.
- It may be undesirable for the homeowner to have a pipe outlet in their back yard.

5.4 RECOMMENDATION

WE would recommend the RM install **Option 1A – Surface Runoff with Armouring** with articulate blocking. This option is expected to be a robust solution that will work well in the design flow as well as larger storm events. The articulate blocking has a design life greater than 25 years, assuming the underlying mesh is covered with limited UV exposure. The blocking will prevent erosion and will provide a location for siltation to deposit. Although visible to the homeowner, we anticipate this option will be acceptable in that it still allows access from the front-yard to the backyard and is relatively aesthetic when compared to rip rap. The articulate blocking allows mowing right over top, which is easy for the homeowner to maintain in conjunction with their typical yard maintenance.

Following installation, Option 1A is the most 'hands-off' option for the RM, resulting in a one-time cost to resolve the issue.

The RM could reduce siltation in the upstream environment by reestablishing and reseeding the roadway ditches, which have been silted over or disturbed and not revegetated, resulting in eroded channels for drainage conveyance. The RM may also want to require silt fence be installed at the time of new lot developments so as to reduce the influx of silts and sands to the drainage system by new builds.

6 SUMMARY OF RECOMMENDATIONS

Find below a summary of the recommendations within this report:

- Implement a swale with articulate blocking in [redacted] to manage storm water runoff downstream of the Central 450 mm diameter culvert. This option is expected to be a robust solution that will work well in the design flow as well as larger storm events. Following installation, this solution is the most 'hands-off' of the options reviewed for the RM, resulting in a one-time cost to resolve the issue.

- The RM could reduce siltation in the upstream environment by reestablishing and reseeding the roadway ditches, which have been silted over or disturbed and not revegetated, resulting in eroded channels for drainage conveyance or blockages to the drainage. The RM may also want to require silt fence be installed at the time of new lot developments so as to reduce the influx of silts and sands to the drainage system by new builds.

- The RM should be completing flushing of their culverts regularly to prevent build up of debris. If the RM does not already have a flushing program, this should be created to ensure all culverts are being flushed on rotation, and priority locations are being flushed regularly to prevent flooding due to blocked culverts either by wildlife or debris.

- The RM should register drainage easements where the developments intended drainage runs through the lots. This is expected to include [redacted]

Below is a summary of prioritized recommendations provided throughout this report with associated Class 5 cost estimates. A Class 5 cost estimate indicates that the design is between 0 and 2 percent complete and the estimate is based on limited information and has wide accuracy ranges. Consequently, the actual cost is expected to fall within a range of -30% to +50% of the cost estimate. Note that all costs are in 2023 dollars even though they may not be implemented for many years.

Table 6-1: Summary of Cost Estimates for Recommendations

Section	Priority	Recommendation	Class 5 Cost Estimate ($)
		Mobilization	20,000
3.4.1	Low	Replace 450 mm with two 600 mm culverts	17,000
3.4.2	Low	Add one 550 mm culvert	8,500
4.1	High	Deepen Ditch and Repair Turnaround	4,000
4.3	Moderate	Deepen Ditch and Remove Siltation	4,750
4.4	Moderate	Fill Low Spot in [redacted]	
4.2	Low	Flush and Remove Debris from 450 mm Highway Culvert	2,000
4.5	Low	Flush and Remove Debris from East 600 mm Culvert	
5.4	High	Add Swale with Articulate Blocking in [redacted]	27,000
		Subtotal (exclusive of applicable taxes)	**83,250**
		Expected Range (-30%)	**58,275**
		Expected Range (+50%)	**124,875**

If the RM needs to prioritize the recommendations, the swale addition (5.4) and deepening of the ditch with repair to the turnaround (4.1) would be considered the highest priorities, as they have highest risks associated with damage to existing infrastructure and public safety.

7 PROFESSIONAL STATEMENT

This report, entitled, Jasmin Development Study was prepared for the Rural Municipality of North Qu'Appelle No. 187, dated, November 23, 2023, by Wyatt Engineering Ltd.

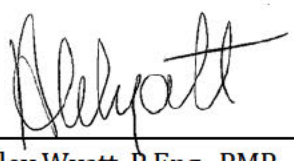
In conformance with applicable regulations, we confirm that:

- This report has been prepared in accordance with the applicable standards; and
- The undersigned has utilized professional judgment and understanding and is experienced completing the assessment carried out during the completion of this project.

Should there be any questions regarding the information within, please do not hesitate to contact the undersigned.

Regards,

WYATT ENGINEERING LTD.



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8 LIMITATIONS

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APPENDIX A FIGURES

LEGEND:

SYMBOLS:

	STORM	
	PROPOSED	EXISTING
CAP/PLUG		
CATCH BASIN		
SIDE INLET CATCH BASIN		
CULVERT		
FLOW DIRECTION		
INLET/OUTFALL		
MANHOLE		

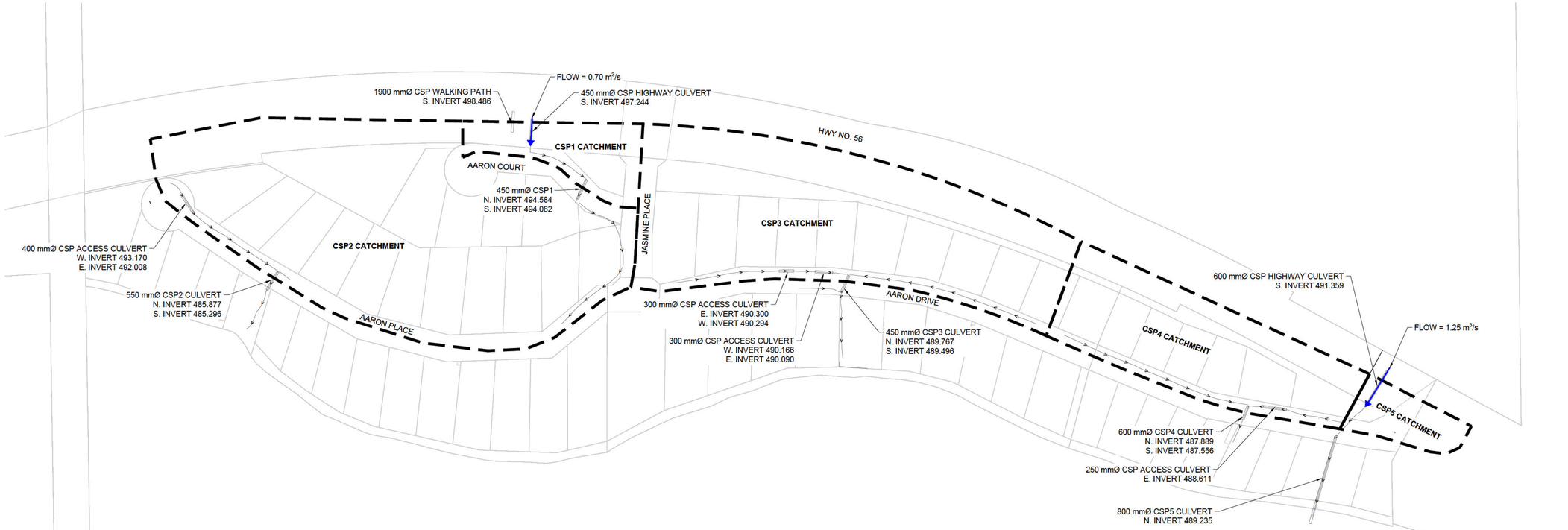
LINETYPES:

	UTILITIES	
	PROPOSED	EXISTING
WATERMAIN		
SANITARY MAIN		
SANITARY FORCEMAIN	FM FM FM	FM FM FM
STORM MAIN		
GAS LINE		GAS GAS GAS
POWER LINE (U/G)		P(UG) P(UG) P(UG) P(UG)
POWER LINE (OH)		P(OH) P(OH) P(OH) P(OH)
TELEPHONE		TEL TEL

SURFACE FEATURES	
BARRIER CURB	
MEDIAN CURB	
ROLLED CURB	
EDGE OF ASPHALT	
SIDEWALK	
EASEMENT	
PROPERTY LINE	
FENCELINE	X X
DITCH/SWALE	

ABBREVIATIONS:

EXISTING - EXST
PROPOSED - PROP
RIGHT-OF-WAY - ROW
SANITARY - SAN
STORM - STM
TRAFFIC WIDTH - TW
TYPICAL - TYP
WATER - WTR
###Ø - NOMINAL PIPE SIZE IN MILLIMETERS



1 CATCHMENTS
1:1250

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CLIENT
RM OF NORTH QU'APPELLE NO. 187

PROJECT
JASMINE DEVELOPMENT DRAINAGE STUDY

SEALS

PRELIMINARY
NOT FOR CONSTRUCTION

KEY PLAN

REVISIONS

REV	DESCRIPTION	DATE	DRWN	BY

SHEET TITLE
CATCHMENTS

SHEET NUMBER
100

PROJECT NUMBER
2022-6701

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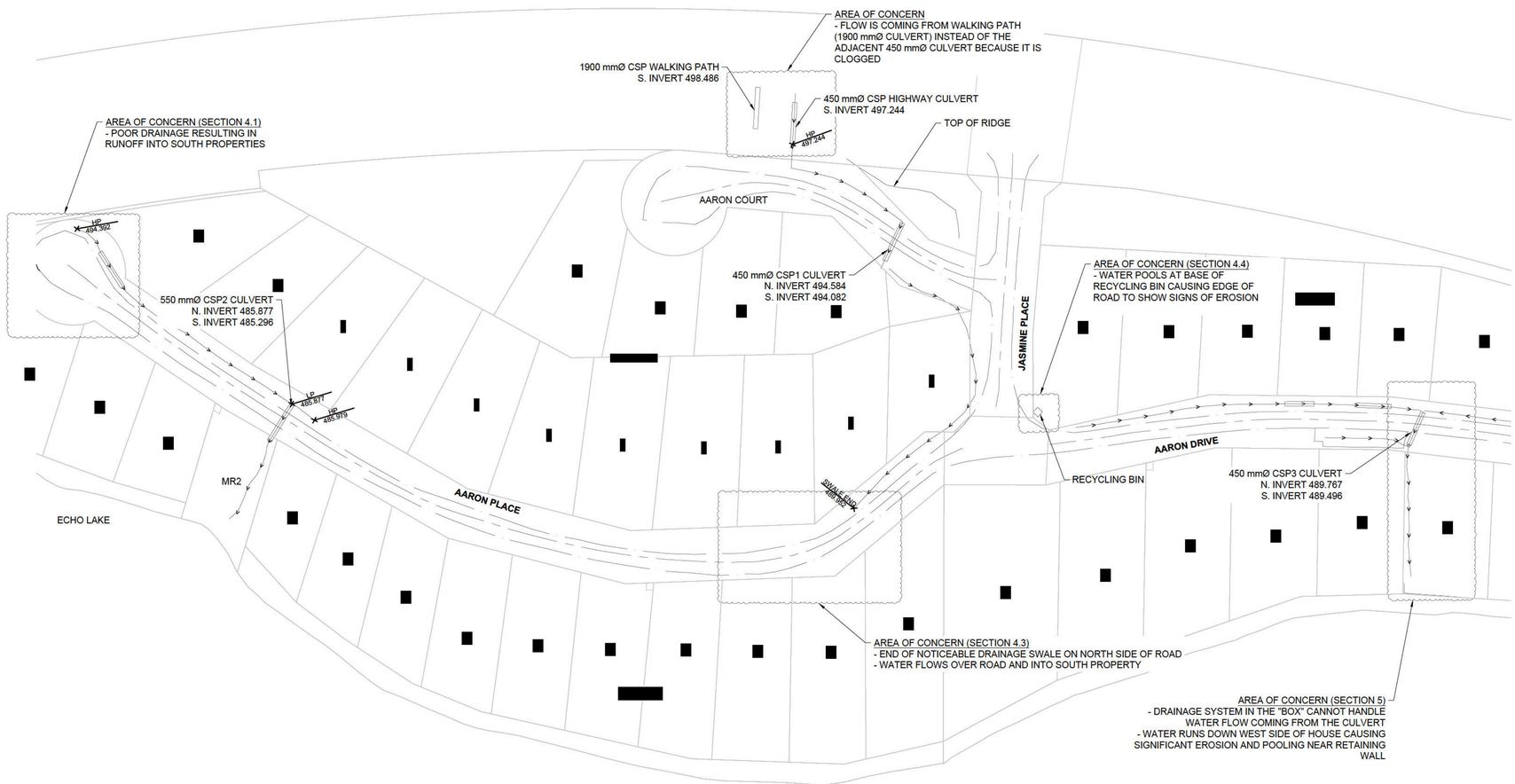

1 EXISTING SITE PLAN WEST
1:750

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PROJECT
JASMINE DEVELOPMENT DRAINAGE STUDY

SEALS

PRELIMINARY
NOT FOR CONSTRUCTION

KEY PLAN

REVISIONS

REV	DESCRIPTION	DATE	DRWN	BY

SHEET TITLE
EXISTING SITE PLAN WEST

SHEET NUMBER
200

PROJECT NUMBER
2022-6701

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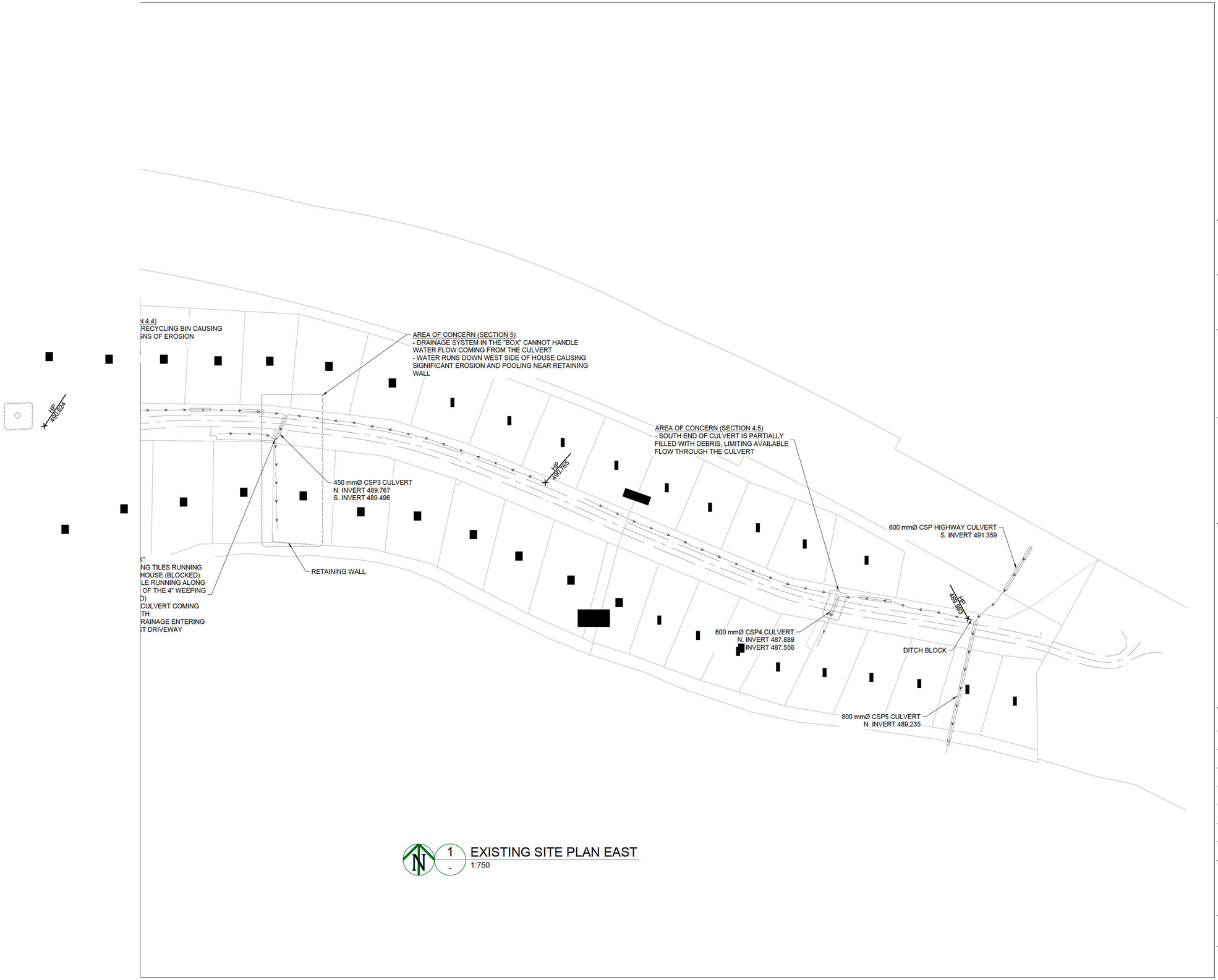

1 EXISTING SITE PLAN EAST
1:750

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PROJECT
JASMINE DEVELOPMENT DRAINAGE STUDY

SEALS

PRELIMINARY
NOT FOR CONSTRUCTION

KEY PLAN

REVISIONS

REV	DESCRIPTION	DATE	DRWN	BY

SHEET TITLE
EXISTING SITE PLAN EAST

SHEET NUMBER
201

PROJECT NUMBER
2022-6701

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APPENDIX B DRAWINGS

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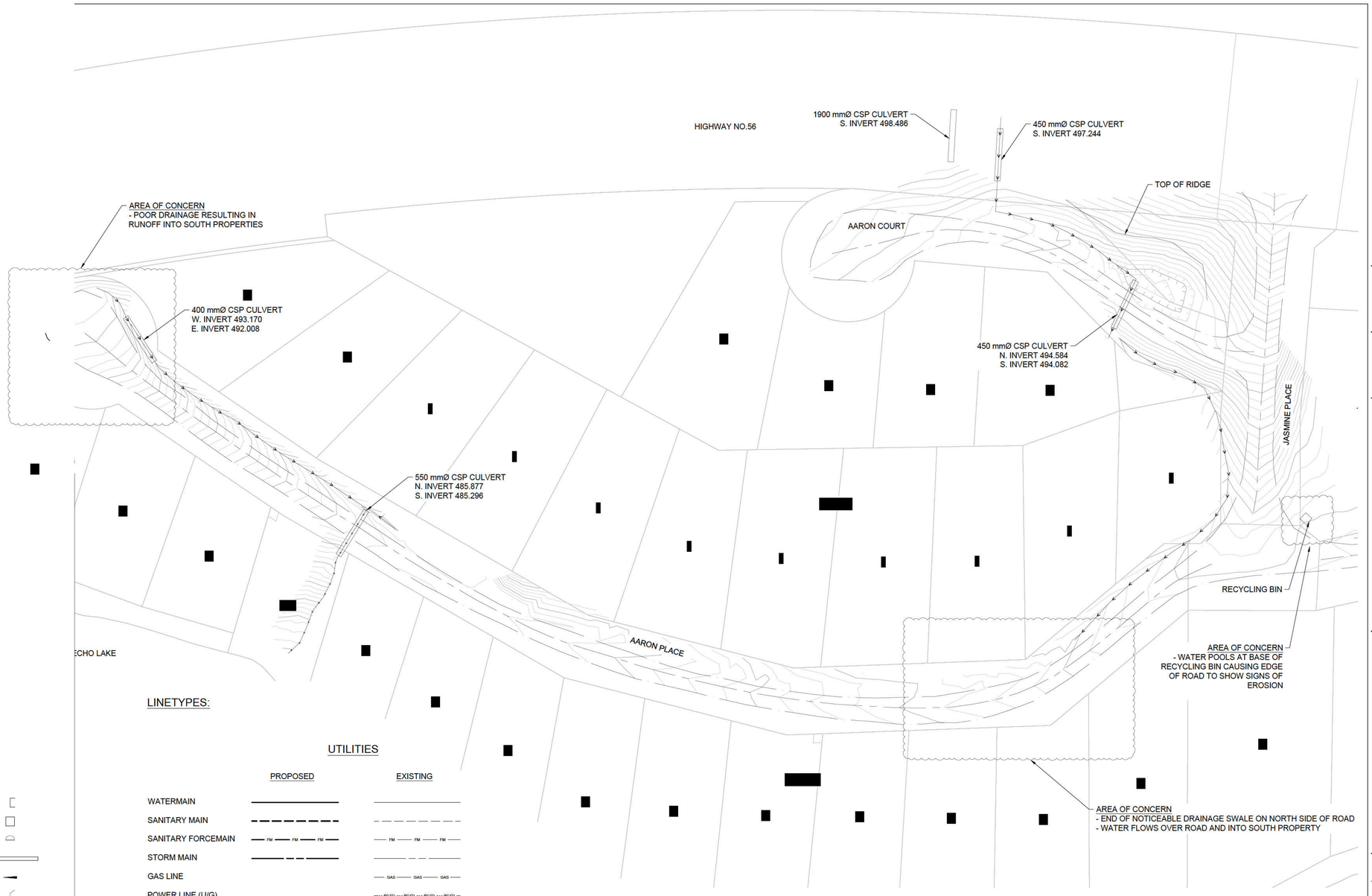
RM OF NORTH QU'APPELLE NO.187
JASMINE DEVELOPMENT DRAINAGE SWALE IMPROVEMENTS

DRAWING LIST

CIVIL

PLAN & PROFILES

SPECIFICATIONS



1 EXISTING SITE PLAN
1:500

LINETYPES:

UTILITIES

	PROPOSED	EXISTING
WATERMAIN		
SANITARY MAIN		
SANITARY FORCEMAIN	FM FM FM	FM FM FM
STORM MAIN		
GAS LINE		GAS GAS GAS
POWER LINE (U/G)		P(UG) P(UG) P(UG) P(UG)
POWER LINE (OH)		P(OH) P(OH) P(OH) P(OH)
TELEPHONE		TEL TEL

SURFACE FEATURES

BARRIER CURB		
MEDIAN CURB		
ROLLED CURB		
EDGE OF ASPHALT		
SIDEWALK		
EASEMENT		
PROPERTY LINE		
FENCELINE	x x	x x
DITCH/SWALE		

NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING EXISTING SURFACE AND UNDERGROUND UTILITIES THAT MAY AFFECT THE WORK OR BE DAMAGED DURING CONSTRUCTION.

WYATT ENGINEERING

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CLIENT
RM OF NORTH QU'APPELLE NO. 187

PROJECT
JASMINE DEVELOPMENT DRAINAGE SWALE IMPROVEMENTS

SEALS

A.M. WYATT PROFESSIONAL ENGINEER SASKATCHEWAN

Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
Wyatt Engineering Ltd.
Number 5461I
Permission to Consult held by:
Discipline: CIVIL Sk. Reg. No.: 29367 Signature: AMWyatt

KEY PLAN

REVISIONS

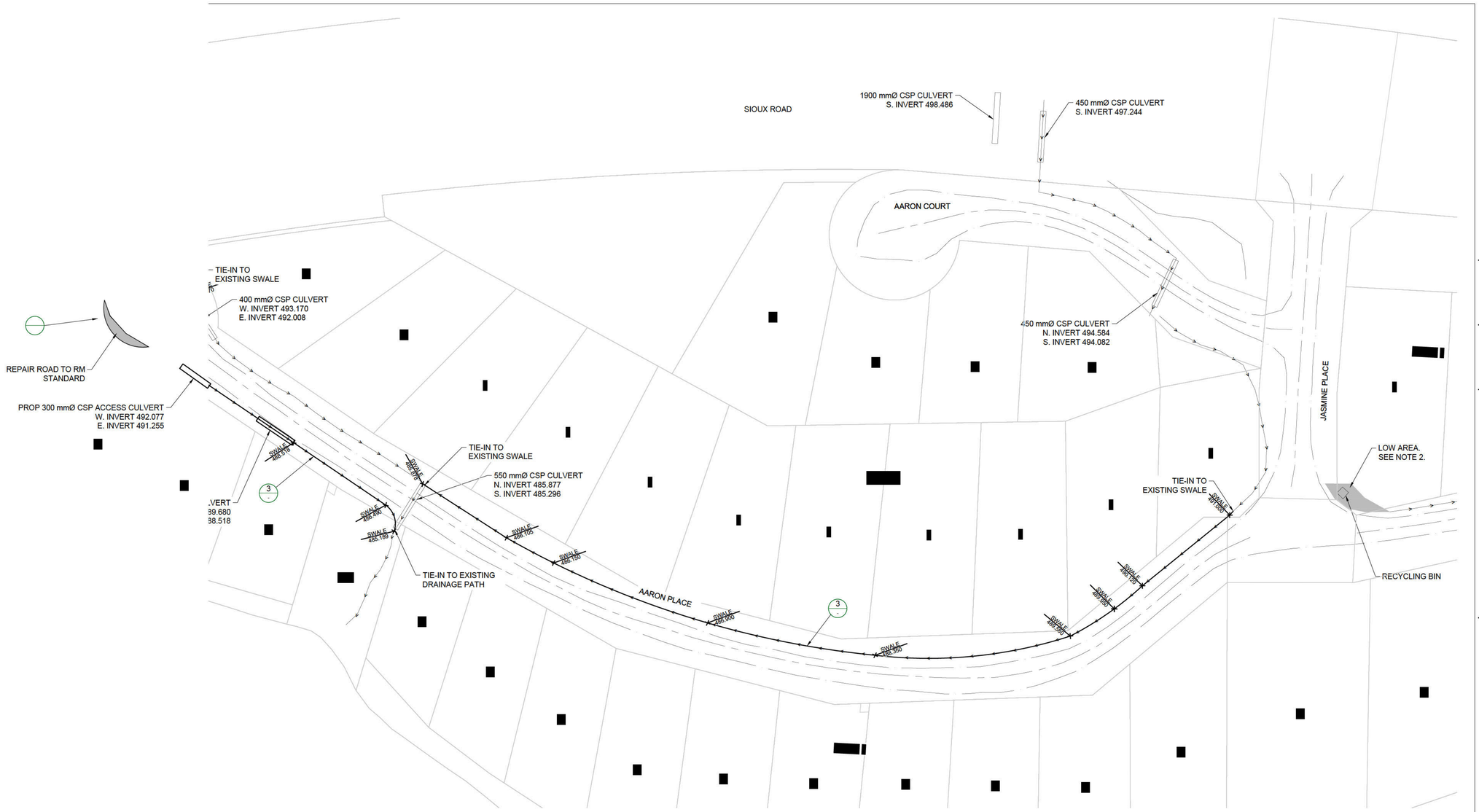
REV	DESCRIPTION	DATE	DRWN	BY
1	ISSUED FOR CONSTRUCTION	23-11-24	CG	AW
0	ISSUED FOR REVIEW	23-07-30	CG	AW

SHEET TITLE
EXISTING SITE PLAN

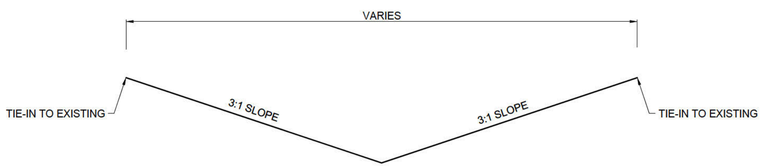
SHEET NUMBER
100

PROJECT NUMBER
2022-6702

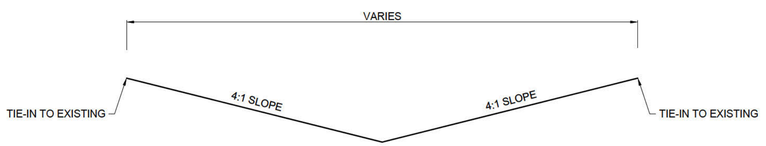
Last saved by: 13065(2023-11-24) Last Plotted: 2023-11-24
Filename: Y:\WYATTENGINEERING\WE.SHARED\2.0 - PROJECTS\2022-6700 RM OF NORTH QU'APPELLE - OWNER'S ENGINEER\2022-6702 JASMIN ON ECHO SWALES\03 DETAILED DESIGN\03.6 DRAWINGS\2022-6702_100_EXISTING GROUND.DWG



1 - PROPOSED SITE PLAN
1:500



2 - SWALE DESIGN 1
N.T.S



3 - SWALE DESIGN 2
N.T.S

NOTES:

1. THE CONTRACTOR IS RESPONSIBLE FOR LOCATING EXISTING SURFACE AND UNDERGROUND UTILITIES THAT MAY AFFECT THE WORK OR BE DAMAGED DURING CONSTRUCTION.
2. USE EXCESS MATERIAL TO FILL IN LOW SPOT. ESTABLISH POSITIVE DRAINAGE FROM NORTHWEST TO SOUTHEAST TO TIE-IN TO EXISTING DITCH.

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RM OF NORTH QU'APPELLE NO. 187

PROJECT
JASMINE DEVELOPMENT DRAINAGE SWALE IMPROVEMENTS

SEALS

Association of Professional Engineers & Geoscientists of Saskatchewan
CERTIFICATE OF AUTHORIZATION
Wyatt Engineering Ltd.
Number 14611
Permission to Consult held by:
Discipline: CIVIL | Sk. Reg. No.: 29367 | Signature

KEY PLAN

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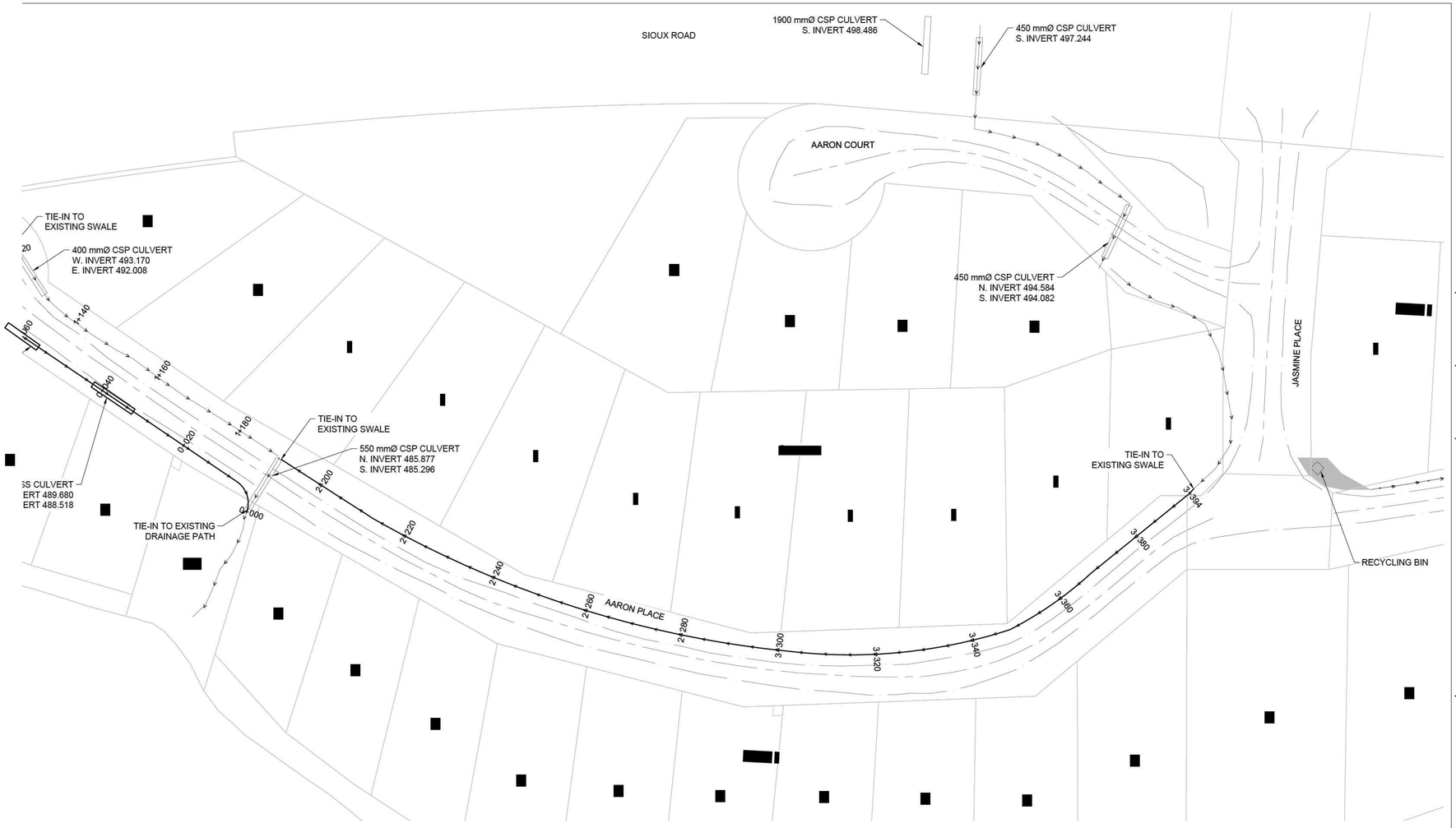
1	ISSUED FOR CONSTRUCTION	23-11-24	CG	AW
0	ISSUED FOR REVIEW	23-07-30	CG	AW

SHEET TITLE
PROPOSED SITE PLAN

SHEET NUMBER
101

PROJECT NUMBER
2022-6702

Last saved by: 13065(2023-11-24) Last Plotted: 2023-11-24
Filename: Y:\WYATTENGINEERING\WE.SHARED\2.0 - PROJECTS\2022-6700 RM OF NORTH QU'APPELLE - OWNER'S ENGINEER\2022-6702 JASMIN ON ECHO SWALES\03 DETAILED DESIGN\03.6 DRAWINGS\2022-6702_101_PROPOSED DRAINAGE.DWG



1 PROPOSED SITE PLAN
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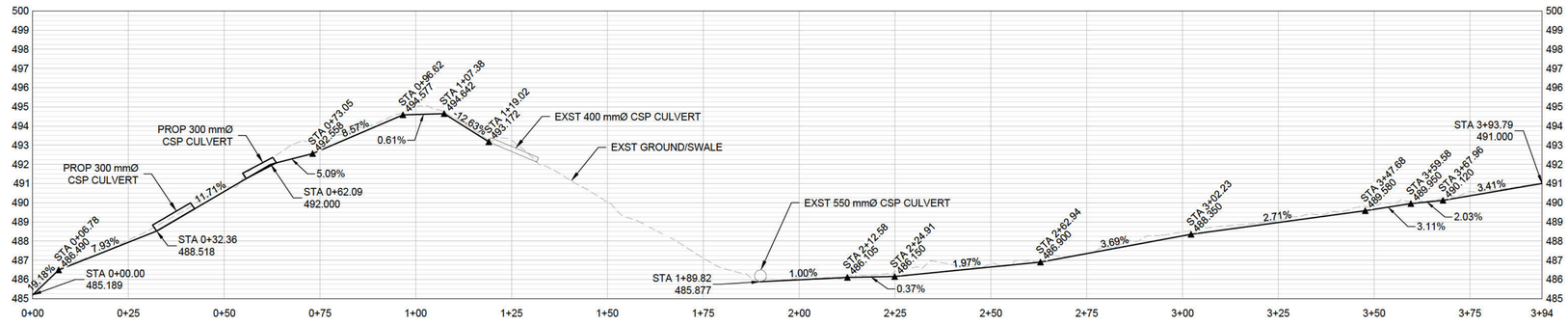

2 PROFILE
1:750

NOTES:

1. CONTRACTOR TO PROVIDE MINIMUM OF 300 mm OF COVER OVER ACCESS CULVERTS. ACCESS AREAS FOR HOMEOWNER DRIVEWAYS ARE TO BE RE-ESTABLISHED BY CONTRACTOR.

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SHEET TITLE
PLAN & PROFILE
STA 0+00 - 3+94

SHEET NUMBER
200

PROJECT NUMBER
2022-6702

Last saved by: 13065(2023-11-24) Last Plotted: 2023-11-24
Filename: Y:\WYATTENGINEERING\WE.SHARED\2.0 - PROJECTS\2022-6700 RM OF NORTH QU'APPELLE - OWNER'S ENGINEER\2022-6702 JASMIN ON ECHO SWALES\03 DETAILED DESIGN\03.6 DRAWINGS\[2022-6702_200_PLAN&PROFILE.DWG

GENERAL REQUIREMENTS:

1. ALTERNATIVES

1.1. In order to establish a minimum standard of quality, the Engineer may refer to products by name. This shall not be construed as eliminating competing products of equivalent or better quality. It is at the sole discretion of the Engineer to determine the acceptability of alternative products.

1.2. In order to utilize alternative products, the Contractor shall submit requests in writing to the Engineer. Each request for an alternative product shall fully descr be the requested alternative product and be complete with technical data such as product catalogue sheets, illustrations, installation methodology and all other information required by the Engineer to evaluate the requested alternative.

1.3. The Engineer will advise in writing if the requested alternative is acceptable to utilize on the Project.

2. PROJECT COORDINATION

2.1. The Contractor shall coordinate all aspects of the Work, including, but not limited to progress of the Work, progress schedules, submittals, use of the Site, temporary utilities, facilities and controls, and quality control.

3. QUALITY CONTROL

3.1. Test results and mix designs shall be in accordance with these specifications and confirmed by an independent testing firm.

3.2. Allow inspection/testing agencies access to the Work, offsite manufacturing and fabrication plants. Cooperate to provide reasonable facilities for proper access to and handling of materials.

4. SAFETY

4.1. The Contractor shall provide adequate signs, barricades, warning lights, and flag person(s) and shall safeguard the Work and safety of the public. Suitable warning signs shall be placed and illuminated at night to delineate in advance where construction, barricades or detours exist.

4.2. The Contractor shall ensure all requisite safety equipment, devices, detectors, materials and procedures are in place, tested and operational before commencing.

4.3. Conform to requirements of all regulatory authorities having jurisdiction.

5. PUBLIC CONVENIENCE

5.1. The Contractor shall perform the Work as to ensure the least obstruction to traffic and inconvenience to the general public and residents adjacent to the area of the Work and to ensure the protection of people and property. No road or street shall be closed to the public except with the permission of the owner and proper authorities.

5.2. Fire hydrants at the Place of the Work or adjacent to the Work shall be kept accessible to fire fighting equipment at all times.

5.3. The Contractor shall provide temporary provisions to ensure the use of sidewa ks, and ensure the proper functioning of gutters, sewers and ditches which shall not be obstructed during construction.

6. SURVEY

6.1. The Engineer will provide survey layout including control points, base lines, stake lines and grades for the Work. The Contractor shall be responsible for the proper evaluation of the layout to ensure that accuracy of his Work.

6.2. The Contractor shall establish all remaining elevations and lines as he may require, utilizing the Engineer's control points as reference. The Contractor shall be responsible for the correctness of the elevations and lines they infer from such references.

6.3. The Contractor shall make a reasonable effort to safeguard all benchmarks, survey stakes and grades and all data pertaining to horizontal and vertical control.

6.4. All legal survey pins, monuments or markers that are damaged or destroyed by the Contractor shall be replaced by a Registered Land Surveyor. Costs for the replacement or reestablishment of said survey pins, monuments or markers shall be borne by the Contractor.

7. PROTECTION OF EXISTING SURFACE AND UNDERGROUND INFRASTRUCTURE

7.1. The Contractor shall familiarize himself with the location of the Work and its relationship to existing power lines, gas lines, telephone lines, water and sewer lines, or other utilities. The locations of underground mains and infrastructure shown on the DRAWINGS are not guaranteed and the Contractor shall locate utilities and related structures. Failure to locate and protect the utilities mention thereof does not negate the Contractors responsibility and duty of care to these infrastructure items.

7.2. The Contractor shall take all necessary measures to protect any infrastructure from damage and shall stabilize and sufficiently support all structures that may be damaged or endangered by the Work or other operations conducted by the Contractor as part of the Contract.

7.3. The Contractor shall make arrangements with the utility owner to be present to supervise the work adjacent to the infrastructure. The Work shall be done in accordance with instructions and under the direct supervision of the utility company involved and all charges by the utility company shall be deemed included in the Contract Price.

7.4. Should any infrastructure be damaged by the Contractor during their operations, the costs of restoring such infrastructure shall be borne by the Contractor.

7.5. Trees, shrubbery, fences, poles and all other private property and surface structures shall be protected unless their removal is identified on the DRAWINGS or authorized by the Engineer.

7.6. Comply with all environmental protection requirements of federal, provincial and local jurisdictions having authority.

8. RESTORATION OF DAMAGED INFRASTRUCTURE

8.1. All existing sidewalks, ditches, culverts, gravel surfaces and other surface infrastructure affected by the Contractors operations shall be restored, at the Contractors expense, to as near as feasible to its condition prior to installation, upon completion of the Work.

9. MANUFACTURERS STORAGE AND INSTALLATION INSTRUCTIONS

9.1. All Products shall be stored in accordance with manufacturer recommendations to ensure the preservation of their quality and fitness for the Work.

9.2. Store packaged or bundled Products in original and undamaged condition with manufacturer's seals and labels intact.

9.3. The Contractor shall be respons ble for accurate installation and assembly of all products. The Contractor shall rigidly adhere to the manufacturer's installation instructions for all Products. Any damage resulting from a failure to observe the manufacturer's installation instructions or as a result of proceeding with the Work without complete understanding of how a specific work is to be performed, shall be the Contractors responsibility and shall make good any loss or damage resulting from same.

9.4. Defective Products are to be rejected, regardless of previous inspections. Removal and replacement of defective Products is at the Contractor's expense including those caused by delays due to the rejection of the Product.

10. CLEAN UP

10.1. The Contractor shall keep the Place of the Work, at all time, free from the accumulation of rubbish, and upon Substantial Performance of the Work, shall remove all waste products, debris, or material at the Place of the Work to restore original site conditions.

10.2. Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris. Costs for disposal of material are the responsibility of the Contractor.

EXCAVATION:

1. GENERAL

1.1. Scope

1.1.1. The work shall consist of the excavation of all materials including but not limited to soil, frozen earth, roots and trees, asphalt, and concrete. Excavation shall be to the finished grade and cross-section shown on the DRAWINGS or as designated by the Engineer.

1.1.2. All excavations shall satisfy the requirement of the most recent version of the Saskatchewan Occupational Health and Safety Regulations.

1.1.3. Excavation to Embankment shall consist of moving excess soil to the designated areas to be spread.

2. EXECUTION

2.1. Construction

2.1.1. Prior to the start of work, the Contractor shall be respons ble for contacting each agency for field locating services to determine the location of any underground utilities or services that may be damaged during excavation.

2.1.2. Strip topsoil and organic material from the area prior to start of excavation. If the excavated topsoil is designated to be re-used on site, it shall be stockpiled on site. Otherwise, it shall be properly disposed of off-site or in locations indicated on the DRAWINGS or as directed by the Engineer.

2.1.3. The Contractor shall shape the cut section to the depth and grades indicated on the DRAWINGS or as established by the Engineer. Suitable excavated material shall be used as far as practicable in the formation of fills, embankments or for other backfill.

2.1.4. Construction of embankment areas shall be in accordance with EMBANKMENTS.

2.1.5. The Contractor will be required to repair any damage caused to existing access roads, haul roads, or underground facilities during excavation, to the original or better condition, at no additional cost to the owner.

2.1.6. The Contractor will be responsible for constructing and maintaining any or all haul roads required in the execution of the work. The Contractor will be respons ble for removing, trimming, scarifying and cleaning of the haul road sites to restore them to their original condition.

EMBANKMENTS:

1. GENERAL

1.1. Scope

1.1.1. The work shall consist of constructing embankments, or miscellaneous backfills with excavated materials to the grades and cross-sections shown on the DRAWINGS or as designated by the Engineer.

2. PRODUCTS

2.1. In-situ material may be used for compacted fill, in areas designated on the DRAWINGS or as directed by the Engineer or Owner.

2.2. Topsoil is humus, peat or other material containing organics, which make up the top layer of the soil.

2.3. Rock excavation is defined as boulders exceeding 1.0 m^3 in volume or solid ledge rock which requires drilling and blasting or other mechanical means for its removal. No soft or disintegrated rock which can be removed with a hand pick or power-operated excavator will be considered rock excavation. No loose, shaken or previously blasted work will be considered rock excavation.

2.3.1. The Contractor is to notify the Engineer immediately if boulders, suitable as rock excavation, are encountered. The Contractor is not to conduct rock excavation without direction of the Engineer to proceed.

3. EXECUTION

3.1. Construction

3.1.1. Embankments shall be constructed as shown on the DRAWINGS or as otherwise specified by the Engineer.

3.1.2. When directed by the Engineer, or as indicated on the DRAWINGS, scarify to 150 mm depth and recompact to ensure a proper bond between new materials and existing surfaces.

3.1.3. The material shall be placed in compacted layers of uniform 150 mm thickness. Each layer shall be spread and bladed evenly so that rollers used for compaction will bear evenly at all times.

3.1.4. The compaction equipment may be of any type, provided it is capable of compacting each lift of the material to the specified density. The Engineer reserves the right to request any particular piece of equipment be remove from the work if it is not capable of compacting the material to the required density in a reasonable time. Hauling equipment over fill will not be accepted in lieu of compaction equipment for embankment.

3.1.5. Subgrade areas, encountered in the construction of the embankment which are not sufficiently stable to properly support the embankment and any additional loading or traffic requirements, shall be scarified and re- compacted or additional fill will be imported.

3.1.6. Each lift layer shall be compacted to a minimum of ninety-eight percent (98%) of the maximum standard proctor dry density as determined by ASTM D698 latest edition.

3.1.7. Each lift shall be brought to within the limits of plus or minus three percent (±3%) of optimum moisture content. Water shall be added and thoroughly mixed if required for proper compaction. If the soil contains excess moisture, it shall be aerated until the moisture content has been reduced to within the limits stated above.

3.1.8. Measurement of the field density and moisture content shall be in accordance with ASTM D6938 latest edition for determination of Density and Moisture content of soil in place by Nuclear Methods.

3.1.9. Where final trimming of surface is required - blade grader shall be used to grade the surface to within plus or minus 25 mm (± 25 mm).

3.1.10. Where topsoil is specified elsewhere, it shall be placed and spread by means of a blade grader or approved equipment to a depth shown on the DRAWINGS.

3.1.11. Removed rock shall be clean of debris and neatly stockpiled.

CULVERTS:

1. GENERAL

1.1. Scope

1.1.1. The work will consist of installing corrugated steel pipe culverts at locations and in conformity with lines, grades and cross-sections shown on the DRAWINGS.

2. PRODUCTS

2.1. CSP Pipe

2.1.1. Corrugated Steel Pipe (CSP) shall be hot-dip galvanized with zinc coating at a rate of 610 g/m2 and shall conform to the requirements of CSA G401-14, with rolled annular ends. Pipe wall thickness shall be minimum 2.0mm and size shall be as shown on the DRAWINGS. Unless otherwise specified, the corrugation profile shall be 68 mm x 15 mm. Minimum size of culverts for roadway applications shall be 100mm for access crossings and 400 mm for road crossings.

2.1.2. Couplers to be corrugated, annular type (i.e. no wedge-type permitted), with gaskets; nuts and bolts to ASTM A307.

2.1.3. When polymer-coated CSP is specified, the polymer coating shall be applied to both sides of the galvanized sheet prior to corrugating in accordance with classification grade 250/250 as specified in CSA G401-14.

2.1.4. When aluminized-coated CSP is specified, the coating shall be to CSA G401- 14.

2.2. Bedding Material

2.2.1. Shall be clean sand free from injurious amounts of deleterious substances.

3. EXECUTION

3.1. Construction

3.1.1. The excavation for the culvert and the culvert bed, including sub-cut if required, shall be in accordance with EXCAVATION. If the foundation is unsuitable, the bottom of the bed shall be sub-cut. The sub-cut shall be backfilled in accordance with the requirements for EMBANKMENTS. The bedding line shall be shaped to fit the culvert.

3.1.2. Corrugated steel pipe culverts shall be placed with the inside circumferential laps pointing downgrade and with the longitudinal laps at the sides or quarter points. The sections of the culvert shall be firmly joined with coupling bands. Joints shall be as tight as possible.

3.1.3. Bedding material under the haunches of culverts shall be compacted with mechanical impact tampers. If a density for embankments has not been specified, mechanical impact tampers shall be used for compacting the earth material against the culvert.

3.1.4. After the earth backfill and bedding material has been placed and compacted around the culvert, the earth material above the bedding line shall be placed, simultaneously and uniformly, in lifts on each side of the culvert. In sub-cut, the lift shall extend to the limits of the sub-cut.

3.1.5. No objectionable material shall be used within that portion of the embankment above or below the bedding line on culverts through the roadbed. The embankment, within three (3) diameters or three (3) spans of the culvert barrel, shall be free from rocks having a dimension of 75 mm or greater when measured in any direction.

3.1.6. The Contractor shall repair or replace, at no direct expense to the Owner, any culvert damaged by his operation.

COARSE GRASS SEEDING:

1. GENERAL

1.1. Scope

1.1.1. The work shall consist of levelling and preparing the seed bed, seeding, fertilizing and cleaning up areas to be seeded in coarse grass as shown on the DRAWINGS.

1.1.2. Topsoil stripped from site may be reused.

2. PRODUCTS

2.1. Grass Seed Mixtures

2.1.1. Use a grass seed mixture equivalent to the one growing on site or as follows.

-50% Creeping Red Fescue

-30% Kentucky Bluegrass

-20% Perennial Rye grass

2.1.2. An alternate mixture may be substituted with the permission of the Engineer, in areas where regular maintenance is doubtful.

2.1.3. All seed specified as Canada Certified No. 1 Grade or Common No. 1 Grade shall be as per Government of Canada Seeds Act Grade Standards.

2.1.4. All seed must be obtained from a recognized seed house or supplier.

2.2. Fertilizer

2.2.1. Fertilizer shall be 16-32-6 controlled release, sulphur coated urea (SCU) or ammonia sulphate fertilizer.

2.3. Topsoil

2.3.1. May utilize the existing site topsoil or borrow site topsoil, if present, or as follows:

2.3.1.1. Planting soil for seeded or sodded areas: mix 3 parts topsoil with 1 part peat moss, manure, or compost and 1 part sand.

2.4. Submittals

2.4.1. Certificate(s) of analysis of each seed sample. Seed analysis report shall be current (i.e. within last 6 months) and show species and variety of seed, date and results of all tests.

2.4.2. All original seed labels and seed bags shall be present at completion of seeding.

2.4.3. Submit other required information and documents as requested or specified.

3. EXECUTION

3.1. Construction

3.1.1. Where designated on DRAWINGS, ground surface shall be worked by equipment in order to fill in low spots and reduce high spots in such a manner as to promote positive drainage.

3.1.2. Unsuitable and excavated material shall be disposed of by the Contractor.

3.1.3. Ensure grades are to the required depth below the final grade prior to placing topsoil.

3.1.4. If specified or approved by the Engineer, replace topsoil previously stripped to the depths as specified.

3.1.5. The surface shall be disced to a minimum depth of 100 mm to prepare seedbed.

3.1.6. Discing shall be followed by harrowing to level out the ground surface.

3.1.7. Should the seeding be done with a large brillion or other applicable type of seeder the work would be acceptable.

3.1.8. Seeding shall follow harrowing, the seed (mixture as specified) to be spread on ground surface at a rate of 0.9 to 1.3 kg per 100 m^2.

3.1.9. Fertilizer shall be spread at a rate of 2.5 kg per 100 m^2 or as recommended by soils test.

3.1.10. After seed and fertilizer have been applied, ground surface shall be harrowed a second time to cover the mixture.

3.1.11. Clean up immediately, soil or other debris spilled and dispose of deleterious materials.

3.2. Maintenance

3.2.1. Repair seeded areas which show root growth failure, deterioration, bare or thin spots, or which have been damaged by any means or cause, including replacement operations. Overseed areas that show inadequate or improper sowing of seed from brillion or other methods.

3.2.2. Correct any erosion and settlement that results from faulty workmanship and/or material. Restore areas by placing topsoil as necessary and spreading new seed. Repair ruts resulting from maintenance equipment and personnel. Maintain a uniformly smooth seed bed surface.

3.2.3. Apply second application of slow release granular turf fertilizer five to six weeks after seeding. Spread evenly at rate of 2.5 kg per 100 m^2 and water in well after application. Postpone fertilizing until spring if application will occur after August 15th.

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PROJECT
JASMINE DEVELOPMENT DRAINAGE SWALE IMPROVEMENTS

SEALS

PROFESSIONAL ENGINEER A.M. WYATT SASKATCHEWAN

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KEY PLAN

REVISIONS

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1	ISSUED FOR CONSTRUCTION	23-11-24	CG	AW
0	ISSUED FOR REVIEW	23-07-30	CG	AW

SHEET TITLE
CONSTRUCTION SPECIFICATIONS

SHEET NUMBER
300

PROJECT NUMBER
2022-6702