VILLAGE OF BARNWELL
IN THE PROVINCE OF ALBERTA

BYLAW NO. 05-19

BEING a bylaw of the Village of Barnwell in the Province of Alberta for the purpose of adopting Bylaw No. 05-19 being the **Torrie Porter Development Area Structure Plan** for lands legally known as Lot 13, Block 1, Plan 071 3622 and that portion of the SW ¼ 28-9-17 W4M which is located within the Village of Barnwell.

WHEREAS the purpose of proposed Bylaw No. 05-19 is to establish a framework and standards and requirements regarding the future development of an 18 lot residential development on the lands Residetnial land use designation.

AND WHEREAS the municipality wishes to provide for orderly growth and development to occur while minimizing land use conflicts;

AND WHEREAS the municipality may adopt an area structure plan pursuant to section 633 of the Municipal Government Act, RSA 2000, Chapter M-26, as amended, and provide for its consideration at a public hearing.

NOW THEREFORE, under the authority and subject to the provisions of the Municipal Government Act, RSA 2000, Chapter M-26, as amended, the Council of the Village of Barnwell in the Province of Alberta, duly assembled does hereby adopt Bylaw No. 05-19 being the **Torrie Porter Development Area Structure Plan** for lands legally known as Lot 13, Block 1, Plan 071 3622 and that portion of the SW ¼ 28-9-17 W4M which is located within the Village of Barnwell

READ a **first** time this 16th day of May, 2019.

Mayor *– Del Bodnarek* ***Municipal Administrator*** *- Wendy Bateman*

Moved by Councillor Bullock *that Bylaw 05-19 be amended as follows: Phase 1 infrastructure components include the east detention pond and the flow conditions of post development be 'equal to' pre development*

READ a **second** time this 15th day of August, 2019 as amended.

Mayor *– Del Bodnarek* ***Municipal Administrator*** *- Wendy Bateman*

READ a **third** time and finally PASSED this 15th day of August, 2019.

Mayor *– Del Bodnarek* ***Municipal Administrator*** *- Wendy Bateman*

VILLAGE OF BARNWELL
IN THE PROVINCE OF ALBERTA

BYLAW NO. 06-19
Revised Bylaw No. 05-19

BEING a bylaw of the Village of Barnwell in the Province of Alberta to revise Bylaw No. 05-19 to correct a clerical error.

WHEREAS Section 63(1) and Section 63(2)(g) of the Municipal Government Act, Revised Statutes of Alberta 2000, Chapter M-26, as amended, provides that a council may by bylaw authorize the revision of a bylaw to make changes, without materially affecting the bylaw in principle or substance, to correct clerical, technical, grammatical or typographical errors in the bylaw; to bring out more clearly what is considered to be the meaning of a bylaw, or to improve the expression of the law; and

WHEREAS Section 692(6) of the Municipal Government Act, Revised Statutes of Alberta 2000, Chapter M-26, as amended, provides that a bylaw under Section 692(1), Planning bylaws, may be amended without giving notice or holding a public hearing if the amendment corrects clerical, technical, grammatical or typographical errors and does not materially affect the bylaw in principle or substance; and

WHEREAS a clerical error has been identified in Bylaw No. 06-19 being a bylaw to amend Bylaw No. 05-19, being the municipal Land Use Bylaw, whereby the legal description of the lands subject to the Torrie Porter Area Structure Plan was misidentified in the bylaw verbiage as SW ¼ 28 instead of NW ¼ 21; and

WHEREAS the Council of the Village of Barnwell deems it proper and expedient to correct the clerical error and deems that the correction does not materially affect the bylaw in principle or substance;

NOW THEREFORE, under the authority and subject to the provisions of the Municipal Government Act, Revised Statutes of Alberta 2000, Chapter M-26, as amended, the Council of the Village of Barnwell in the Province of Alberta duly assembled does hereby enact the following:

1. That the reference to "SW¼ 28-9-17 W4M" be amended and changed to read "NW¼ 21-9-17 W4M".
2. Bylaw No. 06-19 is hereby revised Bylaw No. 05-19 and reflects that correction is authorized to be prepared to Bylaw 05-19.
3. This bylaw shall come into effect upon third and final reading hereof.

READ a first time this 19th day of September, 2019

READ a second time this 19th day of September, 2019.

BY UNANIMOUS CONSENT, READ a third time and finally passed this 19th day of September, 2019.

Mayor

Chief Administrative Officer

Torrie Porter Development

Area Structure Plan

29 July 2019
Bylaw: Village of Barnwell Land Use Bylaw No. 01-19

prepared for the developer:

Ryan Torrie, Benson Porter & Nelson Porter

By:

Wilde Brothers Engineering Ltd.

TABLE OF CONTENTS

1. Introduction 1
   - Background 1
   - Purpose and Intent of the Plan 1

2. Proposed Subdivision Development 2
   - Site Conditions 2
   - Land Use 2

3. Infrastructure 3
   - Required Underground Infrastructure 3
   - 3.1.1. Shallow Underground Utilities 3
   - 3.1.2. Potable Water 3
   - 3.1.3. Fire Hydrants 3
   - 3.1.4. Sanitary Waste Disposal 4
   - 3.1.5. Storm Water Management 4
   - Road Design 5
   - 3.1.6. 3rd Avenue East Access 5

4. Development Standards 6
   - Architectural Controls 6
   - Setbacks 7

5. List of Drawings 8
   - Drawing 1 Proposed Development Location
   - Drawing 2 Proposed Lot Layouts
   - Drawing 3 Topography
   - Drawing 4 Proposed Water & Sewer Services
   - Drawing 5 Proposed Road Design Layout
   - Drawing 6 Typical Road Design Cross Section

6. Appendices 9
   - Appendix A: Land Title Certificate

1. INTRODUCTION

Background

The Torrie Porter Development is located on the land directly north of Highway 3 and east of Heritage Road, located on NW21 9-17-W4. The total development is comprised of 3.24 hectares (8.00 acres) and lies entirely within the limits of the Village of Barnwell. (See drawing 1). It will be comprised of 18 residential lots, sized between 0.25 acres to 0.69 acres. There are residential areas to the north and west of the proposed development.

Purpose and Intent of the Plan

The purpose of the Area Structure Plan is to provide a framework for the future residential subdivision and development of the subject property. This document will address the following:

- Proposed land uses for the area in general
- Density of development in general
- Transportation planning, including the general location of major transportation routes and utilities
- Storm water management
- Water services
- Sanitary sewage services
- Shallow underground utilities
- Compatibility with adjacent land uses
- Consistency with the Municipal Development Plan and other adopted plans within the Village of Barnwell

2. PROPOSED SUBDIVISION DEVELOPMENT

Site Conditions

The parcel as it stands is currently laid to wild grasses, shrubs and landscaped lawn.

Land Use

The entire parcel is zoned as residential, therefore rezoning will not be required. The land to the north and east is also zoned residential. However, one property to the southwest directly adjacent to the proposed development is currently zoned general commercial.

Proposed Development / Highway 3 Boundary

The developer will construct a 1.82m (6 ft) fence at the south side of the proposed development along the boundary between the development and the Highway 3 right-of-way. Upon completion of a lot sale, the individual lot owners will assume responsibility for the maintenance and upkeep of the portion of the fence within their property.

Subdivision Phasing

Before any application is made for the proposed multi-lot subdivision, a preliminary application will be made to subdivide the 0.66 hectare triangular property in NW 21-9-17-4, at the east end of the proposed development, off of the remainder of its title, as requested by the Municipal District of Taber. Presently, this property falls under the joint jurisdiction of the Village of Barnwell and the Municipal District of Taber.

The proposed multi-lot subdivision will proceed in the following phases (see Drawing 2 for lot numbering):

Phase 1) Lots 1-4 will be subdivided (the 4 lots fronting onto 3rd Avenue East) and the east detention pond will be constructed

Phase 2) Lots 5-18 will be subdivided and the west detention pond will be constructed (remainder of subdivision)

3. INFRASTRUCTURE

Required Underground Infrastructure

Underground services will be installed along the full length of the new interior road. There are five main services that will be provided to each lot: electrical, natural gas, Telus, potable water, and sanitary waste disposal. An overview of the proposed underground infrastructure is shown on Drawing 4. Telus, electrical, and gas installation plans will be provided by their respective parties prior to installation. The developer is prepared to bare the burden of these new infrastructure services and that of connecting the new services with existing municipal services.

3.1.1. Shallow Underground Utilities

The shallow utilities (including Telus, natural gas, and electrical) will be installed in a utility easement, 3.5m (11 ft 6 ins.) wide inside the front property line as shown on drawing 8. A 100 amp service will be installed for each lot.

Street lighting for the development will be provided as required by the Village of Barnwell standards and as deemed suitable by the electrical engineer.

3.1.2. Potable Water

Potable water for the proposed development will be supplied via the Village of Barnwell main in 3rd Avenue East. It is proposed that a new 150mmø (6 in.) main be run from the existing main east to the entrance of the proposed development. As the new main enters into the proposed development it must cross an existing 50mmø (2 in.). The exact location is unknown and must be determined in field. This line will be severed and reconnected to the new 150mmø (6in.) main at the point of crossing. Drawing 4 shows the proposed water mains.

Each lot will be supplied with a 25mmø (1 in.) service line. Lots 1-4 will be serviced from the 3rd Avenue East main and Lots 5-17 will be serviced off the internal main in the development. Lot 18 will be installed in the ditch south of 3rd Avenue East outside of the pavement.

3.1.3. Fire Hydrants

Fire hydrants will be placed according to the Municipal Engineering Standards POLICY NO 03-07, Schedule “B”, Design Guidelines For Subdivisions, Section D. Therefore, fire hydrants will be placed no more than 150m (492 ft) apart. They shall be located 1.0m

(5 ft) into the road allowance from the residential property, at the projection of property lines, as shown on Drawing 4.

3.1.4. Sanitary Waste Disposal

Due to the depth of the existing sanitary sewer mains, it is not feasible to service the whole development with a gravity main. It is proposed that a 200mmø (8 in.) gravity main be extended east in 3rd Avenue East to the entrance of the proposed development. Lots 1-4 will be able to be serviced via gravity services into this extended main. The remainder of the development will be serviced via individual lift pumps to a common 100mmø (4 in.) PVC DR26 sanitary force main, located in the proposed development road, that will discharge into the new manhole at the entrance of the development. Drawing 4 provides an overview of the proposed sanitary sewer network. Lots 5-17 will connect on the main in the proposed development road. Lot 18 will be serviced via a 50mmø (2 in.) pipe in the ditch south of 3rd Avenue East outside of the pavement.

Each sewage lift pump will need to be a high head, low flow type pump. The specific requirements for the pump outputs will be determined in the detailed design of the subdivision at the time of development. The lift pumps will be connected to the common main via a 50mmø (2 in.) pipe with a curb stop and check valve.

3.1.5. Storm Water Management

A storm water management plan was completed for this development as part of the preliminary analysis to determine if the development is feasible. It is attached as Appendix B.

As the main direction of flow is south toward the Highway 3 ditch, consultation with Alberta Transportation was required. The proposal includes two storm detention ponds on the south side of the new road that will discharge into the north Highway 3 ditch, and flow west to enter the Village's existing west drain. Alberta Transportation has approved in principle the drainage plan that is part of the Storm Water Network Analysis found in Appendix B.

Both ponds will be constructed with 4:1 side slopes and due to elevation limitations will both be shallow. As such, the ponds will need to be utilized to the maximum capacity possible. This results in the ponds not having any significant free board. Both ponds will be grassed and have overflows to handle storm events greater than the 1-in-100 year storm events. These overflows would be located on the south side and will require armoring to prevent erosion.

Road Design

An efficient cul-de-sac road will allow for the access requirements of individual lots within the development area while keeping the additional traffic local, adding to the safety of adjacent residential neighbourhoods. A standard asphalt road design, including a curb and gutter, will be installed, as indicated in Drawing 5. Road structure will follow the Village of Barnwell's road standards and will include 75mm of type III asphalt, 100mm of crushed granular base, and 350mm of pitrun, as shown on the typical design section, Drawing 6.

The road allowance for the development, directly off 3rd Avenue East, is 18m (59.10 ft), as indicated on Drawing 4. The road allowance diameter of the cul-de-sac is 19m (62.34 ft). The cul-de-sac lip of gutter radius is 15m (49.21 ft) — sufficiently broad to permit municipal and emergency vehicles to maneuver.

3.1.6. 3rd Avenue East Access & Post-Construction Restoration

- The proposed access onto 3rd Avenue East will require the approval of the Village of Barnwell. Permission for this access will be required before construction can begin. The Village is not responsible for any costs associated with upgrades, improvements or maintenance that may be necessary to 3rd Avenue East.
- Following installation of the sewer and water utilities, the 3rd Avenue East road will be reconstructed to original design dimensions and elevations following the basing structure proposed for the development.

4. DEVELOPMENT STANDARDS

Architectural Controls

Architectural controls will be applied and will include the following:

- Mobile homes will be excluded.
- The primary use for each lot will be to construct a single family detached dwelling. However, condos or multiple units may be included. Houses shall have a minimum of 1100 square feet of living area above ground level. Houses may be bungalow or multilevel and must have a minimum eave overhang of 16 inches. The maximum height above ground level shall not exceed the maximum height allowed in the Village of Barnwell, which is 2 stories plus an attic or loft. All households should have an attached garage. While there are no specific restrictions regarding the type or colors of the exterior, a finished weatherproof surface must be completed within twelve months of commencing construction.
- Ready to move or prefabricated manufactured homes with 2x6 construction and pre-finished brick, stucco, or siding finishes are permitted provided they comply with the minimum square footage requirement and are placed on a permanent weather proof sealed and insulated wood or concrete foundation.
- Previously owned moved in dwellings that meet the above noted controls are permitted only if the exteriors are brick, stucco, or siding and are completely finished within twelve months and subject to conditions and approval by MPC.
- Outbuildings must have straight walled construction with a finished (not galvanized steel) exterior surface.
- Basements and/or crawl spaces shall not be any deeper than 4 feet below the natural grade. Weeping tile drainage systems installed around the basements or below grade crawl spaces shall be plumbed separately to a sump hole and pump which discharges subsurface moisture to surface drainage systems.
- Landscaping of front and back yards must be completed timely and at least within 12 months from occupancy.
- There must be adequate area within each property to accommodate parking requirements for all vehicles and/or equipment that may be parked on the lots. However, no long term outside storage of vehicles or equipment is allowed.

- Each lot owner will be required to provide a ‘Plot Plan / Lot Drainage Plan’ that outlines the proposed lot grading to control storm water runoff and shows that the proposed setbacks meet the Village of Barnwell standards. The ‘Plot Plan / Lot Drainage Plan’ will need to be approved by the Village of Barnwell prior to issuance of a development permit.
- For lots directly bordering the Highway 3 right-of-way, the developer will have previously constructed a fence. Upon completing the purchase of those lots, the owner(s) of those lots will assume sole responsibility for the maintenance and upkeep of the portion of the fence located on their lot.

Setbacks

According to the Village of Barnwell Land Use Bylaw No. 01-19, Section 4.1, residential setbacks are as follows:

Front: 7.6m or 25ft.

Secondary Front: 4.6m or 15ft.

Side 1: 1.5m or 5ft.

Side 2: 3.0m or 10ft.

Rear: 7.6m or 25ft.

5. LIST OF DRAWINGS

DRAWING 1	PROPOSED DEVELOPMENT LOCATION
DRAWING 2	PROPOSED LOT LAYOUTS
DRAWING 3	TOPOGRAPHY
DRAWING 4	PROPOSED WATER & SEWER SERVICES
DRAWING 5	PROPOSED ROAD DESIGN LAYOUT
DRAWING 6	TYPICAL ROAD DESIGN CROSS SECTION



LEGEND / NOTES

ISSUE	DATE	REVISION DESCRIPTION
0	14MAR'19	

WILDE BROTHERS
ENGINEERING LTD.
PERMIT TO PRACTICE
P08438

WILDE BROS. ENGINEERING LTD.
Raymond, Alberta

TORRIE & PORTER

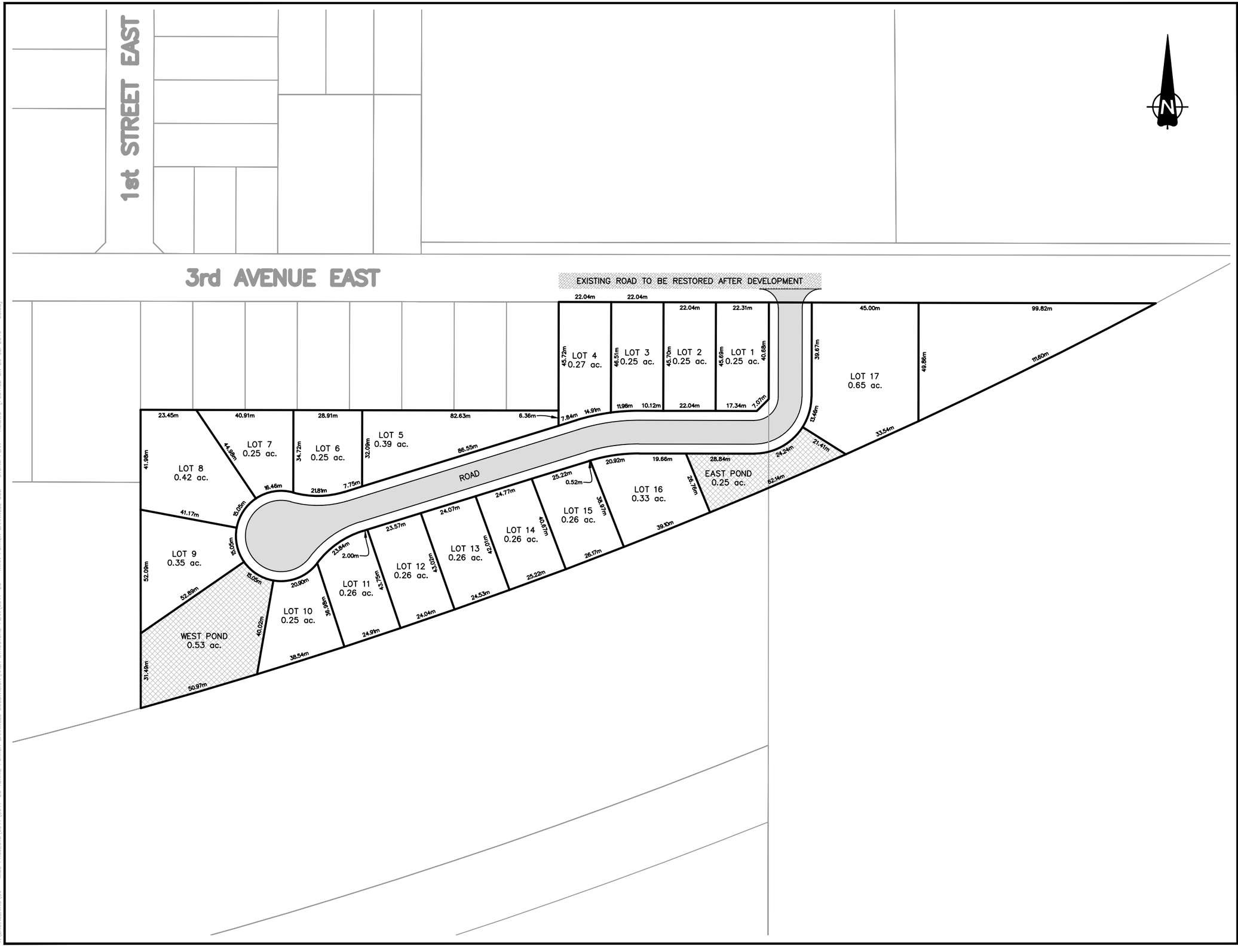
RESIDENTIAL DEVELOPMENT
BARNWELL, AB

PROPOSED DEVELOPMENT
LOCATION

DESIGNED: DJW	CHECKED:
DRAWN: JPL	JOB: 9917-23
SCALE: 1:7500	DIMENSIONS: METERS
DATE: 14 MARCH 2019	DRAWING No: 1

© 2018 Microsoft Corporation

D:\DROPBOX\99 - MISC PROJECTS\9917\9917-23 TORRIE PORTER BARNWELL SUBDIVISION\AREA STRUCTURE PLAN\9917-23 - RYAN PORTER BARNWELL SUB - STORM PLAN - R3.DWG [PLOTTED ON 15 Mar 2019 - 10:10]



LEGEND / NOTES

ISSUE	DATE	REVISION DESCRIPTION
0	29JUL'19	PRELIMINARY

WILDE BROTHERS
ENGINEERING LTD.
PERMIT TO PRACTICE
P08438

WILDE BROS. ENGINEERING LTD.
Raymond, Alberta

TORRIE & PORTER

RESIDENTIAL DEVELOPMENT
BARNWELL, AB

PROPOSED DEVELOPMENT
LAYOUT

DESIGNED: DJW	CHECKED:
DRAWN: JPL	JOB: 9917-23
SCALE: 1:1500	DIMENSIONS: METERS
DATE: 29 JULY 2019	DRAWING No: 2

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LEGEND / NOTES

ISSUE	DATE	REVISION DESCRIPTION
0	29JUL'19	PRELIMINARY

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P08438

WILDE BROS. ENGINEERING LTD.
Raymond, Alberta

TORRIE & PORTER

RESIDENTIAL DEVELOPMENT
BARNWELL, AB

EXISTING TOPOGRAPHY

DESIGNED: DJW	CHECKED:
DRAWN: JPL	JOB: 9917-23
SCALE:	DIMENSIONS: METERS
DATE: 29 JULY 2019	DRAWING No: 3

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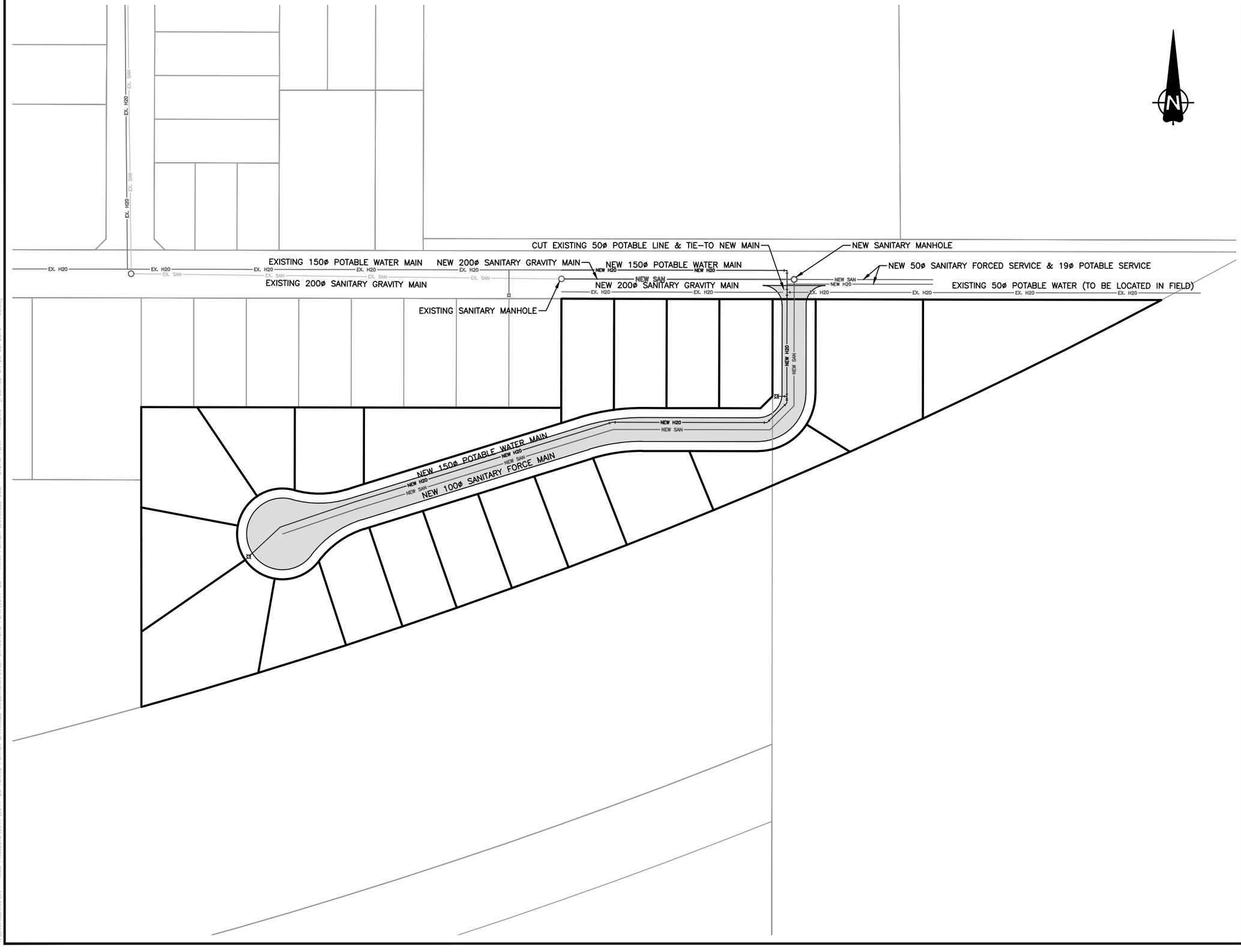

LEGEND / NOTES

ISSUE	DATE	REVISION DESCRIPTION
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WILDE BROS. ENGINEERING LTD.
Raymond, Alberta

TORRIE & PORTER

RESIDENTIAL DEVELOPMENT
BARNWELL, AB

PROPOSED WATER &
SEWER SERVICES

DESIGNED: DJW	CHECKED:
DRAWN: JPL	JOB: 9917-23
SCALE: 1:1500	DIMENSIONS: METERS
DATE: 29 JULY 2019	DRAWING No: 4

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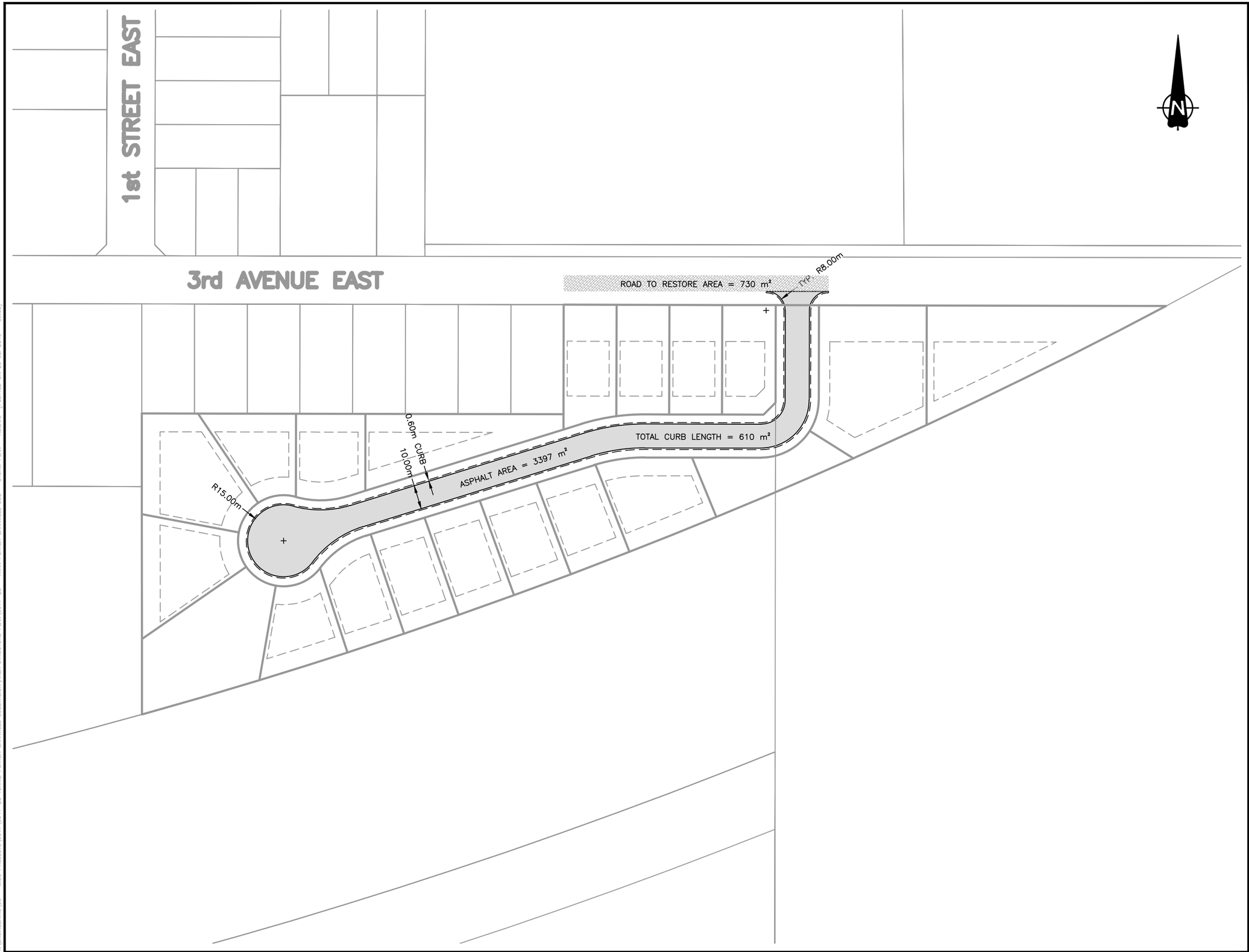

LEGEND / NOTES

ISSUE	DATE	REVISION DESCRIPTION
0	29JUL'19	PRELIMINARY

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WILDE BROS. ENGINEERING LTD.
Raymond, Alberta

TORRIE & PORTER

RESIDENTIAL DEVELOPMENT
BARNWELL, AB

PROPOSED ROAD DESIGN LAYOUT

DESIGNED: DJW	CHECKED:
DRAWN: JPL	JOB: 9917-23
SCALE: 1:1500	DIMENSIONS: METERS
DATE: 29 JULY 2019	DRAWING No: 5

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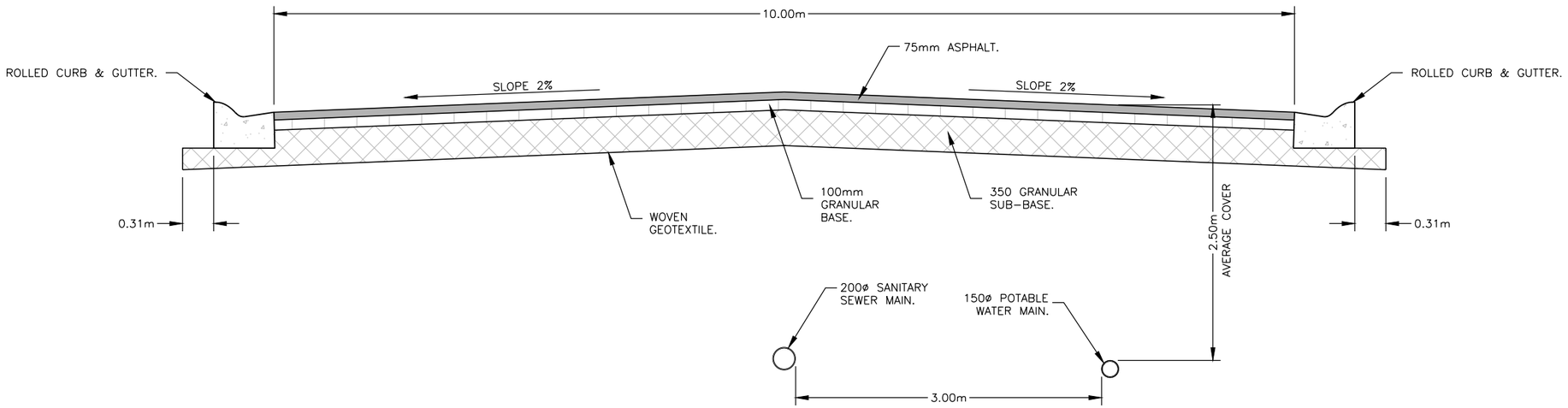

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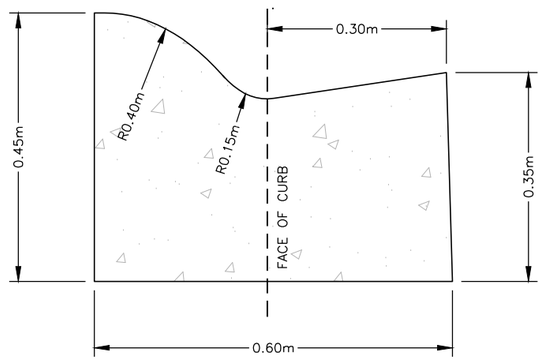
SCALE 1:50



TYPICAL MONOLITHIC CURB AND GUTTER
SCALE 1:10

LEGEND

ISSUE	DATE	REVISION DESCRIPTION

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Raymond, Alberta

TORRIE & PORTER

RESIDENTIAL DEVELOPMENT
BARNWELL, AB

TYPICAL ROAD DESIGN
CROSS-SECTION

DESIGNED:	DJW	CHECKED:	DJW
DRAWN:	J.L.J.	JOB:	9917-23
SCALE:	AS SHOWN	DIMENSIONS:	METRES
DATE:	AUG. 8, 2018	DRAWING No:	6

6. APPENDICES

APPENDIX A: LAND TITLE CERTIFICATE

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0032 547 243	0713622;1;13	171 142 354

LEGAL DESCRIPTION
PLAN 0713622
BLOCK 1
LOT 13
EXCEPTING THEREOUT ALL MINES AND MINERALS
AREA: 2.583 HECTARES (6.38 ACRES) MORE OR LESS

ESTATE: FEE SIMPLE
ATS REFERENCE: 4;17;9;21;NW

MUNICIPALITY: VILLAGE OF BARNWELL

REFERENCE NUMBER: 071 511 496

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
171 142 354	29/06/2017	TRANSFER OF LAND	$156,000	$156,000

OWNERS

RTK RANCHES LTD.
OF BOX 4178
TABER
ALBERTA T1G 2C6
AS TO AN UNDIVIDED 1/3 INTEREST

1581959 ALBERTA LTD.
OF BOX 434
BARNWELL
ALBERTA T0K 0B0
AS TO AN UNDIVIDED 1/3 INTEREST

1582005 ALBERTA LTD.
OF BOX 305
BARNWELL
ALBERTA T0K 0B0
AS TO AN UNDIVIDED 1/3 INTEREST

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
8025LI .	16/10/1972	IRRIGATION ORDER/NOTICE THIS PROPERTY IS INCLUDED IN THE TABER IRRIGATION DISTRICT
941 220 232	24/08/1994	CAVEAT RE : EASEMENT CAVEATOR - BOARD OF DIRECTORS OF THE TABER IRRIGATION DISTRICT. 4900-50 STREET TABER ALBERTA

TOTAL INSTRUMENTS: 002

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 14 DAY OF MARCH, 2019 AT 09:43 A.M.

ORDER NUMBER: 36863419

CUSTOMER FILE NUMBER:

END OF CERTIFICATE

THIS ELECTRONICALLY TRANSMITTED LAND TITLES PRODUCT IS INTENDED FOR THE SOLE USE OF THE ORIGINAL PURCHASER, AND NONE OTHER, SUBJECT TO WHAT IS SET OUT IN THE PARAGRAPH BELOW.

THE ABOVE PROVISIONS DO NOT PROHIBIT THE ORIGINAL PURCHASER FROM INCLUDING THIS UNMODIFIED PRODUCT IN ANY REPORT, OPINION, APPRAISAL OR OTHER ADVICE PREPARED BY THE ORIGINAL PURCHASER AS PART OF THE ORIGINAL PURCHASER APPLYING PROFESSIONAL, CONSULTING OR TECHNICAL EXPERTISE FOR THE BENEFIT OF CLIENT(S).

LAND TITLE CERTIFICATE

S

LINC	SHORT LEGAL	TITLE NUMBER
0031 751 712	4;17;9;21;;11,12,14	061 250 331
0031 751 688	4;17;9;21;NE	

LEGAL DESCRIPTION

FIRST
MERIDIAN 4 RANGE 17 TOWNSHIP 9
SECTION 21
LEGAL SUBDIVISION 11, THAT PORTION OF LEGAL SUBDIVISION 12
SHOWN AS EXTRA ROAD ON PLAN 0011715 AND LEGAL SUBDIVISION 14
ALL IN THE NORTH WEST QUARTER
CONTAINING 33.1 HECTARES (81.81 ACRES) MORE OR LESS
EXCEPTING (OUT OF LEGAL SUBDIVISION 14):

PLAN	NUMBER	HECTARES	(ACRES)	MORE OR LESS
ROAD	0011715	2.958	7.31	

EXCEPTING THEREOUT ALL MINES AND MINERALS

SECOND
MERIDIAN 4 RANGE 17 TOWNSHIP 9
SECTION 21
THE WESTERLY 380 METRES IN PERPENDICULAR WIDTH
THROUGHOUT OF THE NORTH EAST QUARTER
CONTAINING 30.6 HECTARES (75.56 ACRES) MORE OR LESS
EXCEPTING THEREOUT ALL MINES AND MINERALS

ESTATE: FEE SIMPLE

MUNICIPALITY: MUNICIPAL DISTRICT OF TABER / VILLAGE OF BARNWELL

REFERENCE NUMBER: 061 250 288

REGISTERED OWNER(S)

REGISTRATION	DATE(DMY)	DOCUMENT TYPE	VALUE	CONSIDERATION
061 250 331	22/06/2006	NOTIFICATION - RD ABAND & CONSOL		

OWNERS

WILLEM VAN STRAALEN

(CONTINUED)

AND
JANNETJE VAN STRAALEN
BOTH OF:
P.O. BOX 43
COALDALE
ALBERTA T0K 0L0
AS JOINT TENANTS

ENCUMBRANCES, LIENS & INTERESTS

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
1995CT .	03/03/1922	UTILITY RIGHT OF WAY GRANTEE - THE TABER IRRIGATION DISTRICT. AFFECTED LAND: 4;17;9;21;NE
3946DI .	12/10/1925	IRRIGATION ORDER/NOTICE AFFECTED LAND: 4;17;9;21;;11,12,14 THIS PROPERTY IS INCLUDED IN THE TABER IRRIGATION DISTRICT
8025LI .	16/10/1972	IRRIGATION ORDER/NOTICE THIS PROPERTY IS INCLUDED IN THE TABER IRRIGATION DISTRICT "NE 1/4 & E 1/2 LS 11 & 14"
771 165 060	23/11/1977	UTILITY RIGHT OF WAY GRANTEE - FORTY MILE GAS CO-OP LTD. 254-7 ST DUNMORE ALBERTA T1B0K9 AFFECTED LAND: 4;17;9;21;NE AS TO PORTION OR PLAN:IRR679 "THE CANAL RIGHT OF WAY" (DATA UPDATED BY: CHANGE OF NAME 121240594)
791 058 650	20/04/1979	UTILITY RIGHT OF WAY GRANTEE - FORTY MILE GAS CO-OP LTD. 254-7 ST DUNMORE ALBERTA T1B0K9 AFFECTED LAND: 4;17;9;21;NE (DATA UPDATED BY: CHANGE OF NAME 121240663)
811 232 642	14/12/1981	UTILITY RIGHT OF WAY GRANTEE - CANADIAN WESTERN NATURAL GAS COMPANY LIMITED.
841 047 855	20/03/1984	CAVEAT RE : EASEMENT

(CONTINUED)

REGISTRATION NUMBER	DATE (D/M/Y)	PARTICULARS
		CAVEATOR - BOARD OF DIRECTORS OF THE TABER IRRIGATION DISTRICT. TABER ALBERTA AGENT - KEITH E FRANCIS
981 276 962	10/09/1998	IRRIGATION DISTRICT RESOLUTION PART OF AN IRRIGABLE UNIT
011 045 824	16/02/2001	UTILITY RIGHT OF WAY GRANTEE - THE VILLAGE OF BARNWELL. AS TO PORTION OR PLAN:7811474
141 107 274	07/05/2014	MORTGAGE MORTGAGEE - AGRICULTURE FINANCIAL SERVICES CORPORATION. 4910-52 ST CAMROSE ALBERTA T4V2V4 ORIGINAL PRINCIPAL AMOUNT: $160,000
171 160 594	19/07/2017	CAVEAT RE : UTILITY RIGHT OF WAY CAVEATOR - MUNICIPAL DISTRICT OF TABER. 4900B - 50TH STREET TABER ALBERTA T1G1T2 AFFECTED LAND: 4;17;9;21;;11,12,14

TOTAL INSTRUMENTS: 011

THE REGISTRAR OF TITLES CERTIFIES THIS TO BE AN ACCURATE REPRODUCTION OF THE CERTIFICATE OF TITLE REPRESENTED HEREIN THIS 1 DAY OF APRIL, 2019 AT 10:01 A.M.

ORDER NUMBER: 36962459

CUSTOMER FILE NUMBER:

END OF CERTIFICATE

(CONTINUED)

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Torrie / Porter

Barnwell Development

Storm Water Management Plan

Prepared for: **Ryan Torrie, Benson Porter & Nelson Porter**
Prepared by: **Wilde Bros. Engineering Ltd.**

July 29, 2019

Project number: **9917-23**

WILDE BROS.
ENGINEERING LTD.

Table of Contents

1. INTRODUCTION 1
2. PRE-DEVELOPMENT CONDITIONS 1
   - 2.1. PROPOSED DEVELOPMENT SITE 1
   - 2.2. EXISTING TOPOGRAPHY AND DRAINAGE 1
3. POST-DEVELOPMENT CONDITIONS 2
   - 3.1. PROPOSED SITE DEVELOPMENT 2
4. STORM MODEL 5
   - 4.1. PRE-DEVELOPMENT MODEL 5
   - 4.2. POST-DEVELOPMENT MODEL 6
   - 4.3. RESULTS 7
5. SUMMARY 7

DRAWINGS

DRAWING STM1 - PRE-DEVELOPMENT CATCHMENTS

DRAWING STM2 - POST-DEVELOPMENT CATCHMENTS

DRAWING STM3 - FLOW PATH OVERVIEW

DRAWING STM4 - POND LOCATIONS

DRAWING STM5 - POND SECTION

APPENDICES

APPENDIX A - PRE-DEVELOPMENT MODEL RESULTS - 1-IN-5 YEAR 24 HOUR STORM EVENT

APPENDIX B - POST-DEVELOPMENT MODEL RESULTS - 1-IN-100 YEAR 24 HOUR STORM EVENT

1. INTRODUCTION

The Developer is applying to develop a property in the Village of Barnwell that borders along Highway 3. The development would be zoned for residential use. The Developer retained the services of Wilde Brothers Engineering to survey the property and perform a simulated storm analysis in order to determine what stormwater management might be required. This report provides a summary of the results of the study.

2. PRE-DEVELOPMENT CONDITIONS

2.1. PROPOSED DEVELOPMENT SITE

The site of the proposed development is located in the Village of Barnwell directly adjacent to the north side of Highway 3 and east of Heritage Road, as shown in Figure 1. The property is currently void of structures and infrastructure.

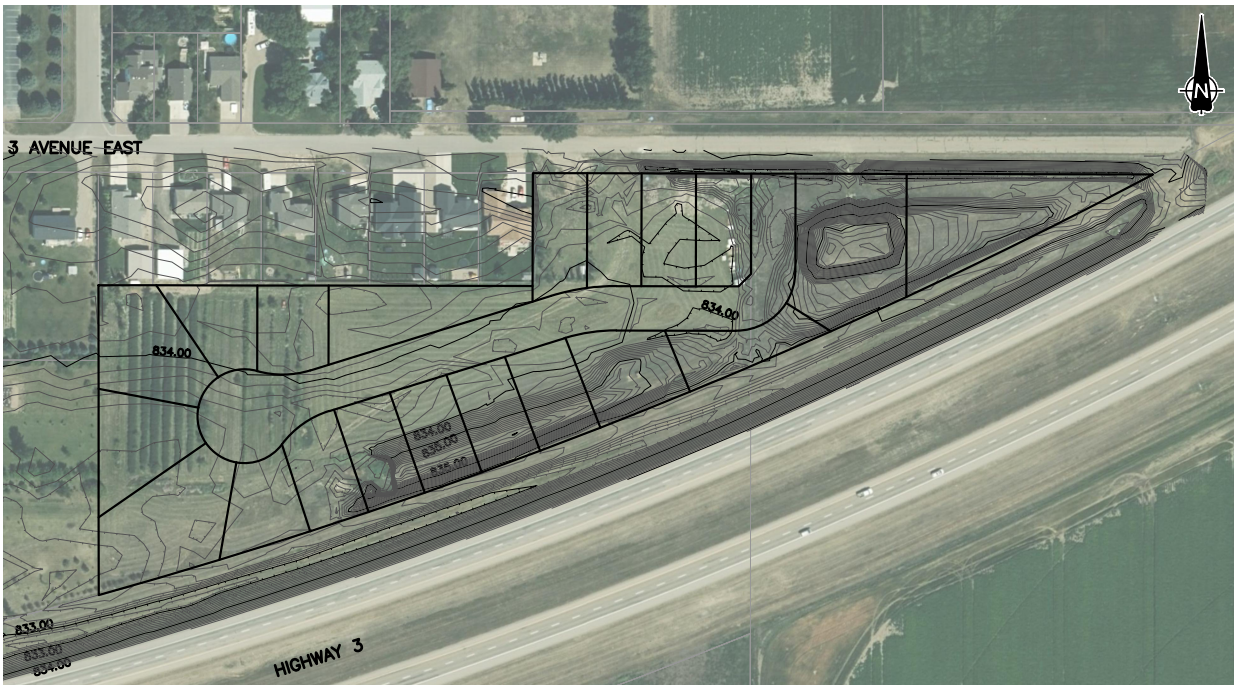
Figure 1: Location Of Proposed Development



2.2. EXISTING TOPOGRAPHY AND DRAINAGE

The site was surveyed with GPS in order to produce a topographical surface. Figure 2 shows the resulting topography. The site is predominantly flat with two soil stockpiles along the south and east parts of the proposed site. These piles will be removed prior to development.

Figure 2: Existing Site Topography



In its current state, some of the property is unable to properly drain without first ponding. The remainder and overflow from the ponded portions appear to flow southwest toward the existing automotive service shop (which is not a part of the development). The shop property is built up which causes the runoff to flow south into the north ditch of Highway 3. From there it is carried west along the highway until it enters a 900mm culvert under Heritage Road. The Village was consulted regarding this culvert as to its historical performance and it appears that there has not been any issues with ponding or overflowing Heritage Road and it has been working well. The runoff then continues west until it enters a drainage ditch and flows north as is shown in Figure 3. There is an existing ditch along the north side of the proposed development. Although this ditch has a slight slope to the west, it has been filled in on the west. The east end of this ditch has a culvert that passes into the Highway 3 ditch.

3. POST-DEVELOPMENT CONDITIONS

3.1. PROPOSED SITE DEVELOPMENT

The proposed development would see the creation of 18 new residential lots. A new paved road would be constructed up the centre of the proposed development that would connect onto 3 Avenue East at the north and terminate in a cul-de-sac at the west end. Five of the lots would face onto 3 Avenue East with the remainder facing onto the new proposed road. See Figure 4 for the proposed layout. In addition to the 18 residential lots, two lots will be designated for use as storm detention.

Figure 3: Existing Drainage Course

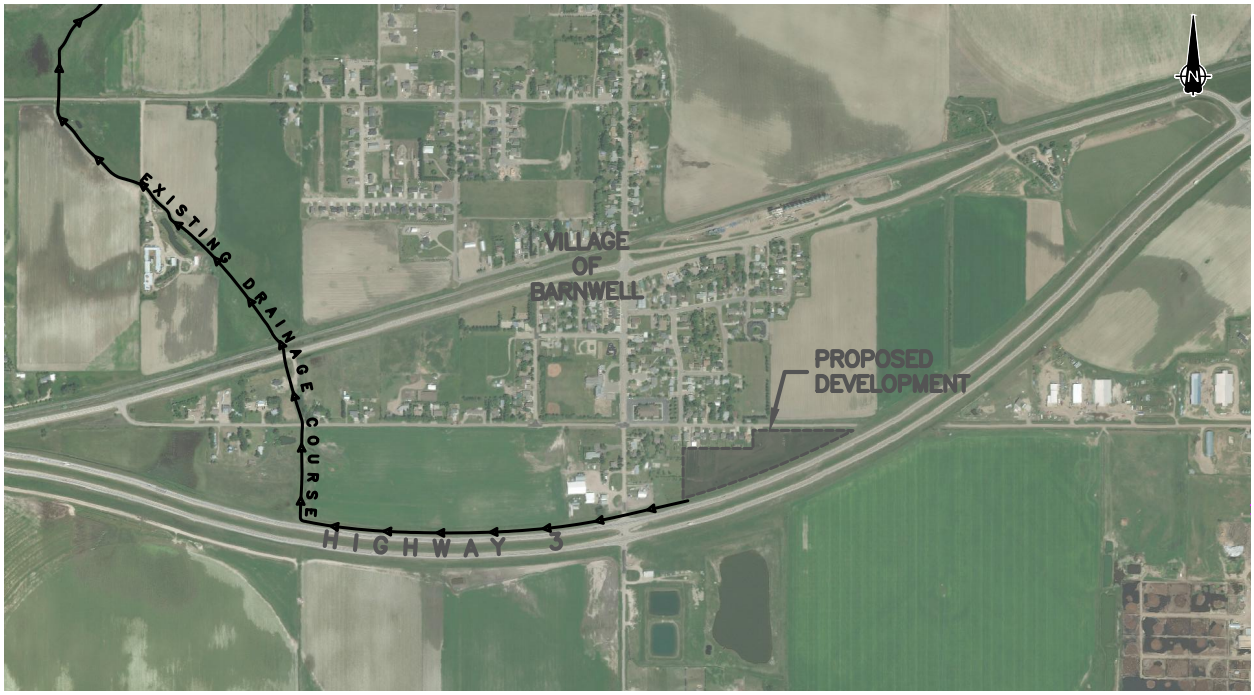
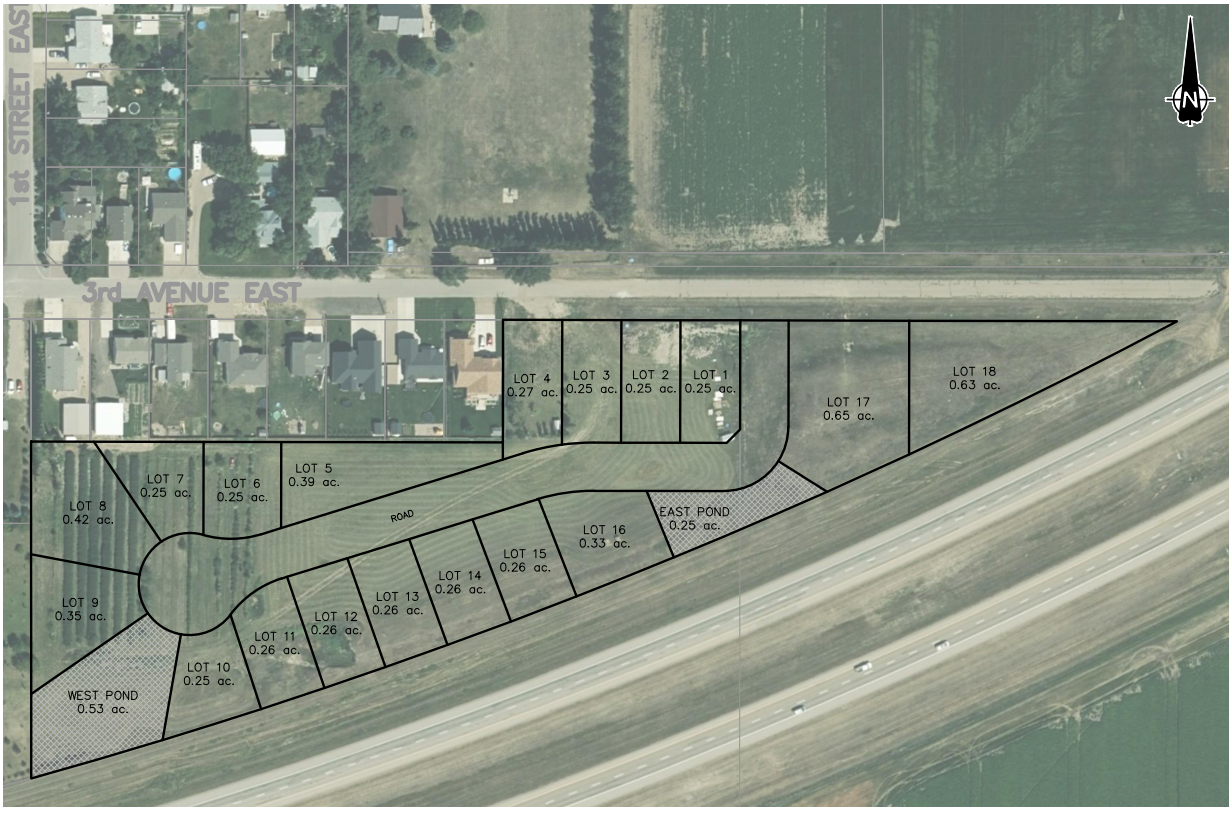
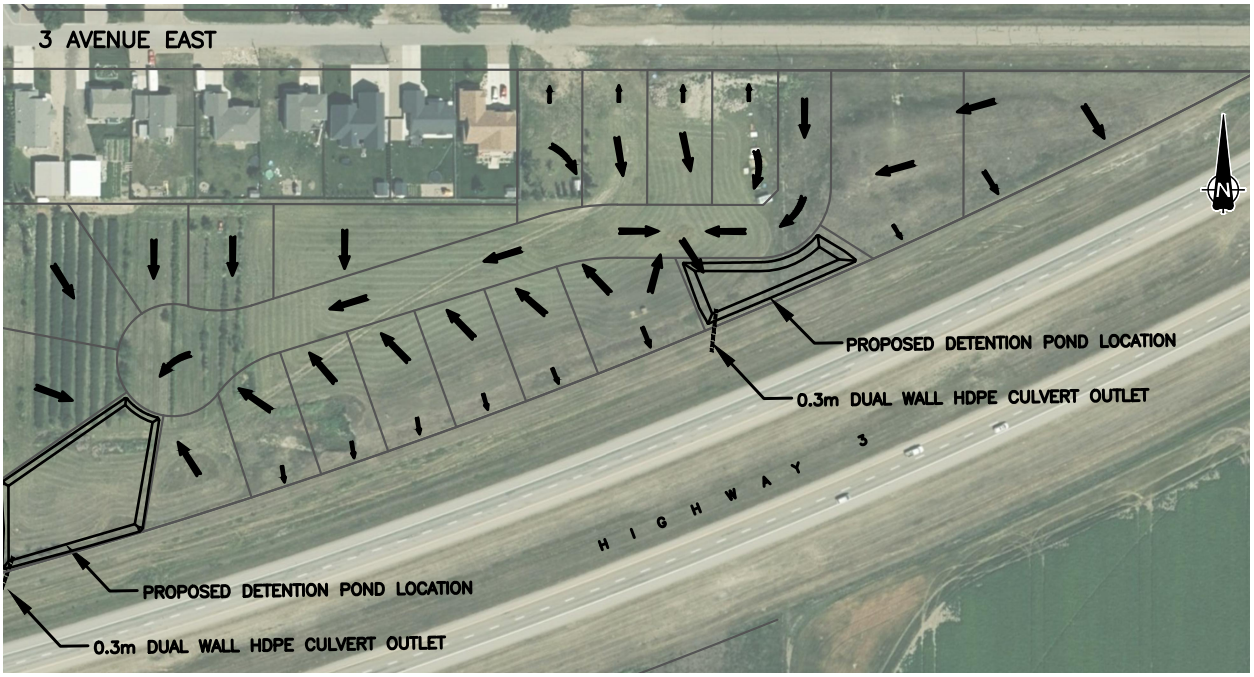


Figure 4: Proposed Development Layout



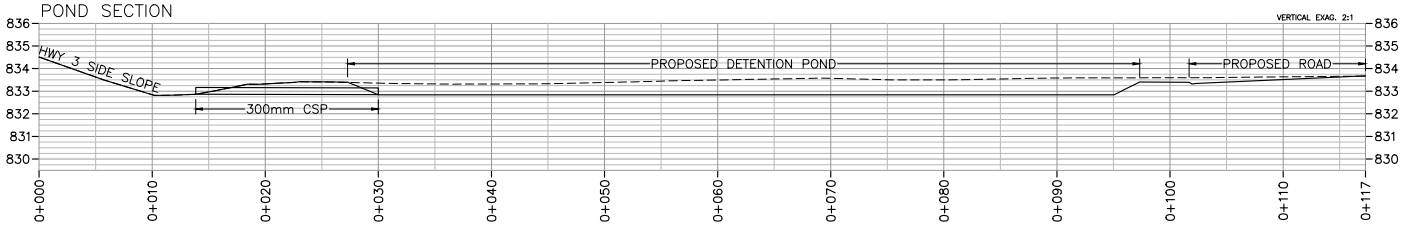
Based upon a preliminary design, most of the lots will be able to drain onto the proposed road. Lots adjacent to the Highway 3 right-of-way will have split drainage with the majority of the lots draining onto the proposed road and the remainder entering the Highway 3 ditch. See Figure 5 for the proposed flow directions.

Figure 5: Location Of Proposed Detention Ponds



The road curbs will carry the collected runoff to two collection points. The northern region of the development will collect into the East Pond. The remainder of the runoff collected by the road will collect into the West Pond. See Figure 5 for the proposed pond locations. The ponds will each have a culvert outlet to the north Highway 3 ditch sized such that the peak flow rate will be restricted so that the combined total runoff from the development equals pre-development conditions. The detention ponds will be sized appropriately to detain the restricted runoff. The pond outlets will

Figure 6: Section Of Proposed Pond (See Drawing STM4 for an Enlarged View)

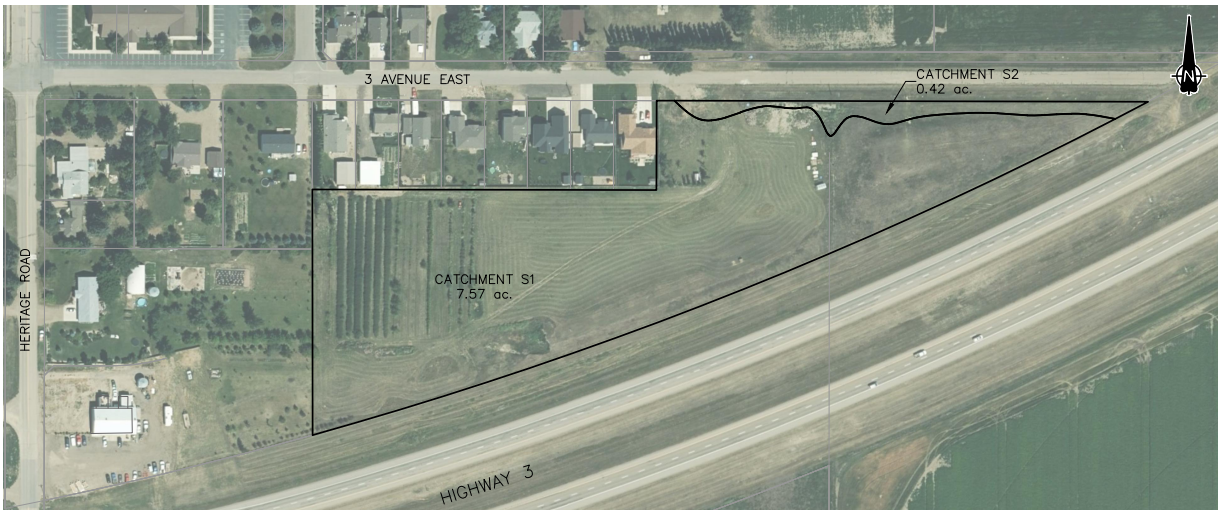


require armor protection, as well as overflows on the south side of the ponds to accommodate storm events greater than the 1-in-100 year 24 hour storm. Figure 6 shows a cross section of the potential pond.

4. STORM MODEL

Computer models of two different storm systems were used for both the pre- and post-development sites in order to determine what magnitude of storm management systems should be implemented. The storm typically used for these models is the Modified Chicago Storm for the region. In order to determine the volume of runoff that would need to be detained, the peak flow rate of the 1-in-100 year 24 hour post-development storm event was restricted to the peak flow rate during a 1-in-5 year 24 hour pre-development storm.

Figure 7: Pre-Development Catchment Areas (See Drawing STM1 for Enlarged View)



4.1. PRE-DEVELOPMENT MODEL

The existing site contours were evaluated and it was determined that the majority of the site ultimately drains into the north ditch of Highway 3, with a small portion in the northeast draining into the south ditch of 3rd Avenue East before it too passes through a culvert to the north ditch of Highway 3. The small portion in the northeast was given the designation of 'S2' and the remainder was given the designation of 'S1', as shown in Figure 7. The proposed site has no impervious areas. This was reflected in analyzing the pre-development conditions. The results of the pre-development model are summarized in Table 1.

Table 1: Pre-Development Model Results

		1-in-5 Year, 24 Hour Storm Event	
Catchment	**Area**	**Peak Flow Rate**	**Total Runoff Volume**
S1	3.04 ha	0.20 m³/s	360 m³
S2	0.17 ha	0.03 m³/s	20 m³
TOTALS	**3.21 ha**	**0.23 m³/s**	**380 m³**

4.2. POST-DEVELOPMENT MODEL

The development will be graded such that the runoff is directed into detention ponds prior to discharging into the north Highway 3 ditch, as much as is possible. Approximated design grades were used in the post-development model and the percent impervious area was based on the assumption that each lot will have ~270 m² (2912 ft²) of impervious area allowing for a residence and driveway. The road and curb were also used as impervious area. Based upon the preliminary grading and the corresponding outlets, the site was broken into three catchment areas as shown in Figure 8.

Figure 8: Post-Development Catchment Areas (See Drawing STM2 for an Enlarged View)



The road curbs will carry the collected runoff down to two collection points where it will enter the detention ponds. The ponds were each modeled with a 0.3m diameter culvert outlet. Based upon the amount of direct discharge into the ditch of Highway 3, this sized culvert would throttle the release from the ponds to a level that would maintain the net peak discharge into the ditch the same as in pre-development conditions. As a result, a portion of the runoff will be detained during the peak of the storm. While the post-development total volume of storm runoff is greater, the flow rate will not exceed that of the pre-existing site and the excess runoff will be detained on site.

The results of the post-development model are summarized in Table 2. It is important to note that the peak outfall flow rates do not happen simultaneously, and as such the peak system flow rate is not the sum of the individual outfall peak flow rates.

Table 2: Post-Development Model Results

		1-in-100 Year, 24 Hour Storm Event	
Outfall	**Area**	**Peak Outflow Rate**	**Total Runoff Volume**
West Pond (from S1)	1.92 ha	0.08 m^3/s	1,071 m^3
East Pond (from S3)	0.33 ha	0.10 m^3/s	556 m^3
Direct Discharge (from S2)	0.97 ha	0.16 m^3/s	166 m^3
System	**3.22 ha**	**0.23 m^3/s**	**1,793 m^3**

4.3. RESULTS

The increased slopes and percentage of impervious areas led to an increase in runoff for all three of the post-development catchments. Although S2 discharges directly into the Highway 3 ditch, the remainder of the development's runoff is passed through the detention pond outlets which effectively attenuate the peak discharge from the majority of the development before it enters the Highway 3 ditch. At the peak of the storm, the West Pond reaches 98% storage capacity (storing a maximum of 670 m^3) and the East Pond reaches 81% storage capacity (storing a maximum of 254 m^3).

5. SUMMARY

Based upon the storm models which were created, the development will lead to an increase in storm water runoff which will require some method of control. The ideal location for detention was the southwest corner of the proposed development where the West Pond is shown. However, it was not possible for the pond to detain the necessary volume when the pond discharge was restricted to pre-development flow rates. This led to the addition of the East Pond. A high point was added to the road that helped direct a significant portion of the runoff into the East Pond. As a result of restricting the peak flows to pre-development conditions, the west pond is required to detain up to 670 m^3 and the East Pond is required to detain up to 254 m^3.

The restricted outflows from these two ponds, combined with the runoff directly discharging into the highway ditch, are equal to that of the pre-development site.

Drawings

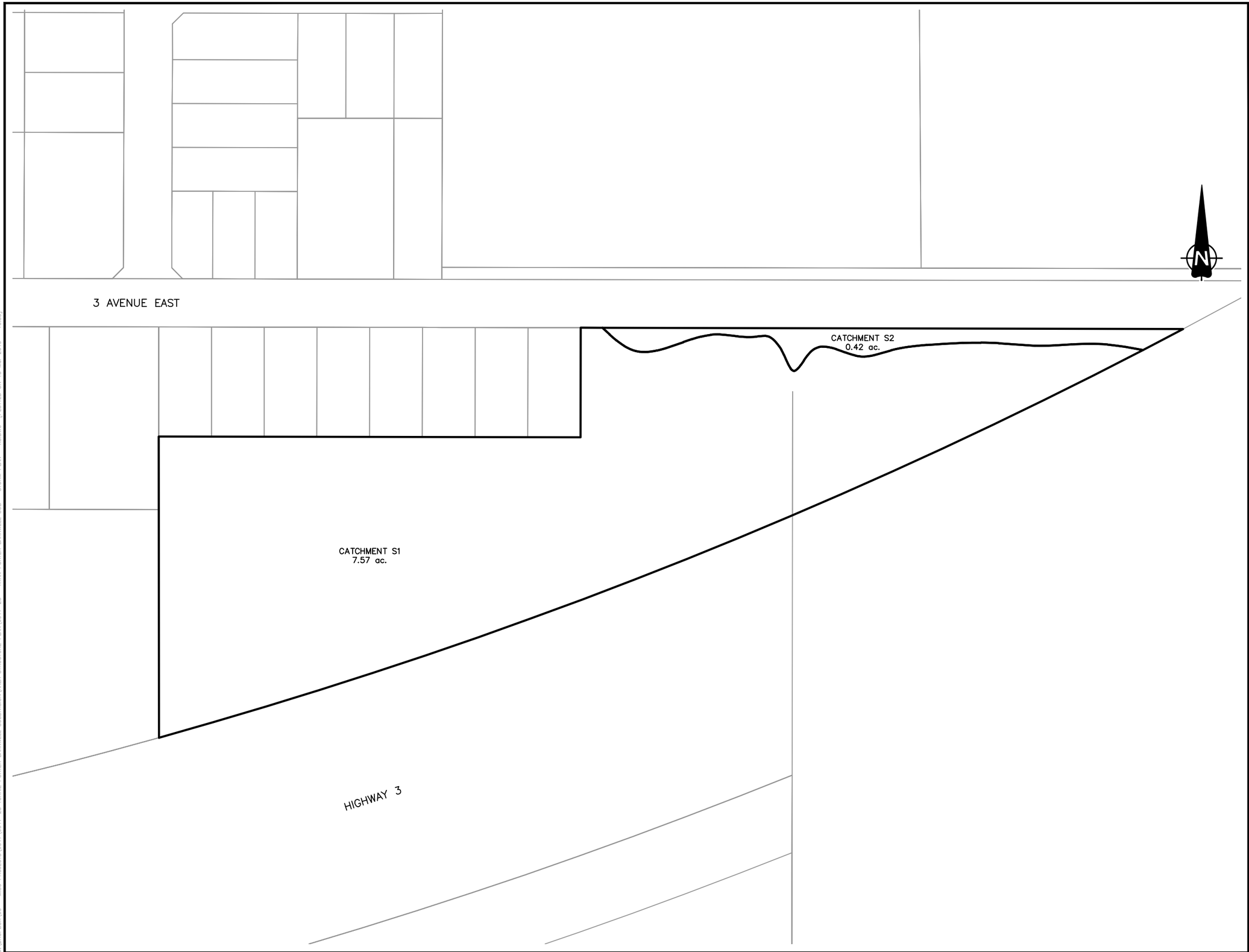
DRAWING STM1 - PRE-DEVELOPMENT CATCHMENTS

DRAWING STM2 - POST-DEVELOPMENT CATCHMENTS

DRAWING STM3 - FLOW PATH OVERVIEW

DRAWING STM4 - POND LOCATIONS

DRAWING STM5 - POND SECTION



LEGEND / NOTES

ISSUE	DATE	REVISION DESCRIPTION
0	15MAR'19	

WILDE BROTHERS
ENGINEERING LTD.
PERMIT TO PRACTICE
P08438

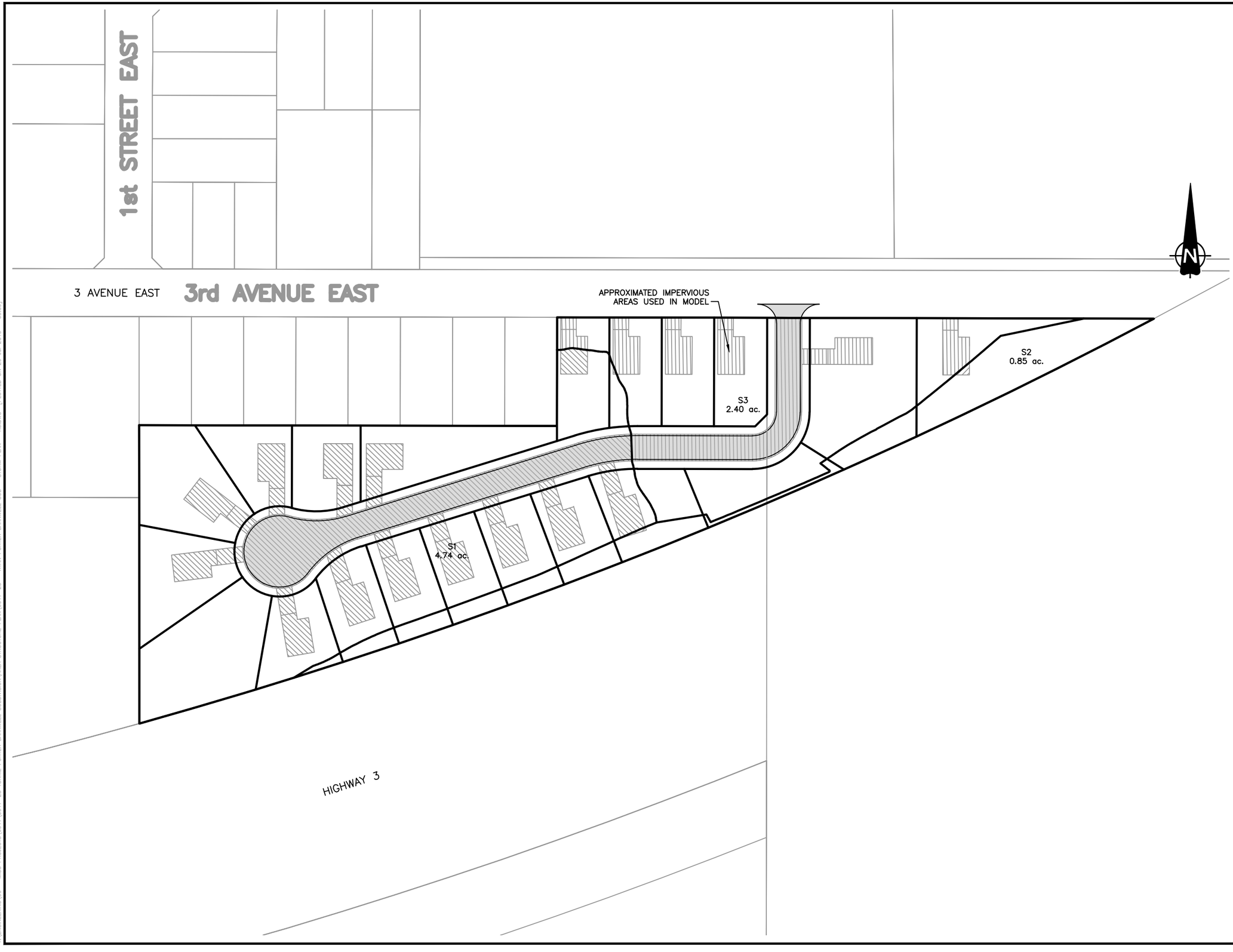
WILDE BROS. ENGINEERING LTD.
Raymond, Alberta

TORRIE & PORTER

COMMERCIAL/ LIGHT INDUSTRIAL
BARNWELL, AB
STORM MODEL:
CATCHMENT AREAS
PREDEVELOPMENT

DESIGNED: DJW	CHECKED:
DRAWN: JPL	JOB: 9917-23
SCALE: 1:1500	DIMENSIONS: METERS
DATE: 15 MARCH 2019	DRAWING No: STM1

D:\DROPBOX\09 - MISC PROJECTS\9917\9917-23 TORRIE PORTER BARNWELL SUBDIVISION\AREA STRUCTURE PLAN\9917-23 - RYAN PORTER BARNWELL SUB - STORM PLAN - R3.DWG [PLOTTED ON 15 Mar 2019 - 10:55]



LEGEND / NOTES

ISSUE	DATE	REVISION DESCRIPTION
0	29JUL'19	PRELIMINARY

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P08438

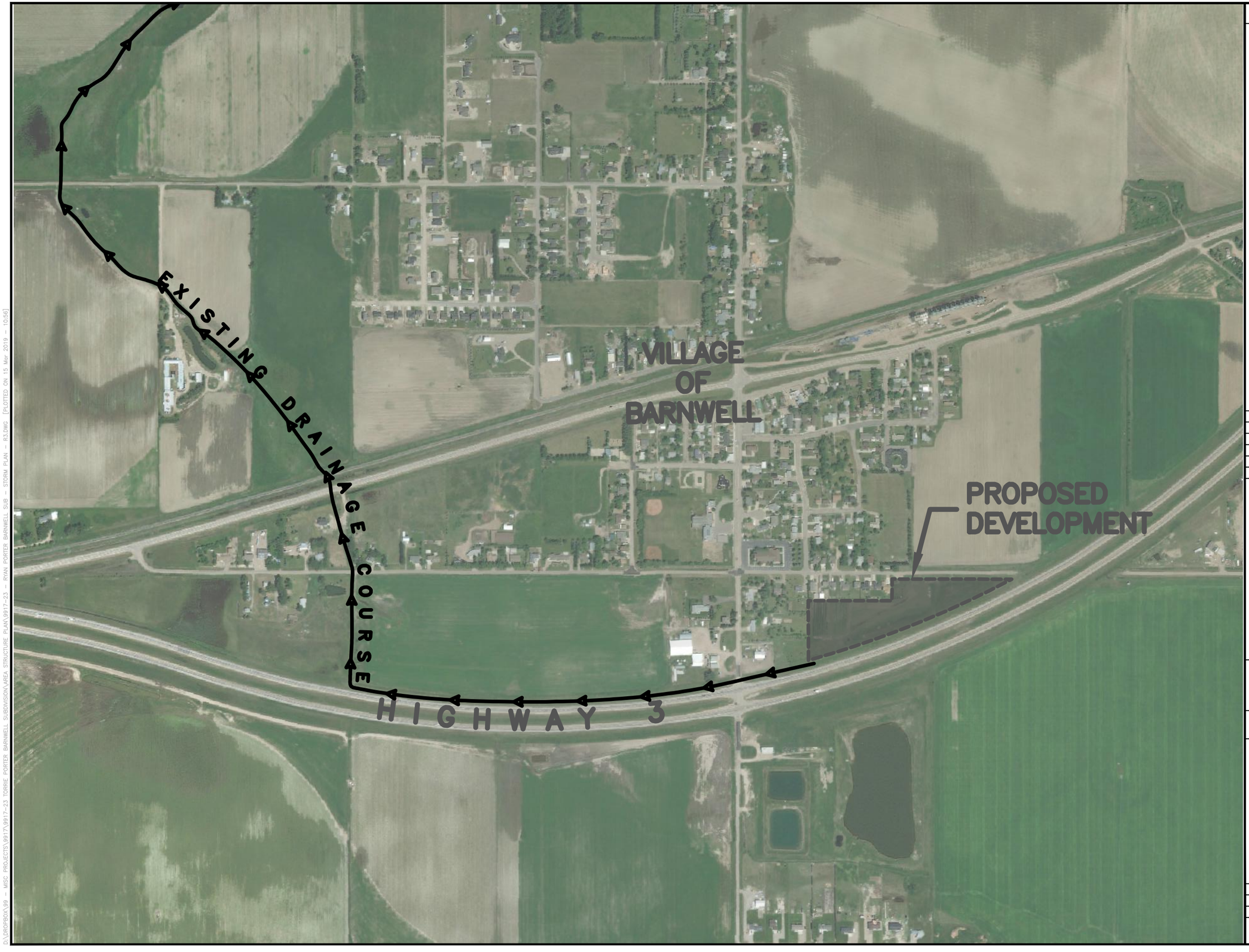
WILDE BROS. ENGINEERING LTD.
Raymond, Alberta

TORRIE & PORTER

RESIDENTIAL DEVELOPMENT
BARNWELL, AB
STORM MODEL:
CATCHMENT AREAS
POST-DEVELOPMENT

DESIGNED: DJW	CHECKED:
DRAWN: JPL	JOB: 9917-23
SCALE: 1:1500	DIMENSIONS: METERS
DATE: 29 JULY 2019	DRAWING No: STM2

X:\ENGINEERING\09 - MISC PROJECTS\9917\9917-23 TORRIE PORTER BARNWELL SUBDIVISION\AREA STRUCTURE PLAN\9917-23 - RVAN PORTER BARNWELL SUB - STORM PLAN - R3.DWG [PLOTTED ON 29 JUL 2019 - 09:09]



LEGEND / NOTES

ISSUE	DATE	REVISION DESCRIPTION
0	15MAR'19	

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ENGINEERING LTD.
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P08438

WILDE BROS. ENGINEERING LTD.
Raymond, Alberta

TORRIE & PORTER

RESIDENTIAL DEVELOPMENT
BARNWELL, AB
STORM MODEL:
PROPOSED DEVELOPMENT
FLOW PATH OVERVIEW

DESIGNED: DJW	CHECKED:
DRAWN: JPL	JOB: 9917-23
SCALE: 1:7500	DIMENSIONS: METERS
DATE: 15 MARCH 2019	DRAWING No: STM3

D:\DROPBOX\99 - MISC PROJECTS\9917\9917-23 TORRIE PORTER BARNWELL SUBDIVISION\AREA STRUCTURE PLAN\9917-23 - RYAN PORTER BARNWELL SUB - STORM PLAN - R3.DWG [PLOTTED ON 15 Mar 2019 - 10:56]



LEGEND / NOTES

ISSUE	DATE	REVISION DESCRIPTION
0	29JUL'19	PRELIMINARY

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Raymond, Alberta

TORRIE & PORTER

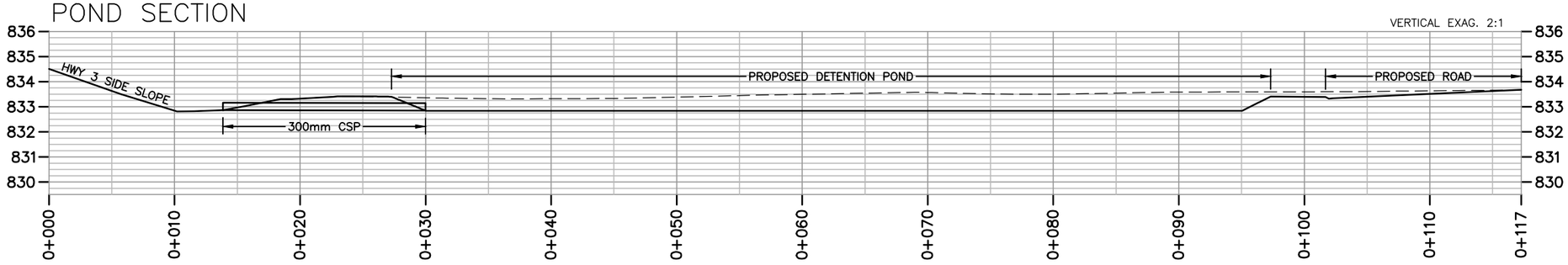
RESIDENTIAL DEVELOPMENT
BARNWELL, AB
STORM MODEL:
PROPOSED DEVELOPMENT
POND LOCATIONS

DESIGNED: DJW	CHECKED:
DRAWN: JPL	JOB: 9917-23
SCALE: 1:1250	DIMENSIONS: METERS
DATE: 29 JULY 2019	DRAWING No: STM4

X:\ENGINEERING\09 - MISC PROJECTS\09I7\9917-23 TORRIE PORTER BARNWELL SUBDIVISION\AREA STRUCTURE PLAN\9917-23 - RYAN PORTER BARNWELL SUB - STORM PLAN - R3.DWG [PLOTTED ON 29 Jul 2019 - 16:03]

D:\DROPBOX\09 - MISC PROJECTS\9917\9917-23 TORRIE PORTER BARNWELL SUBDIVISION\AREA STRUCTURE PLAN\9917-23 - RYAN PORTER BARNWELL SUB - STORM PLAN - R3.DWG [PLOTTED ON 15 Mar 2019 - 10:58]

POND SECTION



LEGEND / NOTES

ISSUE	DATE	REVISION DESCRIPTION

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Raymond, Alberta

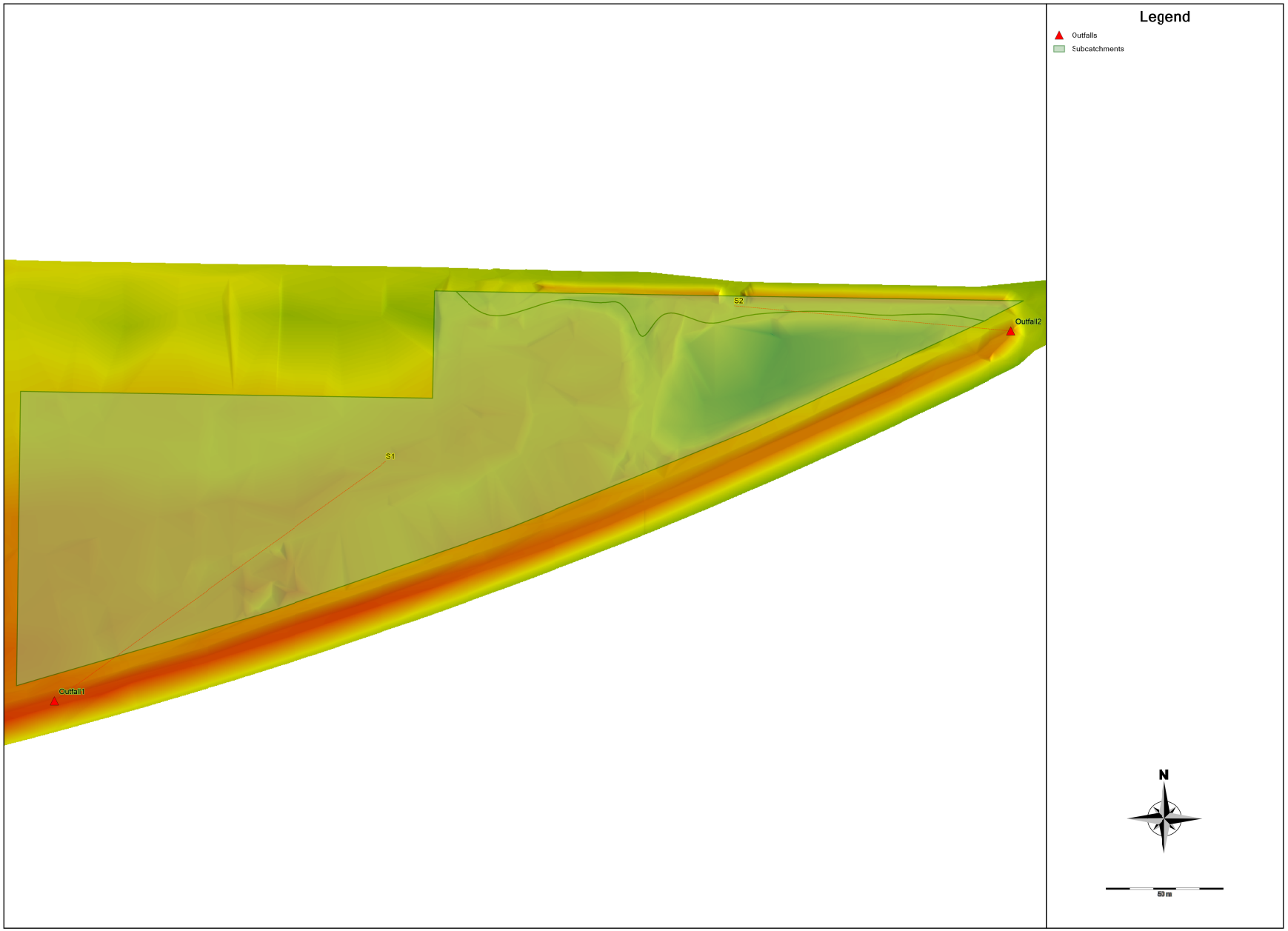
TORRIE & PORTER

RESIDENTIAL DEVELOPMENT
BARNWELL, AB

PROPOSED POND SECTION

DESIGNED:	DJW	CHECKED:	DJW
DRAWN:	JBL	JOB:	9917-23
SCALE:	1:400	DIMENSIONS:	METERS
DATE:	29 MARCH, 2018	DRAWING No:	STM5

APPENDIX B - POST-DEVELOPMENT MODEL RESULTS - 1-IN-100 YEAR 24 HOUR STORM EVENT


Legend
Outfalls
Subcatchments
S2
Outfall2
S1
Outfall1
N
50 m

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

9917-23 - Torrie Barnwell Development - Pre-Development

****
Element Count
****
Number of rain gages 1
Number of subcatchments ... 2
Number of nodes 2
Number of links 0
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Name	Data Source	Data Type	Recording Interval
Leth1in5yr24hr(10min)	Leth1in5yr24hr(10min)	INTENSITY	**10 min.**

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
S1	**3.04**	**483.32**	**0.00**	**2.9420**	**Leth1in5yr24hr(10min)**	**Outfall1**
S2	**0.17**	**100.41**	**0.00**	**8.9470**	**Leth1in5yr24hr(10min)**	**Outfall2**

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
Outfall1	OUTFALL	0.00	0.00	0.0	
Outfall2	OUTFALL	0.00	0.00	0.0	

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO
  Flow Routing ..... NO
  Water Quality ..... NO
Infiltration Method ..... GREEN_AMPT
Starting Date 02/26/2019 00:00:00
Ending Date 02/27/2019 00:00:00
Antecedent Dry Days 0.0
Report Time Step 00:01:00
Wet Time Step 00:05:00
Dry Time Step 00:05:00

Runoff Quantity Continuity	Volume hectare-m	Depth mm
Total Precipitation	0.215	**67.008**
Evaporation Loss	0.000	0.000
Infiltration Loss	0.178	**55.213**
Surface Runoff	0.039	**12.048**
Final Storage	0.000	0.000
Continuity Error (%)	-0.377	

********** Volume Volume

Flow Routing Continuity	hectare-m	10^6 ltr
Dry Weather Inflow	0.000	0.000
Wet Weather Inflow	0.039	0.387
Groundwater Inflow	0.000	0.000
RDII Inflow	0.000	0.000
External Inflow	0.000	0.000
External Outflow	0.039	0.387
Flooding Loss	0.000	0.000
Evaporation Loss	0.000	0.000
Exfiltration Loss	0.000	0.000
Initial Stored Volume	0.000	0.000
Final Stored Volume	0.000	0.000
Continuity Error (%)	0.000	

Subcatchment Runoff Summary

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
S1	67.01	0.00	0.00	55.27	11.95	0.36	0.20	0.178
S2	67.01	0.00	0.00	54.13	13.81	0.02	0.03	0.206

Analysis begun on: Thu Feb 28 14:16:38 2019
Analysis ended on: Thu Feb 28 14:16:38 2019
Total elapsed time: < 1 sec

```
[TITLE]


[OPTIONS]
;;Options            Value
;;------------------ ------------
FLOW_UNITS           CMS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         DYNWAVE
START_DATE           02/26/2019
START_TIME           00:00:00
REPORT_START_DATE    02/26/2019
REPORT_START_TIME    00:00:00
END_DATE             02/27/2019
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:01:00
WET_STEP             00:05:00
DRY_STEP             00:05:00
ROUTING_STEP         5
ALLOW_PONDING        YES
INERTIAL_DAMPING     PARTIAL
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         0
NORMAL_FLOW_LIMITED  BOTH
SKIP_STEADY_STATE    NO
FORCE_MAIN_EQUATION  H-W
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
MAX_TRIALS           8
HEAD_TOLERANCE       0.0015
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              4

[EVAPORATION]
;;Type          Parameters
;;------------- ----------
CONSTANT     0.0
DRY_ONLY     NO

[RAINGAGES]
;;                   Rain      Time   Snow   Data
;;Name               Type      Intrvl Catch  Source
;;------------------ --------- ------ ------ ----------
Leth1in5yr24hr(10min) INTENSITY 0:10   1.0    TIMESERIES Leth1in5yr24hr(10min)

[SUBCATCHMENTS]
;;                                                 Total    Pcnt.             Pcnt.    Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length   Pack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- --------
S1               Leth1in5yr24hr(10min) Outfall1    3.0449   0        483.317  2.942    0
S2               Leth1in5yr24hr(10min) Outfall2    0.1707   0        100.412  8.947    0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
S1               0.011      0.15       2.5        5          25         OUTLET
S2               0.011      0.15       2.5        5          25         OUTLET

[INFILTRATION]
;;Subcatchment   Suction    HydCon     IMDmax
;;-------------- ---------- ---------- ----------
S1               88.9       3.3        0.347
S2               88.9       3.3        0.347

[OUTFALLS]
;;               Invert     Outfall      Stage/Table      Tide
;;Name           Elev.      Type         Time Series      Gate Route To
;;-------------- ---------- ------------ ---------------- ---- ----------------
Outfall1         0          FREE                          NO
Outfall2         0          FREE                          NO

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
;Chicago design storm, a = 440.69, b = 0, c = 0.696, Duration = 1440 minutes, r = 0.3, rain units = mm/hr.
Leth1in5yr24hr(10min)            0:00       0.856
Leth1in5yr24hr(10min)            0:10       0.87
Leth1in5yr24hr(10min)            0:20       0.885
```

Leth1in5yr24hr(10min)	0:30	0.9
Leth1in5yr24hr(10min)	0:40	0.916
Leth1in5yr24hr(10min)	0:50	0.933
Leth1in5yr24hr(10min)	1:00	0.951
Leth1in5yr24hr(10min)	1:10	0.969
Leth1in5yr24hr(10min)	1:20	0.989
Leth1in5yr24hr(10min)	1:30	1.009
Leth1in5yr24hr(10min)	1:40	1.03
Leth1in5yr24hr(10min)	1:50	1.053
Leth1in5yr24hr(10min)	2:00	1.077
Leth1in5yr24hr(10min)	2:10	1.102
Leth1in5yr24hr(10min)	2:20	1.128
Leth1in5yr24hr(10min)	2:30	1.156
Leth1in5yr24hr(10min)	2:40	1.186
Leth1in5yr24hr(10min)	2:50	1.218
Leth1in5yr24hr(10min)	3:00	1.253
Leth1in5yr24hr(10min)	3:10	1.289
Leth1in5yr24hr(10min)	3:20	1.328
Leth1in5yr24hr(10min)	3:30	1.371
Leth1in5yr24hr(10min)	3:40	1.417
Leth1in5yr24hr(10min)	3:50	1.466
Leth1in5yr24hr(10min)	4:00	1.52
Leth1in5yr24hr(10min)	4:10	1.58
Leth1in5yr24hr(10min)	4:20	1.645
Leth1in5yr24hr(10min)	4:30	1.717
Leth1in5yr24hr(10min)	4:40	1.798
Leth1in5yr24hr(10min)	4:50	1.888
Leth1in5yr24hr(10min)	5:00	1.991
Leth1in5yr24hr(10min)	5:10	2.108
Leth1in5yr24hr(10min)	5:20	2.243
Leth1in5yr24hr(10min)	5:30	2.402
Leth1in5yr24hr(10min)	5:40	2.591
Leth1in5yr24hr(10min)	5:50	2.821
Leth1in5yr24hr(10min)	6:00	3.109
Leth1in5yr24hr(10min)	6:10	3.481
Leth1in5yr24hr(10min)	6:20	3.984
Leth1in5yr24hr(10min)	6:30	4.712
Leth1in5yr24hr(10min)	6:40	5.886
Leth1in5yr24hr(10min)	6:50	8.21
Leth1in5yr24hr(10min)	7:00	16.528
Leth1in5yr24hr(10min)	7:10	88.743
Leth1in5yr24hr(10min)	7:20	18.086
Leth1in5yr24hr(10min)	7:30	11.9
Leth1in5yr24hr(10min)	7:40	9.211
Leth1in5yr24hr(10min)	7:50	7.646
Leth1in5yr24hr(10min)	8:00	6.605
Leth1in5yr24hr(10min)	8:10	5.853
Leth1in5yr24hr(10min)	8:20	5.281
Leth1in5yr24hr(10min)	8:30	4.829
Leth1in5yr24hr(10min)	8:40	4.46
Leth1in5yr24hr(10min)	8:50	4.154
Leth1in5yr24hr(10min)	9:00	3.894
Leth1in5yr24hr(10min)	9:10	3.671
Leth1in5yr24hr(10min)	9:20	3.476
Leth1in5yr24hr(10min)	9:30	3.305
Leth1in5yr24hr(10min)	9:40	3.153
Leth1in5yr24hr(10min)	9:50	3.017
Leth1in5yr24hr(10min)	10:00	2.895
Leth1in5yr24hr(10min)	10:10	2.784
Leth1in5yr24hr(10min)	10:20	2.682
Leth1in5yr24hr(10min)	10:30	2.59
Leth1in5yr24hr(10min)	10:40	2.504
Leth1in5yr24hr(10min)	10:50	2.426
Leth1in5yr24hr(10min)	11:00	2.353
Leth1in5yr24hr(10min)	11:10	2.285
Leth1in5yr24hr(10min)	11:20	2.222
Leth1in5yr24hr(10min)	11:30	2.162
Leth1in5yr24hr(10min)	11:40	2.107
Leth1in5yr24hr(10min)	11:50	2.055
Leth1in5yr24hr(10min)	12:00	2.006
Leth1in5yr24hr(10min)	12:10	1.959
Leth1in5yr24hr(10min)	12:20	1.916
Leth1in5yr24hr(10min)	12:30	1.874
Leth1in5yr24hr(10min)	12:40	1.835
Leth1in5yr24hr(10min)	12:50	1.797
Leth1in5yr24hr(10min)	13:00	1.762
Leth1in5yr24hr(10min)	13:10	1.728
Leth1in5yr24hr(10min)	13:20	1.696
Leth1in5yr24hr(10min)	13:30	1.665
Leth1in5yr24hr(10min)	13:40	1.635
Leth1in5yr24hr(10min)	13:50	1.607
Leth1in5yr24hr(10min)	14:00	1.579
Leth1in5yr24hr(10min)	14:10	1.553
Leth1in5yr24hr(10min)	14:20	1.528

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Leth1in5yr24hr(10min)            14:30      1.504
Leth1in5yr24hr(10min)            14:40      1.481
Leth1in5yr24hr(10min)            14:50      1.459
Leth1in5yr24hr(10min)            15:00      1.437
Leth1in5yr24hr(10min)            15:10      1.416
Leth1in5yr24hr(10min)            15:20      1.396
Leth1in5yr24hr(10min)            15:30      1.377
Leth1in5yr24hr(10min)            15:40      1.358
Leth1in5yr24hr(10min)            15:50      1.34
Leth1in5yr24hr(10min)            16:00      1.323
Leth1in5yr24hr(10min)            16:10      1.306
Leth1in5yr24hr(10min)            16:20      1.289
Leth1in5yr24hr(10min)            16:30      1.273
Leth1in5yr24hr(10min)            16:40      1.258
Leth1in5yr24hr(10min)            16:50      1.242
Leth1in5yr24hr(10min)            17:00      1.228
Leth1in5yr24hr(10min)            17:10      1.214
Leth1in5yr24hr(10min)            17:20      1.2
Leth1in5yr24hr(10min)            17:30      1.186
Leth1in5yr24hr(10min)            17:40      1.173
Leth1in5yr24hr(10min)            17:50      1.161
Leth1in5yr24hr(10min)            18:00      1.148
Leth1in5yr24hr(10min)            18:10      1.136
Leth1in5yr24hr(10min)            18:20      1.124
Leth1in5yr24hr(10min)            18:30      1.113
Leth1in5yr24hr(10min)            18:40      1.102
Leth1in5yr24hr(10min)            18:50      1.091
Leth1in5yr24hr(10min)            19:00      1.08
Leth1in5yr24hr(10min)            19:10      1.07
Leth1in5yr24hr(10min)            19:20      1.059
Leth1in5yr24hr(10min)            19:30      1.05
Leth1in5yr24hr(10min)            19:40      1.04
Leth1in5yr24hr(10min)            19:50      1.03
Leth1in5yr24hr(10min)            20:00      1.021
Leth1in5yr24hr(10min)            20:10      1.012
Leth1in5yr24hr(10min)            20:20      1.003
Leth1in5yr24hr(10min)            20:30      0.994
Leth1in5yr24hr(10min)            20:40      0.986
Leth1in5yr24hr(10min)            20:50      0.977
Leth1in5yr24hr(10min)            21:00      0.969
Leth1in5yr24hr(10min)            21:10      0.961
Leth1in5yr24hr(10min)            21:20      0.953
Leth1in5yr24hr(10min)            21:30      0.946
Leth1in5yr24hr(10min)            21:40      0.938
Leth1in5yr24hr(10min)            21:50      0.931
Leth1in5yr24hr(10min)            22:00      0.923
Leth1in5yr24hr(10min)            22:10      0.916
Leth1in5yr24hr(10min)            22:20      0.909
Leth1in5yr24hr(10min)            22:30      0.902
Leth1in5yr24hr(10min)            22:40      0.896
Leth1in5yr24hr(10min)            22:50      0.889
Leth1in5yr24hr(10min)            23:00      0.883
Leth1in5yr24hr(10min)            23:10      0.876
Leth1in5yr24hr(10min)            23:20      0.87
Leth1in5yr24hr(10min)            23:30      0.864
Leth1in5yr24hr(10min)            23:40      0.858
Leth1in5yr24hr(10min)            23:50      0.852
Leth1in5yr24hr(10min)            24:00      0

[REPORT]
INPUT      YES
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS       409189.007600503 5512158.71207393 409661.567381793 5512351.12294886
UNITS            Meters

[COORDINATES]
;;Node           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
Outfall1         409226.802       5512167.458
Outfall2         409634.775       5512325.302

[VERTICES]
;;Link           X-Coord          Y-Coord
;;-------------- ---------------- ----------------

[POLYGONS]
;;Subcatchment   X-Coord          Y-Coord
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S1               409210.488       5512174.021
S1               409210.488       5512174.021
S1               409316.545       5512204.891
S1               409420.871       5512241.18
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S1               409623.231       5512329.622
S1               409615.829       5512331.037
S1               409613.973       5512331.363
S1               409608.373       5512332.134
S1               409606.497       5512332.298
S1               409600.854       5512332.523
S1               409598.966       5512332.52
S1               409593.305       5512332.38
S1               409585.764       5512332.086
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S1               409578.238       5512332.088
S1               409563.216       5512333.317
S1               409561.335       5512333.437
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S1               409488.391       5512332.842
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S1               409485.053       5512331.232
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S1               409478.581       5512323.419
S1               409478.38        5512323.289
S1               409478.17        5512323.172
S1               409478.17        5512323.172
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S1	409478	5512323.104
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S1	409442.137	5512338.45
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S1	409429.697	5512335.035
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S1	409418.547	5512332.012
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S1	409415.022	5512331.819
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S2	409486.274	5512332.083
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S2	409485.442	5512331.541
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S2	409484.684	5512330.899
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S2	409482.836	5512328.781
S2	409481.801	5512327.368
S2	409480.501	5512325.549
S2	409480.216	5512325.163
S2	409479.919	5512324.786
S2	409479.292	5512324.059
S2	409479.13	5512323.882
S2	409478.957	5512323.716
S2	409478.774	5512323.561
S2	409478.581	5512323.419
S2	409478.38	5512323.289
S2	409478.17	5512323.172
S2	409478.17	5512323.172
S2	409478.087	5512323.135
S2	409478	5512323.104
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S2	409477.823	5512323.059
S2	409477.732	5512323.046
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S2	409477.641	5512323.04
S2	409477.566	5512323.041
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S2	409477.271	5512323.099
S2	409477.2	5512323.126
S2	409477.132	5512323.158
S2	409477.132	5512323.158
S2	409477.025	5512323.218
S2	409476.922	5512323.284
S2	409476.824	5512323.357
S2	409476.73	5512323.436
S2	409476.641	5512323.521
S2	409476.641	5512323.521
S2	409476.513	5512323.655
S2	409476.391	5512323.796
S2	409476.275	5512323.941
S2	409476.166	5512324.092
S2	409475.911	5512324.483
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S2	409475.248	5512325.713
S2	409474.785	5512326.741
S2	409473.452	5512329.848
S2	409473.235	5512330.338
S2	409472.523	5512331.779
S2	409472.291	5512332.189
S2	409472.047	5512332.593
S2	409471.524	5512333.379
S2	409471.249	5512333.757
S2	409470.379	5512334.858
S2	409470.062	5512335.23
S2	409469.732	5512335.591
S2	409469.034	5512336.276
S2	409468.675	5512336.585
S2	409468.295	5512336.868
S2	409467.895	5512337.123
S2	409467.478	5512337.348
S2	409467.478	5512337.348
S2	409467.14	5512337.49
S2	409466.792	5512337.604
S2	409466.436	5512337.692
S2	409466.075	5512337.752
S2	409465.71	5512337.785
S2	409465.71	5512337.785
S2	409464.749	5512337.766
S2	409463.789	5512337.714
S2	409461.879	5512337.509
S2	409460.942	5512337.448
S2	409460.004	5512337.415
S2	409458.126	5512337.431
S2	409457.189	5512337.482
S2	409454.384	5512337.753
S2	409452.516	5512338.025
S2	409446.888	5512338.656
S2	409445.94	5512338.689
S2	409444.993	5512338.685
S2	409443.101	5512338.566
S2	409442.137	5512338.45
S2	409441.177	5512338.306
S2	409439.271	5512337.934

```
S2               409438.302       5512337.706
S2               409435.423       5512336.919
S2               409431.579       5512335.684
S2               409429.697       5512335.035
S2               409424.007       5512333.215
S2               409423.095       5512332.959
S2               409420.327       5512332.309
S2               409419.439       5512332.145
S2               409418.547       5512332.012
S2               409416.75        5512331.839
S2               409415.886       5512331.808
S2               409415.022       5512331.819
S2               409414.159       5512331.874
S2               409413.3         5512331.971
S2               409412.879       5512332.038
S2               409412.461       5512332.117
S2               409411.631       5512332.314
S2               409411.218       5512332.432
S2               409410.808       5512332.564
S2               409410.002       5512332.864
S2               409409.186       5512333.223
S2               409408.388       5512333.62
S2               409407.61        5512334.053
S2               409406.852       5512334.523
S2               409406.068       5512335.049
S2               409405.3         5512335.599
S2               409403.815       5512336.766
S2               409403.058       5512337.406
S2               409400.853       5512339.398
S2               409397.928       5512342.224
S2               409397.928       5512342.224

[SYMBOLS]
;;Gage           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
```

APPENDIX B - POST-DEVELOPMENT MODEL RESULTS - 1-IN-100 YEAR 24 HOUR STORM EVENT

EPA STORM WATER MANAGEMENT MODEL - VERSION 5.1 (Build 5.1.012)

9917-23 - Torrie Barnwell Development - Post-Development

****
Element Count
****
Number of rain gages 1
Number of subcatchments ... 3
Number of nodes 5
Number of links 2
Number of pollutants 0
Number of land uses 0

****
Raingage Summary
****

Name	Data Source	Data Type	Recording Interval
Leth1in100yr24hr(10min)	Leth1in100yr24hr(10min)	INTENSITY	10 min.

****
Subcatchment Summary
****

Name	Area	Width	%Imperv	%Slope	Rain Gage	Outlet
S1	1.92	295.08	30.18	2.1960	Leth1in100yr24hr(10min)	WestPond
S2	0.33	146.80	0.73	4.1270	Leth1in100yr24hr(10min)	Outfall3
S3	0.97	216.09	26.44	2.7150	Leth1in100yr24hr(10min)	EastPond

****
Node Summary
****

Name	Type	Invert Elev.	Max. Depth	Ponded Area	External Inflow
Outfall1	OUTFALL	832.80	0.30	0.0	
Outfall2	OUTFALL	833.27	0.30	0.0	
Outfall3	OUTFALL	0.00	0.00	0.0	
EastPond	STORAGE	833.44	0.61	0.0	
WestPond	STORAGE	832.84	0.40	0.0	

****
Link Summary
****

Name	From Node	To Node	Type	Length	%Slope	Roughness
C1	WestPond	Outfall1	CONDUIT	11.3	0.3537	0.0100
C2	EastPond	Outfall2	CONDUIT	10.9	1.5670	0.0100

****
Cross Section Summary
****

Conduit	Shape	Full Depth	Full Area	Hyd. Rad.	Max. Width	No. of Barrels	Full Flow
C1	CIRCULAR	0.30	0.07	0.07	0.30	1	0.07
C2	CIRCULAR	0.30	0.07	0.07	0.30	1	0.16

****
NOTE: The summary statistics displayed in this report are
based on results found at every computational time step,
not just on results from each reporting time step.
****

****
Analysis Options
****
Flow Units ..... CMS
Process Models:
  Rainfall/Runoff ..... YES
  RDII ..... NO
  Snowmelt ..... NO
  Groundwater ..... NO

```
  Flow Routing ..... YES
  Ponding Allowed ..... YES
  Water Quality ..... NO
Infiltration Method ..... GREEN_AMPT
Flow Routing Method ..... DYNWAVE
Starting Date ..... 02/26/2019 00:00:00
Ending Date ..... 02/27/2019 00:00:00
Antecedent Dry Days ..... 0.0
Report Time Step ..... 00:01:00
Wet Time Step ..... 00:05:00
Dry Time Step ..... 00:05:00
Routing Time Step ..... 5.00 sec
Variable Time Step ..... YES
Maximum Trials ..... 8
Number of Threads ..... 1
Head Tolerance ..... 0.001500 m


**************************        Volume         Depth
Runoff Quantity Continuity     hectare-m            mm
**************************     ---------       -------
Total Precipitation ......         0.387       120.146
Evaporation Loss .........         0.000         0.000
Infiltration Loss ........         0.202        62.648
Surface Runoff ...........         0.186        57.647
Final Storage ............         0.002         0.529
Continuity Error (%) .....        -0.564


**************************        Volume        Volume
Flow Routing Continuity        hectare-m       10^6 ltr
**************************     ---------     ----------
Dry Weather Inflow .......         0.000         0.000
Wet Weather Inflow .......         0.185         1.854
Groundwater Inflow .......         0.000         0.000
RDII Inflow ..............         0.000         0.000
External Inflow ..........         0.000         0.000
External Outflow .........         0.179         1.793
Flooding Loss ............         0.000         0.000
Evaporation Loss .........         0.000         0.000
Exfiltration Loss ........         0.000         0.000
Initial Stored Volume ....         0.000         0.000
Final Stored Volume ......         0.006         0.062
Continuity Error (%) .....        -0.004


****************************
Time-Step Critical Elements
****************************
Link C1 (22.32%)
Link C2 (7.17%)


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


*************************
Routing Time Step Summary
*************************
Minimum Time Step           :     0.67 sec
Average Time Step           :     4.56 sec
Maximum Time Step           :     5.00 sec
Percent in Steady State     :     0.00
Average Iterations per Step :     2.00
Percent Not Converging      :     0.00


****************************
Subcatchment Runoff Summary
****************************
```

Subcatchment	Total Precip mm	Total Runon mm	Total Evap mm	Total Infil mm	Total Runoff mm	Total Runoff 10^6 ltr	Peak Runoff CMS	Runoff Coeff
S1	120.15	0.00	0.00	61.23	58.88	1.13	0.72	0.490
S2	120.15	0.00	0.00	71.09	50.27	0.17	0.16	0.418
S3	120.15	0.00	0.00	62.57	57.72	0.56	0.42	0.480

****
Node Depth Summary
****

Node	Type	Average Depth Meters	Maximum Depth Meters	Maximum HGL Meters	Time of Max Occurrence days hr:min	Reported Max Depth Meters
Outfall1	OUTFALL	0.07	0.21	833.01	0 08:00	0.21
Outfall2	OUTFALL	0.03	0.17	833.44	0 07:35	0.17
Outfall3	OUTFALL	0.00	0.00	0.00	0 00:00	0.00
EastPond	STORAGE	0.07	0.52	833.96	0 07:35	0.52
WestPond	STORAGE	0.11	0.39	833.23	0 08:00	0.39

****
Node Inflow Summary
****

Node	Type	Maximum Lateral Inflow CMS	Maximum Total Inflow CMS	Time of Max Occurrence days hr:min	Lateral Inflow Volume 10^6 ltr	Total Inflow Volume 10^6 ltr	Flow Balance Error Percent
Outfall1	OUTFALL	0.000	0.075	0 08:00	0	1.07	0.000
Outfall2	OUTFALL	0.000	0.097	0 07:35	0	0.556	0.000
Outfall3	OUTFALL	0.159	0.159	0 07:20	0.166	0.166	0.000
EastPond	STORAGE	0.419	0.419	0 07:20	0.561	0.561	-0.007
WestPond	STORAGE	0.724	0.724	0 07:20	1.13	1.13	0.004

****
Node Surcharge Summary
****

No nodes were surcharged.

****
Node Flooding Summary
****

No nodes were flooded.

****
Storage Volume Summary
****

Storage Unit	Average Volume 1000 m3	Avg Pcnt Full	Evap Pcnt Loss	Exfil Pcnt Loss	Maximum Volume 1000 m3	Max Pcnt Full	Time of Max Occurrence days hr:min	Maximum Outflow CMS
EastPond	0.031	10	0	0	0.254	81	0 07:35	0.097
WestPond	0.178	26	0	0	0.670	98	0 08:00	0.075

****
Outfall Loading Summary
****

Outfall Node	Flow Freq Pcnt	Avg Flow CMS	Max Flow CMS	Total Volume 10^6 ltr
Outfall1	72.94	0.023	0.075	1.071
Outfall2	73.02	0.014	0.097	0.556
Outfall3	25.45	0.011	0.159	0.166
System	57.14	0.048	0.231	1.793

****
Link Flow Summary
****

Link	Type	Maximum |Flow| CMS	Time of Max Occurrence days hr:min	Maximum |Veloc| m/sec	Max/ Full Flow	Max/ Full Depth

C1	CONDUIT	0.075	0	08:00	1.17	1.01	0.86
C2	CONDUIT	0.097	0	07:35	1.63	0.62	0.78

****
Flow Classification Summary
****

Conduit	Adjusted /Actual Length	Fraction of Time in Flow Class: Dry	Up Dry	Down Dry	Sub Crit	Sup Crit	Up Crit	Down Crit	Norm Ltd	Inlet Ctrl
C1	1.00	0.26	0.00	0.00	0.73	0.00	0.00	0.00	0.00	0.70
C2	1.00	0.26	0.00	0.00	0.64	0.10	0.00	0.00	0.00	0.71

****
Conduit Surcharge Summary
****

Conduit	Hours Full: Both Ends	Upstream	Dnstream	Hours Above Full Normal Flow	Hours Capacity Limited
C1	0.01	2.01	0.01	0.35	0.01
C2	0.01	1.12	0.01	0.01	0.01

Analysis begun on: Wed Mar 06 08:44:33 2019
Analysis ended on: Wed Mar 06 08:44:33 2019
Total elapsed time: < 1 sec

```
[TITLE]


[OPTIONS]
;;Options             Value
;;------------------- ------------
FLOW_UNITS           CMS
INFILTRATION         GREEN_AMPT
FLOW_ROUTING         DYNWAVE
START_DATE           02/26/2019
START_TIME           00:00:00
REPORT_START_DATE    02/26/2019
REPORT_START_TIME    00:00:00
END_DATE             02/27/2019
END_TIME             00:00:00
SWEEP_START          01/01
SWEEP_END            12/31
DRY_DAYS             0
REPORT_STEP          00:01:00
WET_STEP             00:05:00
DRY_STEP             00:05:00
ROUTING_STEP         5
ALLOW_PONDING        YES
INERTIAL_DAMPING     PARTIAL
VARIABLE_STEP        0.75
LENGTHENING_STEP     0
MIN_SURFAREA         0
NORMAL_FLOW_LIMITED  BOTH
SKIP_STEADY_STATE    NO
FORCE_MAIN_EQUATION  H-W
LINK_OFFSETS         DEPTH
MIN_SLOPE            0
MAX_TRIALS           8
HEAD_TOLERANCE       0.0015
SYS_FLOW_TOL         5
LAT_FLOW_TOL         5
MINIMUM_STEP         0.5
THREADS              4

[EVAPORATION]
;;Type          Parameters
;;------------- ----------
CONSTANT     0.0
DRY_ONLY     NO

[RAINGAGES]
;;                     Rain      Time   Snow   Data
;;Name                 Type      Intrvl Catch  Source
;;-------------------- --------- ------ ------ ----------
Leth1in100yr24hr(10min) INTENSITY 0:10   1.0    TIMESERIES Leth1in100yr24hr(10min)

[SUBCATCHMENTS]
;;                                                 Total    Pcnt.             Pcnt.    Curb     Snow
;;Name           Raingage         Outlet           Area     Imperv   Width    Slope    Length   Pack
;;-------------- ---------------- ---------------- -------- -------- -------- -------- -------- --------
S1               Leth1in100yr24hr(10min) WestPond  1.918    30.18    295.077  2.196    0
S2               Leth1in100yr24hr(10min) Outfall3  0.3303   0.73     146.8    4.127    0
S3               Leth1in100yr24hr(10min) EastPond  0.9724   26.44    216.089  2.715    0

[SUBAREAS]
;;Subcatchment   N-Imperv   N-Perv     S-Imperv   S-Perv     PctZero    RouteTo    PctRouted
;;-------------- ---------- ---------- ---------- ---------- ---------- ---------- ----------
S1               0.011      0.15       2.5        5          25         PERVIOUS   100
S2               0.011      0.15       2.5        5          25         PERVIOUS   100
S3               0.011      0.15       2.5        5          25         PERVIOUS   100

[INFILTRATION]
;;Subcatchment   Suction    HydCon     IMDmax
;;-------------- ---------- ---------- ----------
S1               88.9       3.3        0.347
S2               88.9       3.3        0.347
S3               88.9       3.3        0.347

[OUTFALLS]
;;               Invert     Outfall      Stage/Table      Tide
;;Name           Elev.      Type         Time Series      Gate Route To
;;-------------- ---------- ------------ ---------------- ---- ----------------
Outfall1         832.8      FREE                          NO
Outfall2         833.27     FREE                          NO
Outfall3         0          FREE                          NO

[STORAGE]
;;               Invert   Max.     Init.    Storage    Curve                    Ponded   Evap.
```

```
;;Name           Elev.    Depth    Depth    Curve      Params                    Area     Frac.    Infiltration
parameters
;;-------------- -------- -------- -------- ---------- -------- -------- -------- -------- --------
----------------------
EastPond         833.44   0.61     0        TABULAR    EastPond                  0        0
WestPond         832.84   0.401    0        TABULAR    WestPond                  0        0

[CONDUITS]
;;               Inlet            Outlet                      Manning    Inlet      Outlet     Init.      Max.
;;Name           Node             Node             Length     N          Offset     Offset     Flow       Flow
;;-------------- ---------------- ---------------- ---------- ---------- ---------- ---------- ---------- ----------
C1               WestPond         Outfall1         11.308     0.01       0          0          0          0
C2               EastPond         Outfall2         10.85      0.01       0          0          0          0

[XSECTIONS]
;;Link           Shape        Geom1            Geom2      Geom3      Geom4      Barrels
;;-------------- ------------ ---------------- ---------- ---------- ---------- ----------
C1               CIRCULAR     0.3              0          0          0          1          5
C2               CIRCULAR     0.3              0          0          0          1          5

[LOSSES]
;;Link           Inlet      Outlet     Average    Flap Gate  SeepageRate
;;-------------- ---------- ---------- ---------- ---------- ----------

[CURVES]
;;Name           Type       X-Value    Y-Value
;;-------------- ---------- ---------- ----------
EastPond         Storage    0          365.75
EastPond                    0.01       370.794
EastPond                    0.06       394.095
EastPond                    0.11       417.779
EastPond                    0.16       441.848
EastPond                    0.21       466.300
EastPond                    0.26       491.137
EastPond                    0.31       516.358
EastPond                    0.36       541.963
EastPond                    0.41       567.952
EastPond                    0.46       594.325
EastPond                    0.51       621.081
EastPond                    0.56       648.221
EastPond                    0.61       675.744

WestPond         Storage    0          1567.39
WestPond                    0.01       1574.002
WestPond                    0.06       1607.225
WestPond                    0.11       1640.765
WestPond                    0.16       1674.621
WestPond                    0.21       1708.794
WestPond                    0.26       1743.283
WestPond                    0.31       1778.088

[TIMESERIES]
;;Name           Date       Time       Value
;;-------------- ---------- ---------- ----------
;Chicago design storm, a = 1019.2, b = 0, c = 0.731, Duration = 1440 minutes, r = 0.3, rain units = mm/hr.
Leth1in100yr24hr(10min)                0:00       1.358
Leth1in100yr24hr(10min)                0:10       1.382
Leth1in100yr24hr(10min)                0:20       1.407
Leth1in100yr24hr(10min)                0:30       1.432
Leth1in100yr24hr(10min)                0:40       1.459
Leth1in100yr24hr(10min)                0:50       1.488
Leth1in100yr24hr(10min)                1:00       1.517
Leth1in100yr24hr(10min)                1:10       1.548
Leth1in100yr24hr(10min)                1:20       1.581
Leth1in100yr24hr(10min)                1:30       1.615
Leth1in100yr24hr(10min)                1:40       1.651
Leth1in100yr24hr(10min)                1:50       1.689
Leth1in100yr24hr(10min)                2:00       1.729
Leth1in100yr24hr(10min)                2:10       1.771
Leth1in100yr24hr(10min)                2:20       1.816
Leth1in100yr24hr(10min)                2:30       1.864
Leth1in100yr24hr(10min)                2:40       1.914
Leth1in100yr24hr(10min)                2:50       1.969
Leth1in100yr24hr(10min)                3:00       2.027
Leth1in100yr24hr(10min)                3:10       2.089
Leth1in100yr24hr(10min)                3:20       2.156
Leth1in100yr24hr(10min)                3:30       2.228
Leth1in100yr24hr(10min)                3:40       2.306
Leth1in100yr24hr(10min)                3:50       2.391
Leth1in100yr24hr(10min)                4:00       2.484
Leth1in100yr24hr(10min)                4:10       2.586
Leth1in100yr24hr(10min)                4:20       2.698
Leth1in100yr24hr(10min)                4:30       2.823
Leth1in100yr24hr(10min)                4:40       2.962
```

Leth1in100yr24hr(10min)	4:50	3.119
Leth1in100yr24hr(10min)	5:00	3.296
Leth1in100yr24hr(10min)	5:10	3.5
Leth1in100yr24hr(10min)	5:20	3.737
Leth1in100yr24hr(10min)	5:30	4.015
Leth1in100yr24hr(10min)	5:40	4.348
Leth1in100yr24hr(10min)	5:50	4.755
Leth1in100yr24hr(10min)	6:00	5.265
Leth1in100yr24hr(10min)	6:10	5.929
Leth1in100yr24hr(10min)	6:20	6.832
Leth1in100yr24hr(10min)	6:30	8.149
Leth1in100yr24hr(10min)	6:40	10.295
Leth1in100yr24hr(10min)	6:50	14.606
Leth1in100yr24hr(10min)	7:00	30.521
Leth1in100yr24hr(10min)	7:10	189.347
Leth1in100yr24hr(10min)	7:20	33.491
Leth1in100yr24hr(10min)	7:30	21.566
Leth1in100yr24hr(10min)	7:40	16.477
Leth1in100yr24hr(10min)	7:50	13.551
Leth1in100yr24hr(10min)	8:00	11.619
Leth1in100yr24hr(10min)	8:10	10.234
Leth1in100yr24hr(10min)	8:20	9.186
Leth1in100yr24hr(10min)	8:30	8.361
Leth1in100yr24hr(10min)	8:40	7.693
Leth1in100yr24hr(10min)	8:50	7.139
Leth1in100yr24hr(10min)	9:00	6.67
Leth1in100yr24hr(10min)	9:10	6.269
Leth1in100yr24hr(10min)	9:20	5.921
Leth1in100yr24hr(10min)	9:30	5.615
Leth1in100yr24hr(10min)	9:40	5.344
Leth1in100yr24hr(10min)	9:50	5.102
Leth1in100yr24hr(10min)	10:00	4.885
Leth1in100yr24hr(10min)	10:10	4.688
Leth1in100yr24hr(10min)	10:20	4.509
Leth1in100yr24hr(10min)	10:30	4.346
Leth1in100yr24hr(10min)	10:40	4.195
Leth1in100yr24hr(10min)	10:50	4.057
Leth1in100yr24hr(10min)	11:00	3.929
Leth1in100yr24hr(10min)	11:10	3.81
Leth1in100yr24hr(10min)	11:20	3.699
Leth1in100yr24hr(10min)	11:30	3.596
Leth1in100yr24hr(10min)	11:40	3.499
Leth1in100yr24hr(10min)	11:50	3.408
Leth1in100yr24hr(10min)	12:00	3.323
Leth1in100yr24hr(10min)	12:10	3.242
Leth1in100yr24hr(10min)	12:20	3.166
Leth1in100yr24hr(10min)	12:30	3.094
Leth1in100yr24hr(10min)	12:40	3.026
Leth1in100yr24hr(10min)	12:50	2.961
Leth1in100yr24hr(10min)	13:00	2.9
Leth1in100yr24hr(10min)	13:10	2.841
Leth1in100yr24hr(10min)	13:20	2.785
Leth1in100yr24hr(10min)	13:30	2.732
Leth1in100yr24hr(10min)	13:40	2.681
Leth1in100yr24hr(10min)	13:50	2.632
Leth1in100yr24hr(10min)	14:00	2.585
Leth1in100yr24hr(10min)	14:10	2.541
Leth1in100yr24hr(10min)	14:20	2.498
Leth1in100yr24hr(10min)	14:30	2.456
Leth1in100yr24hr(10min)	14:40	2.416
Leth1in100yr24hr(10min)	14:50	2.378
Leth1in100yr24hr(10min)	15:00	2.341
Leth1in100yr24hr(10min)	15:10	2.306
Leth1in100yr24hr(10min)	15:20	2.272
Leth1in100yr24hr(10min)	15:30	2.238
Leth1in100yr24hr(10min)	15:40	2.206
Leth1in100yr24hr(10min)	15:50	2.176
Leth1in100yr24hr(10min)	16:00	2.146
Leth1in100yr24hr(10min)	16:10	2.117
Leth1in100yr24hr(10min)	16:20	2.089
Leth1in100yr24hr(10min)	16:30	2.061
Leth1in100yr24hr(10min)	16:40	2.035
Leth1in100yr24hr(10min)	16:50	2.009
Leth1in100yr24hr(10min)	17:00	1.985
Leth1in100yr24hr(10min)	17:10	1.961
Leth1in100yr24hr(10min)	17:20	1.937
Leth1in100yr24hr(10min)	17:30	1.914
Leth1in100yr24hr(10min)	17:40	1.892
Leth1in100yr24hr(10min)	17:50	1.871
Leth1in100yr24hr(10min)	18:00	1.85
Leth1in100yr24hr(10min)	18:10	1.829
Leth1in100yr24hr(10min)	18:20	1.809
Leth1in100yr24hr(10min)	18:30	1.79
Leth1in100yr24hr(10min)	18:40	1.771

```
Leth1in100yr24hr(10min)            18:50      1.753
Leth1in100yr24hr(10min)            19:00      1.735
Leth1in100yr24hr(10min)            19:10      1.717
Leth1in100yr24hr(10min)            19:20      1.7
Leth1in100yr24hr(10min)            19:30      1.683
Leth1in100yr24hr(10min)            19:40      1.667
Leth1in100yr24hr(10min)            19:50      1.651
Leth1in100yr24hr(10min)            20:00      1.635
Leth1in100yr24hr(10min)            20:10      1.62
Leth1in100yr24hr(10min)            20:20      1.605
Leth1in100yr24hr(10min)            20:30      1.59
Leth1in100yr24hr(10min)            20:40      1.576
Leth1in100yr24hr(10min)            20:50      1.562
Leth1in100yr24hr(10min)            21:00      1.548
Leth1in100yr24hr(10min)            21:10      1.535
Leth1in100yr24hr(10min)            21:20      1.521
Leth1in100yr24hr(10min)            21:30      1.509
Leth1in100yr24hr(10min)            21:40      1.496
Leth1in100yr24hr(10min)            21:50      1.483
Leth1in100yr24hr(10min)            22:00      1.471
Leth1in100yr24hr(10min)            22:10      1.459
Leth1in100yr24hr(10min)            22:20      1.448
Leth1in100yr24hr(10min)            22:30      1.436
Leth1in100yr24hr(10min)            22:40      1.425
Leth1in100yr24hr(10min)            22:50      1.414
Leth1in100yr24hr(10min)            23:00      1.403
Leth1in100yr24hr(10min)            23:10      1.392
Leth1in100yr24hr(10min)            23:20      1.382
Leth1in100yr24hr(10min)            23:30      1.372
Leth1in100yr24hr(10min)            23:40      1.361
Leth1in100yr24hr(10min)            23:50      1.352
Leth1in100yr24hr(10min)            24:00      0

[REPORT]
INPUT      YES
CONTROLS   NO
SUBCATCHMENTS ALL
NODES ALL
LINKS ALL

[TAGS]

[MAP]
DIMENSIONS       409189.007600503 5512160.04025197 409661.567381793 5512351.05970229
UNITS            Meters

[COORDINATES]
;;Node           X-Coord          Y-Coord
;;-------------- ---------------- ----------------
Outfall1         409214.409       5512168.723
Outfall2         409456.381       5512249.38
Outfall3         409618.659       5512316.655
EastPond         409455.132       5512260.155
WestPond         409216.559       5512179.821

[VERTICES]
;;Link           X-Coord          Y-Coord
;;-------------- ---------------- ----------------

[POLYGONS]
;;Subcatchment   X-Coord          Y-Coord
;;-------------- ---------------- ----------------
S1               409423.121       5512268.919
S1               409423.121       5512268.919
S1               409422.877       5512269.32
S1               409422.206       5512270.56
S1               409422.008       5512270.985
S1               409421.824       5512271.416
S1               409421.5         5512272.296
S1               409421.358       5512272.746
S1               409420.997       5512274.115
S1               409420.893       5512274.587
S1               409420.619       5512276.01
S1               409420.309       5512277.834
S1               409420.23        5512278.296
S1               409419.962       5512279.68
S1               409419.816       5512280.13
S1               409419.692       5512280.587
S1               409419.59        5512281.049
S1               409419.511       5512281.515
S1               409419.333       5512292.694
S1               409419.333       5512292.694
S1               409419.263       5512293.129
S1               409419.166       5512293.559
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S1	409419.043	5512293.982
S1	409418.895	5512294.397
S1	409418.786	5512294.817
S1	409418.483	5512296.085
S1	409418.391	5512296.505
S1	409418.15	5512297.772
S1	409418.079	5512298.213
S1	409417.912	5512299.542
S1	409417.874	5512299.983
S1	409417.811	5512301.31
S1	409417.807	5512301.758
S1	409417.825	5512303.103
S1	409417.877	5512304.939
S1	409417.887	5512305.391
S1	409417.884	5512306.748
S1	409417.87	5512307.18
S1	409417.767	5512308.473
S1	409417.71	5512308.893
S1	409417.638	5512309.31
S1	409417.446	5512310.135
S1	409417.324	5512310.542
S1	409417.181	5512310.943
S1	409417.019	5512311.336
S1	409416.837	5512311.721
S1	409416.632	5512312.1
S1	409415.961	5512313.204
S1	409415.718	5512313.577
S1	409415.017	5512314.716
S1	409414.809	5512315.1
S1	409414.615	5512315.492
S1	409414.268	5512316.294
S1	409414.112	5512316.703
S1	409413.671	5512317.941
S1	409413.063	5512319.595
S1	409412.904	5512320
S1	409412.404	5512321.206
S1	409411.778	5512322.642
S1	409411.593	5512323.089
S1	409411.422	5512323.542
S1	409411.125	5512324.464
S1	409411.004	5512324.953
S1	409410.867	5512325.437
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S1	409410.494	5512326.518
S1	409410.43	5512326.638
S1	409410.358	5512326.754
S1	409410.277	5512326.863
S1	409410.189	5512326.967
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S1	409409.99	5512327.154
S1	409409.882	5512327.236
S1	409409.767	5512327.31
S1	409409.648	5512327.375
S1	409409.524	5512327.432
S1	409409.524	5512327.432
S1	409409.084	5512327.521
S1	409408.637	5512327.575
S1	409408.189	5512327.594
S1	409407.74	5512327.577
S1	409407.74	5512327.577
S1	409407.284	5512327.594
S1	409406.83	5512327.63
S1	409405.928	5512327.759
S1	409404.259	5512328.044
S1	409402.52	5512328.281
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S1	409399.169	5512328.751
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S1	409397.326	5512329.037
S1	409396.896	5512329.117
S1	409396.463	5512329.186
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S1	409392.13	5512328.906
S1	409391.698	5512328.825
S1	409391.264	5512328.757
S1	409390.391	5512328.656
S1	409389.954	5512328.639
S1	409389.516	5512328.634
S1	409388.642	5512328.665

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S1	409388.114	5512296.663
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S1	409212.226	5512299.557
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S1	409275.8	5512192.329
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S1	409284.127	5512197.208
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S1	409284.529	5512197.344
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S1	409284.869	5512197.463
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S1	409285.81	5512197.801
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S1	409287.103	5512198.293
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S1	409287.59	5512198.488
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S1	409421.997	5512252.468
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S1	409422.919	5512252.843
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S2	409575.292	5512331.682
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S2	409552.637	5512313.09
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S2	409551.351	5512312.065
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S2	409550.286	5512311.218
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S2	409545.151	5512307.164
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S2	409544.07	5512306.317
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S2	409541.081	5512303.987
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S2	409528.803	5512296.588
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S2	409522.419	5512293.176
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S2	409520.393	5512292.253
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S2	409518.085	5512291.043
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S2	409515.965	5512289.922
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S2	409500.177	5512278.21
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S2	409500.789	5512277.712
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S2	409501.197	5512277.38
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S2	409502.499	5512276.323
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S2	409502.522	5512276.303
S2	409502.543	5512276.282
S2	409502.562	5512276.26
S2	409502.58	5512276.236
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S2	409502.623	5512276.158
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S2	409502.656	5512275.985
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S2	409502.617	5512275.818
S2	409502.604	5512275.792
S2	409502.589	5512275.768
S2	409502.573	5512275.744
S2	409502.555	5512275.722
S2	409502.555	5512275.722
S2	409502.537	5512275.702
S2	409502.517	5512275.683
S2	409502.496	5512275.665

S2	409502.474	5512275.649
S2	409502.45	5512275.635
S2	409502.426	5512275.621
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S2	409502.401	5512275.61
S2	409502.138	5512275.499
S2	409502.138	5512275.499
S2	409501.746	5512275.333
S2	409501.746	5512275.333
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S2	409500.085	5512274.634
S2	409500.085	5512274.634
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S2	409467.769	5512261.391
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S3	409544.07	5512306.317
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S3	409545.151	5512307.164
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[SYMBOLS]
;;Gage            X-Coord          Y-Coord
;;--------------- ---------------- ----------------
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