MPE Engineering Ltd.

Final Report for:

ROCKY VIEW COUNTY

SPRINGBANK CREEK CATCHMENT DRAINAGE PLAN

Date: December 15, 2015
Project#: 2285-057-00

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www.mpe.ca

Suite 320, 6715 – 8 Street NE
Calgary, AB T2E 7H7
Phone: 403-250-1362
1-800-351-0929
Fax: 403-250-1518

Rocky View County
911 – 32 Avenue NE
Calgary, Alberta
T2E 6X6

December 15, 2015
File: N:\2285\057\00\R02-1.1

Attention: Rick Wiljamaa
Engineering Services Manager Infrastructure & Operations

Dear Rick:

Re: Rocky View County – Springbank Creek Catchment Drainage Plan
Final Report

Please find enclosed the *Springbank Creek Catchment Drainage Plan* for your review and comment. The Springbank Creek catchment has a number of undersized culverts and experiences flooding issues related to springs and high water tables. These issues are summarized in the report along with a proposed design approach to manage the stormwater and policy recommendations.

If you have any enquiries regarding the report, please contact Alvin Chan at (403) 219-6450 or the undersigned.

Yours truly,

MPE ENGINEERING LTD.

David Seeliger, P.Eng.
Senior Project Manager

DS/ac
Enclosure

CORPORATE AUTHORIZATION

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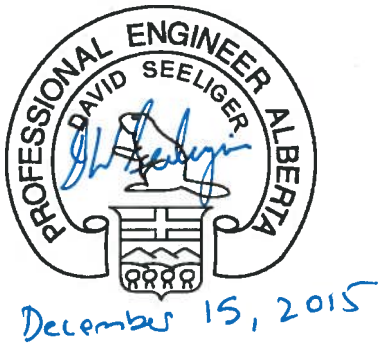

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MPE ENGINEERING LTD.
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The Association of Professional Engineers and Geoscientists of Alberta

David Seeliger, P.Eng.

Professional Seal

Corporate Permit

TABLE OF CONTENTS

LETTER OF TRANSMITTAL

CORPORATE AUTHORIZATION

APPENDICES

TABLES

FIGURES

1.0 INTRODUCTION

MPE Engineering Ltd. was retained by Rocky View County (RVC) to update the *Springbank Master Drainage Plan* (Springbank MDP) (MPE Engineering, 2015) for the *Springbank Area Structure Plan* (ASP) area. The updated MDP provides an overview of the study area, a review of suitable policies, and identifies opportunities and constraints, leading to policy recommendations.

The *Springbank Creek Catchment Drainage Plan* was prepared as a supplement to the Springbank MDP. It aims to provide detailed analysis of the Springbank Creek catchment including quantifying existing drainage issues, proposing potential solutions and budget costs. This study will also provide specific stormwater management requirements for new developments within the Springbank Creek catchment to address specific issues identified in the area.

1.1 Flood Mitigation Objectives

Stormwater management is an essential component of development. Managing runoff through defined drainage courses can improve residents' quality of life by managing flood risk, avoiding property damage and maintaining infrastructure.

Stormwater systems in Alberta are generally categorized as *minor* and *major* drainage systems. In a typical urban area, the minor system is a buried pipe system with catch basin inlets. The minor system is typically designed to accommodate a 1:5 year return period storm event. The major system is the parallel network of roadways and overland conveyance routes that safely convey runoff from large storm events (i.e. a 1:100 year return period storm). In the Springbank Creek catchment, most developments consist of roadside ditches and culverts, which act both as major and minor systems. To remain effective, these ditches and culverts must remain clear of blockages such as fill or ice, and should be protected by easements where appropriate.

2.0 BACKGROUND

2.1 Study Area

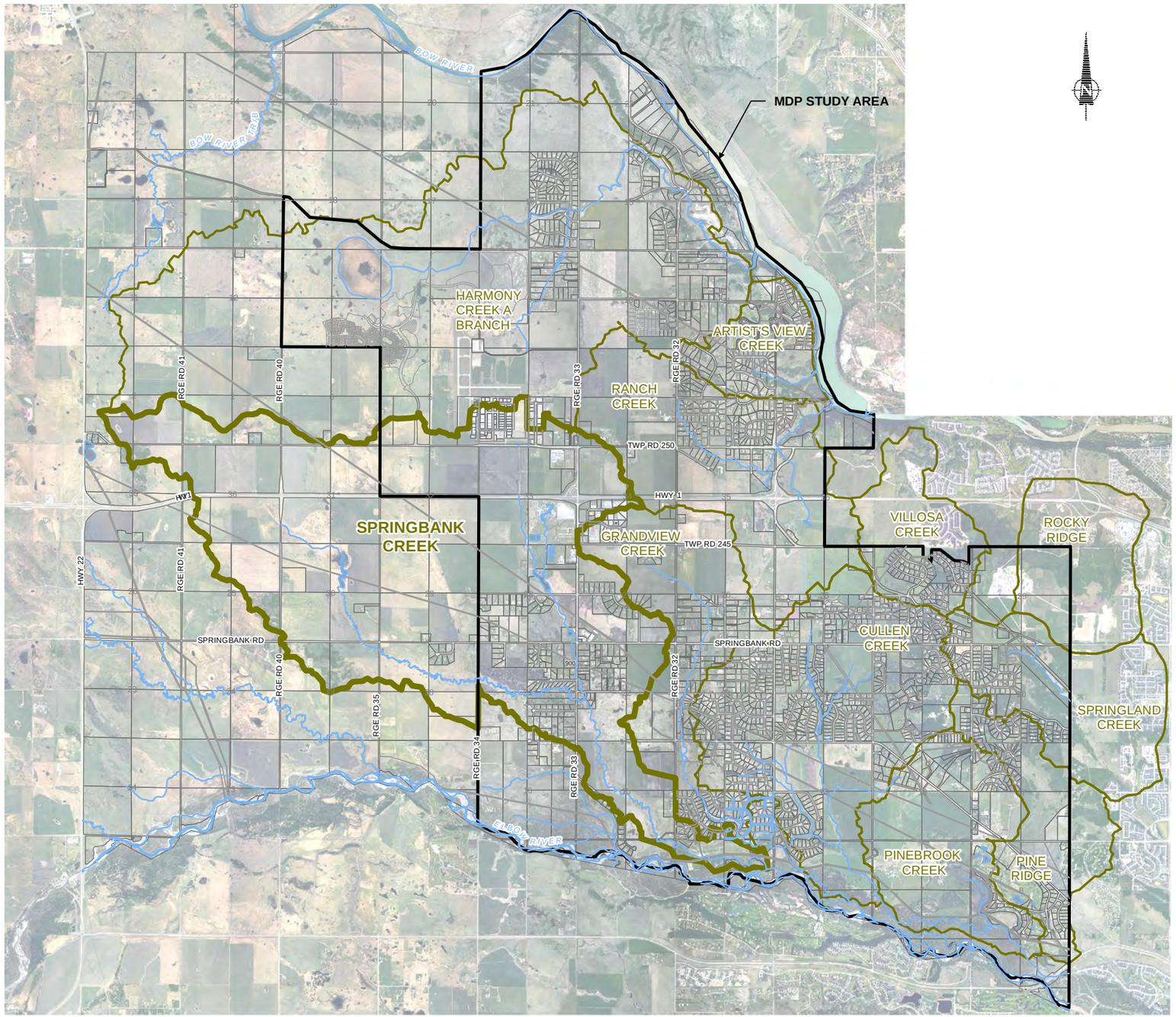
Springbank Creek has an estimated catchment of approximately 3,400 ha, including approximately 1,600 ha located within the Springbank MDP study area. The top of the catchment is located two quarter sections north of the TransCanada Highway (Highway 1) and generally drains in a south to southeasterly direction to the Elbow River as shown in ***Figure 2.1***.

The study area is comprised primarily of agricultural and undeveloped land to the west with most of the residential, commercial and industrial areas located on the east side of the catchment, in proximity to the City of Calgary. The Springbank Creek bed ranges in width from 18 m to 83 m and a depth of 6 m in the north to 15 m at the confluence of the Springbank Creek and the Elbow River. The bed slopes of Springbank Creek range between 0.3% and 0.11% with an average grade of 0.6%. The catchment consists of three main creek reaches that combine into a single reach approximately two thirds of the way down the catchment before ultimately discharging into the Elbow River.

2.2 Existing Drainage Infrastructure

The Springbank Creek catchment predominantly relies on overland flow, roadside ditches, pipe culverts and the main creek channels to convey stormwater to designated drainage routes. These pipe culverts form most of the constrictions in the catchment. There are also a number of dams and small culverts that create stormwater storage in the creek channel, along with various trapped lows throughout the catchment. The major culverts have been identified and indicated on ***Figure 2.2***.

The culvert crossings on RVC roads are typically installed with minimal hydrology undertaken to determine the appropriate culvert size. This can lead to upstream flooding and the road can overtop and wash out in extreme events. Also culverts are susceptible to damage from farm equipment, road graders and vandalism. The ends can be pinched, blocked or buried, which reduces the capacity of the culvert.



Legend

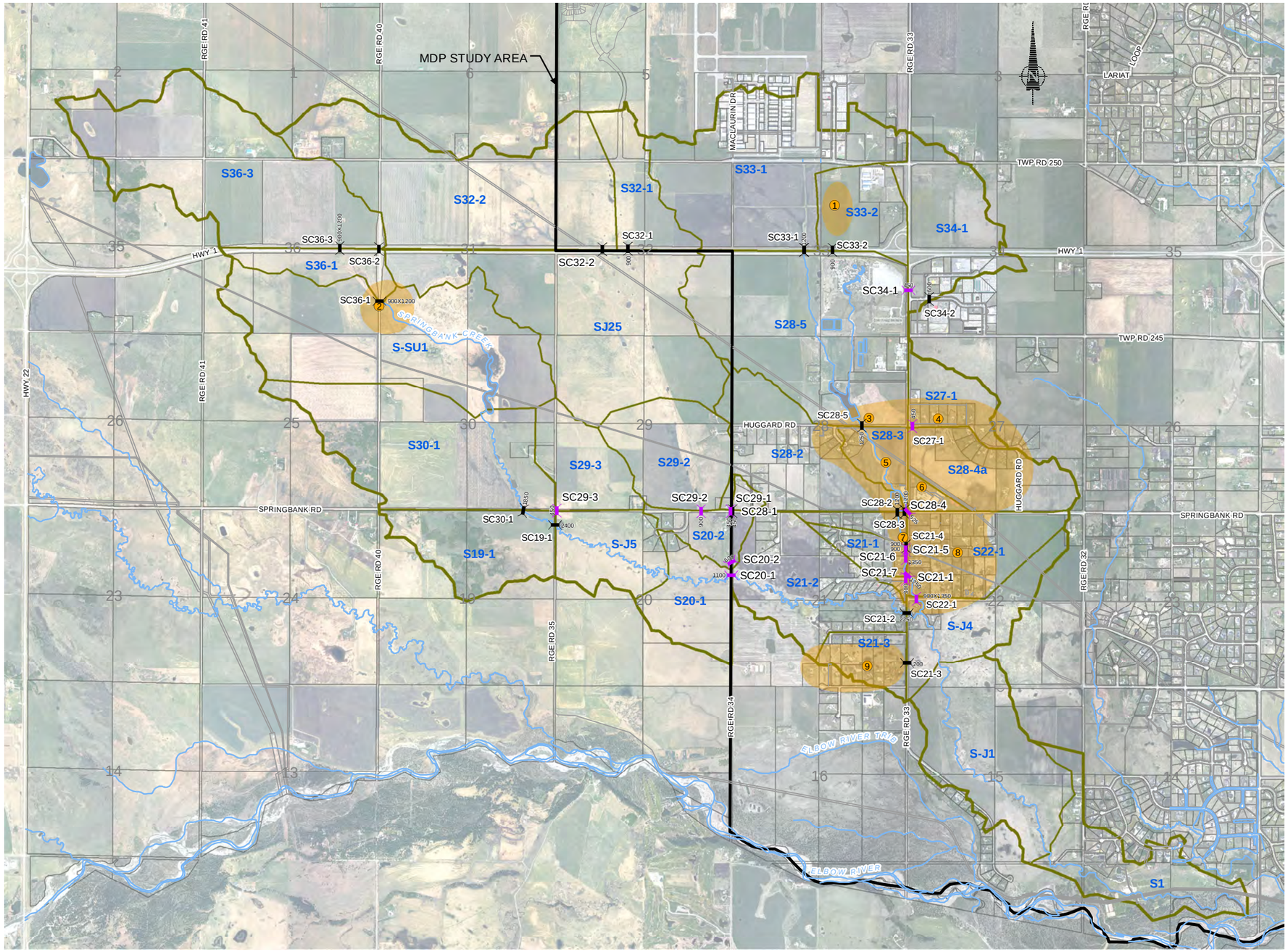
- Existing Drainage Course
- Catchment Area Boundary
- Springbank Creek Catchment
- MDP Study Area

ROCKY VIEW COUNTY
Cultivating Communities

MPE Engineering Ltd.

SPRINGBANK CREEK
CATCHMENT STUDY AREA

DATE:	DECEMBER 2015	SCALE:	1:75,000
JOB:	2285-057	FIGURE:	2.1



Name	Location	Local Catchment (ha)	Total Catchment (ha)	Size (mm)
SC19-1	Range Road 35	90	870	2400
SC20-1	Range Road 34	135	1080	1100x1600
SC20-2	Range Road 34	30	750	600
SC21-1	Range Road 33	20	1010	1250
SC21-2	Range Road 33, south of TWP 243A	125	1950	2250
SC21-3	Range Road 33	40	40	200
SC21-4	Range Road 33 driveway	20	990	900
SC21-5	Range Road 33 driveway	-	990	900
SC21-6	Range Road 33 driveway	-	990	900
SC21-7	Hill Crest Estates	3	3	300
SC22-1	TWP RD 243A	90	1100	1350
SC27-1	Huggard Road	45	50	450
SC28-1	Range Road 34 & Springbank Rd	3	7	450
SC28-2	Range Road 33 west of Springbank Rd	155*	970*	1200
SC28-3	Range Road 33 & Springbank Intersection	155*	970*	1200
SC28-4	Range Road 33 & Springbank Intersection	95	140	525
SC28-5	Huggard RD	270	670	1250
SC29-1	Range Road 34 & Springbank Rd	7	10	450
SC29-2	Springbank Rd west of Range Road 34	370	710	900
SC29-3	Range Road 35 & Springbank Rd	65	70	450
SC30-1	West of Range Road 35	480	780	1850
SC32-1	Highway 1	60	60	900
SC32-2	Highway 1	270	270	Unconfirmed
SC33-1	Highway 1	220	220	1200
SC33-2	Highway 2	70	70	900
SC34-1	Range Road 33	100	100	450
SC36-1	Hot Spots of Hwy 1 on Range Road 40	40	300	900, 1200
SC36-2	Highway 1	-	-	Unconfirmed
SC36-3	Highway 1	260	260	900, 1200

Legend

- Existing Culvert (Undersized)
- Existing Culvert
- Problem Area Location ID
- Problem Area
- Existing Drainage Course
- Existing Ground Contour
- Subcatchments
- Springbank Catchment Area
- MDP Study Area

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Cultivating Communities

MPE Engineering Ltd.

SPRINGBANK CREEK
SUBCATCHMENT AND DRAINAGE PLAN

DATE: DECEMBER 2015 | SCALE: 1:40,000

JOB: 2285-057 | FIGURE: 2.2

2.3 Problem Areas

Over the past number of years, RVC has seen an increase in the number of drainage problems and complaints within the catchment. Highlighted in ***Table 2.1*** are problem areas identified by RVC. These are shown in ***Figure 2.2***.

Table 2.1 : Problem Areas

ID#	Location	Reported Problem
1	West of Edge School, south of Mountain View Trail and Township Rd 250	Saturated lands
2	Range Road 40, south of Highway 1	Existing springs and sloughs
3	Range Road 33 and Huggard Road	Existing springs
4	Huggard Road	A spring has developed in the area, homes have experienced basement flooding
5	West of Range Road 33 (Springbank Park for All Seasons)	Saturated lands including playing fields
6	East of Range Road 33 (Springbank Park for All Seasons)	Local drainage issues with foundation damage, iced culverts resulting in ponding at entranceway and with parking lot.
7	Range Road 33, south of Springbank Road	Flooding
8	South of Springbank High School, east of Range Road 33 (Wilson Concept Scheme)	High water table, poor drainage. Six culverts have also been replaced following damage from the June 2005 storm event on the east side of Range Road 33.
9	South of Westview Estates	Saturated land

A common thread in most of these issues is high water tables as well as poor local drainage due to the water retaining nature of the land.

Another common issue is the icing of the culverts and the formation of ice dams resulting in local flooding issues. ***Figure 2.3*** is a photo of an example of iced culvert issues in the catchment. The photo was taken at the intersection near the Springbank Park for All Seasons following a March 2014 snow melt event.

Figure 2.3 – Flooding Near Springbank Park for All Seasons (March 2014)

2.4 Currently Proposed Local Drainage Improvement Works

As highlighted in ***Table 2.1***, many of the drainage problems in Springbank are local drainage problems, caused by poorly drained land, presence of high groundwater and springs. Two drainage projects located within the Springbank Creek catchment are proposed to alleviate local drainage issues:

- Meadow Lark Lane/Range Road 33: Subject area is quite flat compared to upstream areas with a trapped low with no formal drainage path. Upgrades include a proposed grass swale from an existing trapped low to the existing drainage ditch on the east side of Range Road 33. These works are in Problem Area 7.
- Springbank Park for All Seasons, Corner of Range Road 33 and Springbank Road (problem Area 6): The Park has been experiencing local drainage issues for years, with a recent focus on foundation integrity concerns for the concrete slabs under the indoor and outdoor ice arenas caused by poor drainage. Proposed mitigation measures include improving the surface and subsurface drainage interception against the arenas and redirecting offsite drainage towards the municipal road ditch that runs south along Range Road 33. In addition, entry way and parking lot drainage issues are also being addressed.

2.5 Relevant Documents

There are a number of existing conceptual schemes and master drainage plans in the study area of the catchment including:

- *Staged Master Drainage Plan for the Springbank Creek Conceptual Scheme Plan Area* (Westhoff Engineering, January 2007).
- *Springbank Creek Conceptual Scheme* (Rocky View County, Bylaw C-6478-2007, adopted June 12, 2007).
- *Wilson Conceptual Scheme* (Rocky View County, Bylaw C-6249-2006, adopted June 26, 2007).
- *Bingham Crossing Master Drainage Plan* (Urban Systems, February 2012).

3.0 HYDROLOGICAL ANALYSIS

Hydrological modelling is required to account for the effect that the physical characteristics of a catchment has on flow rates in order to identify existing issues and works needed to address flooding issues. Modelling for the study was performed using PCSWMM to model the hydrology and hydraulic characteristics of the catchment.

The modelling was performed to:

- Estimate peak flows;
- Account for storage in the catchments, creek channels and upstream of culverts;
- Estimate the capacity of existing culverts; and
- Determine the required infrastructure to safely pass the 1:100 year return period flow.

3.1 Model Geometry

The Springbank Creek catchment has been delineated based on LiDAR and site inspection of culvert crossings. A total of 31 subcatchments have been delineated with areas varying from 3 ha to 270 ha. These subcatchments are shown in ***Figure 2.2*** above along with culverts that have been included in the model. Details of these subcatchments are outlined in ***Table 3.1*** below and were used as catchment inputs into the PCSWMM model.

Table 3.1 : Individual Subcatchment Parameters

Name	Outlet Node	Area (ha)	Slope (%)	Impervious Areas (%)
S19-1	SC19-1	92.1	3.2	2
S20-1	SC20-1	64.7	1	4
S20-2	SC20-2	32.4	2.2	6
S21-1	SC21-1	23.8	1.7	5
S21-2	SC21-2	127.0	1.21	2.8
S21-3	SC21-3	35.8	0.68	15
S21-4	SC21-4	18.0	1.7	10
S21-7	SC21-7	2.9	3	15
S22-1	SC22-1	91.5	1.3	10
S27-1	SC27-1	46.4	1.2	5
S28-1	SC28-1	2.7	2.6	7
S28-2	SC28-2/3	123.7	1.3	2
S28-3	SC28-2/3	30.8	1.56	2
S28-4a	SC28-4	85.1	2.4	5
S28-4b	SC28-4	11.3	1.3	50
S28-5	SC28-5	269.2	1.07	7
S29-1a	SC29-1	6.7	2.6	10
S29-2	SC29-2	95.4	0.9	2
S29-3	SC29-3	65.7	1.3	2
S30-1	SC30-1	209.0	2.6	2
S32-1	SC32-1	61.2	0.7	2
S32-2	SC32-2	271.2	1.3	3
S33-1	SC33-1	221.8	0.69	17
S33-2	SC33-2	67.7	1.0	5
S34-1	SC34-1	41.3	1.2	24
S34-3	SC34-3	64.7	1.2	55
S36-1	SC36-1	40.28	3.8	6
S36-3	SC36-3	258.3	2.2	2
S-J1	J1	154.3	0.86	2
S-J25	J25	277.5	0.9	2
S-J4	J4	80.3	1.44	3
S-J5	J5	70.2	1	4
S-SU1	SU1	268.9	2.2	3.5

To model the main creek channels, cross sections were cut every 100 meters along the length of the channel. These cross sections were averaged across each reach between junctions and culverts and

input into PCSWMM as irregular conduits. A Manning's Roughness value of 0.04 was used for these channels.

The details of the culverts were modelled using the following:

- The sizes of culverts were determined based on site inspection, along with an estimate of road cover.
- Most culverts were modelled as circular pipes with a Manning's Roughness value of 0.024 using culvert code 5 (circular corrugated metal pipe, mitered to slope) and an entrance loss K of 0.9 (Corrugated Pipe with no headwall).
- Invert estimates were determined from LiDAR and confirmed using road cover estimates from site inspection. Generally, the lowest points (upstream and downstream of the culvert) were used, except in some cases where ponding or a buried culvert would have a lower invert.
- Culverts were assumed to be undamaged and unblocked with full capacity.
- LiDAR was used to determine a spill elevation for the culvert.
- Storage volumes were determined using LiDAR where necessary.

There are a number of dams and trapped lows within the catchment. For modelling purposes, it was assumed these would be full or close to full and would not provide significant detention storage to the system during the storm event.

3.2 Hydrological Model Input Parameters

The PCSWMM modelling was performed using the Calgary based Chicago 24 hour storm event, using 1:2, 1:5, 1:10, 1:25, 1:50 and 1:100 year return periods.

The subcatchments were modelled using catchment characteristics identified in ***Table 3.1*** and the parameters outlined in ***Table 3.2*** below. Infiltration was modelled using the Green Ampt method adopting values that have been slightly adjusted from the *City of Calgary Stormwater Management & Design Manual* (2011) for silty clay loam. These adjustments together with increasing the pervious Dstore value was made to reflect peak flows that are more in line with flows from rural and semi-rural catchments with significant flood storage routing.

Table 3.2 : General Subcatchment Parameters

Parameter	Value
Manning's N for Impervious Areas	0.01
Manning's N for Pervious Areas	0.1
Dstore Impervious (mm)	5
Dstore Pervious (mm)	15
Suction Head (mm)	270
Conductivity (mm/hr)	1.2
Initial Deficit Fraction	0.235
Subarea Routing to Pervious Fraction	60%

3.3 Modelling Results

The culverts were all modelled in PCSWMM in order to determine their capacities and level of service. A culvert was assigned a level of service based on the largest storm event it can convey without causing inundation of the road. The details of culverts and the results of the modelling are included in ***Table 3.3***. A plan with the model layout and existing scenario results is included in ***Appendix A***.

Table 3.3 : Modelling Results for Culverts

Name	Location	Local Catchment (ha)	Total Catchment (ha)	Size (mm)	Flow (L/s, 1:100 year event)	Capacity (L/s)	Level of Service (1:X Year)	Less than 1:100 year Standard	Notes
SC19-1	Range Road 35	90	870	2400	3,780	>5,000	100	N	
SC20-1	Range Road 34	135	1,080	1100x1600	5,020	3,080	25	Y	Elliptical
SC20-2	Range Road 34	30	750	600	3,100	530	10	Y	Some overflow to culvert SC20-1
SC21-1	Range Road 33	~20	1010	1250	4,330	3,530	25	Y	
SC21-2	Range Road 33, south of TWP 243A	125	1950	2250	8,300	>10,000	100	N	Ponding between downstream culverts
SC21-3	Range Road 33	40	40	200	33	>33	100	N	Significant storage behind culvert throttles flow
SC21-4	Range Road 33 driveway	20	990	900	4,360	980[1]	5[1]	Y	Mostly submerged [1] level of service does not include flow path behind gas regulation station
SC21-5	Range Road 33 driveway	-	990	900	4,340	1,970	10	Y	Mostly submerged
SC21-6	Range Road 33 driveway	-	990	900	4,320	1,500	10	Y	
SC21-7	Hill Crest Estates	3	3	300	270	100	5	Y	Obscured by reeds
SC22-1	TWP RD 243A	90	1,100	1350	4,320	>4,900	100	N	Significant storage behind culvert and a higher 900 will allow a much higher capacity
SC27-1	Huggard Road	45	50	450	400	300	25	Y	Obscured by reeds, slight damage
SC28-1	Range Road 34 & Springbank Rd	3	7	450	140	290	100	N	Deformed on south side to 250 mm
SC28-2 & SC28-3	Range Road 33 west of Springbank Rd	155	970	1200	4,570	>5,100[2]	100	N	[2] Combined capacity of two culverts

Name	Location	Local Catchment (ha)	Total Catchment (ha)	Size (mm)	Flow (L/s, 1:100 year event)	Capacity (L/s)	Level of Service (1:X Year)	Less than 1:100 year Standard	Notes
SC28-4	Range Road 33 & Springbank Intersection	95	140	525	1,550	350	5	Y	
SC28-5	Huggard RD	270	670	1250	4,030	>4,500	100	N	Storage behind culvert mitigates flow
SC29-1	Range Road 34 & Springbank Rd	7	10	450	360	300	25	Y	Partially buried, downstream totally buried and badly deformed
SC29-2	Springbank Rd west of Range Road 34	370	710	900	4,070	1,730	10	Y	
SC29-3	Range Road 35 & Springbank Rd	65	70	450	720	180	5	Y	
SC30-1	West of Range Road 35	480	780	1850	3,440	>4,800	100	N	Partially removed and in disrepair, lots of sediment on south side
SC32-1	Highway 1	60	60	900	610	>800	100	N	
SC32-2	Highway 1	270	270	900[3]	1,140	>1,200	100	N	[3] Culvert size assumed
SC33-1	Highway 1	220	220	1200	1,160	>1,600	100	N	Partially shared flow with SC33-2
SC33-2	Highway 2	70	70	900	1,070	>1,100	100	N	Partially shared flow with SC33-1
SC34-1	Range Road 33	100	100	450[4]	495	300	25	Y	[4] Entrance is damaged, restricted inflow. Modelled ignoring restriction.
SC36-1	South of Hwy 1 on Range Road 40	40	300	900, 1200	1,720	>2,700	100	N	
SC36-3	Highway 1	260	260	900, 1200	1,700	>2,800	100	N	

3.3.1 Problem Area Analysis

In *Section 2.3*, a number of problem areas were identified, however, it appears that many of these culverts are not reported as issues. Many of the problem areas are also not directly related to the culvert drainage issues, many resulting from springs and high water table levels.

An analysis of elevations of buildings nearest to the main waterways indicates that most flooding issues are local, as most residences and buildings are metres above the adjacent floodplain. The exception to this is a high pressure gas regulating station on Range Road 33 (next to culvert SC21-4) and Springbank Park for All Seasons.

A number of driveway culverts on the east side of Range Road 33 and south of Springbank Road have been replaced after being damaged by the June 2005 storm event. Site inspection and analysis of road levels indicate that the flows from the upstream creek likely overtopped Range Road 33, resulting in damage to the culverts. Upgrading the culverts and conducting some channel works on the west side of Range Road 33 will enable the 1:100 year return period flow to be contained and allow the driveway culverts on the east side to only service the local catchment.

3.4 2D Floodplain Modelling

MPE has developed a model of the floodplain extents using PCSWMM's 2D hydraulic modelling capabilities. 2D Floodplain models use topographical data to calculate the behavior of stormwater based on grades in a two dimensional grid.

The following outlines the considerations while developing the 2D model.

- The model was created using the 1D Model as the basis, using the same parameters and storm events for the subcatchments. The 1D modelling of the culverts was retained, while the modelling of stream flow was replaced by 2D modelling.
- Topographical data used included LiDAR of the watercourses and detailed survey of the culverts. Some discrepancies between the two (due to the accuracy of the LiDAR or standing water) meant that some road and stream bed elevations were altered.
- PCSWMM supports varying grid sizes for increased computational efficient. For the model, a 2 m grid (with a Manning's Roughness value of 0.033) was used for the majority of the floodplain.

However, in some overflow and wide floodplain areas a less refined 15 m (with a Manning's Roughness value of 0.04) grid was used.

- The 2D model focused on the main watercourses in the ASP area. The mapping shows that the reaches adjacent to Range Road 33 are the most flood prone mainly due to culvert restraints at a number of locations. Hydrographs from the 1D Model were also used as inputs for the 2D Model for sections outside this area.

The resulting floodplain maps for the existing conidition are included in ***Appendix B***.

4.0 STORMWATER MANAGEMENT IMPROVEMENTS

A number of drainage constraints along the main watercourse within the Springbank Creek catchment have been identified by the modelling results. These constraints primarily involved undersized culverts and other issues addressed by the proposed works outlined below.

4.1 Drainage Improvements Overview

The creek channels appear to generally be capable of conveying flows without impacting residences and buildings on private property. The most significant restriction to stormwater conveyance is undersized road and driveway culverts, resulting in backwater impacts and flow overtopping the road. This can be alleviated by increasing the flow capacity of the culverts or by increasing storage upstream of the culverts. Creating new storage is possible but opportunities would be limited due to difficulties in obtaining land and the associated costs. As a result, the proposed infrastructure for the catchment largely includes upgrades to existing culverts.

The following goals were desired in the proposed upgrades:

- No inundation on County roads in the 1:100 year return period storm event.
- Analysis of downstream impacts must be determined when increasing culvert sizes to avoid negative impacts.

4.2 Proposed Drainage Upgrades

The upgrades listed in ***Table 4.1*** and shown in ***Figure 4.1*** and ***Figure 4.2*** were determined to provide a 1:100 year return period storm level of service. Each set of culverts was also given a priority based on the following:

- Downstream works are required prior to construction works further upstream;
- Potential damage to structures;
- Significance of roads for access;
- Frequency of inundation of pipe culverts; and
- Capital Cost.

Table 4.1 : Proposed Drainage Upgrades

Priority	Culverts	Existing Level of Service	Problem	Proposed Upgrades	Cost Estimate	
1	SC21-4, SC21-5, SC21-6, SC21-1, SC22-1	1:10yr	These four culverts follow each other and form a constriction that results in flooding over Range Road 33. The channel linking these culverts is poorly defined resulting in flow spreading out into the adjacent floodplain. The culverts, particularly the driveways (SC21-4 to 6), are each undersized for the catchment. SC21-4 is a short driveway leading to a small gas regulation station, resulting in the majority of the flow spilling around the station during a major flood event. Provided this is considered acceptable, SC21-4 does not require upgrades as long as the downstream conditions are improved (through the proposed upgrades). In addition to these upgrades, SC22-1 will need to be upgraded. Although the road adjacent to the culvert does not overtop, the constriction affects upstream culverts.	SC21-4: No upgrades. SC21-5: Replace existing culvert with 2x1200 culverts. Additional review may be required on this culvert to determine its condition. SC21-6: Replace existing culvert with 2x1200 culverts. SC21-1: Add new 1200 CSP to existing 1200 CSP. Widen and regrade existing creek channel between culverts, forming a clear flow path. Costs include acquisition of land or easements. SC22-1: Add new 1350 CSP to existing 1350 CSP.	SC21-4 SC21-5 SC21-6 SC21-1 SC22-1 Creek Upgrades **Total**	$0 $110,000 $116,000 $298,000 135,000 $116,000 **$777,000**
2	SC28-4	1:5yr	The existing 525 culvert is modified from an existing culvert, resulting in a pipe with multiple bends that would negatively impact its hydraulic capacity. This culvert is the outfall for the Springbank Park for All Seasons and Springbank High School. It is undersized for its catchment, which would cause flooding in the local parking lot and road.	Add new 2x900 CSP at a lower invert to existing 525 CSP. Enlarge and regrade existing roadside ditches alongside Springbank Park for All Seasons and Springbank High School. This may include the restructure of two existing culverts.	SC28-4 Other **Total**	$193,000 $153,000 **$346,000**
3	SC21-7	1:5yr	This culvert is very small for the catchment, and has a very low capacity. The road is the only access for Hill Crest Estates. This culvert is high enough not to be significantly affected by backwater effects from the other culverts in the area.	Replace existing 300 CSP culvert with 2x600 CSP culvert at lower invert.		$98,000

Priority	Culverts	Existing Level of Service	Problem	Proposed Upgrades	Cost Estimate	
4	SC27-1	1:25yr	The houses in the area have reported basement flooding. The outlet culvert is higher than the upstream culverts and causes ponding in the road side ditches and depressions.	Replace existing 450 CSP culvert with 750 CSP culvert at lower invert. Additional works to remediate the upstream ditches and culverts may be required.		$78,000
5	SC20-1, SC20-2	1:10yr	These culverts have a shared overflow path over the low point on Range Road 34. This road is the only access for a number of properties to the south.	SC20-1: Add new 1100x1600 elliptical CSP to existing 1100x1600 elliptical CSP. SC20-2: Replace existing 600 CSP with 3x900 CSP at lower invert. Some regrading downstream of culvert will be required in adjacent land. Building up the low road in between these culverts would reduce the size and amount of the culverts.	SC20-1 SC20-2 **Total**	$110,000 $166,000 **$276,000**
6	SC29-3	1:5yr	This culvert has a low standard which can result in flowing over Springbank Road.	Replace with 2x750 CSP and lower inlet invert.		$105,000
7	SC29-2	1:10yr	This culvert has a low standard which can result in flowing over Springbank Road.	Add 2x900 CSP to existing 900 CSP.		$167,000
8	SC29-1	1:25yr	This culvert conveys the flow from a relatively small subcatchment across Springbank Road, down to Springbank Creek. SC29-1 is partially buried, which may also affect its capacity.	Replace with 2x450 CSP.		$84,000
9	SC34-1	1:25yr	Stormwater ponds in the adjacent field upstream of this culvert. The culvert is undersized as the area north of the TransCanada Highway drains to this culvert.	Install new 600 CSP. Note this has been designed assuming a peak flow of 90 L/s from Bingham Crossing.		$88,000
10	Various	n/a	Some culverts are partially buried, submerged or damaged which will negatively impact their ability to convey stream flow.	General repairs and maintenance to culverts and ditches.		$50,000
				Total Cost of Works		**$2,069,000**

The priorities of the proposed upgrades could be reordered based on the needs of the residents and RVC, provided any upgrade undertaken does not adversely increase the flooding risk downstream. This implies that downstream works should be implemented generally before the upstream works, except where flood flow would not change due to the flow simply overtopping the road. Detailed survey of individual culverts would also be required to confirm the size of the culverts. Each upgrade should also include installation of riprap and reshaping of inlet and outlet creek channels where required.

4.3 Floodplain Modelling

As discussed in Section 3.4, MPE has developed a model of the floodplain extents for the existing conditions. This model was also used to generate floodplain mapping which includes the proposed culvert upgrades and channel improvements. These floodplain maps can be found in ***Appendix C***.

Comparison with the existing conditions floodplain maps illustrates the improvements the proposed works make to the flood extents, particularly in preventing the overtopping of roads and the extensive flooding of Range Road 33. The proposed works around Range Road 33 contain the main flow to the west side of the road, instead of spreading throughout the area. However, it should be noted that the ditch on the east side of Range Road 33 will still need to convey local catchment flows.

4.4 Capital Costs

The capital costs of the proposed upgrades were estimated for each of the culverts and are provided in ***Table 4.1***. The total cost of the works is approximately $2,070,000, which includes culvert construction, riprap, demolition, channel upgrades where required and a nominal $50,000 for general culvert repairs around the catchment. Detailed cost estimates are provided in ***Appendix D***. Costs are provided in 2015 dollars and include allowances of 40% contingency and 15% for engineering. No operating or maintenance costs have been included.

4.5 Impacts of Upgrades

The flow rates in the creek before and after the upgrades for the 1:100 year return period storm event are compared in ***Table 4.2*** below.

The analysis indicates that flows do not significantly increase in the majority of locations. The largest increase occurs downstream of Range Road 33 and results from the significantly reduced flooding adjacent to Range road 33, south of Springbank Road. The higher flow for these reaches results in a small increase in flood level and has no direct impact on the property due to the incised nature of the floodplain. In some cases, the upgrades can result in a significant decrease in peak flows, particularly in the case of culvert SC34-1. This is because spill over the road in the existing scenario allows for a higher peak flow, as opposed to the steady flow of the pipe culvert. When the culvert is upgraded, the flow no longer spills over the road.

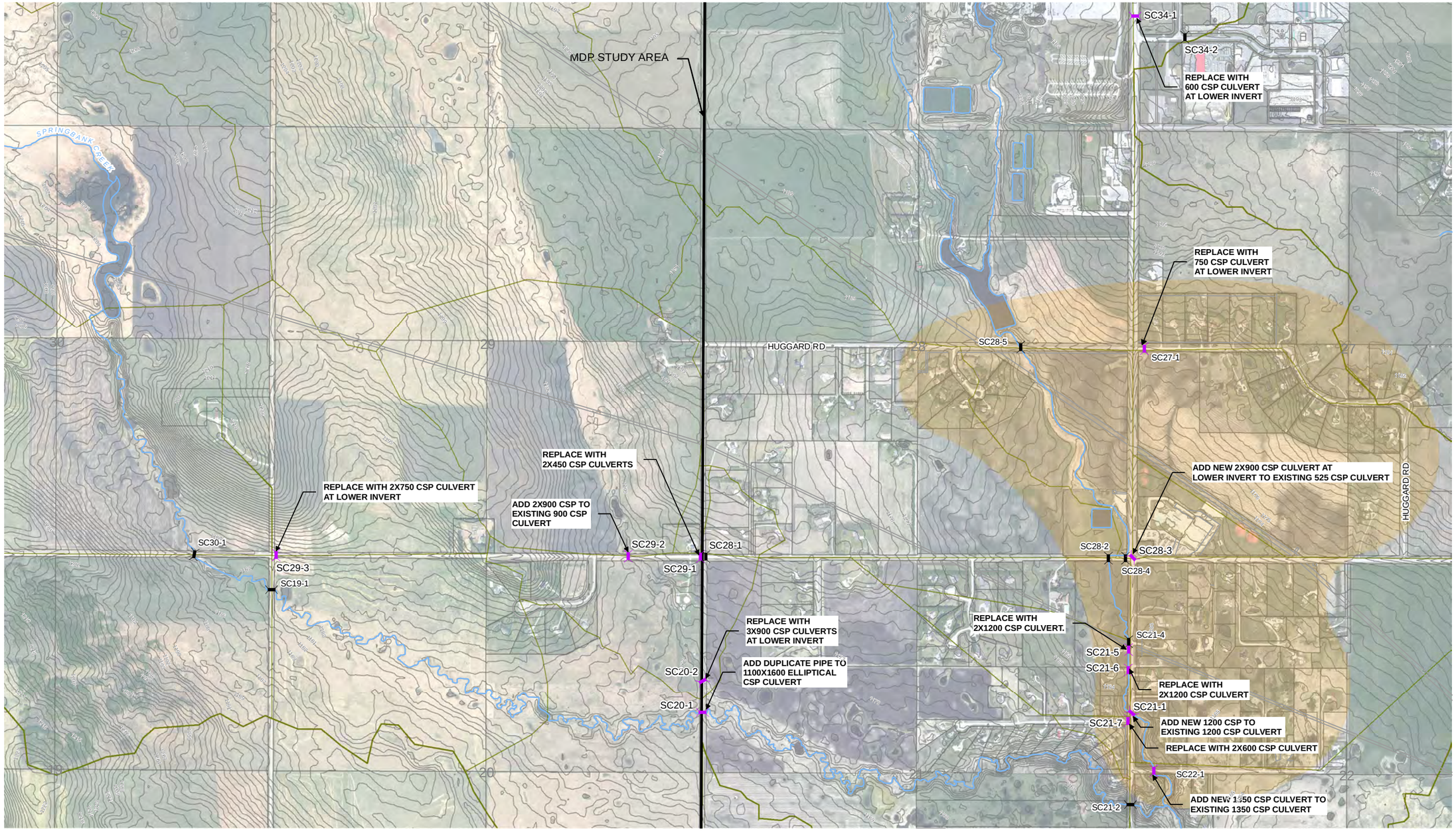
Table 4.2 : Upgrade Impacts to 1:100 Year Return Period Flow

Upstream Culvert	Location	Existing 1:100 Year Return Period Flow Rate	Proposed Upgrades 1:100 Year Return Period Flow Rate	% Change
SC19-1	Range Road 35	3,740 L/s	3,740 L/s	+0.0%
SC34-1	South of Range Road 33 & TransCanada Highway	500 L/s	340 L/s	-42.0%
SC28-2 and SC28-3	Range Road 33 and Springbank Road	4,570 L/s	4,720 L/s	+3.3%
After confluence of outlets of SC20-1 and SC20-2	East of Range Road 34	7,940 L/s	8,360 L/s	+5.3%
SC22-1	TWP RD 243A	4,320 L/s	4,800 L/s	+11.1%
SC21-2	Range Road 33, south of TWP 243A	8,300 L/s	8,880 L/s	+7.0%
After confluence of outlets from SC22-1 and SC21-2	Range Road 33 and TWP 243A	11,700 L/s	13,580 L/s	+16.1%

4.6 Implementation

Prior to implementation, the following relevant regulatory approvals should be considered:

- *Water Act* – Covers works in natural courses and water bodies. *Water Act* application may require public advertising and approvals may take one to six months.
- *Land Easement Acquisitions* - Requires property owner approval and consultation where works are constructed on private property.



Legend

- Existing Culvert (Undersized)
- Existing Culvert
- Existing Drainage Course
- Subcatchments
- Springbank Catchment Area
- Problem Area
- MDP Study Area

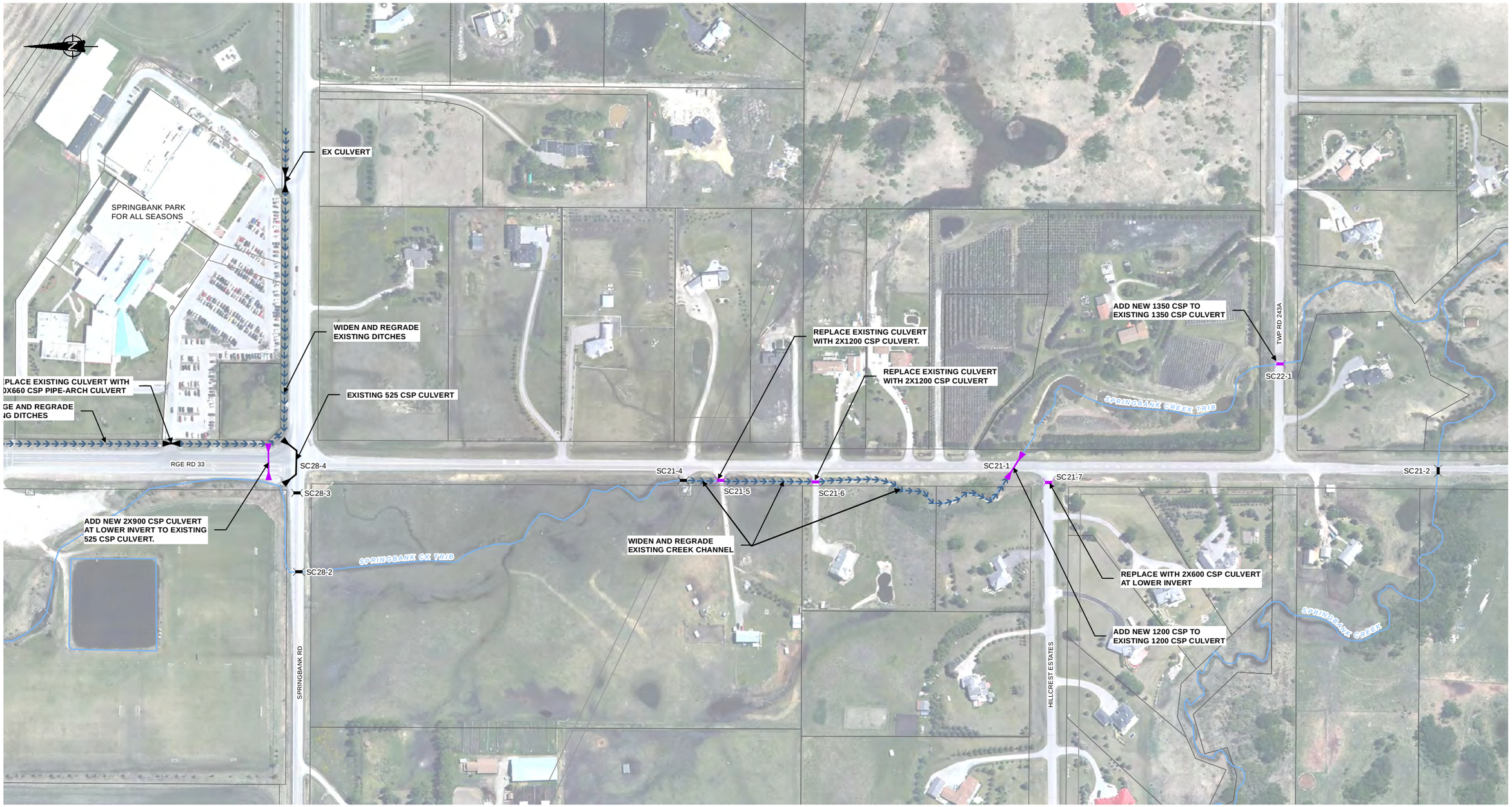
ROCKY VIEW COUNTY
Cultivating Communities

MPE Engineering Ltd.

SPRINGBANK CREEK
PROPOSED DRAINAGE UPGRADES

DATE: DECEMBER 2015 | SCALE: 1:15,000

JOB: 2285-057 | FIGURE: 4.1



Legend

- Existing Culvert (Undersized)
- Existing Culvert
- Proposed drainage upgrades
- Existing drainage course

ROCKY VIEW COUNTY
Cultivating Communities

MPE Engineering Ltd.

SPRINGBANK CREEK
PROPOSED DRAINAGE UPGRADES - RANGE ROAD 33

DATE: DECEMBER 2015 | SCALE: 1:3,148

JOB: 2285-057 | FIGURE: 4.2

5.0 POLICY AND ADMINISTRATIVE IMPROVEMENTS

Details of policy changes are introduced in the Springbank MDP and should be implemented for the Springbank Creek catchments with the following differences discussed below.

5.1 Flood Protection and Management

The following may need to be considered and addressed as required:

- Some sections of creek channel may need to be purchased to create easements in order to protect the natural watercourse.
- A portion of the costs of the proposed upgrades can be passed onto the community and future development in the form of levies.

5.2 Recommended Unit Area Release Rate for Future Development

The unit area release rate (UARR) is established through hydrological modelling as a maximum allowable unit area flow that limits peak discharge from new developments given the increase in impervious surface area. Generally the intent is to limit flow rate to a pre-determined "pre-development" flow rate.

The Springbank MPR recommends that the Unit Area Release Rate (UARR) of 1.71 L/s/ha be adopted for the 1:100 year return period storm event. This is consistent with the *Report on Drainage Strategies for Springbank* (Westhoff Engineering Ltd., 2004) which has been serving as the MDP for the more recent developments within Springbank. This value has been adopted as the maximum recommended UARR for the Springbank Creek catchment, except where a downstream constraint exists.

Using pipe culvert capacities calculated from the model, ***Figure 5.1*** shows the recommended UARR across the Springbank Creek catchment for the existing stormwater system. The recommended UARR could be increased to 1.71 L/s/ha as the downstream culverts are upgraded and constrictions removed. ***Table 5.1*** identifies which culverts will need to be upgraded in order to increase the recommended UARR.

Table 5.1 : Catchments with Restricted UARR

Catchment	Recom-mended UARR (L/s/ha)	Culverts to be Upgraded Prior to Increasing Recommended UARR	Notes
Northwest of intersection of Range Road 34 and Springbank Road	0.7	SC20-2	
Northwest of intersection of Range Road 33 and Springbank Road	1.5	SC21-1, SC21-5, SC21-6, SC22-1	Some of these culverts have a greater capacity individually, but create restrictions that impact the upstream culverts.
East of intersection of Highway 1 and Range Road 33	1.5	SC34-1	This culvert is assumed to have a lower capacity due to the damaged inlet.
South of Westview Estates and West of Range Road 33	0.9	SC21-3	There are no planned upgrades for this culvert. The County may accept a higher UARR as there is sufficient detention storage provided at this culvert.

A brief analysis of the catchment was conducted to determine potential sites for stormwater management facilities in the MDP Study Area. Consideration was given to grades, potential for development and suitability of sites. The potential sites are included in ***Figure 5.2***.

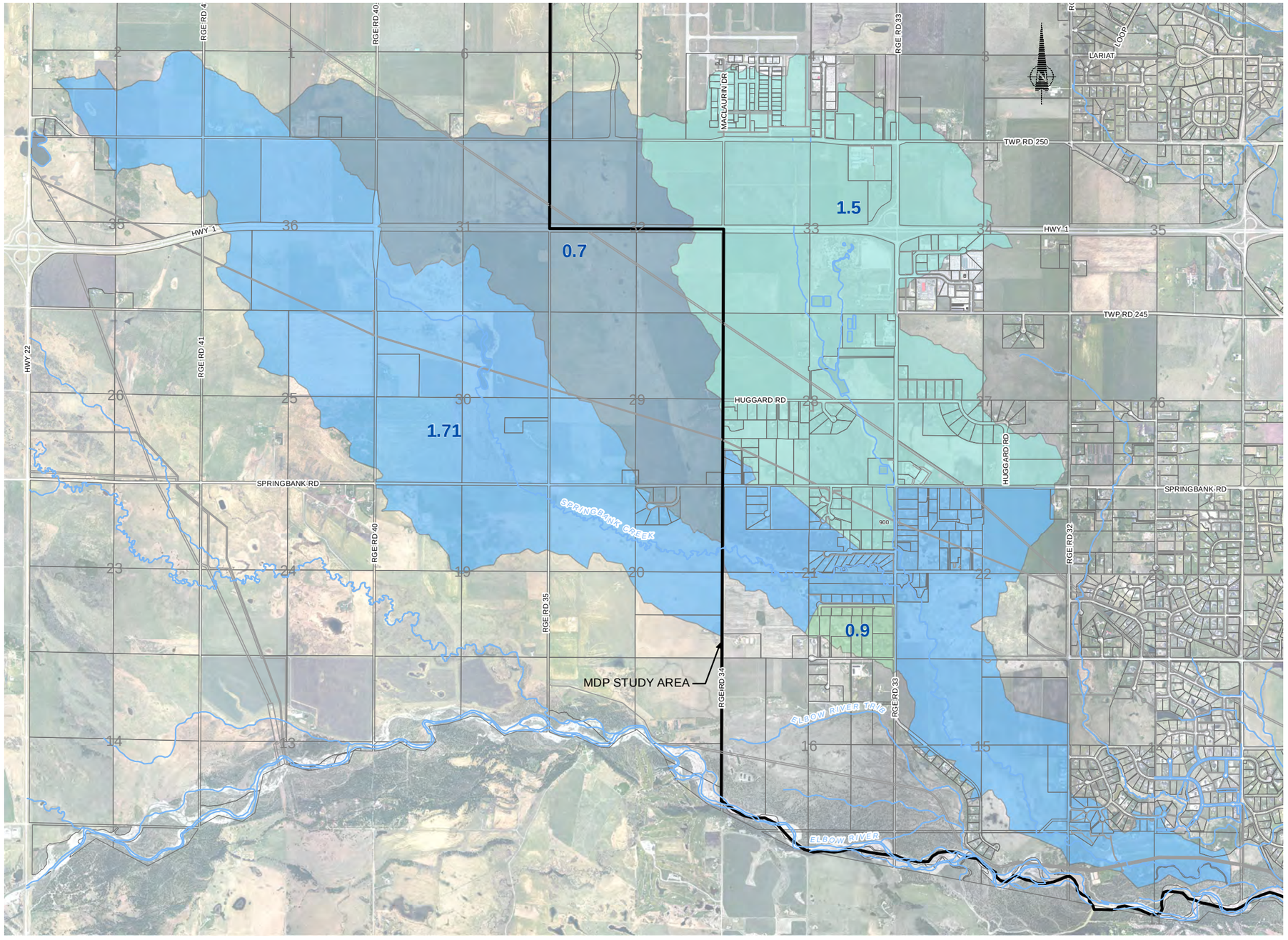
5.3 Acreage Assessment

As analysis of the catchment was performed comparing the cost of proposed works against areas of possible future development. This area is shown in Figure 5.3.

The areas of possible future development with the MDP Study Area were determined and assumed to include areas that are not currently developed or large residential lots (four or more acres) that may be subdivided. Most areas within 60 m from the main creeks were excluded. An acreage cost was generated for these areas based on the following equation.

$$Acreage\ Cost\ = \frac{Cost\ of\ proposed\ upgrades}{Area\ of\ possible\ development}$$

The total cost of proposed upgrades is $2,070,000 and the total area of developable land is estimated to be 1,130 ha. This results in an acreage cost of $1,831 per hectare.



NOTES:

1. RECOMMENDED UNIT RELEASE RATES BASED ON CULVERT CAPACITIES UNDER EXISTING CONDITIONS. IN THE EVENTOF UPGRADES OF DOWNSTREAM CULVERTS, RECOMMENDED UNIT AREA RELEASE RATES SHOULD BE REVISED TO REFLECT THE UPGRADED CONDITIONS, UP TO A MAXIMUM OF 1.71L/s/ha.

Legend

- Existing Drainage Course
- Existing Ground Contour
- MDP Study Area

ROCKY VIEW COUNTY
Cultivating Communities

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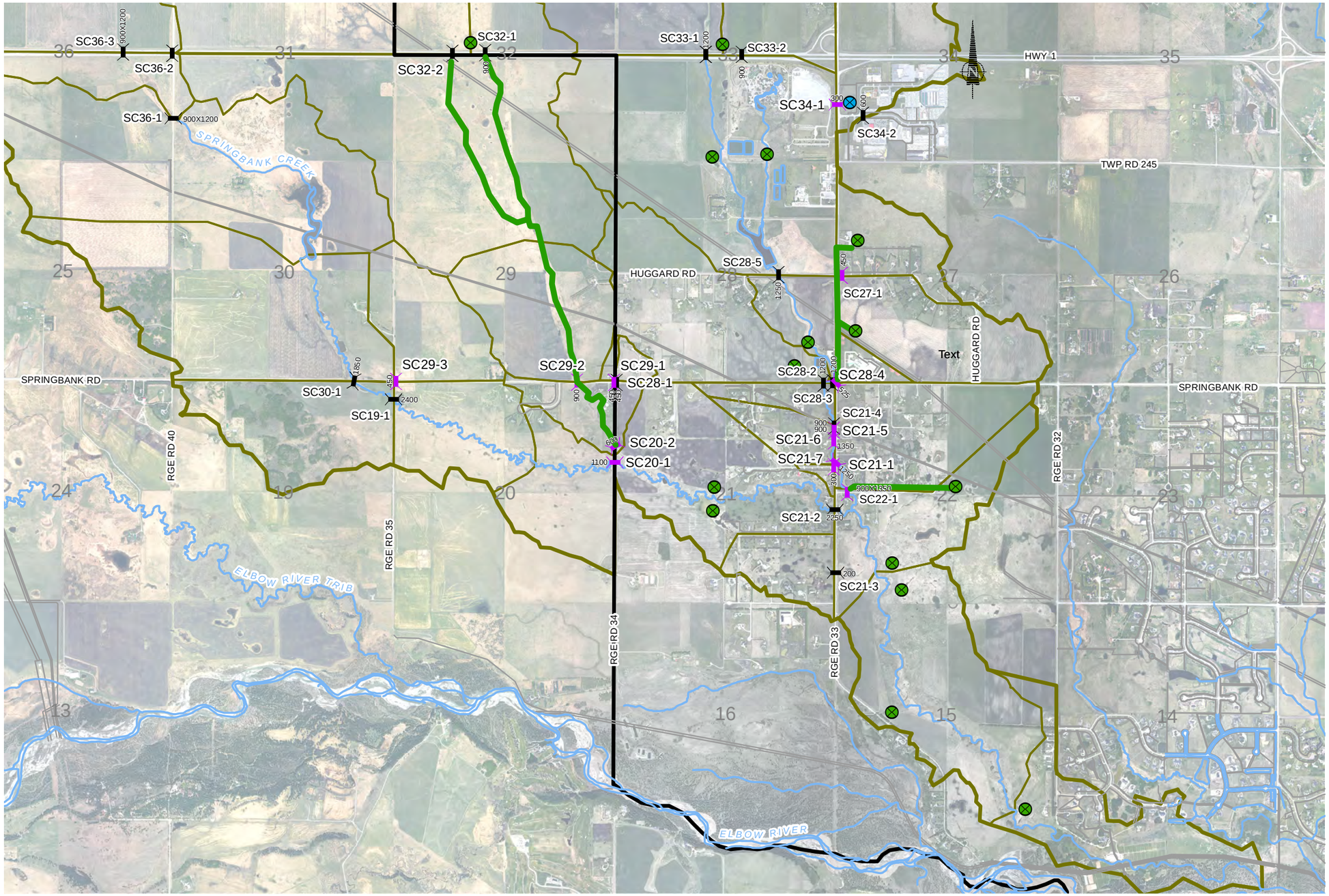
SPRINGBANK CREEK
RECOMMENDED UNIT AREA RELEASE RATES

DATE: DECEMBER 2015	SCALE: 1:40,000
JOB: 2285-057	FIGURE: 5.1



Legend

- Existing Stormwater Management Facility
- Potential Stormwater Management Facility Site
- Potential Easement to Main Creek Channel
- Existing Culvert (Undersized)
- Existing Culvert
- Existing Drainage Course
- Existing Ground Contour
- Subcatchments
- Springbank Catchment Area
- MDP Study Area

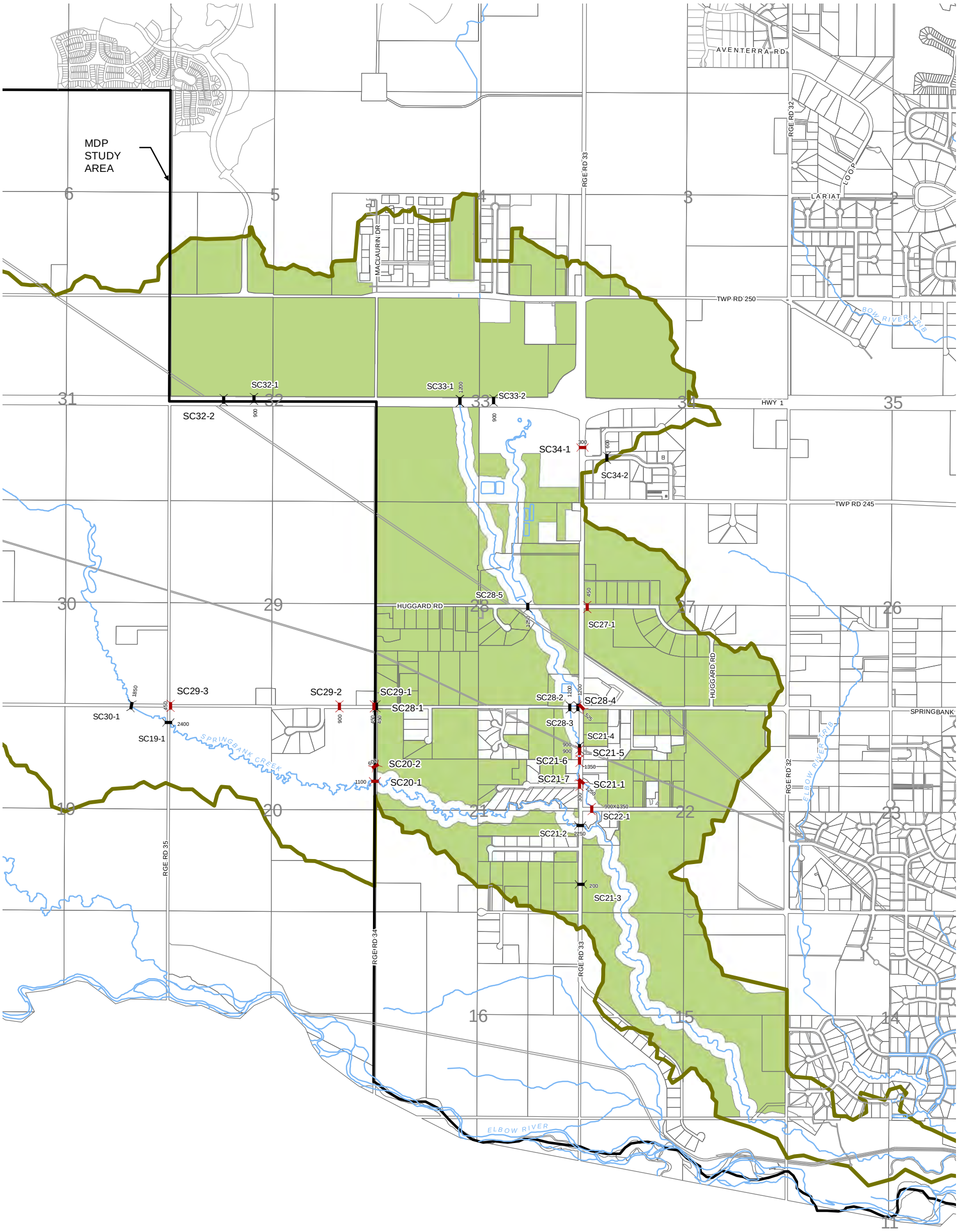
ROCKY VIEW COUNTY
Cultivating Communities

MPE Engineering Ltd.

SPRINGBANK CREEK
STORMWATER MANAGEMENT FACILITIES

DATE: DECEMBER 2015 | SCALE: 1:30,000

JOB: 2285-057 | FIGURE: 5.2


MDP
STUDY
AREA
AVENTERRA RD
RGE RD 32
RGE RD 33
LOOP
LARIAT
MACLAURIN DR
TWP RD 250
BOW RIVER TRIB
HWY 1
TWP RD 245
SC32-1
SC32-2
SC33-1
SC33-2
SC34-1
SC34-2
HUGGARD RD
SC28-5
SC27-1
SC29-3
SC29-2
SC29-1
SC28-1
SC28-2
SC28-4
SC28-3
SC30-1
SC19-1
SPRINGBANK CREEK
SC21-4
SC21-5
SC21-6
SC20-2
SC21-7
SC21-1
SC20-1
SC22-1
SC21-2
SC21-3
RGE RD 35
RGE RD 34
ELBOW RIVER
SPRINGBANK
ELBOW RIVER TRIB
MDP Study Area
Springbank Catchment Area
Future Development
Existing Culvert (Undersized)
Existing Culvert
ROCKY VIEW COUNTY
Cultivating Communities
MPE
Engineering Ltd.
SPRINGBANK CREEK
FUTURE DEVELOPMENT
DATE: DECEMBER 2015
SCALE: 1:30,000
JOB: 2285-057
FIGURE: 5.3

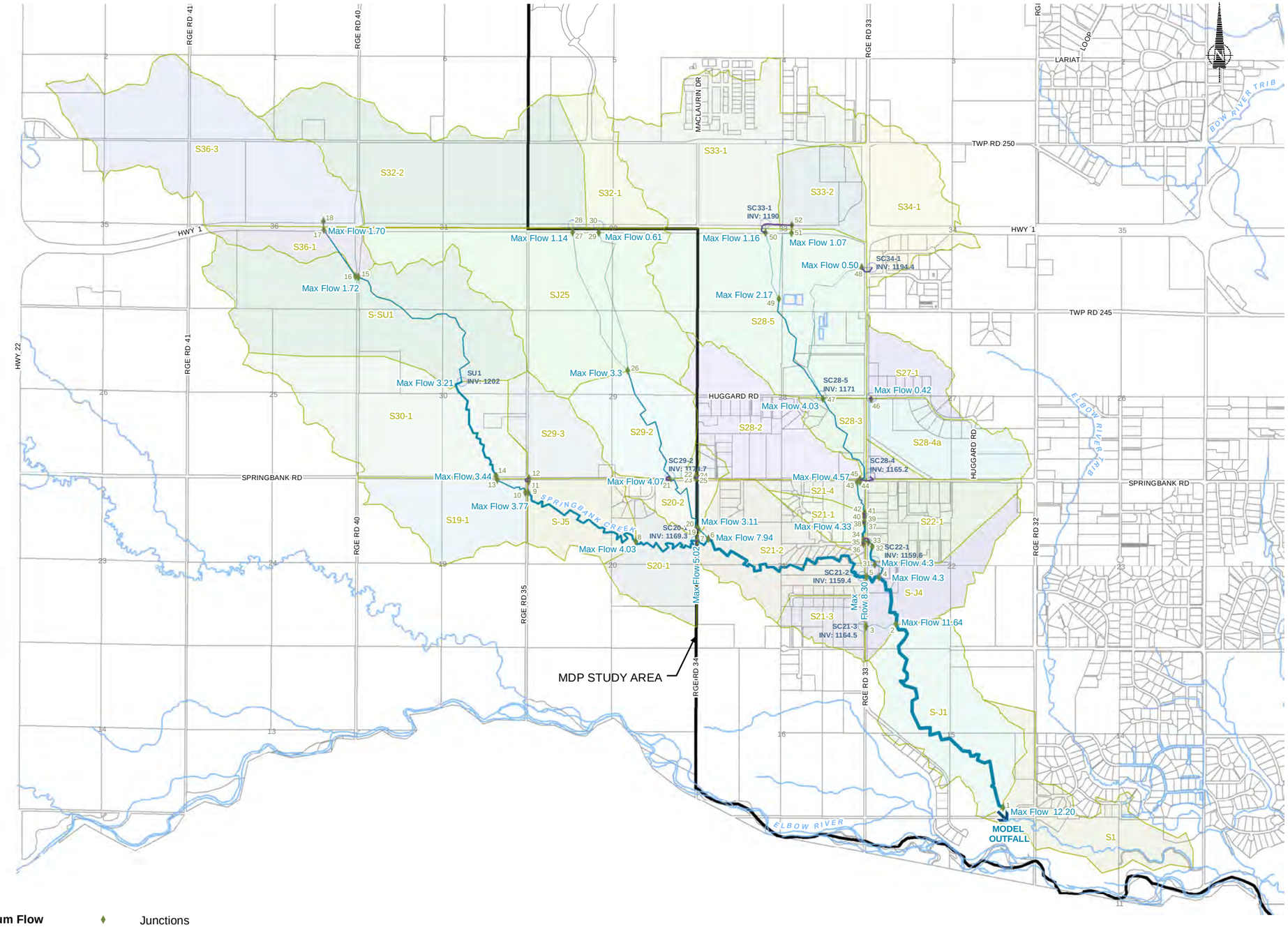
6.0 CONCLUSIONS AND RECOMMENDATIONS

The following conclusions can be drawn from this report:

- There are a number of reports of springs, sloughs and high water tables resulting in saturated land and some impacts on basements. This is difficult to address without first addressing the surface flows.
- There are many undersized culverts in the Springbank Creek catchment, particularly along Range Road 33 and the southern main channel of Springbank Creek. This report outlines a number of works to address this issue (***Table 4.1***), including culvert and creek channel upgrades. The estimate cost of the upgrade works within the Springbank Creek catchment is $2,070,000.
- Policies for future development in the Springbank creek catchment should be implemented as follows:
    - Stormwater management policy requirements and design targets provided in the Springbank MDP are applicable to the Springbank Creek Catchment. These include runoff volume targets, and controlling discharge to minimize downstream erosion potential.
    - This report provides extra policy requirements in addition to those contained in the Springbank MDP.
        - Development upstream of culverts that have capacities below the recommended UARR shall restrict releases as provided in ***Figure 5.1***. A UARR of 1.71 L/s/ha would apply once the recommended culvert upgrades are complete.
        - Definitions of the 1:100 year floodplain for existing and future conditions have been provided to help guide planning and future development.
- Acreage assessments have been estimated considering the potential future developments in order to recover a portion of the costs of the recommended drainage works improvements. The resulting acreage costs for the catchment is $1,831 per hectare.

APPENDIX A

PCSWMM Model Plan and Results



Number	Junction Name	Invert
1	J1	1141
2	J4	1157.75
3	SC21-3D	1164.5
4	J2	1158.5
5	SC21-2D	1158.75
6	J3	1168.25
7	SC20-1D	1169.25
8	J5	1173.75
9	SC19-1D	1180.5
10	SC19-1	1180.5
11	SC29-3D	1184.25
12	SC29-3	1184.3
13	SC30-1D	1182.25
14	SC30-1	1182.5
15	SC36-1D	1208.25
16	SC36-1	1208.5
17	SC36-3D	1212.5
18	SC36-3	1214.5
19	SC20-2D	1169.6
20	SC20-2	1169.6
21	SC29-2D	1174.75
22	SC28-1	1178
23	SC28-1D	1177.9
24	SC29-1	1178.1
25	SC29-1D	1178
26	J25	1181.5
27	SC32-2D	1193
28	SC32-2	1193.5
29	SC32-1D	1192.5
30	SC32-1	1193.25
31	SC22-1D	1159.5
32	SC22-1ext	1159.5
33	SC21-1D	1160.8
34	SC21-1	1160.9
35	SC21-7D	1163
36	SC21-7	1163.4
37	SC21-6D	1161.6
38	SC21-6	1161.7
39	SC21-5D	1161.9
40	SC21-5	1161.9
41	SC21-4D	1162
42	SC21-4	1162
43	SC28-2D	1163.75
44	SC28-3D	1164
45	SC28-2/3	1164.375
46	SC27-1D	1179.3
47	SC28-5D	1170.75
48	SC34-1D	1191.5
49	J6	1180.8
50	SC33-1D	1189
51	SC33-2D	1189
52	SS33-2	1189.1

Legend

Conduits by Maximum Flow

- 0.0 - 2.5
- 2.6 - 5.0
- 5.1 - 7.5
- 7.6 - 10.0
- 10.1 - 15.0

- Junctions
- Outfalls
- Storages
- Weirs
- Subcatchments
- MDP Study Area

ROCKY VIEW COUNTY
Cultivating Communities

MPE Engineering Ltd.

SPRINGBANK CREEK
STORMWATER MODEL

DATE: OCTOBER 2015 | SCALE: 1:40,000

JOB: 2285-057 | FIGURE: A.1

APPENDIX B

Floodplain Maps: Existing Conditions

IMPORTANT NOTICE TO READERS

This report contains a series of flood inundation maps.

Each of these maps must be read in conjunction with the following information and the main study report "Springbank Creek Catchment Drainage Plan, December 2015".

Background

This map has been prepared using the best technology currently available to an of accuracy sufficient for broad scale flood risk management and planning. All maps in the series will help promote awareness of flooding associated with the Springbank Creek and its tributaries. It is expected that it will be of use to persons undertaking development and by the authorities that assess land capability and development proposal. It will also assist in planning essential services and emergency response.

Flood behavior

A flood occurs when a pipe, channel or creek cannot carry the volume of water entering from a catchment. When this occurs, floodwaters travel across the surface of the land potentially damaging property built upon the floodplain and potentially threatening the safety of people in the floodplain.

Flood Return Period

The flood return period is the likelihood of occurrence of a flood of given size or larger in any one year. This is expressed as a ratio, for example 1:100 or 1%. There is a 1% chance that the 1:100 year flood will be equaled or exceed in any one year. Similarly, there is a 5% chance that a 1:20 year flood will be exceeded in any one year.

Due to the random nature of floods, however, a 1:100 year flood need not occur in every 100 years and conversely, several floods which exceed the 1:100 year flood could occur within any one period of 100 years.

Storm durations

The flooding response of a catchment is dependent on the duration of any storm event. Generally shorter, more intense storms produce the greatest flows from urban areas. Longer duration, but less intense storms, produce the greatest flows from rural and semi-rural areas.

Impact on buildings

The flood extents shown are a prediction of land affected for the specific level of risk and do not necessarily indicate a threat to buildings located on that land. Flood assessment for particular sites will require more detailed interpretation, survey and analysis by qualified and experienced persons.

Basis of mapping

The data contained on this map is based on topographical LIDAR information, hydraulic and hydrological modelling (as at 2015) to an accuracy sufficient for broad scale flood risk management and planning. The modelling reflects current practice, but it must be realized that there are uncertainties and assumptions associated with the data and the processes on which the models are based, and the flood extents shown on this map cannot be regarded as exact predictions. The maps provide an indication of the flood elevation and should not be interpolated.

The flood extents are not based on actual historical floods.

Scope of the mapping

The limit of flooding shown on this map is not a boundary between flood prone and flood free land.

Land outside the flood extent shown on this map could be affected by:

- flooding from the mapped flood that extends beyond the area that has been mapped;
- larger storms;
- flooding from local drainage systems which can occur as a result of localized heavy rainfall or culvert blockage;
- storms with a different flood return period
- floodplain accuracy and extents are limited in some locations due to limitation of model extents and detailed LIDAR coverage

Areas of very shallow flooding

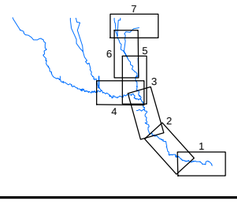
In areas shown as being affected by flood depths of less than 0.1m (100mm), fences, walls, landscaping and buildings will affect the flow of floodwaters. Resolution to this level of detail is beyond the capabilities of the modelling process and consequently the level of certainty in relation to flood depths in these areas is reduced.

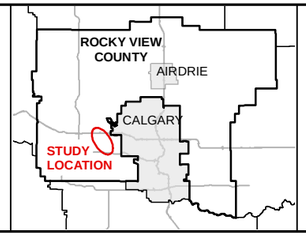
Changes to the catchment

The flood extent shown on the maps is based on conditions current at 2015. Further development, earthworks and other changes to the catchment may affect the actual flood extents.

Disclaimer

The maps are for information purposes only and are meant to provide graphical representation of potential flooding extents. They have been provided on the basis that those responsible for preparation and publication do not accept any responsibility for any loss or damage alleged to be suffered by anyone as a result of the publication of the maps, the notations on them or as a result of the use or misuse of the information provided therein. More detailed analysis is required on a site specific basis in order to more accurately determine potential flooding impacts on specific properties.





NOTES

1. 'A' MAP SERIES REFER TO FLOOD MODEL RESULTS AS PER EXISTING CONDITIONS.
2. 'B' MAP SERIES REFER TO FLOOD MODEL RESULTS WITH PROPOSED CULVERT UPGRADES.

ROCKY VIEW COUNTY
Cultivating Communities

SPRINGBANK CREEK FLOOD STUDY

MPE Engineering Ltd.

PROJECT	2285-057-01
DATE	OCTOBER 2015

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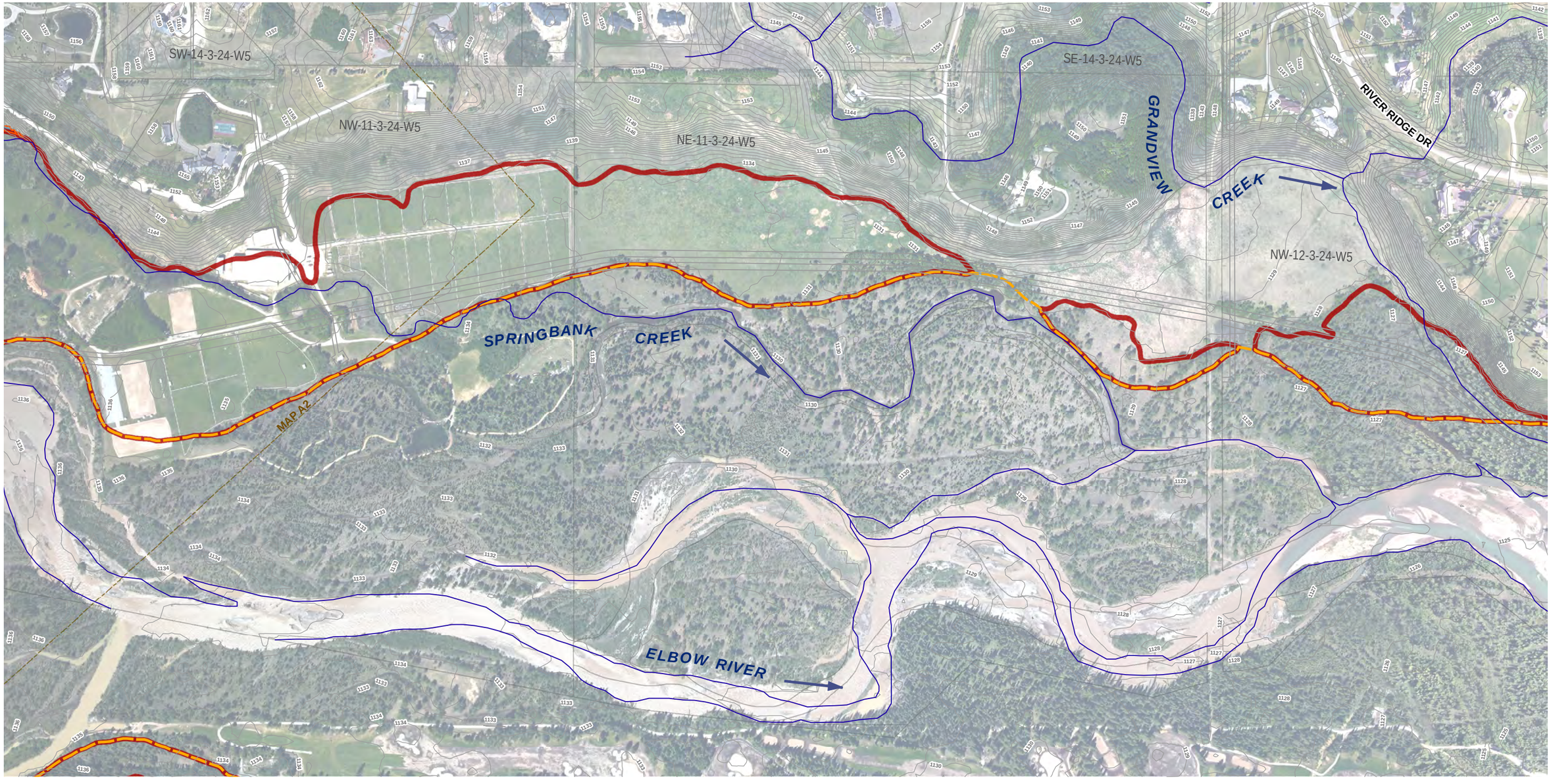

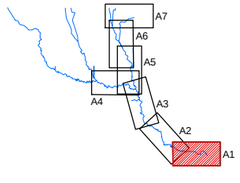

N
W E
S

100 0 100 m

SCALE 1:5,000

- Map Index
- Maximum Flood Extents - Existing Conditions
- Elbow River Floodway
- Elbow River Flood Fringe
- Creek
- Flow Arrow
- Culvert

Existing Conditions Maximum Flood Depth (m)

- < 0.5
- 0.6 - 1.0
- 1.1 - 1.5
- 1.6 - 2.0
- > 2.0

NOTES

1. THE FLOOD DEPTH SHOWN ON THE MAP INDICATES THE DEPTH OF WATER ABOVE PERMANENT WATER BODIES' SURFACE WATER LEVEL.
2. CONTOUR INTERVAL IS 1m. CONTOURS GENERATED FROM LIDAR DATA.
3. COORDINATE SYSTEM IS 3TM (CENTRAL MERIDIAN = -114. SCALE FACTOR = 0.9999, DATUM = NAD 83)

ROCKY VIEW COUNTY
Cultivating Communities

SPRINGBANK CREEK FLOOD STUDY
EXISTING CONDITIONS

MPE Engineering Ltd.

	MAP A1/7
PROJECT	2285-057-01
DATE	OCTOBER 2015

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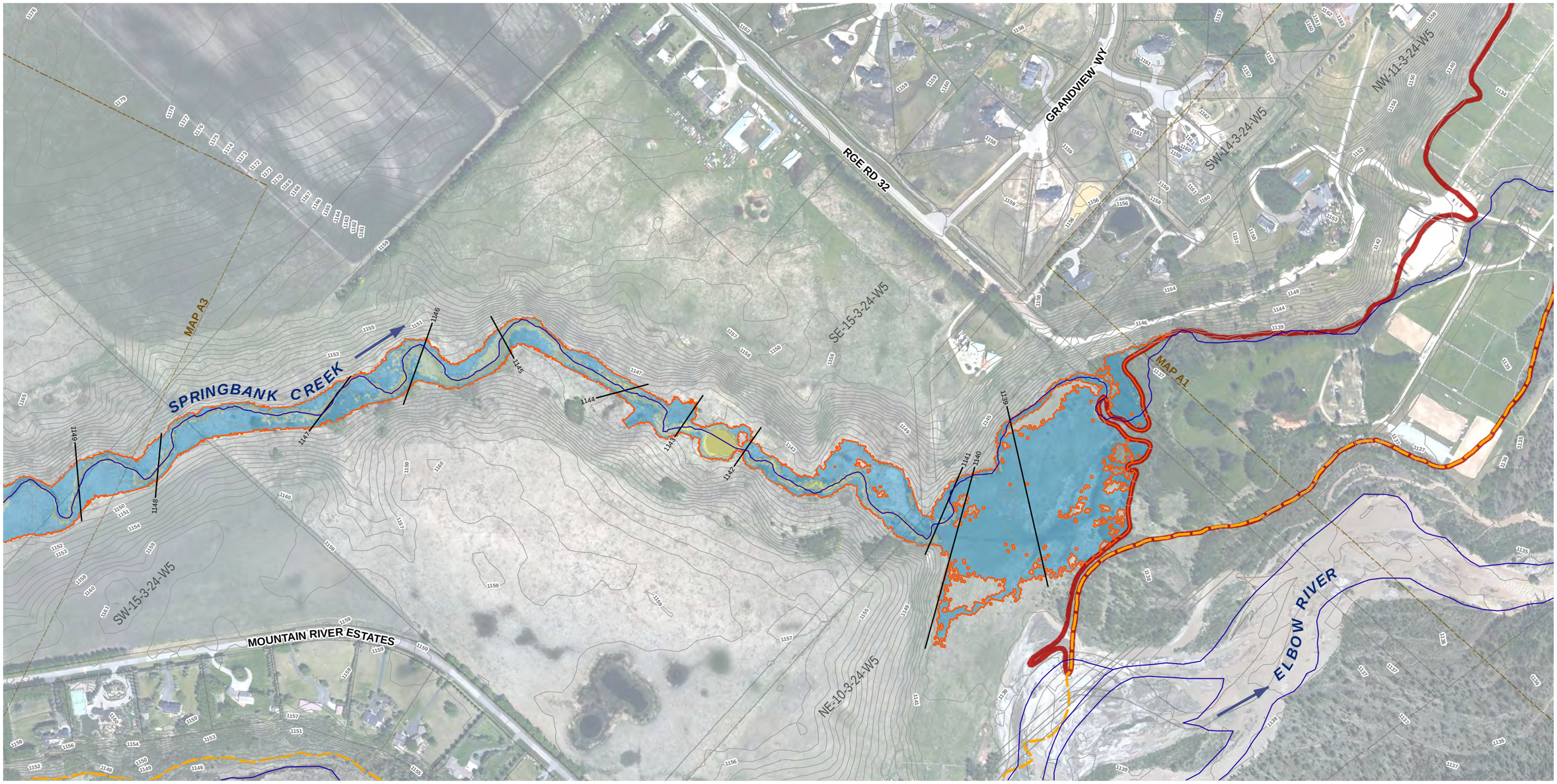

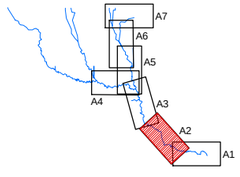

N E S W

100 0 100 m

SCALE 1:5,000

- Map Index
- Maximum Flood Extents - Existing Conditions
- Elbow River Floodway
- Elbow River Flood Fringe
- Creek
- Flow Arrow
- Culvert

Existing Conditions Maximum Flood Depth (m)

- < 0.5
- 0.6 - 1.0
- 1.1 - 1.5
- 1.6 - 2.0
- > 2.0

NOTES

1. THE FLOOD DEPTH SHOWN ON THE MAP INDICATES THE DEPTH OF WATER ABOVE PERMANENT WATER BODIES' SURFACE WATER LEVEL.
2. CONTOUR INTERVAL IS 1m. CONTOURS GENERATED FROM LIDAR DATA.
3. COORDINATE SYSTEM IS 3TM (CENTRAL MERIDIAN = -114. SCALE FACTOR = 0.9999, DATUM = NAD 83)

ROCKY VIEW COUNTY
Cultivating Communities

SPRINGBANK CREEK FLOOD STUDY
EXISTING CONDITIONS

MPE Engineering Ltd.

	MAP A2/7
PROJECT	2285-057-01
DATE	OCTOBER 2015

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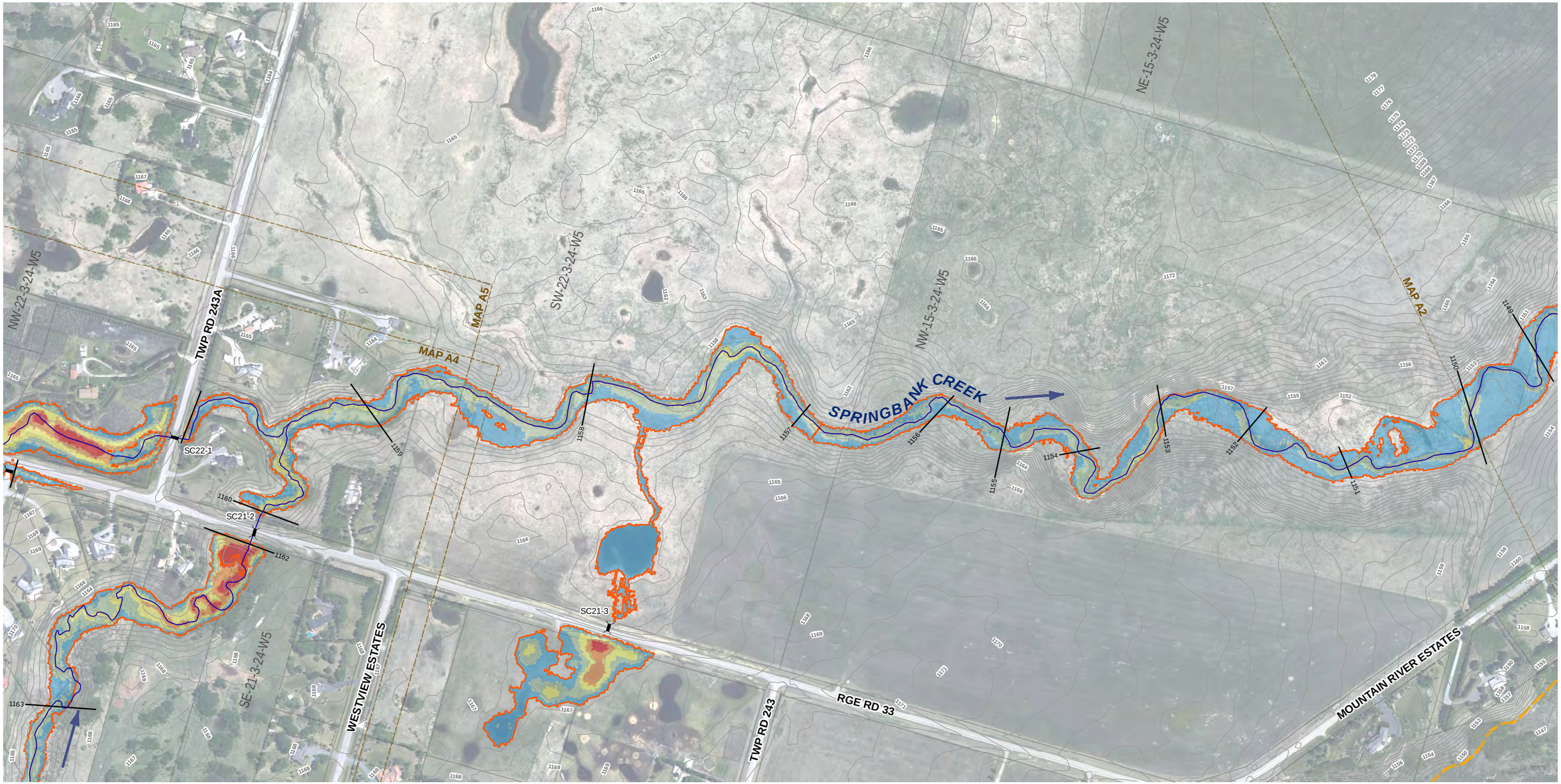

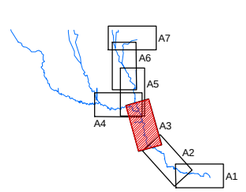

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SCALE 1:5,000

- Map Index
- Maximum Flood Extents - Existing Conditions
- Elbow River Floodway
- Elbow River Flood Fringe
- Creek
- Flow Arrow
- Culvert

Existing Conditions Maximum Flood Depth (m)

- < 0.5
- 0.6 - 1.0
- 1.1 - 1.5
- 1.6 - 2.0
- > 2.0

NOTES

1. THE FLOOD DEPTH SHOWN ON THE MAP INDICATES THE DEPTH OF WATER ABOVE PERMANENT WATER BODIES' SURFACE WATER LEVEL.
2. CONTOUR INTERVAL IS 1m. CONTOURS GENERATED FROM LIDAR DATA.
3. COORDINATE SYSTEM IS 3TM (CENTRAL MERIDIAN = -114. SCALE FACTOR = 0.9999, DATUM = NAD 83)

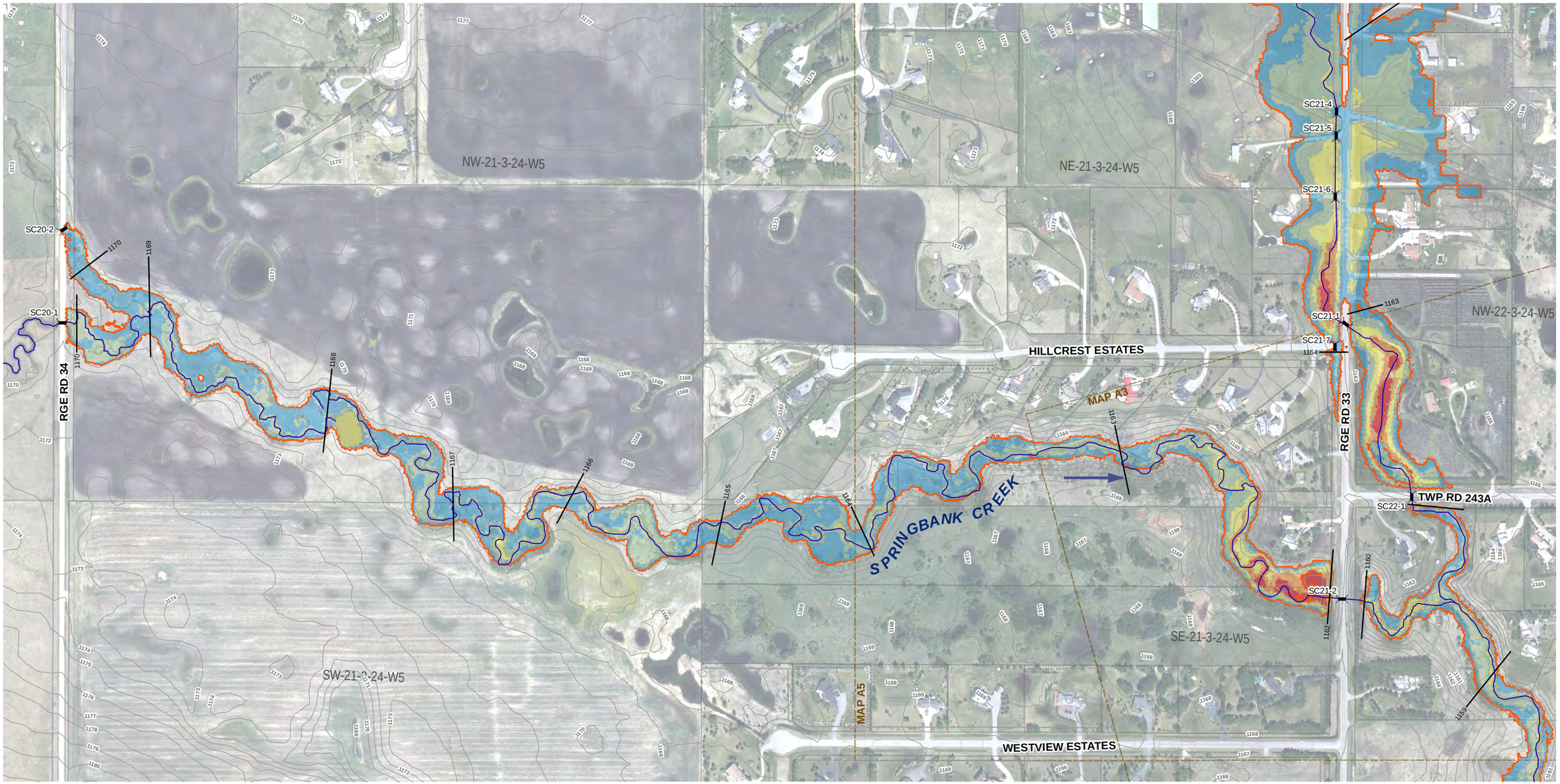
ROCKY VIEW COUNTY
Cultivating Communities

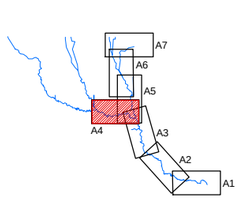
SPRINGBANK CREEK FLOOD STUDY
EXISTING CONDITIONS

MPE Engineering Ltd.

	MAP A3/7
PROJECT	2285-057-01
DATE	OCTOBER 2015

Document Path: N:\2285 M.D. of Rockyview\057-01 Flood Mapping\GIS\Springbank_Existing.mxd





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SCALE 1:5,000

- Map Index
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- Elbow River Flood Fringe
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- Culvert

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ROCKY VIEW COUNTY
Cultivating Communities

SPRINGBANK CREEK FLOOD STUDY
EXISTING CONDITIONS

MPE Engineering Ltd.

MAP A4/7

PROJECT	2285-057-01
DATE	OCTOBER 2015

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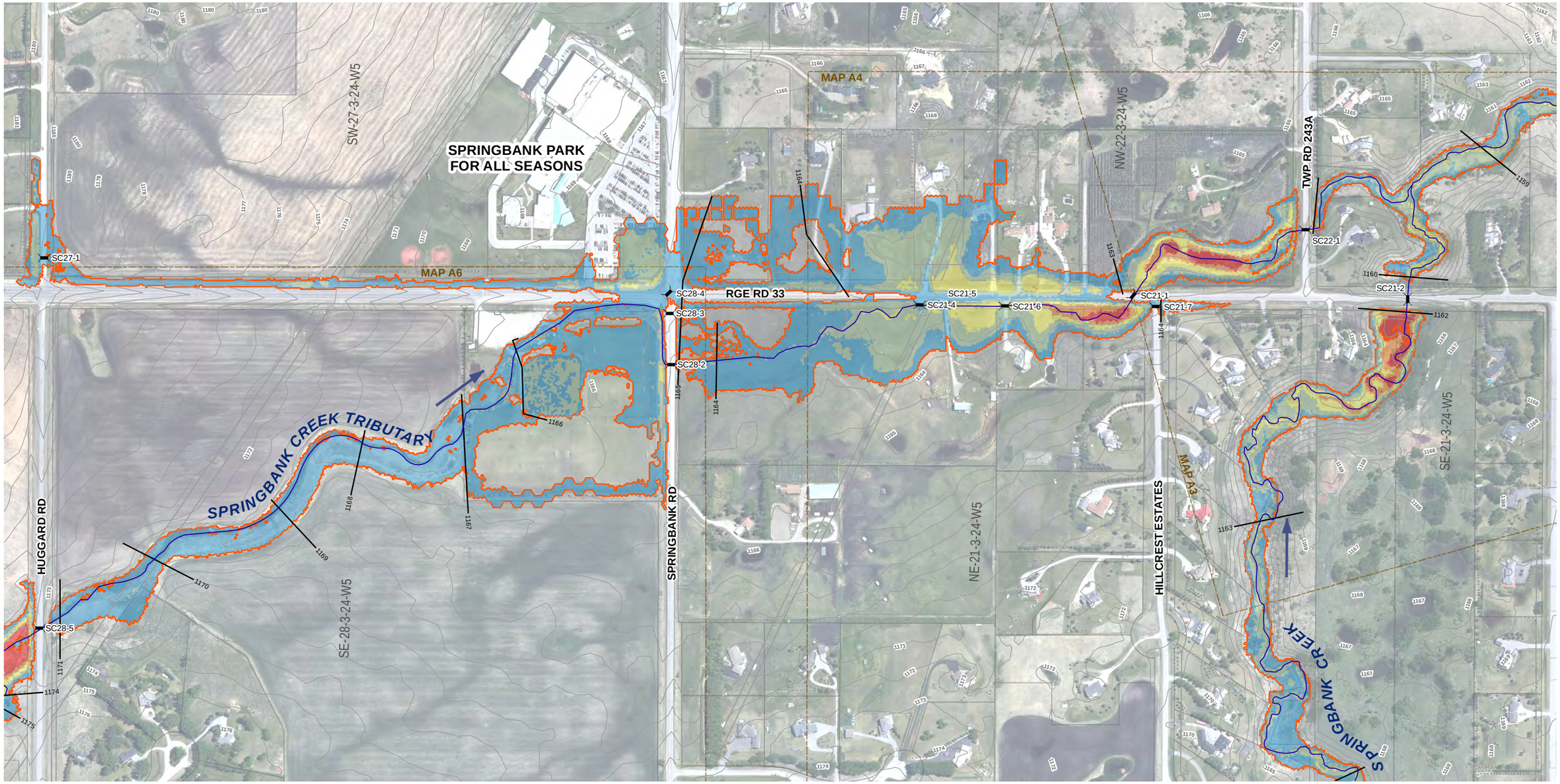

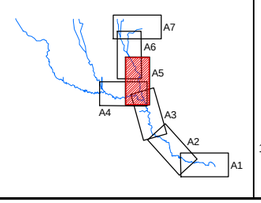

N E S W

100 0 100 m

SCALE 1:5,000

- Map Index
- Maximum Flood Extents - Existing Conditions
- Elbow River Floodway
- Elbow River Flood Fringe
- Creek
- Flow Arrow
- Culvert

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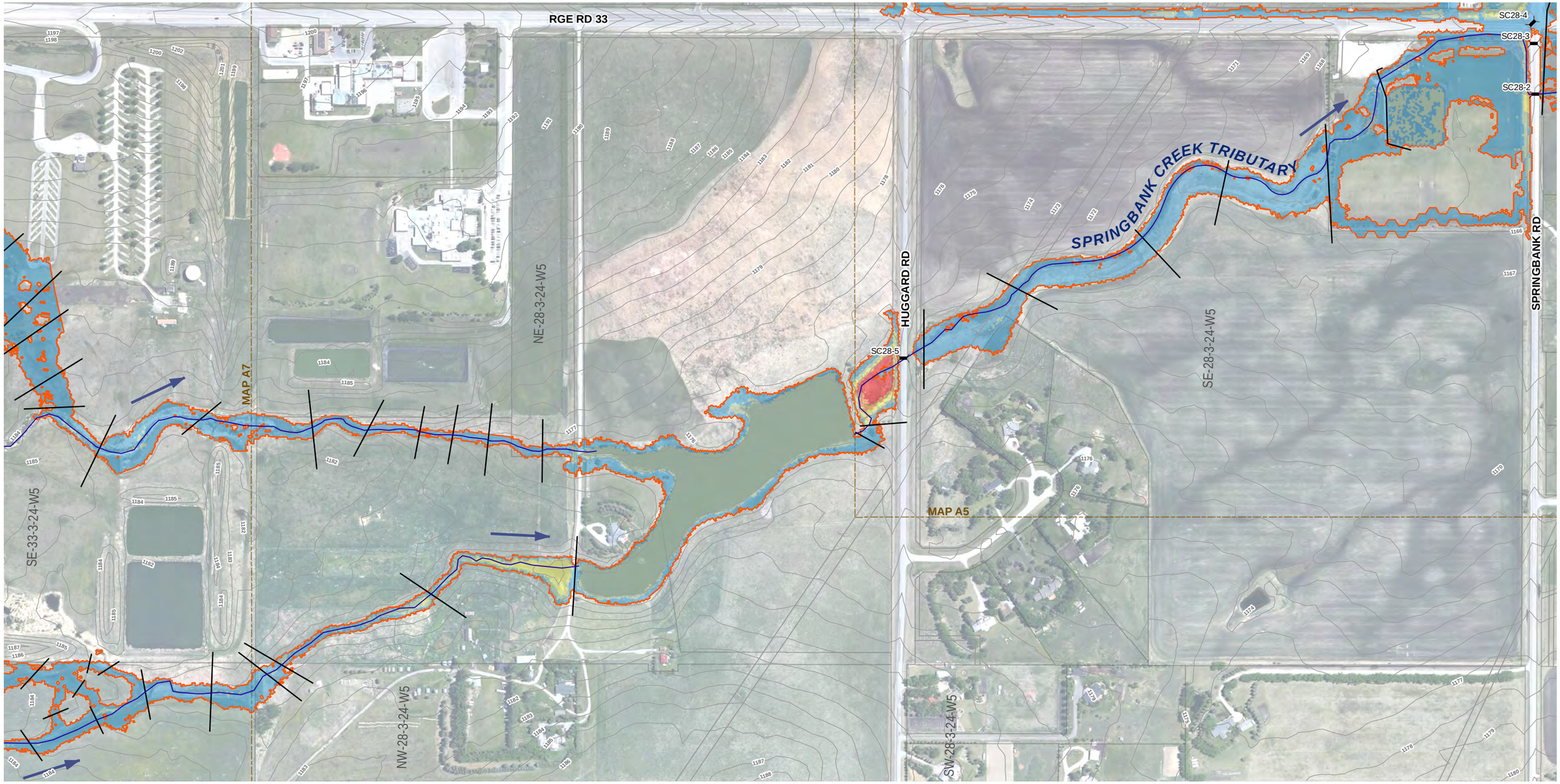
ROCKY VIEW COUNTY
Cultivating Communities

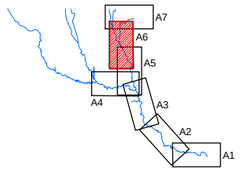
SPRINGBANK CREEK FLOOD STUDY
EXISTING CONDITIONS

MPE Engineering Ltd.

	MAP A5/7
PROJECT	2285-057-01
DATE	OCTOBER 2015

Document Path: N:\2285 M.D. of Rockyview\057-01 Flood Mapping\GIS\springbank_Existing.mxd





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SCALE 1:5,000

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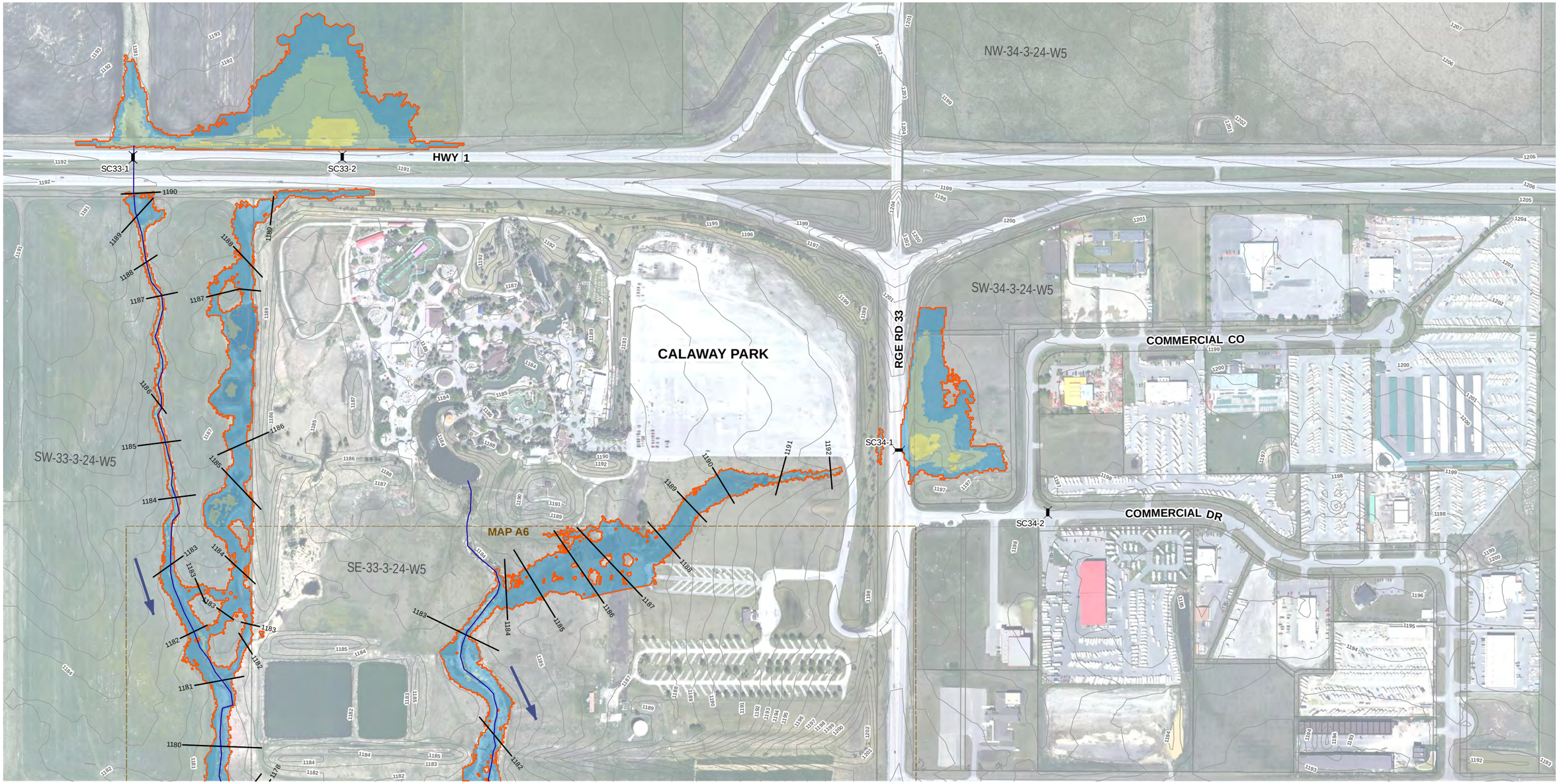
ROCKY VIEW COUNTY
Cultivating Communities

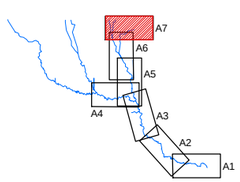
SPRINGBANK CREEK FLOOD STUDY
EXISTING CONDITIONS

MPE Engineering Ltd.

	MAP A6/7
PROJECT	2285-057-01
DATE	OCTOBER 2015

Document Path: N:\2285 M.D. of Rockyview\057-01 Flood Mapping\GIS\Springbank_Existing.mxd





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SCALE 1:5,000

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ROCKY VIEW COUNTY
Cultivating Communities

SPRINGBANK CREEK FLOOD STUDY
EXISTING CONDITIONS

MPE Engineering Ltd.

	MAP A7/7
PROJECT	2285-057-01
DATE	OCTOBER 2015

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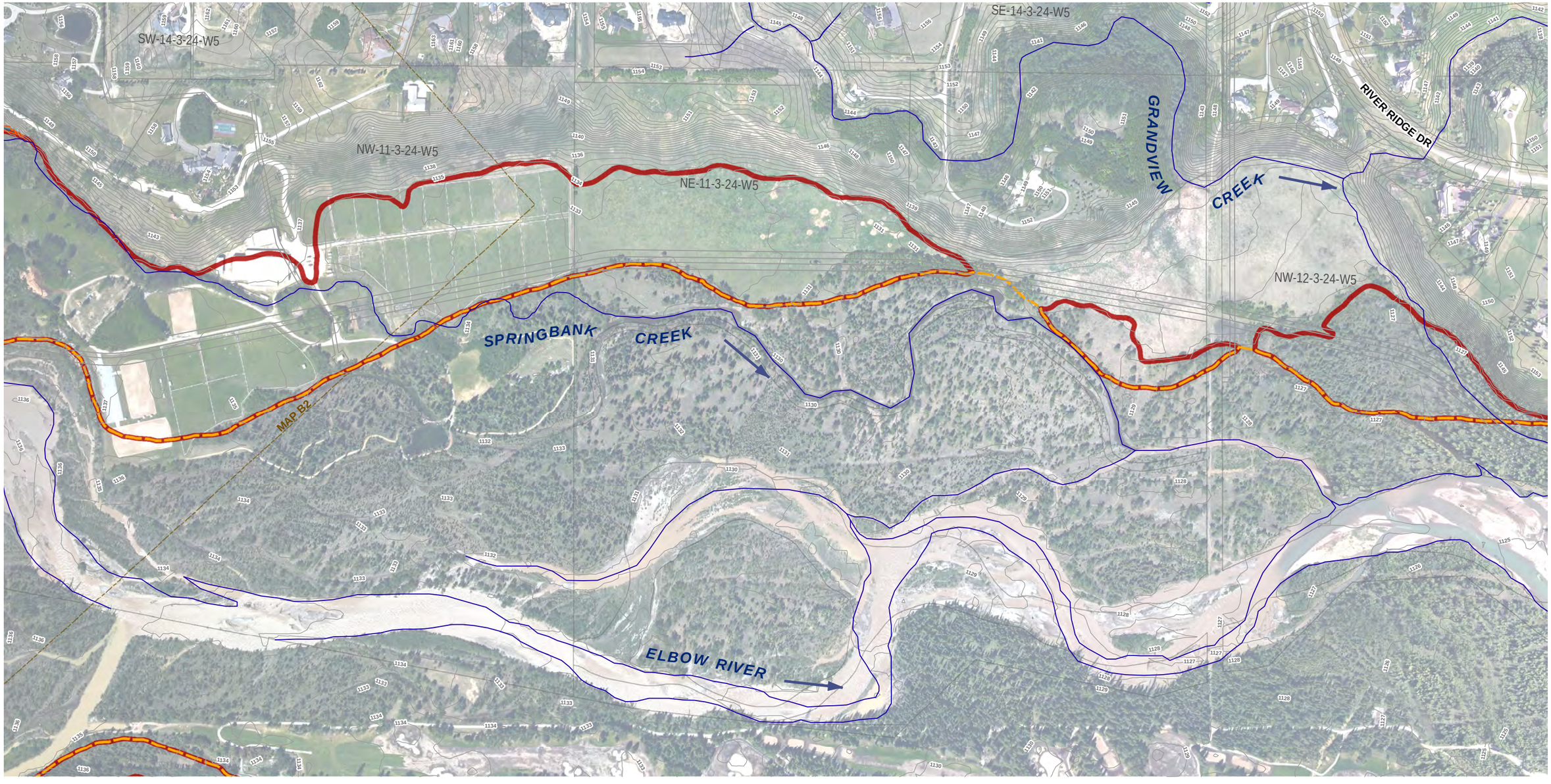
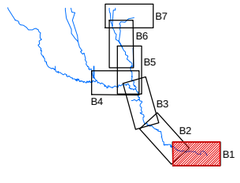
APPENDIX C

Floodplain Maps: Future Conditions





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SCALE 1:5,000

- Map Index
- Maximum Flood Extents
- Elbow River Floodway
- Elbow River Flood Fringe
- Creek
- FlowArrow
- Retain Existing Culvert
- Proposed Upgrades to Culvert

Maximum Flood Depth (m)

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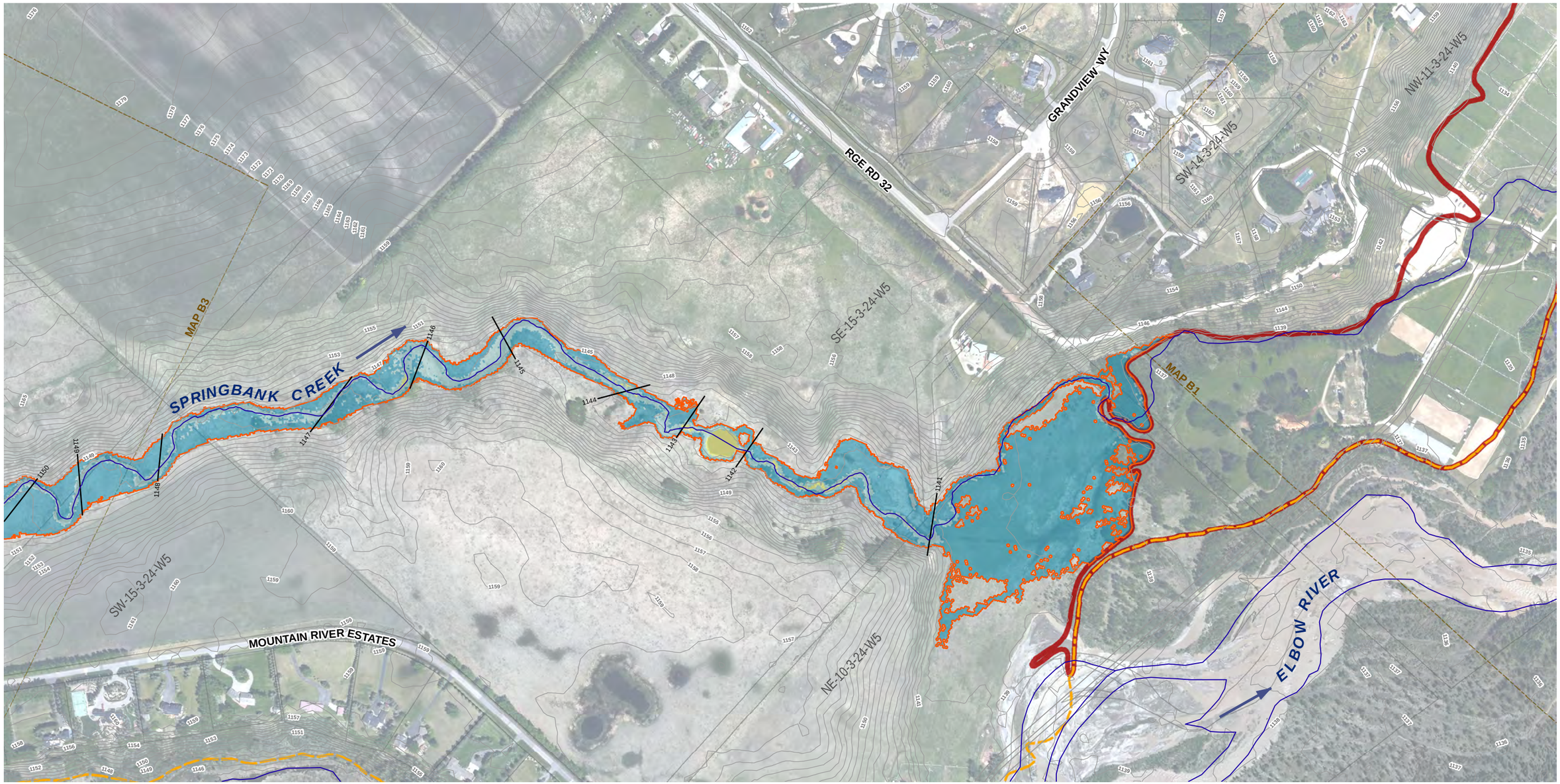
ROCKY VIEW COUNTY
Cultivating Communities

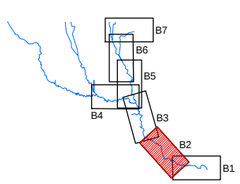
SPRINGBANK CREEK FLOOD STUDY
FUTURE CONDITIONS
AFTER PROPOSED CULVERT UPGRADES

MPE Engineering Ltd.

	MAP B1/7
PROJECT	2285-057-01
DATE	OCTOBER 2015

Document Path: N:\2285 M.D. of Rockview\057-01 Flood Mapping\GIS\Springbank_Upgrades.mxd





N E S W

100 0 100 m

SCALE 1:5,000

- Map Index
- Maximum Flood Extents
- Elbow River Floodway
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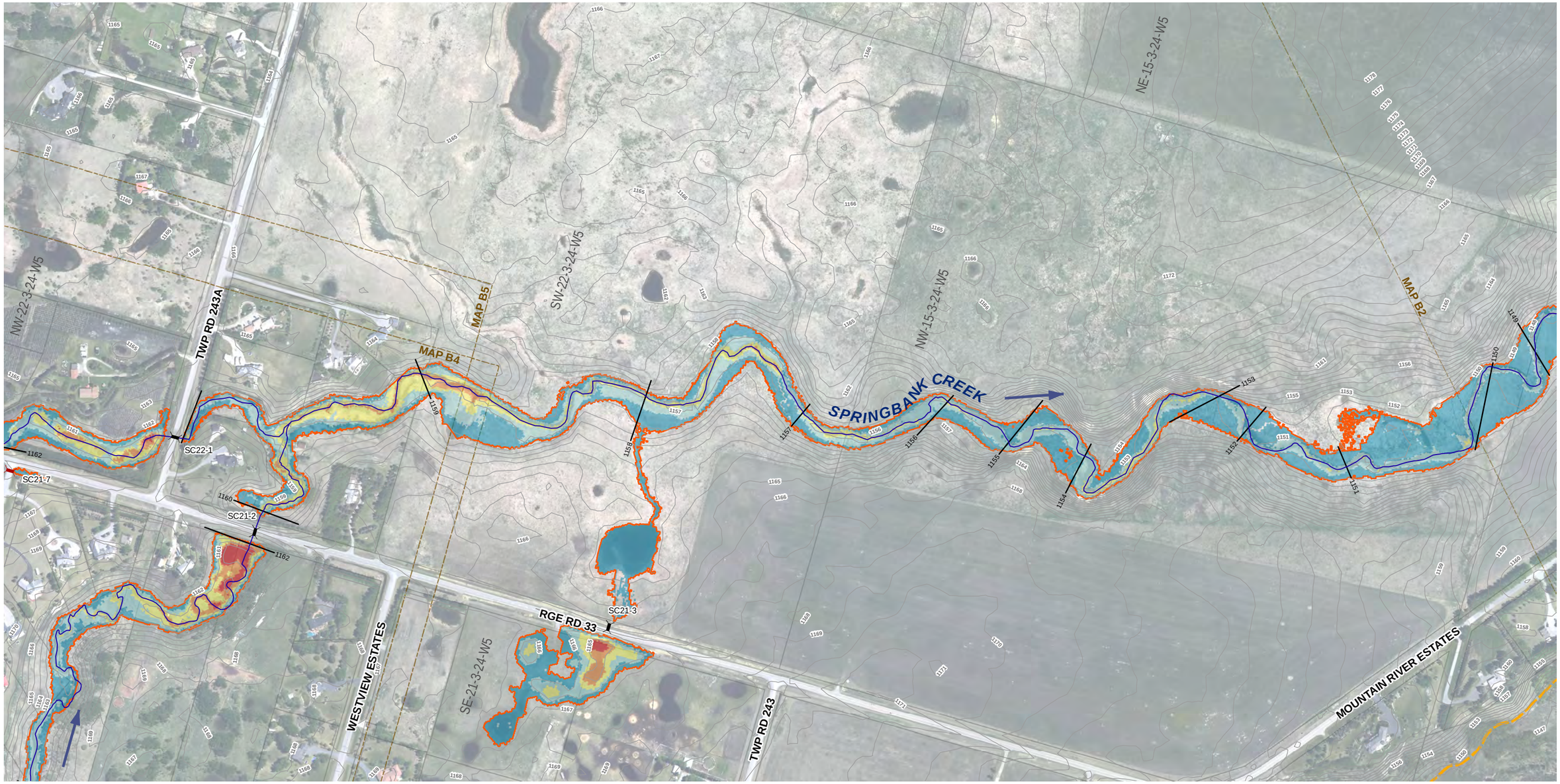
ROCKY VIEW COUNTY
Cultivating Communities

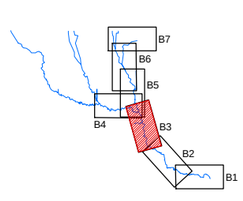
SPRINGBANK CREEK FLOOD STUDY
FUTURE CONDITIONS
AFTER PROPOSED CULVERT UPGRADES

MPE Engineering Ltd.

	MAP B2/7
PROJECT	2285-057-01
DATE	OCTOBER 2015

Document Path: N:\2285-M.D. of Rockyview\057-01 Flood Mapping\GIS\Springbank_Upgrades.mxd





N E S W

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SCALE 1:5,000

- Map Index
- Maximum Flood Extents
- Elbow River Floodway
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ROCKY VIEW COUNTY
Cultivating Communities

SPRINGBANK CREEK FLOOD STUDY
FUTURE CONDITIONS
AFTER PROPOSED CULVERT UPGRADES

MPE Engineering Ltd.

	MAP B3/7
PROJECT	2285-057-01
DATE	OCTOBER 2015

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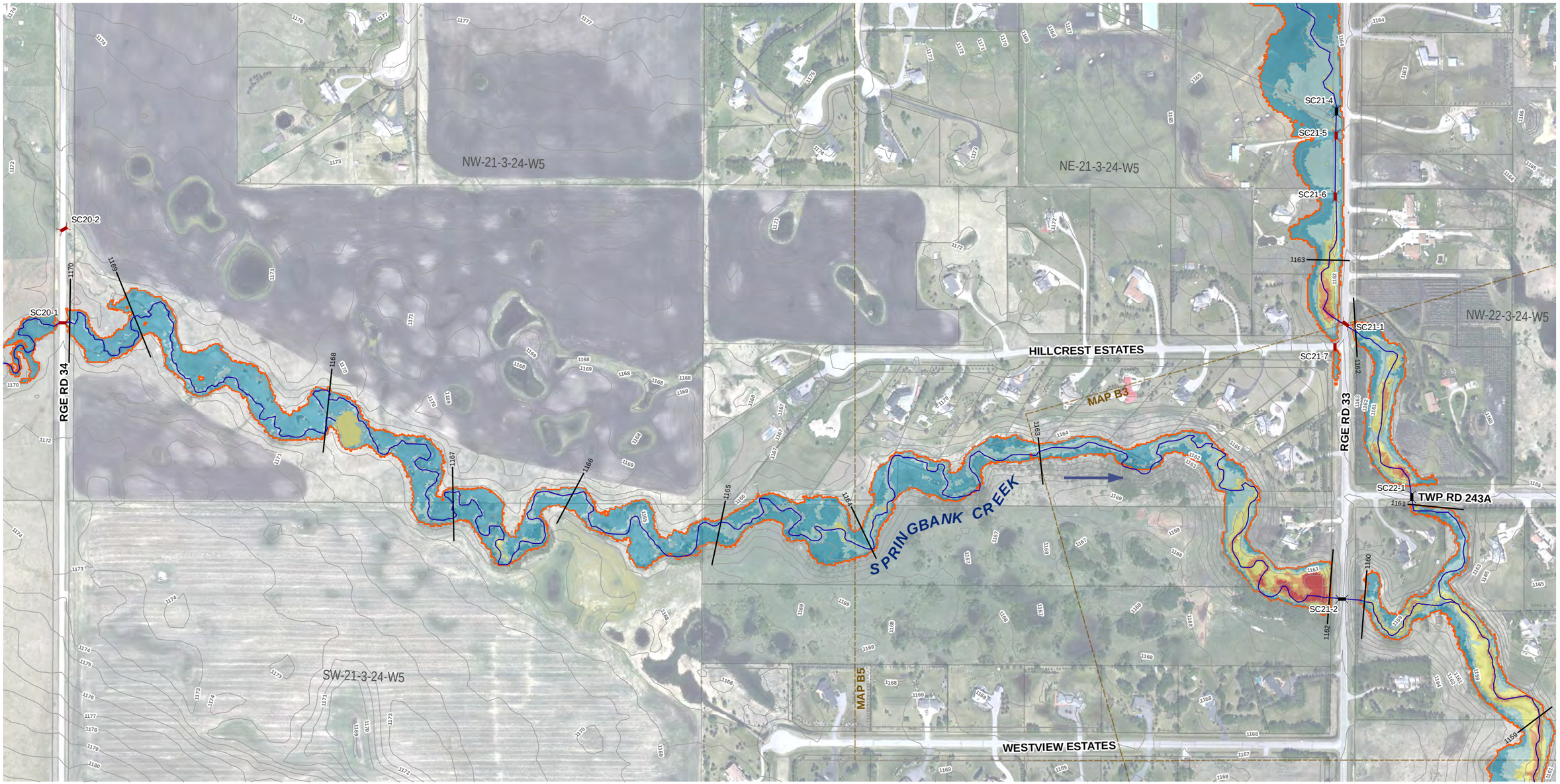

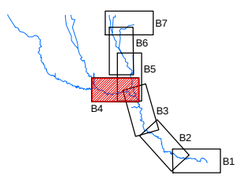

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SCALE 1:5,000

- Map Index
- Maximum Flood Extents
- Elbow River Floodway
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ROCKY VIEW COUNTY
Cultivating Communities

SPRINGBANK CREEK FLOOD STUDY
FUTURE CONDITIONS
AFTER PROPOSED CULVERT UPGRADES

MPE Engineering Ltd.

	MAP B4/7
PROJECT	2285-057-01
DATE	OCTOBER 2015

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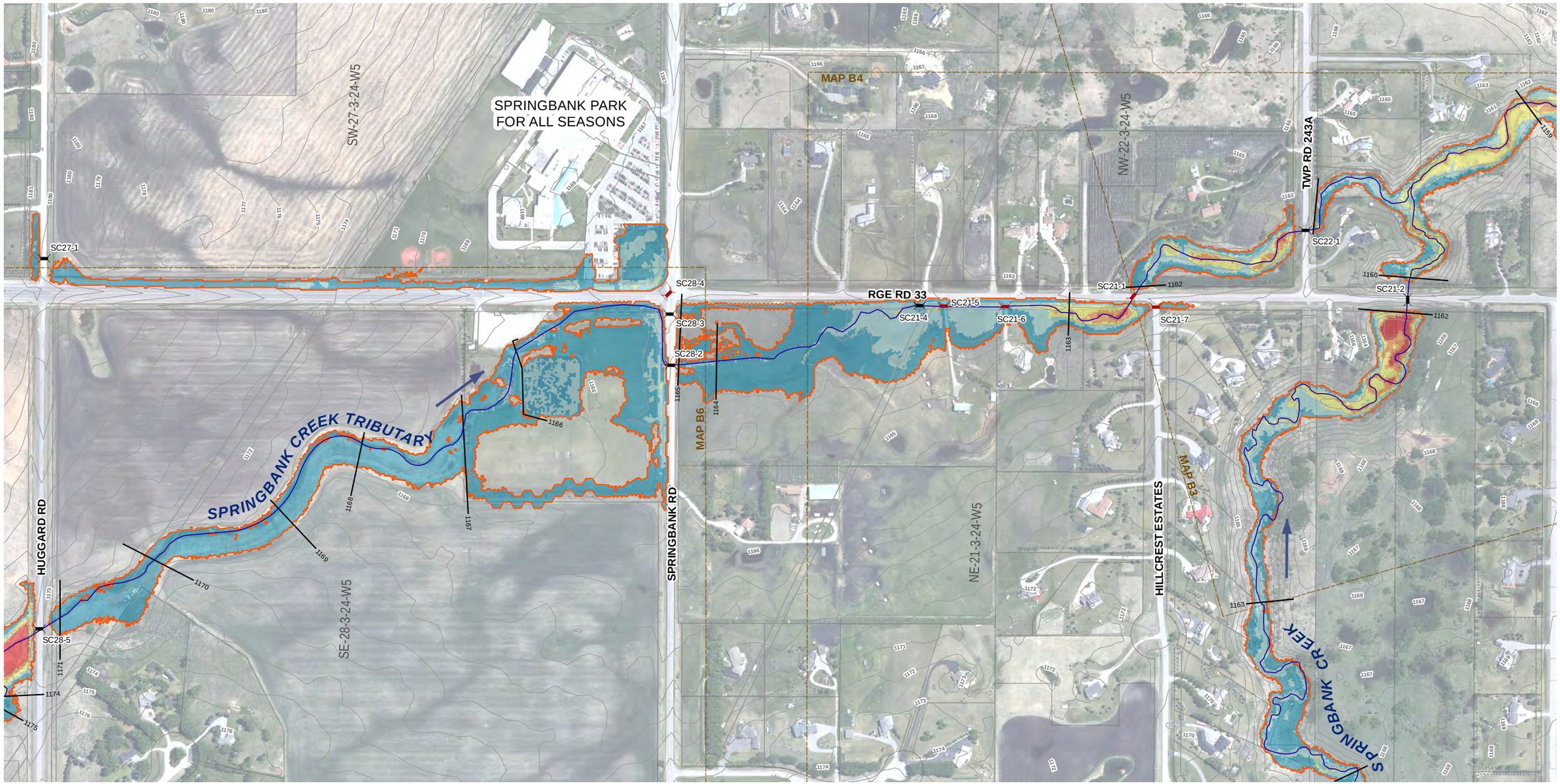

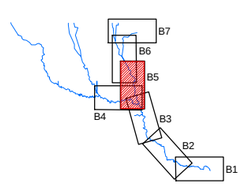

N E S W

100 0 100 m

SCALE 1:5,000

- Map Index
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ROCKY VIEW COUNTY
Cultivating Communities

SPRINGBANK CREEK FLOOD STUDY
FUTURE CONDITIONS
AFTER PROPOSED CULVERT UPGRADES

MPE Engineering Ltd.

	MAP B5/7
PROJECT	2285-057-01
DATE	OCTOBER 2015

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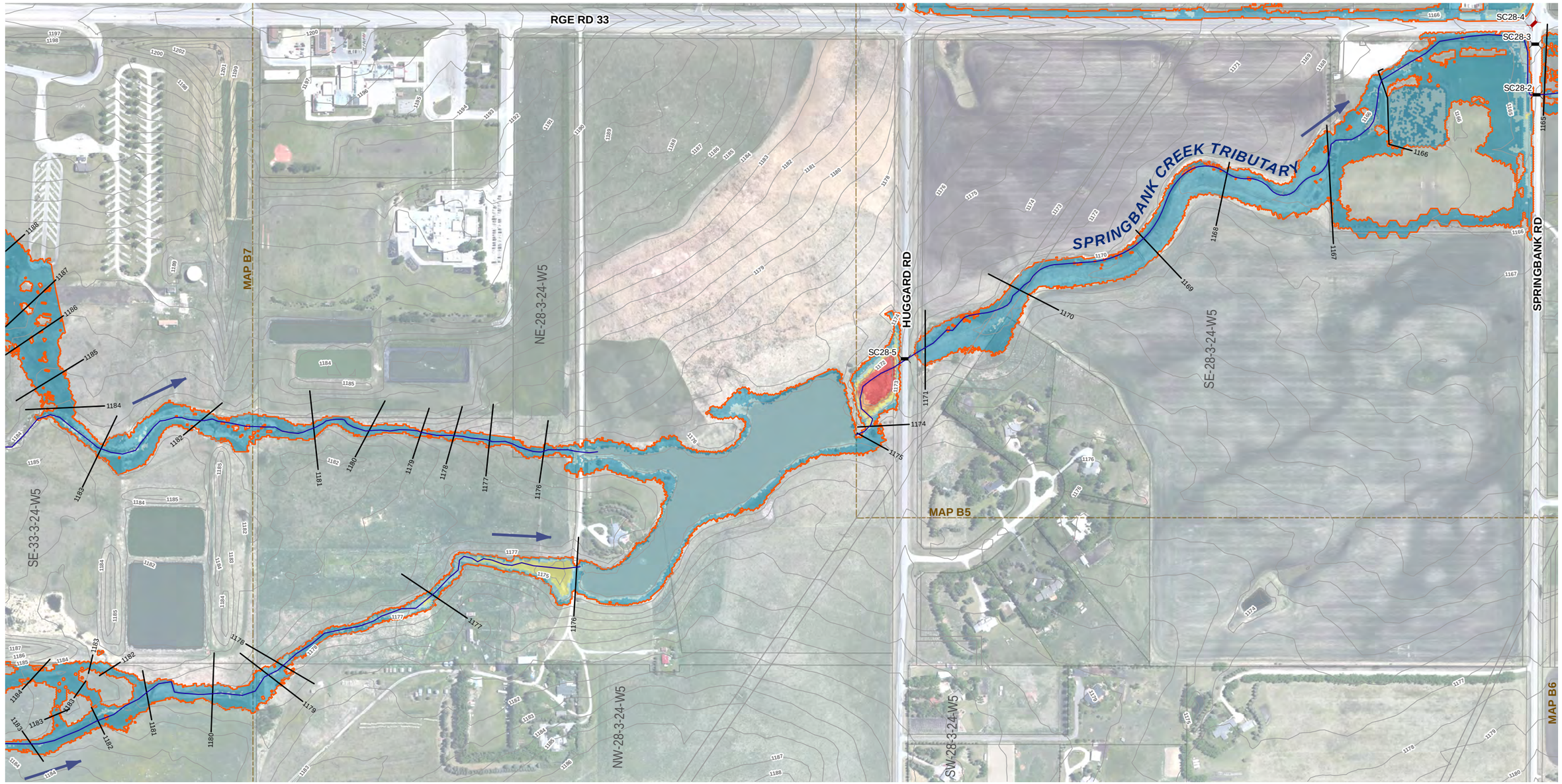

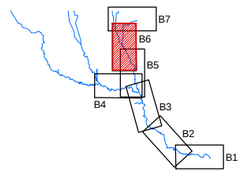

N E S W

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SCALE 1:5,000

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ROCKY VIEW COUNTY
Cultivating Communities

SPRINGBANK CREEK FLOOD STUDY
FUTURE CONDITIONS
AFTER PROPOSED CULVERT UPGRADES

MPE Engineering Ltd.

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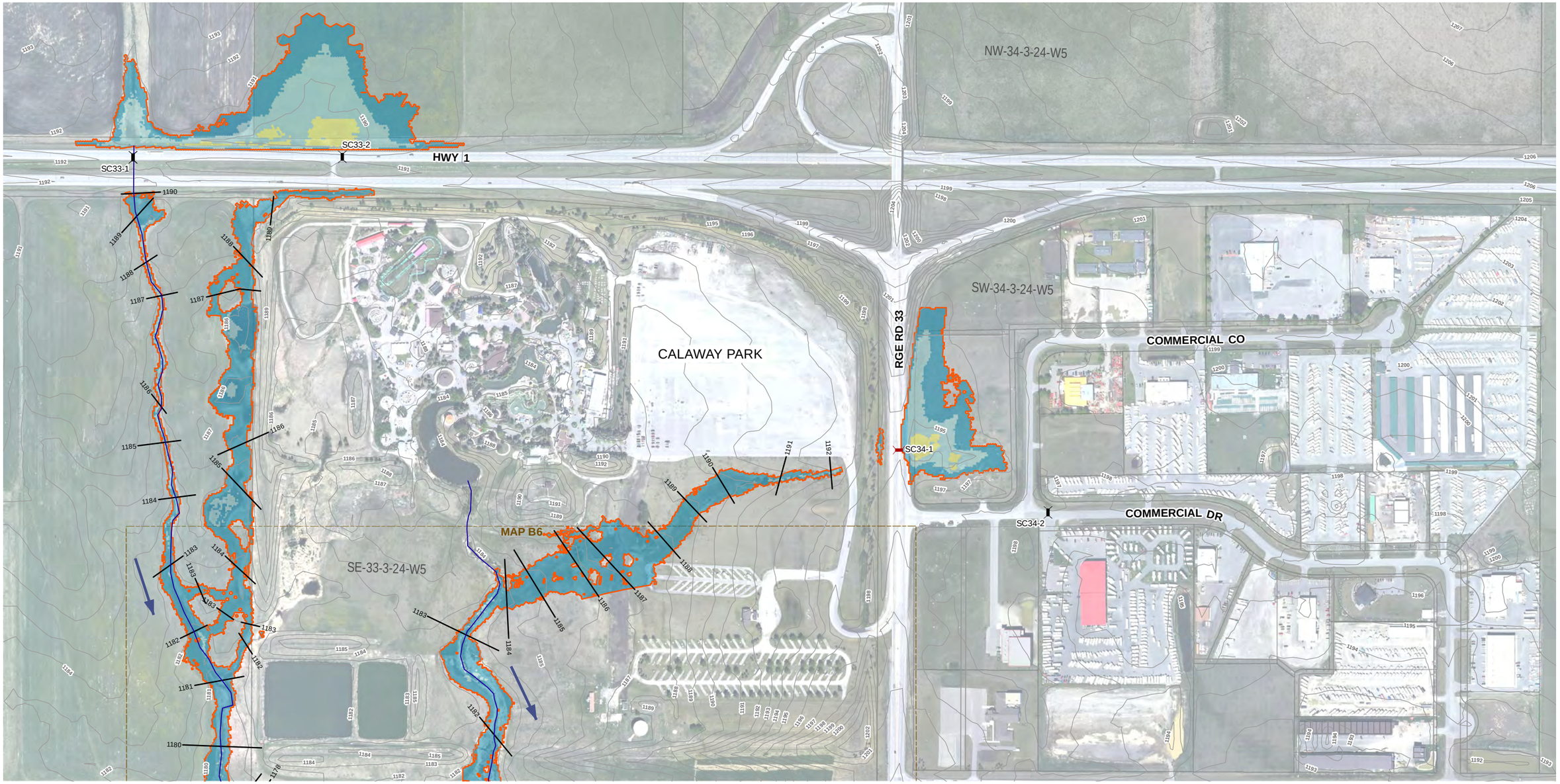

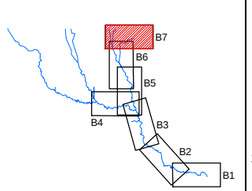

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ROCKY VIEW COUNTY
Cultivating Communities

SPRINGBANK CREEK FLOOD STUDY
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MPE Engineering Ltd.

	MAP B7/7
PROJECT	2285-057-01
DATE	OCTOBER 2015

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APPENDIX D

Cost Estimates

Project:	***Rocky View County***	**Project Manager:**	DWS
	Sprinbank Creek Catchment drainage Plan	**Prepared By:**	AYC
File:	*N:* ***2285-057 Springbank Costs***	**Revision No.**	1
Date:	***15-Dec-15***		

PROBABLE COST ESTIMATE - DITCHES

Engineering+Contingency 55%

	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	COST
1	**West Side of Range Road 33 Ditches (282m)**	282			
1.1	Ditch Reshaping	800	m^3	$ 30	$ 24,000
1.2	Landscaping/Grass Seeding	1400	m^2	$ 8	$ 11,200
1.3	Culvert Rebuilding (Included in culverts spreadsheet)	0	LS	$ 20,000	$ -
1.4	Land Acquisition/Easments	4000	m^2	$ 10	$ 40,000
	1. Subtotal				$ 75,200
	1. Total Incl. Engineering and Contingency				**$ 116,600**
2	**Springbank Park for All Seasons Ditches (550m)**	550			
2.1	Ditch Reshaping	1700	m^3	$ 30	$ 51,000
2.2	Landscaping/Grass Seeding	2800	m^2	$ 8	$ 22,400
2.3	Culvert Rebuilding	1	LS	$ 25,000	$ 25,000
	2. Subtotal				$ 98,400
	2. Total Incl. Engineering and Contingency				**$ 152,600**
GRAND TOTAL					**$ 269,200**

Priority	Culvert		Road Width	Diameter		Length	Barrels	New Barrels	Depth	Supply and Install Culverts: 450 $450	600 $500	750 $700	900 $800	1200 $900	1350 $1,200	Mobilization/ Demobilization 15%	Traffic Management	Care of Water	Erosion Control	Excavation $20	Removal and Disposal of Existing CSP $150	Staging Management	Granular Backfill $55	Clay Plug Backfill $45	Compacted Native Backfill $20	Pitrun Gravel $70	Road Gravel $20	Road Reinstatement $40	Bedding Gravel for RipRap $110	RipRap Class 1 $150	Seeding $6	Subtotal	Contingency	Engineering	Total
				mm		m			m	m	m	m	m	m	m	LS	LS	LS	LS	m³	m	LS	m³	m³	m³	m³	m²	m³	m³	m3	m²		40%	15%	
1	SC21-4	Gravel Driveway	5																															
	SC21-5	Gravel Driveway	5	1200	1200	15	2	2	1.4					30 $27,000		1 $6,000	1 $2,000	1 $1,000	1 $1,000	230 $4,600	15 $2,250	- -	68 $3,713	35 $1,575	50 $1,000	18 $1,260	40 $800	- -	20 $2,200	92 $13,800	500 $3,000	**$71,198**	$28,479	$10,680	**$110,356**
	SC21-6	1 lane asphalt drivew	10	1200	1200	15	2	2	1.4					30 $27,000		1 $6,000	1 $2,000	1 $2,000	1 $2,000	230 $4,600	15 $2,250	- -	68 $3,713	35 $1,575	50 $1,000	18 $1,260	- -	70 $2,800	20 $2,200	92 $13,800	500 $3,000	**$75,198**	$30,079	$11,280	**$116,556**
	SC21-1	RR33 2 lane asphalt	10	1250	1200	55	2	1	3.25					55 $49,500		1 $19,000	1 $10,000	1 $4,000	1 $2,000	1210 $24,200	- -	1 $50,000	124 $6,806	35 $1,575	92 $1,834	33 $2,310	- -	50 $2,000	20 $2,200	92 $13,800	500 $3,000	**$192,225**	$76,890	$28,834	**$297,949**
	SC22-1	2 lane asphalt	10	1350	1350	25	2	1	2.3						25 $30,000	1 $7,000	1 $5,000	1 $3,000	1 $2,000	360 $7,200	- -	- -	78 $4,263	45 $2,025	45 $900	18 $1,225	- -	60 $2,400	24 $2,640	108 $16,200	500 $3,000	**$86,853**	$34,741	$13,028	**$134,621**
		Ditches																														**$75,200**	$30,080	$11,280	**$116,560**
2	SC28-4	Main Road RR33 4 l	22	900	900	40	2	2	1.4				80 $64,000			1 $8,000	1 $5,000	1 $2,000	1 $2,000	510 $10,200	- -	- -	90 $4,958	25 $1,125	160 $3,200	54 $3,780	- -	140 $5,600	16 $1,760	68 $10,200	500 $3,000	**$124,823**	$49,929	$18,723	**$193,475**
		Ditches																														**$98,400**	$39,360	$14,760	**$152,520**
3	SC21-7	Minor side road, asp 21m	22	600	600	20	2	2	1		40 $20,000					1 $6,000	1 $5,000	1 $2,000	1 $2,000	150 $3,000	20 $3,000	- -	13 $710	15 $675	160 $3,200	23 $1,610	- -	130 $5,200	10 $1,100	44 $6,600	500 $3,000	**$63,095**	$25,238	$9,464	**$97,797**
4	SC27-1	Side Road 2 lane as 9m	10	750	750	25	1	1	1.5			25 $17,500				1 $4,000	1 $5,000	1 $2,000	1 $2,000	160 $3,200	25 $3,750	- -	13 $724	20 $900	100 $2,000	15 $1,050	- -	40 $1,600	6 $660	18 $2,700	500 $3,000	**$50,084**	$20,033	$7,513	**$77,630**
5	SC20-1	2 lane gravel	10	1100x1600	1350	20	2	1	1.5						20 $24,000	1 $6,000	1 $3,000	1 $2,000	1 $2,000	180 $3,600	- -	- -	62 $3,410	45 $2,025	36 $720	14 $980	60 $1,200	- -	24 $2,640	108 $16,200	500 $3,000	**$70,775**	$28,310	$10,616	**$109,701**
	SC20-2	2 lane gravel	10	900	900	20	3	3	1.5				60 $48,000			1 $8,000	1 $3,000	1 $2,000	1 $2,000	420 $8,400	20 $3,000	- -	68 $3,718	25 $1,125	120 $2,400	41 $2,835	90 $1,800	- -	24 $2,640	102 $15,300	500 $3,000	**$107,218**	$42,887	$16,083	**$166,188**
6	SC29 3	2 lane asphalt, SB R	10	750	750	20	2	2	1.2			40 $28,000				1 $5,000	1 $5,000	1 $2,000	1 $2,000	200 $4,000	20 $3,000	- -	21 $1,158	20 $900	160 $3,200	24 $1,680	- -	60 $2,400	12 $1,320	36 $5,400	500 $3,000	**$68,058**	$27,223	$10,209	**$105,490**
7	SC29-2	2 lane asphalt, SB R	10	900	900	30	3	2	1.6				60 $48,000			1 $8,000	1 $5,000	1 $2,000	1 $2,000	450 $9,000	- -	- -	68 $3,718	25 $1,125	120 $2,400	41 $2,835	- -	70 $2,800	24 $2,640	102 $15,300	500 $3,000	**$107,818**	$43,127	$16,173	**$167,118**
8	SC29-1	2 lane asphalt, SB R	10	450	450	20	2	2	1	40 $18,000						1 $5,000	1 $5,000	1 $2,000	1 $2,000	130 $2,600	20 $3,000	- -	7 $383	15 $675	160 $3,200	22 $1,540	- -	60 $2,400	8 $880	32 $4,800	500 $3,000	**$54,478**	$21,791	$8,172	**$84,440**
9	SC34-1	4 lane asphalt, RR33	25	600	600	35	1	1	1.5		35 $17,500					1 $5,000	1 $5,000	1 $2,000	1 $2,000	210 $4,200	35 $5,250	- -	11 $621	15 $675	140 $2,800	20 $1,409	- -	90 $3,600	5 $550	22 $3,300	500 $3,000	**$56,905**	$22,762	$8,536	**$88,202**

Cost Estimate Dec 15 2015 AYC MPE
Springbank Creek Catchment Drainage Plan

Mobilization/demobilization was assumed to be 15% of the other costs
Excavation summes 375mm excavation below invert, 500mm buffer on each side of the pipe and a 1:1 s/s for the trench.
Staging management included for SC21-1 due to the extra depth and the additional difficulties this may cause in construction.
Backfill quantities based on pipe size and depths
Road reinstatement assumes that gravel roads will not be upgraded. Quantities
Average unit costs based on 2014 quotes adjusted for inflation.