

**Design Report**

**Woody Creek Study**  
**Resources Road to 68<sup>th</sup> Avenue**

Prepared by:

Ian Ketchum  
Beirsto, Lehnert, Ketchum Engineering  
9607 102 St. Grande Prairie, AB, T8V 2T8  
532-4919 (W) 532-4739 (F)

Rev. November, 2006

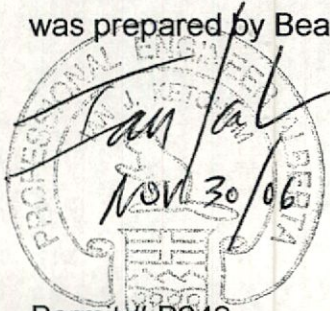
**BEIRSTO LEHNERS KETCHUM ENGINEERING LTD.**

**DISCLAIMER**

This report was prepared for the City of Grande Prairie. All evaluations and recommendations made were based on the information available to Beirsto, Lehnerns, Ketchum Engineering, at the time of preparation. If any changes or additional information should become available, the recommendations may be altered or modified in writing by the undersigned. Beirsto, Lehnerns, Ketchum Engineering is not responsible for any damages suffered from a third party which makes use or decisions based on this report.

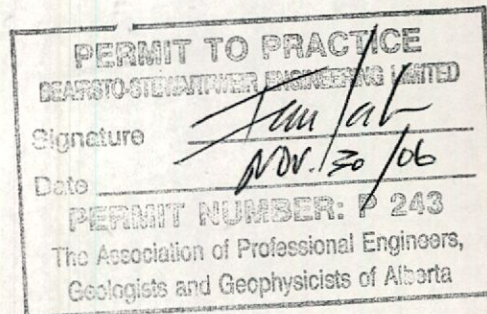
**AUTHORIZATION**

This document entitled "Woody Creek Study – Resources Road to 68<sup>th</sup> Avenue" was prepared by Beirsto, Lehnerns, Ketchum Engineering Ltd.



Permit # P243

Professional Seal



## TABLE OF CONTENTS

---

<b>1.0</b>	<b>-</b>	<b><u>Introduction</u></b>	<b>1</b>
1.1	-	Background	1
1.2	-	Design Criteria	2
<b>2.0</b>	<b>-</b>	<b><u>Existing Conditions</u></b>	<b>5</b>
2.1	-	Servicing Area – Existing City	5
2.2	-	Determine Woody Creek Capacity	5
<b>3.0</b>	<b>-</b>	<b><u>Woody Creek Upgrades – City</u></b>	<b>7</b>
3.1	-	Recommended City Upgrades	7
3.1.1	-	Recommended City Upgrades - Ditch Crossings	8
3.1.2	-	Recommended City Upgrades – Impact on Groundwater	9
3.1.3	-	Recommended City Upgrades - Water Quality	9
3.1.4	-	Recommended City Upgrades – Biophysical Assessment	10
3.1.5	-	Recommended City Upgrades - Navigable Waters	11
3.1.6	-	Recommended City Upgrades - Sustainable Resource Development	11
3.1.7	-	Recommended City Upgrades - ATCO	11
3.2	-	Sanitary East Trunk Main Crossing	12
3.2.1	-	Alternative #1 – Inverted Storm Sewer	13
3.2.2	-	Alternative #2 – Wet Channel	14
3.2.3	-	Alternative #3 – Grade Change	14
3.3	-	Upgraded Woody Creek Flows – City	15
<b>4.0</b>	<b>-</b>	<b><u>Woody Creek Basin Completely Developed</u></b>	<b>16</b>
4.1	-	Woody Creek Basin – Developed Areas	16
4.1.1	-	Ultimate Basin Development - SE5 Basin	16
4.1.2	-	Ultimate Basin Development - SE4 Basin	17
4.1.3	-	Ultimate Basin Development - SE1-3 Basins	19
4.2	-	Woody Creek Development Flows	20
4.2.1	-	Ultimate Basin Development - SE5 Basin Flows	20
i	-	Allowable SE5 Peak Discharge - Alternative #1 – Inverted Storm	21
ii	-	Allowable SE5 Peak Discharge - Alternative #2 – Wet Pond	22
iii	-	Allowable SE5 Peak Discharge - Alternative #3 – Grade Change	23
4.2.2	-	Ultimate Basin Development – SE4 Basin Flows	24

<b>5.0</b>	-	<b><u>Cost Sharing</u></b>	<b>27</b>
<b>5.1</b>	-	Improvements Required for Existing Deficiencies Only	<b>27</b>
<b>5.2</b>	-	Improvements Required for Both Existing And Future Development	<b>28</b>
<b>TABLE 5.2 - Proposed Woody Creek Storm Water Drainage Reserve</b>			
<b>5.3</b>	-	Improvements Required for Future Development Only	<b>30</b>
<b>5.4</b>	-	Woody Creek Storm Water Drainage Reserve	<b>32</b>
<b>5.5</b>	-	Woody Creek Parkway	<b>33</b>
<b>5.6</b>	-	Woody Creek Land Costs	<b>33</b>
<b>6.0</b>	-	<b><u>Recommendations</u></b>	<b>33</b>

## **List of Figures**

---

- Figure 1 – Woody Creek Basin
- Figure 2 – Woody Creek Study Area
- Figure 3 – Woody Creek Existing Capacity
- Figure 4a – Woody Creek Upgrade – City STA 0+000 to 0 + 950
  - 4b – Woody Creek Upgrade – City Alternative #1 STA 0 + 950 to 2 + 160
  - 4c – Woody Creek Upgrade – City STA 2 + 160 to 68<sup>th</sup> Avenue
- Figure 5a – Woody Creek Cross Section Resources Road to 92 ST
  - 5b – Woody Creek Cross Section From 92 ST
  - 5c – Signature Fall Lineal Wet Pond
- Figure 6a – Detail - Alternative 1
- Figure 7a – Detail - Alternative 2
  - 7b – Woody Creek Upgrade – Alternative #2 Profile
- Figure 8a – Detail – Alternative #3
  - 8b – Woody Creek Upgrade – Alternative #3 Profile
- Figure 9 – Woody Creek Upgrade – Signature Fall Profile
- Figure 10 – Proposed 92 Street Storm – Cobblestone
- Figure 11 – Cost Sharing Areas
- Figure 12 – Woody Creek PUL Widths

## **List of Appendices**

---

### **Appendix I**

Figure 4.8 – Proposed Storm Water Management Concept	1pg
Figure 5.4 – Proposed Dry Pond Concept	1pg
Figure 5.5 – Proposed Wet Pond Concept	1 pg
Figure 5.7 – Proposed Drainage Parkway Concept	1pg
Exhibit 6.2 – Ultimate Term Roadway Improvements	1pg

### **Appendix 2**

Water Act Application and Regulatory Approvals	8 pgs
Navigability Enquiry of Woody Creek	1pg
Email – Public Lands Requirements	3 pgs
Application for Shore Line/ Water Body Modification	1pg
Email – Alberta Fish and Wildlife	3 pgs

### **Appendix 3**

Additional Surface Water Monitoring Points	1pg
Water Quality Sampling Program	4 pgs

### **Appendix 4**

Figure # 1 – Signature Fall Overall Grading and Storm Sewer System	1pg
Figure # 2 – Countryside Storm Catchment Areas	1pg
Figure # 5 - Signature Falls Development Storm Contributing Areas	1pg
Figure # 6 - Countryside SWM Contributing Areas	1pg

### **Appendix 5**

Outlet Hydrograph for Regional SE 1, 2, & 3 Ponds	1pg
SE5 Peak Discharges – Alternative #1	2 pgs
SE5 Peak Discharge – Alternative #2	3 pgs
SE5 Peak Discharge – Alternative #3	2 pgs

## **Appendix 6**

Figure #2 Railway Lands 97 Avenue to 84 <sup>th</sup> Avenue	1pg
--	-----

## **Appendix 7**

Notice of Public Open House Meeting	2 pgs
-------------------------------------	-------

Public Open House Meeting - Handout	1pg
-------------------------------------	-----

Email – Woody Creek Open House	2 pgs
--------------------------------	-------

Eagle Estates Residents Letter	4 pgs
--------------------------------	-------

## **1.0 Introduction**

### **1.1 *Background***

The City of Grande Prairie retained Beirsto, Lehnert, Ketchum Engineering to provide a detailed evaluation of a portion of the Woody Creek drainage basin within the City limits, (from Resources Road to 68<sup>th</sup> Avenue – Figure #2). The purpose for this investigation was to achieve the following objectives:

- Improve poor drainage conditions at Resources Road outlet into Woody Creek.
- Determine capacity within the existing Woody Creek ditch with current and anticipated future development.
- Provide a detailed drainage strategy for both the existing City and also, future development within the area; and
- Provide a cost estimate to implement required upgrades to the basin, as well as, recommend a cost-sharing program to implement the changes.

The study includes the following tasks:

- An assessment of the existing storm drainage system.
- Preparation of a drainage strategy to improve existing conditions.
- An assessment of impacts from future development within the basin.
- Preparation of a drainage strategy for a fully developed basin.
- Preparation of development construction costs and strategies for recovery or contributions.
- A stakeholder meeting with landowners, developers, Alberta Environment and the City to determine the feasibility of the various options outlined in the drainage strategy; and

- Meetings with the City administration, and or Council, to explain the program and to come up with an implementation strategy.

The final engineering and construction design will be completed as a separate item from this report, and will be subject to approval from the City of Grande Prairie, as well as Alberta Environmental Protection, Standards & Approvals Division pertaining to storm sewer systems.

## **1.2 Design Criteria**

The following design criteria were used in evaluating storm drainage systems in this report:

- The computer-modeling program XP-SWMM (Version 9.0) was used. This program is the preferred dynamic computer modeling system used by numerous consulting firms and municipalities. Computer modeling accurately predicts backwater affects, inlet and outlet controls, soil moisture affects and time of concentration impacts. It is considered to be much more representative of actual flows and is considered the proper protocol for areas exceeding 65 Ha. Our design assumptions were based on parameters established in the City of Grande Prairie *Storm Drainage Master Plan October 2004*, prepared by Associated Engineering, whenever applicable. The basis for all other assumptions and information are derived from the following manuals:

1. Railway Lands Stormwater Study City of Grande Prairie & Peter Nicolson, *Focus Intec*, April 2001.
2. Proposed Cobblestone Development Part of the NW ¼ Section 19-71-5-W6M, Overall Stormwater Management Concept, *GPEC Consulting Ltd.*, February 2003

3. Emerald Park Estates Storm Water Study, Ed Braun, *Beirsto, Lehnert, Ketchum Engineering Ltd.*, May 2003
4. Summerside Developments, NE and S 7-71-5 W6M, Overall Stormwater Servicing Concept, *Beirsto, Lehnert, Ketchum, Engineering Ltd.*, September 2005
5. City of Grande Prairie Transportation Master Plan, *Infrastructure Systems Ltd.*, 2002
6. Drainage Manual-Volume 1, *Transportation Association of Canada*, 1982
7. Handbook of Steel Drainage and Highway Construction Products, *American Iron and Steel Institute*, 1971
8. Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems, *Alberta Environmental Protection*, December, 1997
9. Screening Level Biophysical Assessment of Woody Creek, Ryan Taylor, *Nichols Environmental (Canada) Ltd.*, December 2, 2004
10. Erosion Evaluation Woody Creek S1/2 7-71-5-W6M & E1/2 18-71-5-W6M, *Nichols Environmental (Canada) Ltd.*, December 21, 2004
11. Proposed Signature Fall Development SE ¼ Section 18-71-5-W6M, Overall Stormwater Management Concept, *GPEC Consulting Ltd.*, Revised January 2006; and
12. Proposed Country Side Development Part of the SW ¼ Section 18-71-5-W6M, Overall Stormwater Management Concept, *GPEC Consulting Ltd.*, Revised April 2005
13. Proposed Cobblestone East Development East ½ NW ¼ Section 19-71-5-W6M, Overall Stormwater Management Concept, *Focus Corporation.*, October 2006

- SWMM Imperviousness used were, 20% for parks, 40% for single family residential, 60% for multi-family and commercial.
- Initial infiltration rate for pervious surfaces: 15mm/hr. Equilibrium infiltration rate for fully saturated pervious surfaces: 3 mm/hr.
- Initial abstraction for a 5yr storm event; impervious surface: 2.0 mm, pervious surface: 5.0 mm. No abstraction for 1:100 year events.
- A Manning's Formula 'n' value of 0.013 for PVC and Concrete, 0.024 for CSP Culverts, and 0.070 for vegetated ditches was used.
- The 4hr Chicago Distribution was used to analyze the 1 in 5 year storm event. The 24hr SCS Type II Distribution was used to analyze the system during a major event and determine peak discharges. The 24hr event was chosen, as past experience indicated this distribution causes higher runoff and peak flows, than the 12hr AES, or 5hr Chicago distributions.
- Predevelopment runoff rate of 5 L/s/ha was used to determine allowable discharges for new developments.

Existing XP-SWMM stormwater models for the City catchment areas draining into the Woody Creek ditch were provided by Associated Engineering with permission from the City of Grande Prairie. The design parameters for these models are outlined in the *Storm Drainage Master Plan (2004)*. These models included all City infill areas, and basins as outlined in Appendix 1, Figure 4.8. Changes to the models were made in order to retain all rainfall (ie. no runoff leaving the model). This change was made to ensure adequate downstream capacity, and account for any overland runoff that can occur.

## **2.0 Existing Conditions**

### **2.1 *Servicing Area – Existing City***

Figure #1 outlines the existing City that is included in the subject basin. This area was determined from the *Storm Drainage Master Plan, October 2004*, as well as air contours for the County Portion of the Basin.

### **2.2 *Determine Woody Creek Capacity***

In April and November, 2004 a detailed survey of the Woody Creek Ditch from Resources road to 68<sup>th</sup> Avenue, was completed by Beairsto, Lehnerns, Ketchum Engineering Ltd. Figures #4a-4c reflect the profile results including all existing culvert crossings.

From the results of the survey, concerns raised in the Storm Drainage Master Plan regarding the Woody Creek Ditch grading and pipe inverts are evident. The existing outlets from Resources Road are as much as 0.38m lower than the downstream CNR culverts and the downstream 92<sup>nd</sup> Street crossing is as much as 0.40m higher than the CNR outfall. This poorly graded section of Woody Creek causes backup into the storm sewer system and possible deposition issues. Also further downstream some sections of the ditch exhibit poor grading as well as slumping. Both the biophysical and the erosion reports prepared by Nichols Environmental further discuss the existing Woody Creek conditions, including concerns with present slumping conditions.

From the Woody Creek profile, capacity of the existing ditch was determined. For clarification it was assumed that any surcharging above the top of bank was considered flooding, and the ditch capacity was determined at that point. It should be noted that portions of the ditch that reflect surcharging may have

higher lands surrounding the ditch and therefore the flooding would be limited. The existing capacity of Woody Creek is outlined in Figure #3.

A review of the existing City outlets into Woody Creek was done to check capacity. Using the City infill models discussed in Section 1.2, along with the detailed Woody Creek Ditch profile an overall City Infill model was created. The summarized results for the 5-year Chicago Distribution storm water event are as follows:

<u>Location</u>	<u>Elevation (m)</u>	<u>Flow (m<sup>3</sup>/s)</u>
Resources Outfall	652.265	1.92
CNR Inlet	652.158	
92 <sup>nd</sup> Street Inlet	652.040	1.63
92 <sup>nd</sup> Street Outflow		4.84

A model run was also done for the 24hr SCS Type II Distribution to determine the peak runoff rates. Referring to Figure #4a, the summarized results are as follows:

<u>Location</u>	<u>Elevation (m)</u>	<u>Flow (m<sup>3</sup>/s)</u>
Resources Outfall	652.784	3.57
CNR Inlet	652.698	
92 <sup>nd</sup> Street Inlet	652.392	3.38
92 <sup>nd</sup> Street Outflow		7.62
Downstream Woody		Portions Flooding

Comparing the estimated capacities of Woody Creek Ditch outlined in Figure #3, with the existing peak discharge of 7.62 m<sup>3</sup>/s from the City, it was determined that portions of the ditch are surcharged. A further review of existing peak discharge for the entire Woody Creek basin as outlined in Figure #1 was not done since the current City flows already cause surcharging.

### **3.0 Woody Creek Ditch Upgrades - City**

#### **3.1 *Recommended City Upgrades***

To provide adequate outlet from Resources Road, as well as to contain the 1:100 year storm event within the banks, the existing Woody Creek drainage way will need to be upgraded. Referencing Figures #4a to #4c it is recommended that the ditch be lowered at the Resources Road outlet by approximately 0.65m. The resultant ditch bottom elevation of 650.53m would be level with the invert of the existing 1050mm outlet. There is a newly upgraded 2400mm culvert at the downstream 68<sup>th</sup> Avenue crossing that has sufficient capacity. It is recommended that the existing conditions at the 68<sup>th</sup> Avenue crossing remain. The resultant upgraded ditch slope from Resources Road to 68<sup>th</sup> Avenue is 0.10%.

It is recommended in the Storm Drainage Master Plan, that any “major drainage channels be planned and designed as drainage parkways to minimize the maintenance requirements and to provide an aesthetic and recreation resource”. Revisions to the parkway cross-section recommended in the Master Plan (Appendix 1; Figure 5.7), were made due to discussions with City personnel, as well as Alberta Environment. Also with the expected peak runoff rates, will produce greater than 1.0m fluctuations in the channel. Figures #5a and 5b outline the recommended cross sections and locations. Note a parkway between Resources Road and 92<sup>nd</sup> Street is not included. Acquiring a crossing agreement through CNR rail to promote pedestrian traffic is not recommended at this time. Referring to Appendix 1, Exhibit 6.2, from the City of Grande Prairie Transportation Master Plan, a future 84<sup>th</sup> Avenue extension from Resources Road east to 92 Street may occur if the railway is relocated. At this time a separate sidewalk layout should be included to complete the trail network.

In discussions with City personnel, it was suggested that retention of existing City discharge is not an option, however, any additional lands outside of the designated infill area will require stormwater retention to predevelopment rates. This retention philosophy differs from the *Storm Drainage Master Plan*, in that the Master Plan recommends that all flows be reduced to predevelopment rates. As a result, the proposed regional pond SE5 outlined in the Stormwater Master Plan will have no contribution from the City.

### 3.1.1 Recommended City Upgrades – Ditch Crossings

In order to lower the ditch as recommended, all crossings (with the exception of 68<sup>th</sup> Avenue) will need to be upgraded or removed.

The issue with the required CNR and 92 Street crossings is not pipe capacity but elevation problems. In order to reduce upgrade costs and still provide a clean functioning ditch, it is recommended that a 800mm diameter pipe be installed at the CNR Crossing and the 92<sup>nd</sup> Street crossing. A crossing agreement will be required for the CNR Rail portion. Section 3.0 of the Water Act Application (Appendix 2), prepared by Nichols Environmental, provides further details of the requirements and process.

The new pipes will be sufficient to handle low flow events, with the larger 5 year and 100 year events, using the existing pipe crossings to handle the flows.

The existing Crossings A and B (Figures #4b & 4c) downstream from 92<sup>nd</sup> Street, have both grading and capacity issues. In addition, these crossings are too short for any future road crossings. It is recommended both of these crossing be removed.

### 3.1.2 Recommended City Upgrades – Impact on Groundwater

Beirsto, Lehnert, Ketchum Engineering retained Nichols Environmental to complete an evaluation of groundwater impacts, if Woody Creek ditch is upgraded. The report entitled “Erosion Evaluation Woody Creek S1/2 7-71-5-W6M & E1/2 18-71-5-W6M, *Nichols Environmental (Canada) Ltd.*, December 21, 2004” was reviewed and approved by the City (November 25, 2005). The evaluation concluded that upgrading Woody Creek will have minimal impacts on the groundwater elevations. As the permanent creek water level is not expected to rise and as the phreatic surface (groundwater elevation) is already at the creek water level, it is not possible to raise this any further in the immediate vicinity of the creek.

Changes in groundwater elevation may be expected in the upland areas that are to be developed bordering the creek. With the addition of storm sewers and basements with weeping tile/sump pumps, dewatering of the upper 3 to 4 m of soil over portions of the developed area can be expected.

### 3.1.3 Recommended City Upgrades – Water Quality

Beirsto, Lehnert, Ketchum Engineering retained Nichols Environmental to complete an evaluation of erosion and water quality impacts, on Woody Creek if the ditch was upgraded. The report entitled “Erosion Evaluation Woody Creek S1/2 7-71-5-W6M & E1/2 18-71-5-W6M, *Nichols Environmental (Canada) Ltd.*, December 21, 2004” was reviewed and approved by the City (November 25, 2005). Recommendations outlined in this report should be followed during detailed design.

It was recommended that a water quality program be instituted to ensure that construction of the upgrades does not adversely affect Woody Creek and potentially Bear Creek, located downstream. A water quality sampling program has been submitted by Nichols Environmental (Appendix 3), and should be initiated at the time of detailed design. Sample locations and scheduling of samples must be reviewed and approved by the City as well as Alberta Environment, prior to implementation.

Baseline water quality data should be collected both up and down stream prior to, during and after the construction activities to determine if any further mitigative actions would be required to maintain or improve the water quality. Data collected from the preliminary sampling program will aid in determining an appropriate sediment control plan.

#### 3.1.4 Recommended City Upgrades – Biophysical Assessment

Beirsto, Lehnert, Ketchum Engineering retained Nichols Environmental to complete a biophysical assessment pertaining to the potential upgrading of Woody Creek. The report entitled “Screening Level Biophysical Assessment of Woody Creek, *Nichols Environmental (Canada) Ltd.*, December 2, 2004” was reviewed and approved by the City (November 25, 2005). Recommendations outlined in this report should be followed during detailed design.

Of special note from the assessment were timing of construction and re-vegetation requirements to limit the impacts of the upgrade on the water quality as well as the local wildlife populations.

#### 3.1.5 Recommended City Upgrades – Navigable Waters

The Department of Fisheries and Oceans as well as Transport Canada were forwarded copies of the Biophysical Screening assessment, both departments indicated that Woody Creek is not navigable within the subject area of this report. (Appendix 2)

Alberta Fish and Wildlife, who were contacted by Nichols Environmental, also commented that Woody Creek is not a viable fish bearing stream. (Appendix 2)

#### 3.1.6 Recommended City Upgrades – Sustainable Resource Development

An application to Public Lands – Sustainable Resources Development is required as soon as the methods of improvements to Woody Creek are decided on. This department controls the bed and shore of the permanent watercourse, and alterations to it will require approval. Appendix 2, details the requirements further, and includes the application form.

#### 3.1.7 Recommended City Upgrades – ATCO

There is an existing ATCO overhead powerline at the outlet of the 92<sup>nd</sup> Street crossing that will require re-alignment. Also, ATCO Pipelines has a high-pressure line running underneath the existing Woody Creek at this location. This line will have to be hydrovaced, to determine location, and if may require lowering. Applications to both ATCO Electric, as well as ATCO Pipelines will be required at detailed design stage.

### **3.2 Sanitary East Trunk Main Crossing**

The recommended Woody Creek upgrades will cause a conflict with the newly constructed East Sanitary Trunk Main. Referring to Figure #4b, it was determined that the upgraded ditch bottom would contact the trunk main almost perfectly at the middle of the 900mm pipe. This conflict was noticed prior to construction of the East Trunk Main. The City decision was to remedy the conflict via the Woody Creek upgrades, as opposed to modifying the trunk main layout or pipe sizes.

An open house was held Thursday, September 7, 2006 to inform developers and the public of the design options and provide an opportunity for input (Appendix 7). At this open house, the general consensus was for a wet channel (Alternative #2). As a follow-up to the open house, twenty Eagle Estates residents signed a letter stating they want a wet pond adjacent the Eagle Estates land and do not support a dry ditch (Appendix 7). Although the change requested by Eagle Estates residents to making this all wet-pond is viable hydraulically, all three options outlined below and presented at the open house have a dry ditch between the sanitary crossing and the proposed SE4 lineal wet pond. This proposed dry ditch section matches the approved Signature Falls storm report, and was designed dry due to cross-section widths and an adjacent future school site.

The three alternatives to remedy the trunk main crossing conflict are outlined below. Aquatera should review all three alternatives and provide the City with comments and preferences.

### 3.2.1 Alternative#1 – Inverted Storm Sewer

This alternative suggests leaving the upgraded channel as recommended above, and provide a combination of a storm pipe underneath the Trunk main, with a weir system above the main to

provide cover (Figures #4b and 6a). The proposed Woody Creek cross section remains unchanged as outlined in Figure #5b

All low flows would pass through a 900mm diameter storm sewer, running underneath the sanitary main, with larger flows running overtop of the weir. Due to the storm main containing water at all times, the main size recommended is not only for flows, but also to promote scouring for maintenance purposes. A specialized grate and manhole system would have to be designed to allow for easy maintenance.

A model run was done to simulate blockage in the pipe during a major event. If the inverted pipe was fully blocked, the high water level in the channel raises less than 25mm, indicating the weir system above the sanitary main will easily handle the flows without affecting adjacent lands.

The benefits of this alternative is it keeps the consistent 0.1% ditch grade, and recommended parkway cross section. Also, the construction costs of implementing this alternative are reasonable, and there are no additional land costs due to increased PUL width. The downside to this option is possible maintenance issues. A maintenance schedule for checking pipe flow would have to be implemented. A visual inspection during a dry period would be all that is required, as the inlet rim should be dry, if there is standing water, the pipe is blocked. Removing the blockage could require pumping of the storm line.

### 3.2.2 Alternative#2 – Wet Channel

This alternative suggests creating a weir (identical to Alternative #1 weir) overtop of the sanitary main to provide cover, and use a wet channel

upstream to match grades (428.8m length) (Figures #7a and b). The proposed cross section is shown in Figure #5b.

The benefits of this alternative are there is very little maintenance required, and the wet channel look is more aesthetically pleasing. Also, the wet channel would provide additional storage volume, and/or reduce high water levels. The downside to this alternative is construction costs are significantly higher than the other two alternatives, as well as an additional 4m width of land is required for the length of the wet pond.

### 3.2.3 Alternative #3 – Grade Change

This alternative suggests creating a weir (identical to Alternative #1 weir) overtop of the sanitary main to provide cover, and adjust upstream grades to 0.05% until it matches the recommended 0.1% grade (831.5m length) (Figures #8a and b). The proposed cross section is shown in Figure #5b.

The benefits of this alternative is it keeps the recommended parkway cross section. Also, the construction costs of implementing this alternative are very minimal, and there are no additional land costs due to increased PUL width. The downside to this option is possible maintenance issues. Although the Drainage Master Plan suggests a longitudinal slope of 0.05% can be used, it recommends a minimum of 0.1%. This recommendation of longitudinal slope is also based on promoting wetland growth, a condition that for the most part has been removed as per Section 3.1. It can be argued that the “dry” ditch will always have portions of standing water due to the low 0.1% slope anyways, which would make this the preferred alternative.

## **3.3 Upgraded Woody Creek Ditch Flows - City**

All three alternatives discussed in the previous section to rectify the East Sanitary Trunk main conflict, will not impact the following flow discussion, as 92<sup>nd</sup> Street is far enough upstream from all alternatives.

Due to the relatively small 800mm culverts proposed, the recommended ditch upgrades would reduce the 5-year storm event peak flow by 0.37 m<sup>3</sup>/s to **4.47 m<sup>3</sup>/s** and the major 100-year event peak flow by 0.19 m<sup>3</sup>/s to **7.42 m<sup>3</sup>/s**. In doing so, the maximum water elevation upstream of 92<sup>nd</sup> Street decreases as summarized below.

Location	Elevation	Elevation	Diff.
	Existing (m)	Upgraded (m)	
Resources Outfall	652.784	651.948	-0.84
CNR Inlet	652.698	651.809	-0.89
92 <sup>nd</sup> Street Inlet	652.392	651.462	-0.93

A discussion of the effects the proposed upgrade has on the 92<sup>nd</sup> Street storm main is outlined in Section 4.2.1.

Conditions downstream of the 68<sup>th</sup> Avenue crossing are not within the scope of this report. However, it should be noted that there are capacity issues downstream and retaining flows north of 68<sup>th</sup> Avenue as much as possible is recommended. This is discussed further in Section 4.2.2.

#### **4.0 Woody Creek Basin Completely Developed**

##### **4.1 *Woody Creek Basin Developed Areas***

In accordance with the Storm Drainage Master Plan, all additional development should retain peak flows to 5L/s/ha. The study area of Woody Creek can be

broken down into two areas as per the Master Plan, based on the recommended regional pond locations (Appendix #1, Figure 4.8).

#### 4.1.1 Ultimate Basin Development – SE5 Basin Area

The upstream area, referred to as the SE5 basin (Figure #1), contains all existing City development, as well as some new residential, commercial and industrial developments.

Changes to the SE5 Basin outlined in the Master Plan were made in this report as follows:

1. Cobblestone and Cobblestone East development was added to the basin
2. The entire Riverstone development was added to the basin. This includes the 80 acres to the north of Woody Creek; and
3. The entire undeveloped land within NE ¼ Sec13 71-6-6, between CNR lands and 92<sup>nd</sup> Street was added.

The above additions to the SE5 basin were made for the most part due to land ownership boundaries. These changes reflect the storm Drainage reports proposed by each development (Referenced in Section 1.2)

The area of new development within the SE5 basin total 228.9 ha. Combined with the existing City area of 302.2ha, the total basin area is 531.1 ha.

#### 4.1.2 Ultimate Basin Development – SE4 Basin Area

The downstream area, referred to as the SE4 basin (Figure #1), contains new City residential, and industrial developments, as well as a portion of the existing Eagle Estates Acreage development that is within the County.

Unlike the SE5 basin; in which there is currently submitted storm drainage design reports for developments, but nothing yet approved by the City; the SE4 basin has an approved storm drainage concept for the Signature Falls development. The approved report entitled “Proposed Signature Fall Development SE ¼ Section 18-71-5-W6M, Overall Stormwater Management Concept, *GPEC Consulting Ltd.*, Revised January 2006”, includes the SE4 regional pond, and modifies it to a lineal wet pond (Figure #5c; Appendix 4, Figure # 1)

The Signature Falls report outlines the SE4 regional pond shape and size, however there are no details on the outlet structure, road crossings, high water levels created by inflow from other basins, nor the impact of high water levels on Eagle Estates. The report does mention “there will be additional storage capacity available in Woody Creek beyond what is required by the Signature Falls and Countryside North Developments.” It is therefore, assumed in this report, that the Signature Falls developer will be constructing the SE4 lineal pond, and any additional capacity available can be used by areas outside of the SE4 basin, as long as there are no adverse affects to Eagle Estates. This assumption is discussed further in Section 4.2.2.

The Signature Falls report also states “the storm water management improvements to Woody Creek will occur in stages starting from 68<sup>th</sup> Avenue to the north as the subdivision areas are developed to ensure adequate storage is provided.” This method of staging raises two concerns. The first being, it is not efficient nor cost effective for the City

to upgrade Woody Creek as per recommendations outlined in Section 3, then have the developer follow up with creating a wet pond and adjusting the alignment. Secondly, there are various environmental concerns with staging construction. In discussions with both the City and Alberta Environment, it is recommended that any improvements done to Woody Creek be completed in one process.

Changes to the SE4 Basin outlined in the Master Plan were made in this report as follows:

1. The entire Countryside North Development discharges to Woody Creek, with the north 27.7 ha outleting directly to Woody Creek using the SE4 linear storage pond; and the south 9.6 ha using onsite detention and discharging to Woody Creek at predevelopment rates. (Appendix 4, Figure #6)
2. The entire Signature Falls Development discharges to Woody Creek, with the north 37.2 ha outleting directly to Woody Creek using the SE4 linear storage pond; and the south 29.0 ha using onsite detention and discharging to Woody Creek at predevelopment rates. (Appendix 4, Figure #5)
3. Lot 2 Plan 962 2350 and lands between CNR and 92<sup>nd</sup> Street are included, however as per the Countryside North Storm report, flows are to be held to predevelopment. This areas discharge is  $18\text{ha} * 5 \text{ L/s/ha}$  which equals 90L/s allowable peak discharge to Woody Creek. (Appendix 4, Figure #2)

These changes reflect the approved storm drainage reports proposed by each development (Referenced in Section 1.2)

The area of new development within the SE4 basin totals 123.5 ha. Combined with the existing Eagle Estates area that drains into the basin of 42.8 ha, the total basin area is 166.3 ha.

#### 4.1.3 Ultimate Basin Development – SE 1-3 Basin Area

As per the Storm Drainage Master Plan, the proposed regional ponds SE1 – 3 will outlet via a parkway channel through Eagle Estates and into SE4. Each regional pond is required to retain flows to predevelopment rates. The majority of the basins are within the County of Grande Prairie, so an agreement should be in place between the City and County, to ensure that any new development within the Woody Creek basin as defined in Figure #1 be retained to 5L/s/ha.

Referencing Figure #1 the combined outlet hydrograph from SE 1,2 and 3 into Eagle Estates during a major 1:100 year event is outlined in Appendix 5. The peak flow is assumed to be 3.225 m<sup>3</sup>/s. If future development within these basins increase the assumed hydrograph, and/or change the inlet time for peak flows, from this report, a check on downstream conditions will be required.

## **4.2 Woody Creek Basin Developed Flows**

#### 4.2.1 Ultimate Basin Development – SE5 Basin Flows

The area to be newly developed within the SE5 basin is estimated at 228.9 ha. Based on a predevelopment rate of 5 L/s/ha for the area, along with the estimated peak City infill discharge of 7.62 m<sup>3</sup>/s from Section 2.2, the allowable discharge from SE5 is 8.76m<sup>3</sup>/s. However, the Cobblestone development is proposing constructing a new 1200mm diameter line along 92<sup>nd</sup> Street, from 92<sup>nd</sup> Avenue, south to outlet into

Woody Creek (Figure #10). This line will act not only as an outlet for Cobblestone, but will also tie-into the existing 92<sup>nd</sup> Street Storm Trunk Main, to help relieve surcharging conditions of the main. It is estimated that with the new Cobblestone line being constructed, in addition to the improved hydraulics from the Woody Creek improvements, the existing City flows will increase along 92<sup>nd</sup> Street during a major event by 0.85 m<sup>3</sup>/s. Following the philosophy of not retaining existing City development this additional peak flow will be added to the allowable discharge, increasing it from 8.76 m<sup>3</sup>/s to **9.61 m<sup>3</sup>/s**.

All three Woody Creek alternatives that were outlined in Section 3.2 were reviewed to provide the best means of retaining flows to 9.61 m<sup>3</sup>/s within the SE5 basin. All alternatives have the same two basic principals:

1. Using the improved ditch capacity to retain flows. This storage philosophy is recommended in all scenarios, as it allows less land use, than separate regional ponds. This philosophy also creates a cost-sharing situation between the City and Developers, as the improvements to Woody Creek will benefit all parties. Methods of cost sharing are discussed in Section 5.0; and
2. Using the future Riverstone crossings as well as the proposed Sanitary crossing as control structures. This philosophy is obvious in that culvert crossings will be required anyways, so the dual purpose of runoff retention is cost effective. All crossing size recommendations can be changed during detailed design, as long as peak flow and high water level conditions are met. A change to the crossings may involve installing one large conduit as opposed to multiple smaller ones. This option would allow a control device to be attached to the conduit to retain flows, which can easily be upgraded as new development comes online. In all cases special consideration during detailed design of the crossings should be

made to ensure overflow during a major event does not undermine the integrity of the structure. This includes but is not limited to proper compaction and armoring of the banks.

The following is the hydrological breakdown of each alternative:

i – Allowable SE5 Peak Discharge – Alternative #1 – Inverted Storm

Referring to Figures #4b and 6a, this alternative requires two 1500mm diameter culverts at all crossings. The resultant peak conditions are as follows:

Crossing	Elevation	Crossing*	Ponding Depth	Road
Location	Retained (m)	Elev. (m)	(m)	Overflow
Riverstone #1	652.156	652.05	3.07	Yes
Riverstone #2	651.635	651.70	3.00	No
Sanitary Trunk	650.418	650.60	2.04	No

\* The crossings should be designed so that overflow would occur prior to the Woody Creek banks being breached. A minimum 20m length of crossing should be set so that the peak elevation is as noted in the above table. Note that during a 1:100 year event, the Riverstone #1 crossing will allow overflow runoff at an estimated depth of 0.106m.

SE5 Peak Outflow (Appendix 5) = 9.27 m<sup>3</sup>/s

Referring to the Storm Master Plan recommended high water levels for dry ponds (Appendix 1, Figure #5.4); the high water level at all crossings are within tolerance of the 3.0m maximum fluctuation.

The maximum flow and velocity through the inverted storm would be 3.24 m<sup>3</sup>/s and 4.96 m/s respectively.

ii – Allowable SE5 Peak Discharge – Alternative #2 – Wet Pond

Referring to Figures #7a and 7b, the required crossings are 2x1500mm culverts at Riverstone #1 and the sanitary crossing, with 3x1800mm culverts at the Riverstone #2 crossing. Figure #5b details the recommended cross section. The resultant peak conditions are as follows:

Crossing	Elevation	Crossing*	Ponding Depth	Road
<u>Location</u>	<u>Retained (m)</u>	<u>Elev. (m)</u>	<u>(m)</u>	<u>Overflow</u>
Riverstone #1	652.020	652.05	2.93	No
Riverstone #2	651.246	651.40	2.45	No
Sanitary Trunk	651.017	651.02	2.22	No

\* The road crossings should be designed so that overflow would occur prior to the Woody Creek banks being breached. A minimum 20m length of road should be set so that the peak elevation is as noted in the above table.

SE5 Peak Outflow (Appendix 5) = 9.52 m<sup>3</sup>/s

Referring to the Storm Master Plan recommended high water levels for wet and dry ponds (Appendix 1, Figures 5.4 and 5.5); the high water level at the Riverstone #1 crossing is within the 3.0m maximum fluctuation recommended for a dry pond. However, both the sanitary crossing and the Riverstone #2 crossing exceed the recommended 2.0m high water level fluctuation for a wet pond. An analysis was done to

reduce this excess ponding by increasing the proposed channel widths. It was determined that for every 1m in extra channel width, the ponding fluctuation reduced approximately 0.05m. With an estimated additional cost of \$30,000, excluding land, to increase the channel width 1m per kilometer, reducing the ponding is not cost effective. The maximum excess 0.45m ponding occurs for only 5.5 hours during a 24hr 1:100 year major event (Appendix 5). Due to the costs required to eliminate the excess ponding, which would occur very rarely, for a short duration, it is assumed the proposed crossing is acceptable as proposed above.

iii – Allowable SE5 Peak Discharge – Alternative #3 – Grade Change

Referring to Figures #8a and 8b, this alternative requires two 1600mm diameter culverts at all crossings. The resultant peak conditions are as follows:

Crossing	Elevation	Crossing*	Ponding Depth	Road
Location	Retained (m)	Elev. (m)	(m)	Overflow
Riverstone #1	652.212	652.16	3.05	Yes
Riverstone #2	651.714	651.93	2.86	No
Sanitary Trunk	650.698	650.70	1.90	No

\* The road crossings should be designed so that overflow would occur prior to the Woody Creek banks being breached. A minimum 20m length of road should be set so that the peak elevation is as noted in the above table. Note that during a 1:100 year event, the Riverstone #1 crossing will allow overflow runoff at an estimated depth of 0.052m.

SE5 Peak Outflow (Appendix 5) = 9.57 m<sup>3</sup>/s

Referring to the Storm Master Plan recommended high water levels for dry ponds (Appendix 1, Figure #5.4); the high water level at all proposed crossings are within the 3.0m maximum fluctuation recommended.

#### 4.2.2 Ultimate Basin Development – SE4 Basin Flows

The area to be newly developed within the SE4 basin is estimated at 123.5 ha, and the existing Eagle Estates acreage development estimated to contribute to the basin is 42.8 ha, totaling 166.3 ha. Based on a predevelopment rate of 5 L/s/ha for the area, the allowable discharge from SE4 is 0.832 m<sup>3</sup>/s.

In addition to the SE4 basin, both the SE5 and SE1-3 basins use Woody Creek as the discharge carriageway. From the hydrograph presented in Section 4.1.3 (Appendix 5) for the SE1-3 basins, along with the allowable

discharge for the SE5 basin discussed above, the total allowable discharge through 68<sup>th</sup> Avenue is 13.67 m<sup>3</sup>/s.

Using the Woody Creek improved cross-sections outlined in the Signature Falls storm report (Figure #5c and Appendix 4, Figure #1), the discharge of 13.67 m<sup>3</sup>/s does not require the full 1.5m ponding depth that is provided. In fact, using only the proposed Signature Falls road crossing as a retention structure, the SE4 basin does not need an outlet structure prior to the 68<sup>th</sup> Avenue crossing. This can be expected as a retention pond was introduced within the SE4 basin that holds back a significant area, prior to discharge to Woody (Appendix 5, Figures #5 and 6). Also, the Industrial lands east of 92<sup>nd</sup> Street, are required to retain flows to predevelopment (Appendix 5, Figure #2).

It is recommended that the City utilize the remaining storage that is provided within the SE4 basin for three reasons:

1. Relief for the 68<sup>th</sup> Avenue culvert.
2. The approved storm water report for the downstream portion of Woody Creek Ditch, which details the section from 68<sup>th</sup> Avenue south entitled "Summerside Developments, NE and S 7-71-5 W6M, Overall Stormwater Servicing Concept" prepared by Beirsto, Lehnert, Ketchum, Engineering Ltd., September 2005, has capacity for only 10.23 m<sup>3</sup>/s peak discharge; and
3. Retaining flows from the allowable 13.67 m<sup>3</sup>/s can downsize the proposed Signature Falls road crossing.

Referring to Figure #9, the introduction of a restriction at the proposed Signature Falls crossing, as well as an outlet structure just north of 68<sup>th</sup> Avenue should be introduced. The recommended outfall structure for all alternatives outlined in Section 3.2 is three 1800mm diameter culverts. The Signature Falls crossing requires three 1800mm diameter culverts

for Alternative #2 outlined in Section 3.2, or three 1700mm diameter culverts for Alternatives #1&3. Alterations to the structure types can be done at detailed design stage as long as flow and high water levels are consistent. The resultant peak conditions are as follows:

Crossing	Elevation	Elevation	Ponding Depth
<u>Location</u>	<u>NWL (m)</u>	<u>Retained (m)</u>	<u>(m)</u>
Signature Falls	648.00	650.06	2.06
Outlet	648.00	649.60	1.60

68<sup>th</sup> Avenue Peak Outflow (Appendix 5):

Alternative #1 = 11.41 m<sup>3</sup>/s

Alternative #2 = 12.06 m<sup>3</sup>/s

Alternative #3 = 11.75 m<sup>3</sup>/s

A revision to the Signature Falls report for the portion of wet channel north of the proposed road crossing is recommended. In the Signature Falls report the maximum high water fluctuation is 1.5m, however referring to the Storm Master Plan the allowable fluctuation is 2.0m. Reviewing the surrounding Eagle Estates lot elevations, as well as the proposed Signature Falls elevations, the increased 0.5m should be acceptable.

The high water fluctuation downstream of the road crossing will be set at 1.6m, due to the existing Range Road shoulder grade will not accommodate higher levels.

The recommended use of additional storage within SE4, will reduce the peak outflow into 68<sup>th</sup> Avenue from 13.67 m<sup>3</sup>/s to a maximum peak of **12.06 m<sup>3</sup>/s**. A review on downstream affects of the higher than

estimated flows through Summerside will have to be done outside of this report.

## **5.0 Cost Sharing**

The Storm Drainage Master Plan proposes three classes of improvements:

1. those which are required to correct existing deficiencies.
2. those which will correct existing deficiencies and extend service to future development areas.
3. those which are required solely to provide service to the future development areas.

The following sections detail the recommended method of construction and cost recovery. Table 5.2, and Figure #11 outline the estimated construction costs for the following Sections 5.1 and 5.2.

### **5.1 *Improvements Required for Existing Deficiencies Only***

Referring to the Stormwater Master Plan, “works which are required to correct existing deficiencies should be the responsibility of the City and would need to be funded through general revenues (taxes).” This situation was reviewed in two areas:

1. The first is from Resources Road to the outfall of the CNR crossing. This area is defined as City only improvements, as it is upstream of new development areas, and is directly related to existing poor drainage situations (Section 2.2). Note, the contributing areas defined in the “Railway Lands Stormwater Study”, by Focus Intec, April 2001 (Appendix 6, Figure #2), are not considered new development for two reasons. The first reason is the storm water study has already been completed and

approved and there is no mention of cost sharing for Woody Creek Upgrades. The second reason is the study does not specify retention as being required. All City flow numbers used in this report include the Raintown area as existing City.

There is a possibility of the Raintown owners wanting to pipe Woody Creek from Resource through their lands and outlet on the upstream side of the CNR crossing. This option would increase developable land, however, it would also be more costly than upgrading the ditch alone. If a separate study is completed and concludes that there are no negative issues regarding discharge levels and/or maintenance then this option is viable. It is recommended that any additional costs for the alternative, be covered directly by the Raintown developers

2. The second is the cost for the SE4 outlet structure as defined in Section 4.1.2. The proposed three 1800mm diameter culverts are used to reduce City flows and are not required by the SE4 developers. However, by introducing the additional retention and allowable high water table fluctuations, the proposed Signature Falls road crossing can be significantly reduced. It is recommended that cost sharing occur between the City and Signature Falls developers for the recommended outlet structure, since both parties benefit.

## ***5.2 Improvements Required for Both Existing and Future Development***

Referring to the Stormwater Master Plan, “works which serve both existing and future areas should be cost-shared on the basis of area served”. It is recommended that all lands discharging to Woody Creek should contribute to the upgrade costs. The contribution would be calculated from the subject lands connection point to Woody Creek, and anything downstream. The costs would be distributed on a gross area basis. Figure #11 illustrates which land areas would contribute to the upgrades, at different reaches of Woody Creek.

**TABLE #5.2 - PROPOSED WOODY CREEK STORM WATER DRAINAGE RESERVE - ALTERNATIVE #3**

CONTRIBUTION START POINT FROM FIGURE#11	LAND DESCRIPTION	AREA (ha)	RESOURCES TO RAILWAY	RAILWAY CROSSING	RAILWAY TO 92ST	92ST CROSSING	92ST TO A	A TO B	B TO 68AVE	90 DEG. CORNER	REPORT COSTS	TOTAL COST	COST PER ha
1	CITY LANDS	302.2	\$153,730	\$199,383	\$122,468	\$100,979	\$205,007	\$263,223	\$412,092		\$44,139	\$1,501,021	\$4,967
1	RAILTOWN	12.6	\$6,410	\$8,313	\$5,106	\$4,210	\$8,548	\$12,469	\$15,043		\$1,840	\$61,939	\$4,916
2	INDUSTRIAL (NORTH)	8.7			\$3,526	\$2,907	\$5,902	\$8,610	\$10,387		\$1,271	\$32,602	\$3,747
3	COBBLESTONE	31.5					\$21,369	\$31,172	\$37,608		\$4,601	\$94,750	\$3,008
3	CREEKSIDE - MF	2.4					\$1,628	\$2,375	\$2,865		\$351	\$7,219	\$3,008
3	CREEKSIDE - C	0.9					\$611	\$891	\$1,075		\$131	\$2,707	\$3,008
3	CREEKSIDE	28.9					\$19,605	\$28,599	\$34,504		\$4,221	\$86,930	\$3,008
3	RIVERSTONE (EAST)	23.1					\$15,671	\$22,860	\$27,579		\$3,374	\$69,484	\$3,008
4	COBBLESTONE EAST	32.1						\$31,766	\$38,324		\$4,688	\$74,779	\$2,330
4	RIVERSTONE (WEST)	62.2						\$61,553	\$74,261		\$9,085	\$144,899	\$2,330
	<b>SE5 TOTAL</b>	<b>504.6</b>	<b>\$160,140</b>	<b>\$207,696</b>	<b>\$131,100</b>	<b>\$108,096</b>	<b>\$278,340</b>	<b>\$463,518</b>	<b>\$653,738</b>		<b>\$73,701</b>	<b>\$2,076,330</b>	<b>\$4,115</b>
5	EAGLE ESTATES (If Density Intensified)	41.3							\$98,530			\$98,530	\$2,386
5	*INDUSTRIAL (SOUTH)	10.9							\$13,014		\$1,592	\$14,606	\$1,340
5	COUNTRYSIDE NORTH	27.9							\$66,562		\$4,075	\$70,637	\$2,532
5	SIGNATURE FALL	55.4							\$141,572	\$108,000	\$8,092	\$257,664	\$4,651
	<b>SE4 TOTAL</b>	<b>135.5</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$0</b>	<b>\$319,678</b>	<b>\$108,000</b>	<b>\$13,759</b>	<b>\$441,436</b>	<b>\$3,258</b>
	<b>TOTAL PROJECT COST</b>	<b>640.1</b>	<b>\$160,140</b>	<b>\$207,696</b>	<b>\$131,100</b>	<b>\$108,096</b>	<b>\$278,340</b>	<b>\$463,518</b>	<b>\$973,416</b>	<b>\$108,000</b>	<b>\$87,460</b>	<b>\$2,517,766</b>	<b>\$3,933</b>

\* INDUSTRIAL SOUTH PROVIDES ONSITE RETENTION, THEREFORE CONTRIBUTES ONLY TO THE CITY PORTION OF WOODY CREEK UPGRADES (NOT SE4 LINEAR POND EXPANSION)

ALTERNATIVE #1 INCREASES COSTS - **\$49,188**  
 ALTERNATIVE #2 INCREASES COSTS - **\$138,978**

This report recommends that this cost-sharing philosophy, for the improvements outlined below, be incorporated for the remaining study area:

- All topsoil stripping and replacement
- Clay grading and placement for required City improvements outlined in Figures #4a-c including the chosen alternative for the sanitary crossing. (Additional clay work required to construct the regional SE4 pond is the responsibility of the SE4 landowners only).
- All re-vegetation using the accepted seed
- Additional erosion protection required beyond re-vegetation, excluding future outfalls, crossings, retention structures within the SE5 basin, and any additional reinforcement that is required at the Signature Falls proposed corner re-alignment at approximately Station 2+150.
- All applications, approvals, reports and engineering that is required to complete the improvements (excluding future asphalt trail and tree planting)

As presented in this report the City requires the Woody Creek improvements for existing drainage concerns as well as downstream capacity issues. Developers can use an improved Woody Creek for stormwater retention, which will provide a greater lot yield than, individual ponds or a regional pond outside of the ditch itself. There are also other benefits for cost-sharing the improvements between developers and City:

- Developers can use excess clay from the improvements to grade adjacent lots, which is cost effective, in that stormwater management is being provided along with lotgrading simultaneously. The City benefits by not having to deal with excess clay, such as stockpiling or hauling it offsite.
- Environmental issues, such as erosion protection and water quality, during and after construction can be cost shared as opposed to separate programs being required. Vegetation in areas outside of future outfalls

and retention structures will only be disturbed once, allowing vegetation to establish.

- Developers can use the proposed lower Woody Creek ditch elevation to reduce possible grading and insulation issues that can occur with higher storm outlet elevations. Costs for possible City maintenance issues are reduced with less insulated pipe.
- Landowners adjacent Woody Creek can easily construct the required walking trail and plant trees, to complete the parkway without requiring additional grading. The City can easily ensure that the parkway grading and layout meets their needs, without piece-mealing different developments together.

The estimated costs outlined in Table 5.2, do not include any upgrades outlined in Section 5.3 (with exception to SE4 lineal pond and gabions), which are developer only costs.

### **5.3 *Improvements Required for Future Development Only***

The third class of improvements, which provide service solely for future areas, would be the retention facilities, road crossings and the parkway upgrades.

It is recommended that the retention facilities proposed for the SE4 and SE5 basin should be cost shared with the land owners within their respective basin, based on development area. This would include:

- any additional clay work required beyond improvements outlined in Figures #4 a-c. This includes additional work to construct the SE4 lineal wet pond (cost are included in Table 5.2 for this item). If development within Signature Falls or Countryside North requires the lineal pond, prior to City run improvements, it is recommended total costs to upgrade Woody Creek from 68<sup>th</sup> Avenue, north to the sanitary crossing be

upfronted by the developers. Recovery for the cost-sharing portion of the improvements can be in the form of credit from the proposed Woody Creek Stormwater Drainage Reserve, outlined in Table 5.2.

- any additional costs due to re-alignment of Woody Creek. This occurs specifically through the SE4 basin (Figure #9) in which a ninety-degree bend and “straightening” of the ditch is proposed. Additional cost may be, but not limited to, bed and shore alteration costs, as well as increased erosion protection (Gabion costs are included in Table 5.2 as an example, however, other methods of erosion protection can be explored in the detailed design stage).
- any retention structures required within the SE5 basin. This would include any additional erosion protection, and landscaping required, as well as costs associated for approval with government agencies.

The upgrade of Woody Creek to a parkway standard as illustrated in Figures #5b and #5c, would be the responsibility of adjacent lands only. This upgrade would include a trail network, and tree planting.

Any crossings and outfalls required by new development would be paid for and constructed by the developers. Some outfalls may require cost sharing between parties, such as the new storm line along 92<sup>nd</sup> Street between the City and Cobblestone developers, or the Signature Falls outfall #1, between Country Side North and Signature Falls developers. Any cost sharing required for these items would be handled separately from this report. This would include any additional erosion protection, and landscaping required, as well as costs associated for approval with government agencies.

#### **5.4 Woody Creek Stormwater Drainage Reserve**

From Table #5.2 it was determined that the City cost of **\$1,501,021** is required in order to complete the recommended Woody Creek upgrades outlined in

Sections 5.1 and 5.2. This report recommends that all channel *sitework* upgrades be done simultaneously due to environmental concerns, as well as cost effectiveness. In order to complete the sitework upgrades in one construction season, the City will need to upfront the remaining construction costs outlined in Section 5.2, estimated at **\$1,016,745**, which makes the total project cost **\$2,517,766**.

In order to collect the additional **\$1,016,745** from undeveloped lands, it is recommended that a “**Woody Creek Stormwater Drainage Reserve**” be implemented. A price per gross hectare as outlined in Table #5.2 would be payable by each landowner within the designated areas. This levy amount would be payable at servicing agreement stage. Any development that has already occurred within the areas designated as new, in Figure #11, should be required to pay levies on the entire developed portion on the next servicing agreement.

The lands south of 68<sup>th</sup> Avenue would continue to have capacity issues, but again, these lands have historically had water problems, and as long as new development does not occur adjacent the ditch, then upgrades can wait.

### **5.5 Woody Creek Parkway**

Additional work will be required by adjacent landowners to construct an asphalt pathway and plant trees, as outlined in Sections 5.3. These upgrades can be staged, and developer driven by individual phases.

### **5.6 Woody Creek Land Costs**

Compensation by the City to landowners for land costs, due to PUL widening, should not be made. It is a requirement for all new developments to retain storm water runoff to predevelopment flows with no land compensation, and the proposed regional ponds are no different.

Compensation from landowners within the new development areas that do not border Woody Creek, to those landowners that do, should not be made. It is assumed landowners that are required to provide the additional Woody Creek PUL width will be compensated by the value of the land increasing adjacent the aesthetically pleasing channel.

## **6.0 Recommendations**

In order to correct existing drainage and capacity issues within Woody Creek, upgrades are required. The following are the recommendations:

- Lower the Creek by 0.65m at the Resources Road outlet
- Grade the ditch bottom at 0.1% from Resources Road through to 92<sup>nd</sup> Street, using a 3m ditch bottom, and 5:1 sideslopes (Figures #4a & 5a).
- Push a 800mm diameter culvert through the CNR and 92<sup>nd</sup> Street crossings to provide low flow drainage of the new profile.
- Using Alternative #3, grade Woody Creek at 0.1% from 92<sup>nd</sup> Street, to a transition point, in which a new 0.05% slope is required to cross the existing Sanitary Trunk Main. Use a parkway cross section for this area (Figures #5b & 8b).
- Re-align existing overhead powerline at the 92<sup>nd</sup> Street outlet. Investigate the possibility of lowering the existing high-pressure gasline.
- Construct a concrete weir and control structure over the Sanitary trunk main (Figure #8a)
- Remove existing Crossings 'A&B'
- Grade Woody Creek from the Sanitary Weir to the proposed lineal wet pond at 0.1%, using a parkway cross-section. (Figure #5b)
- Provide gabion erosion protection at the outside 90-degree corner. Costs to be borne by SE4 developers only.

- Construct the lineal wet pond through Signature Falls. (Figures #5c & 9). Additional cost to re-align Woody Creek and construct the wet pond, are borne by SE4 developers only.
- All outfall and crossing details to meet City of Grande Prairie Guidelines and must be confirmed at detail design stage
- Construct an outlet control prior to release into the existing 68<sup>th</sup> Avenue crossing. Details of control type to be confirmed at detailed design stage.
- Implement a baseline water study in which data is collected prior to, during, and after construction.
- Implement a **“Woody Creek Storm Water Drainage Reserve”**, to recover a portion of the upgrade costs, from future developments. (Table 5.2)
- Review and amend where necessary all previously prepared storm design reports within the SE4 and 5 basins for new developable lands, to meet the criteria outlined in this report, or to deal with issues arising from the recommendations in this report. This includes but is not limited to future outfall inverts.

Structures required by future development, such as control weirs, outfalls, and road crossings are recommended in this study, however, construction costs are not included. A cost-sharing program between developers who require these items should be implemented.

Costs to upgrade portions of Woody Creek to include a trail network and trees, are not included in this report. Landowners adjacent the creek are required to construct the upgrades.

Landowners should provide the required PUL widening for the upgraded Woody Creek with no payment from the City. Compensation is achieved through storm water retention made available, as well as an increase in land value due to an aesthetically pleasing creek.

**WOODY CREEK  
SE5 BASIN  
STUDY**



SE1 BASIN  
AREA = 260.3 ha.

SE2 BASIN  
AREA = 299.4ha.

SE3 BASIN  
AREA = 179.1 ha.

SE4 BASIN  
AREA = 166.3  
ha.

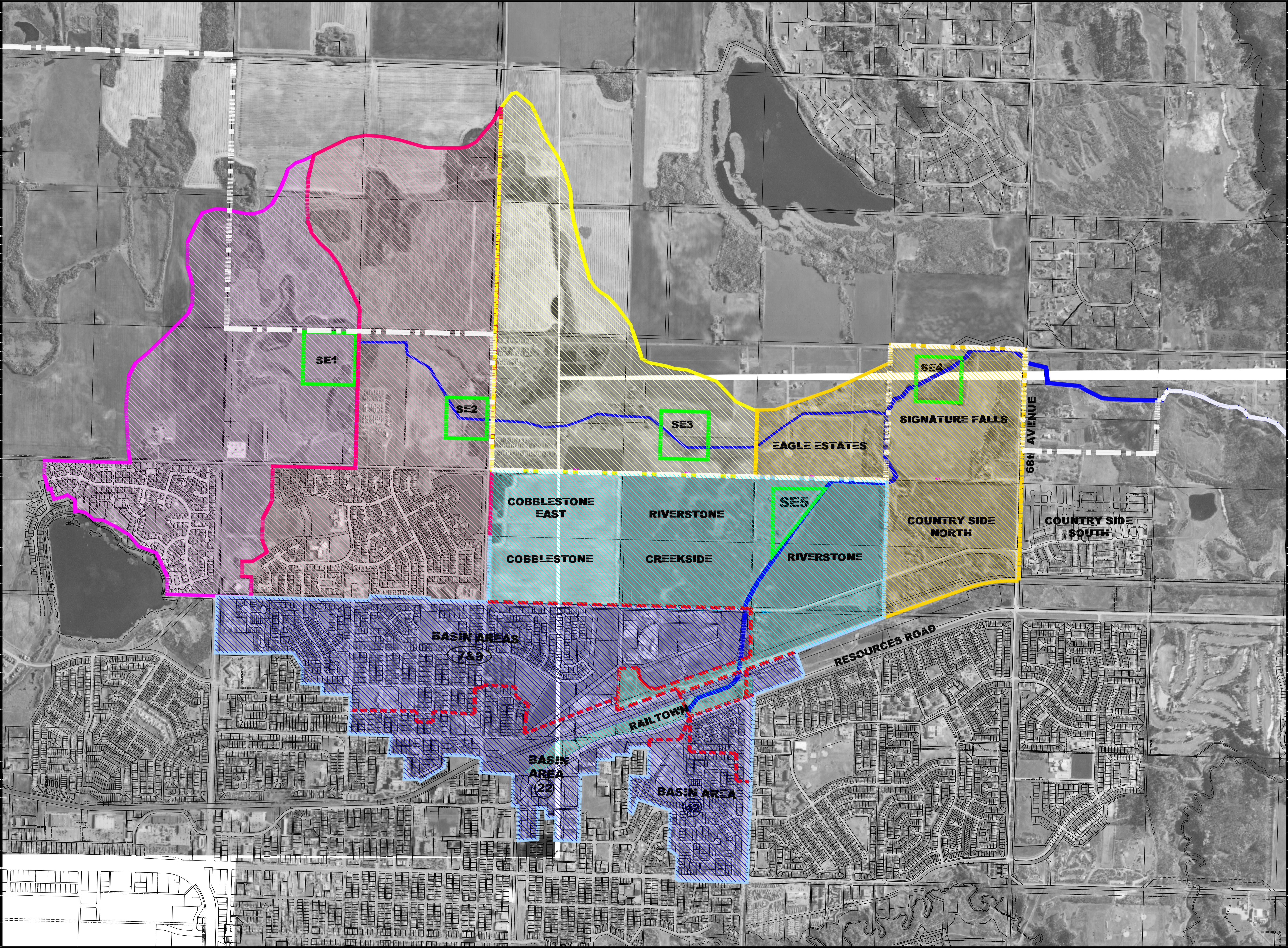
SE5 CITY BASIN  
AREA = 302.2 ha.

SE5 NEW  
DEVELOPMENT BASIN  
AREA = 228.9 ha.

INTERNAL  
BASIN  
BOUNDARY

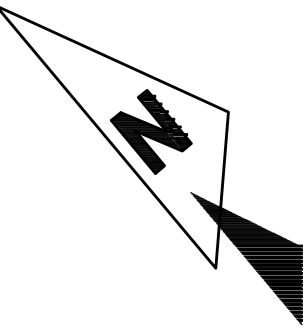
EXISTING  
WOODY CREEK  
CENTERLINE

CITY LIMITS



**FIGURE 1  
WOODY  
CREEK  
BASIN**

**WOODY CREEK  
SE5 BASIN  
STUDY**



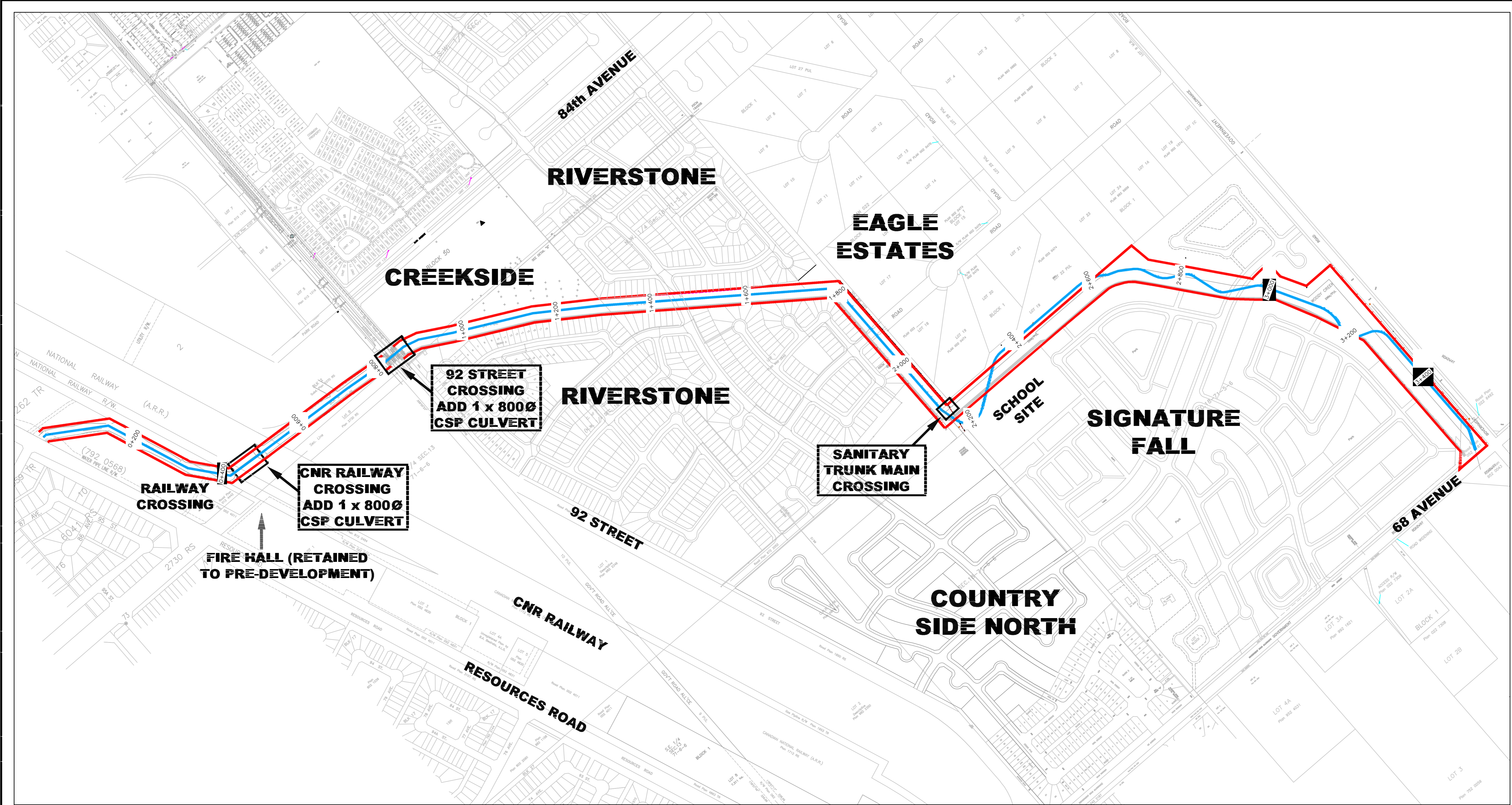
EXISTING WOODY  
CREEK CENTERLINE

IMPROVED WOODY  
CREEK EXTENTS

**FIGURE 2  
WOODY  
CREEK  
STUDY AREA**

BEIRSTO LEHNERS KETCHUM  
ENGINEERING LIMITED  
9607 102nd ST. GRANDE PRAIRIE, ALBERTA  
T8V 2T8

PHONE 532-4919 FAX 532-4739  
CAD FILE FINAL/NOV FILE NO. 06030



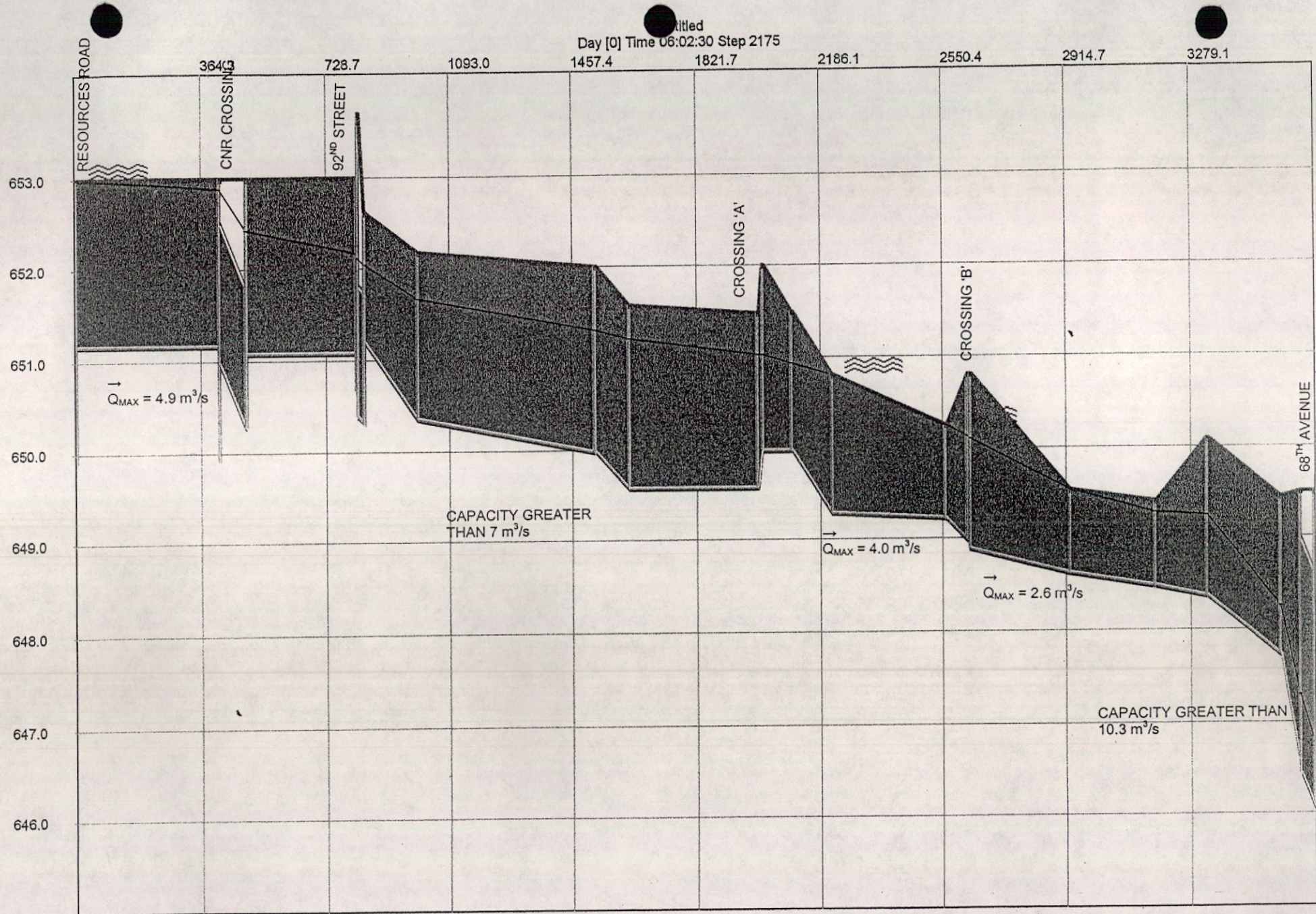
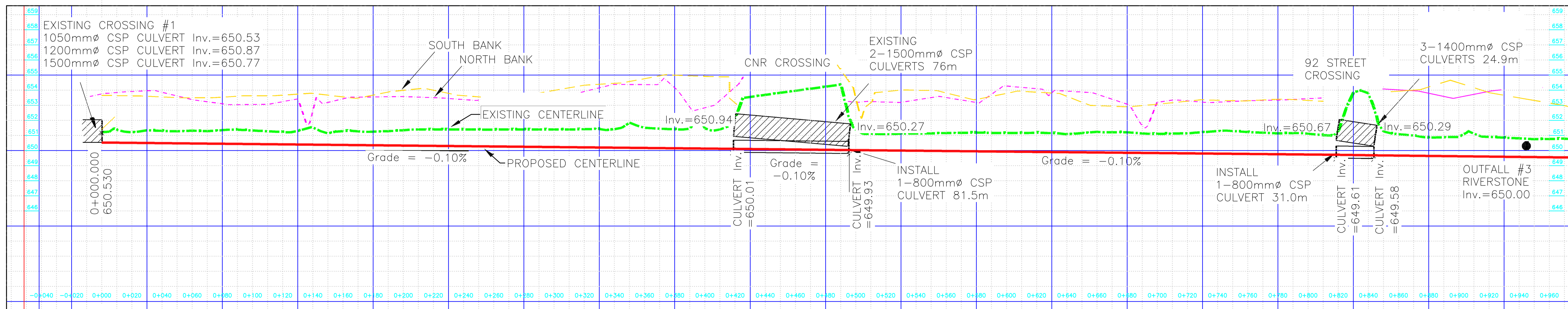
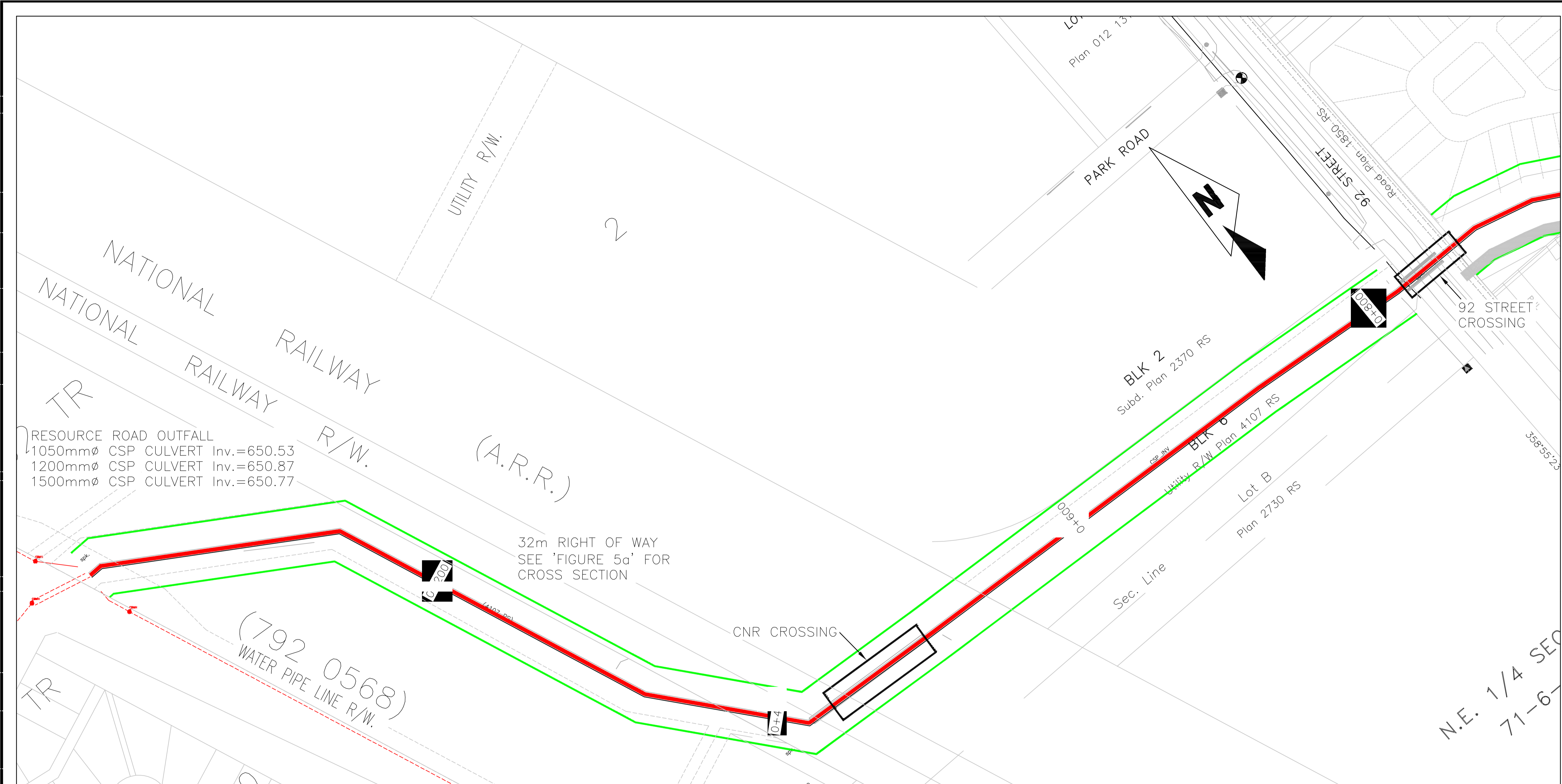
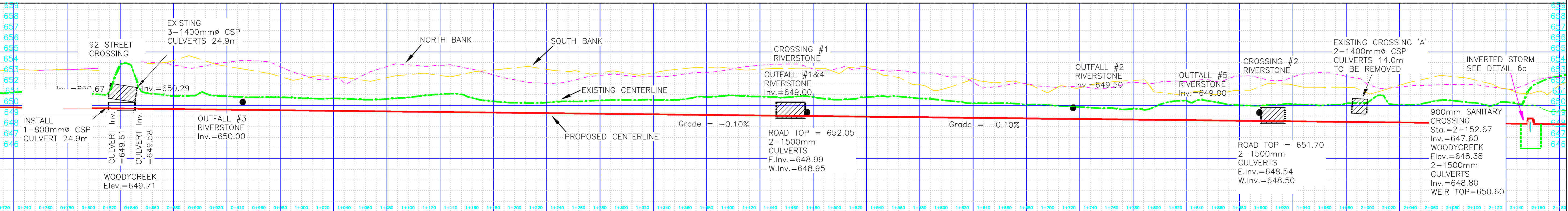
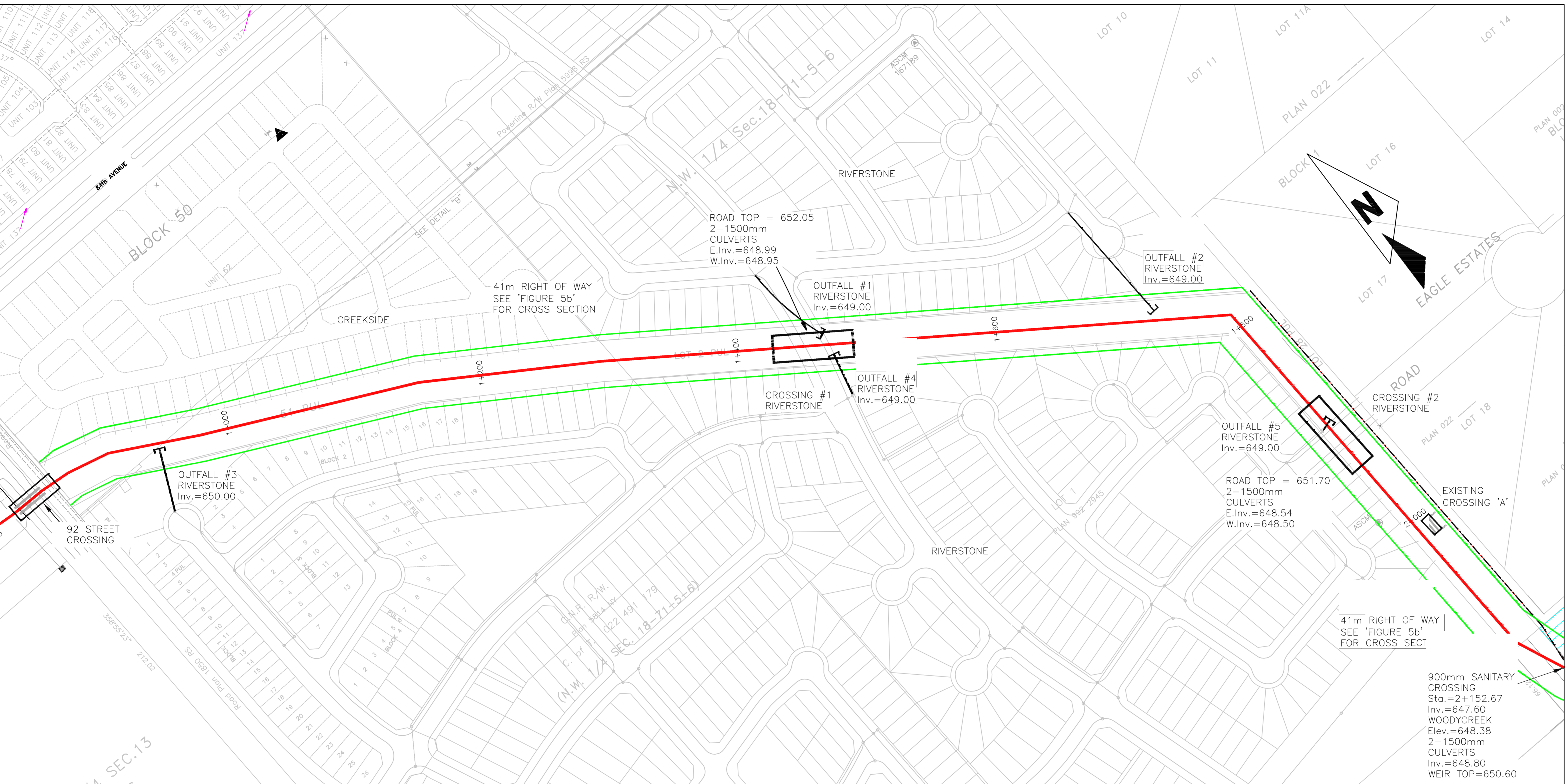


FIGURE #3 WOODY CREEK EXISTING CAPACITY

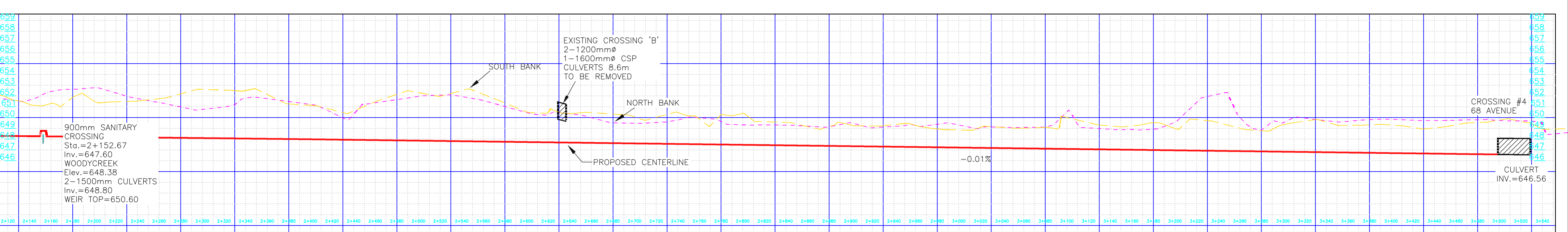
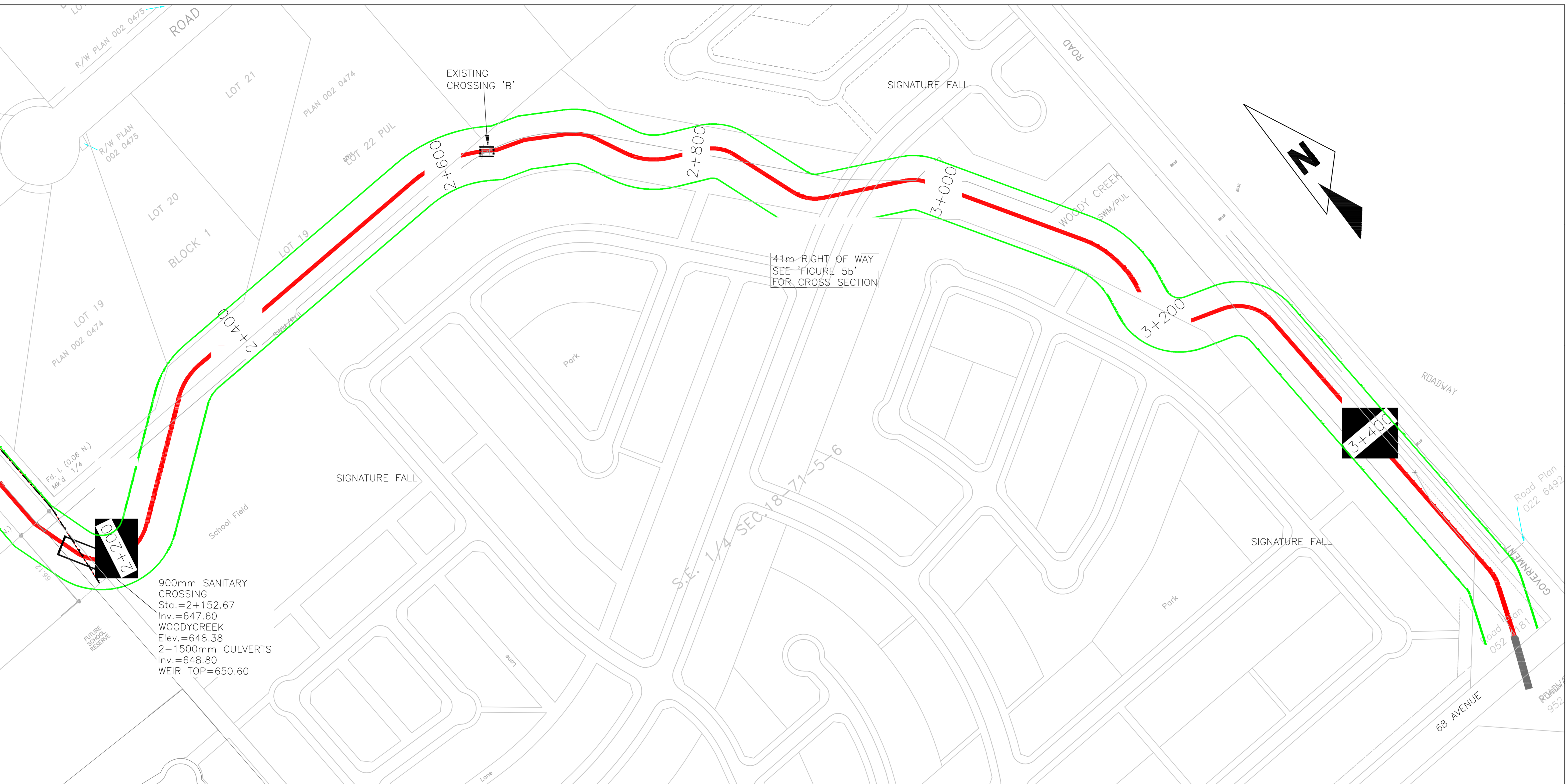
**WOODY CREEK  
UPGRADE-CITY  
STA 0+000  
to 0+950****FIGURE 4a**

**WOODY CREEK  
UPGRADE-CITY  
ALTERNATIVE #1**  
**Sta. 0+950  
to 2+160**



**FIGURE 4b**

**WOODY CREEK  
UPGRADE-CITY  
Sta. 2+160  
to 68th AVENUE**



**FIGURE 4c**

WOODY CREEK  
SE5 BASIN  
STUDY

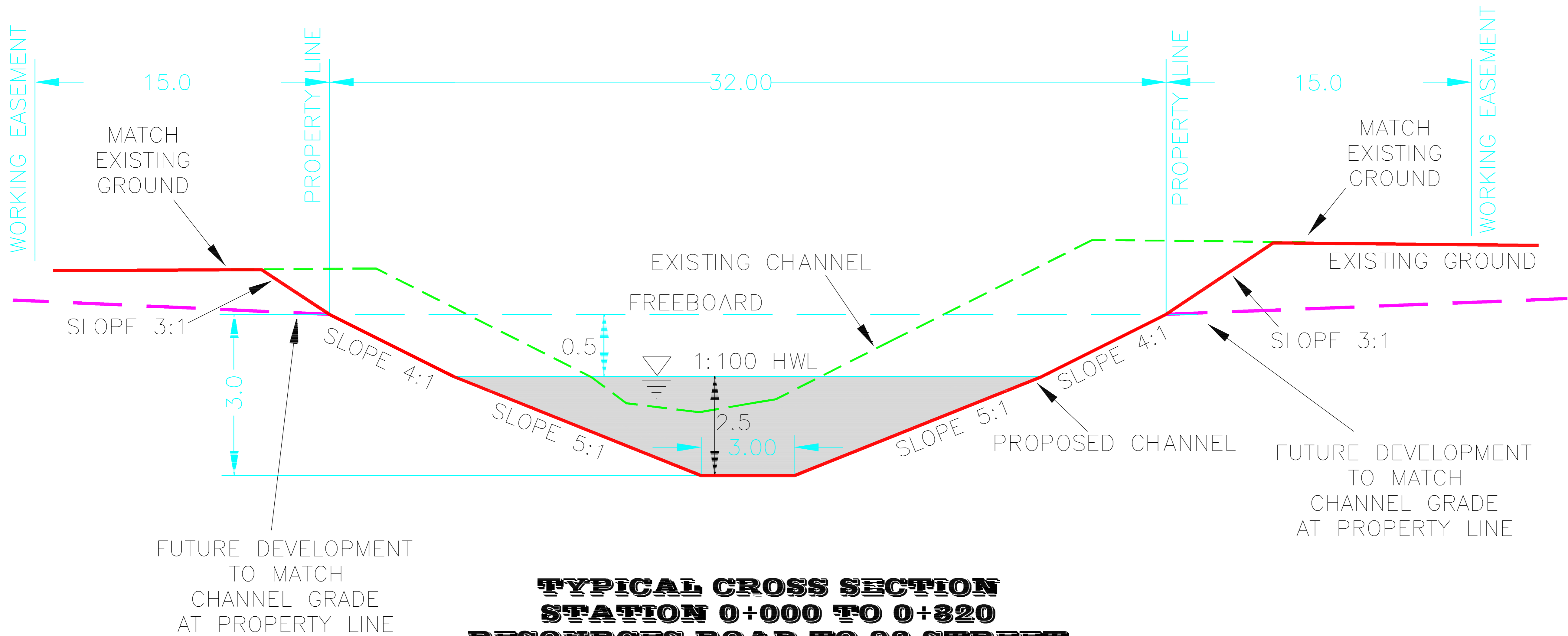
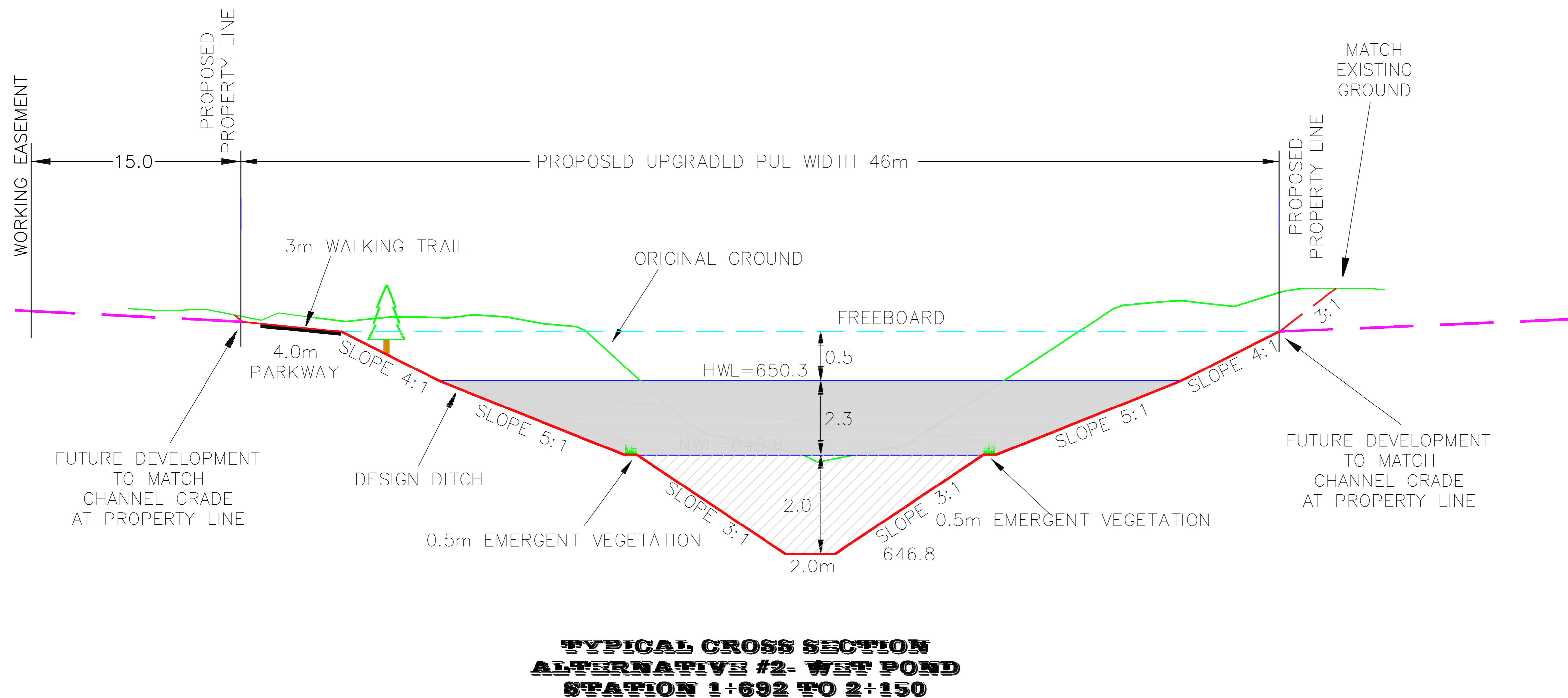


FIGURE 5A

WOODY CREEK  
CROSS-SECTION  
RESOURCES  
ROAD TO 92  
STREET

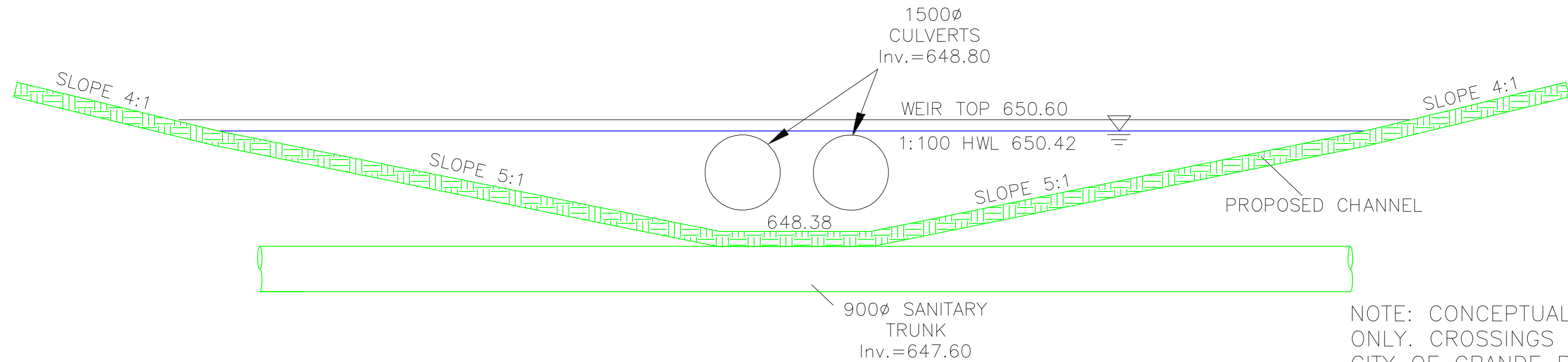
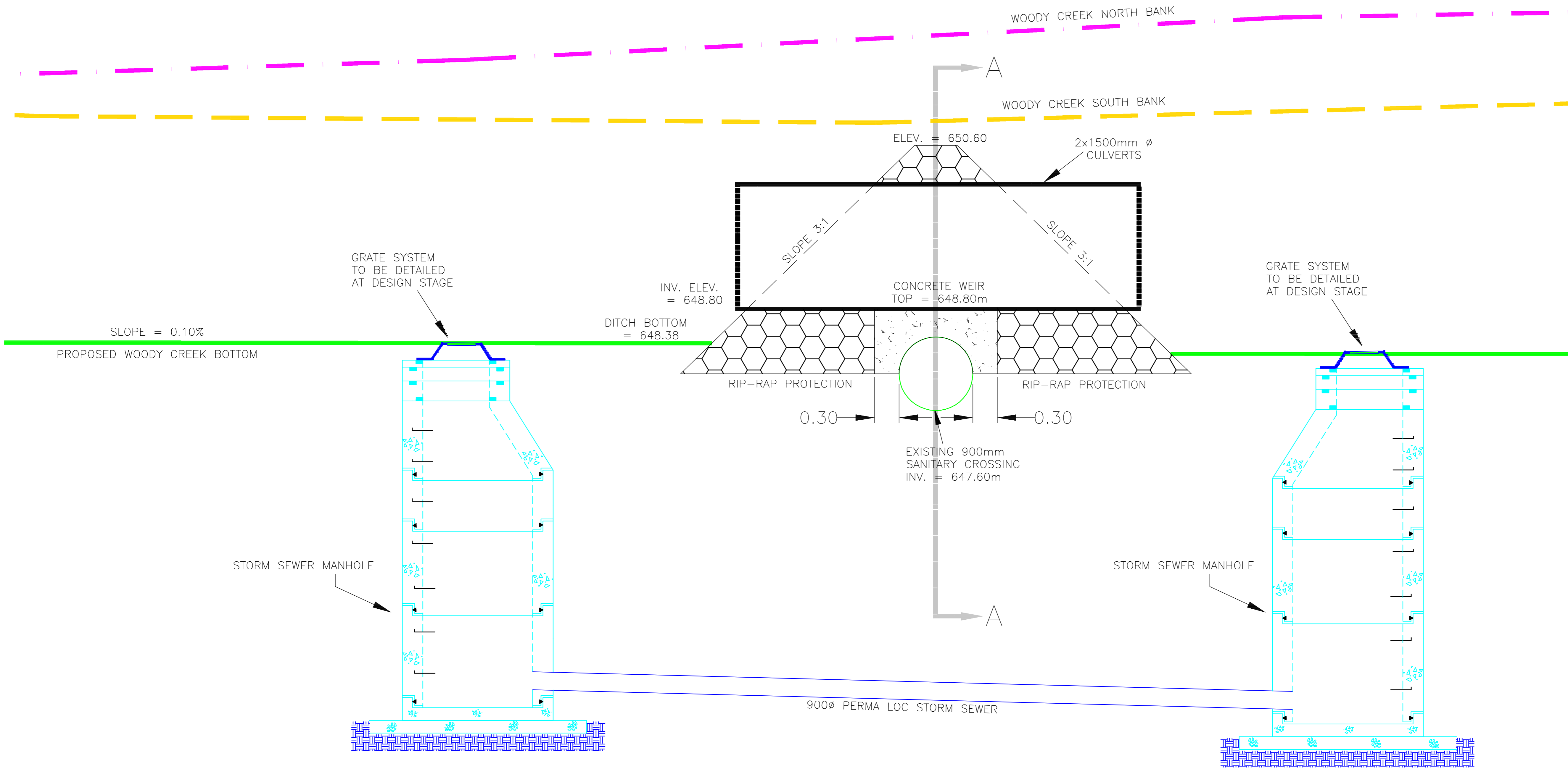


**WOODY CREEK  
CROSS-SECTION  
FROM 92 STREET**



**WOODY CREEK  
CROSS-SECTION  
SIGNATURE FALLS  
WET POND**

**WOODY CREEK  
SE5 BASIN  
STUDY**



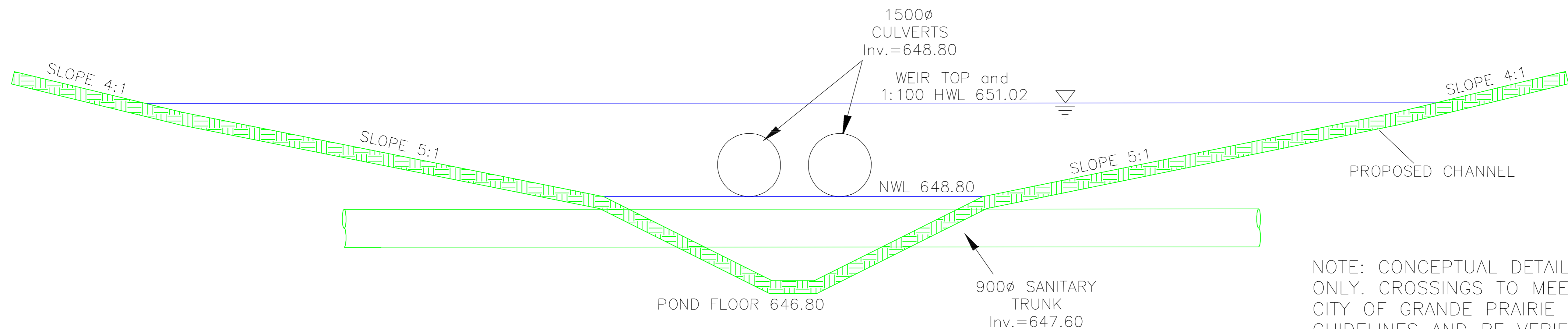
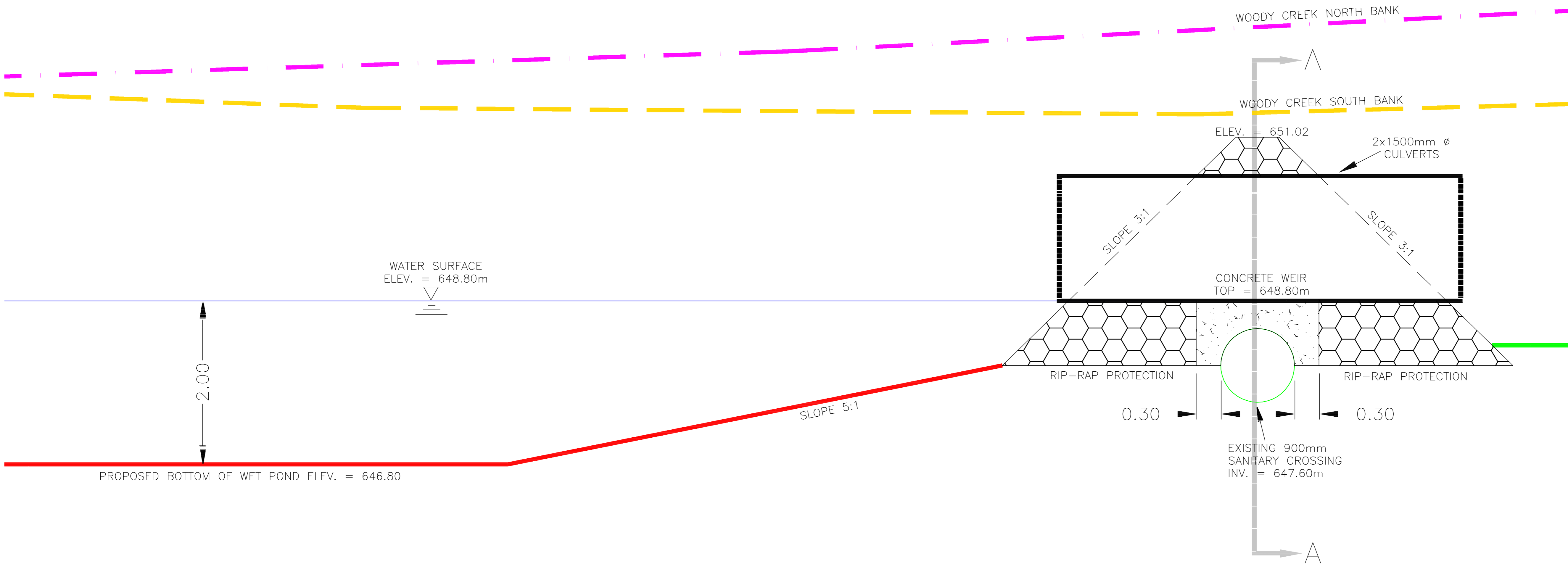
SECTION A-A

NOTE: CONCEPTUAL DETAIL ONLY. CROSSINGS TO MEET CITY OF GRANDE PRAIRIE GUIDELINES AND BE VERIFIED AT DETAILED DESIGN STAGE

**FIGURE 6A**

**DETAIL -  
ALTERNATIVE 1**

WOODY CREEK  
SE5 BASIN  
STUDY

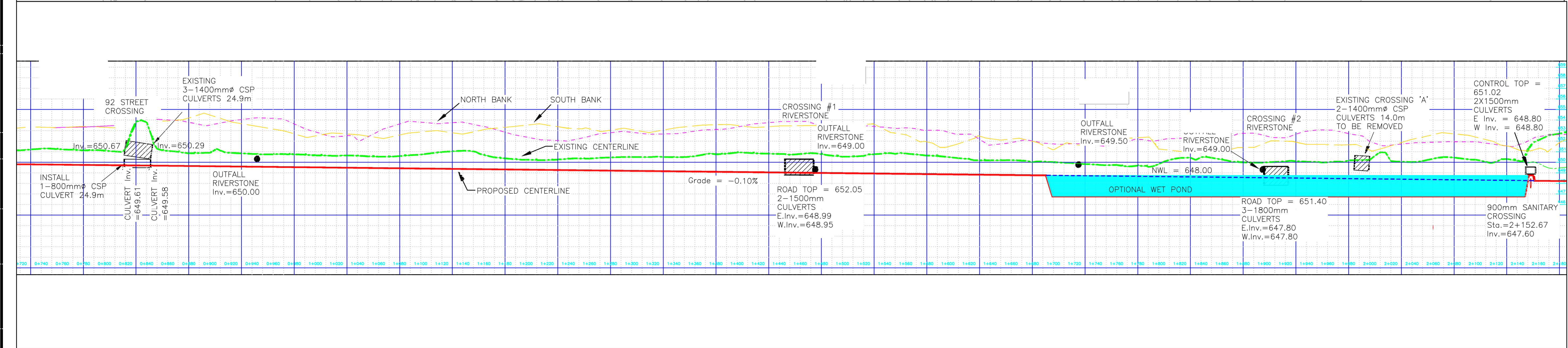


SECTION A-A

NOTE: CONCEPTUAL DETAIL  
ONLY. CROSSINGS TO MEET  
CITY OF GRANDE PRAIRIE  
GUIDELINES AND BE VERIFIED  
AT DETAILED DESIGN STAGE

FIGURE 7A

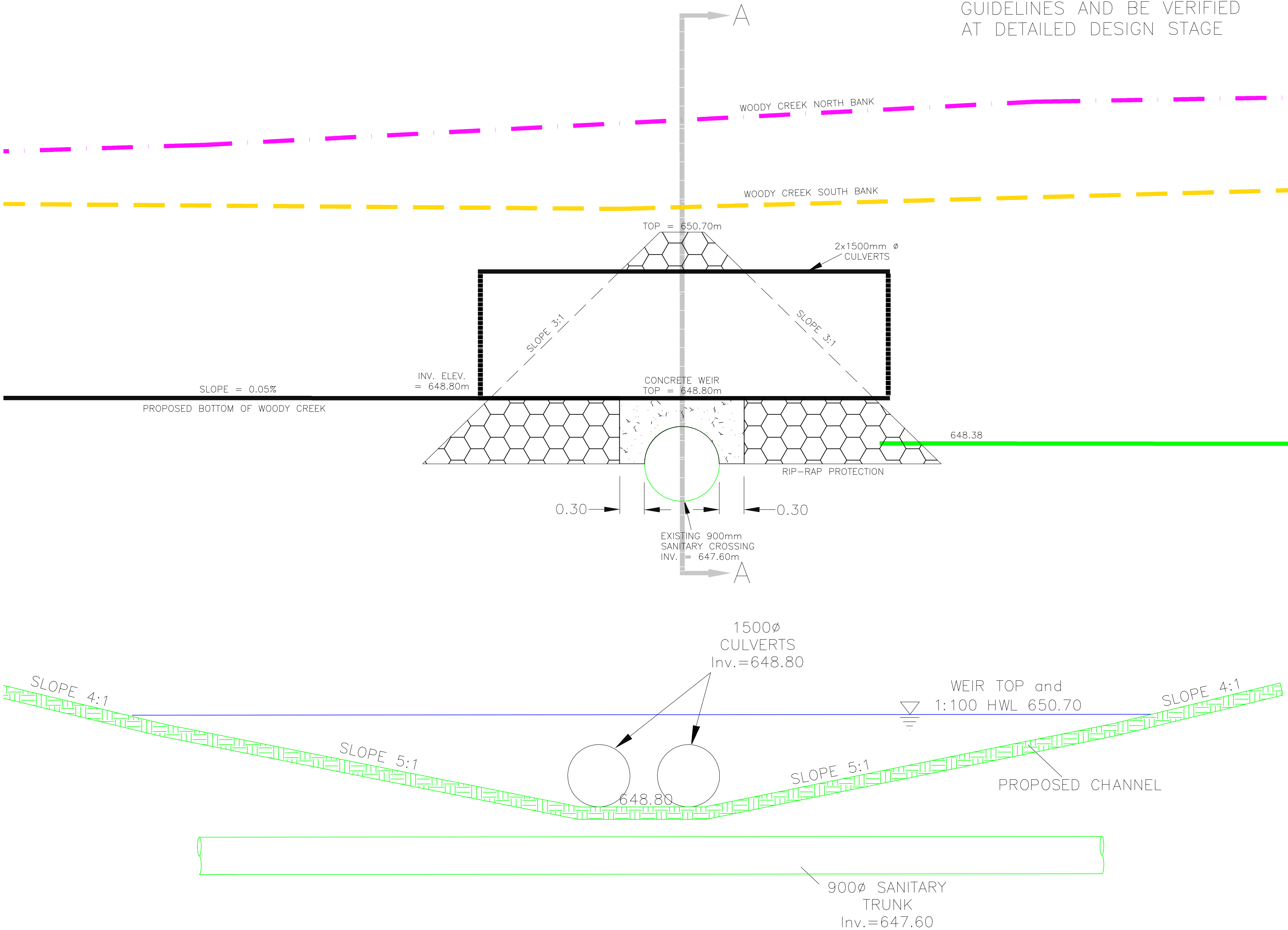
DETAIL -  
ALTERNATIVE 2



### FIGURE 7b

WOODY CREEK  
SE5 BASIN  
STUDY

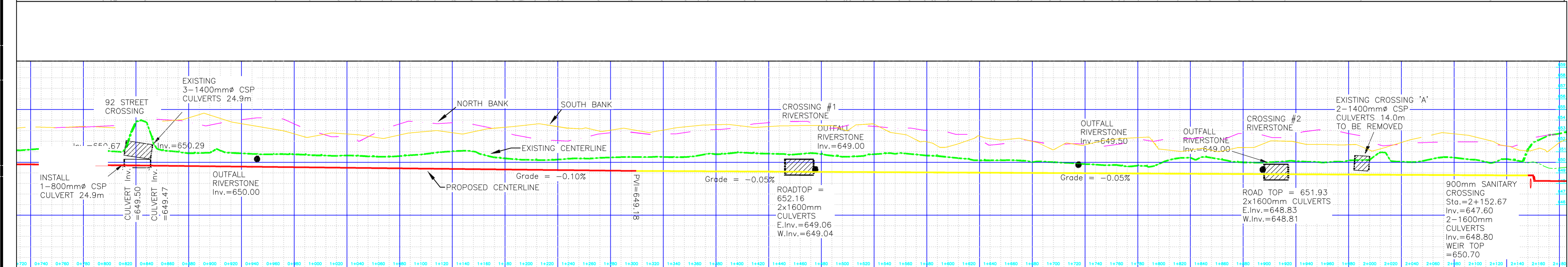
NOTE: CONCEPTUAL DETAIL  
ONLY. CROSSINGS TO MEET  
CITY OF GRANDE PRAIRIE  
GUIDELINES AND BE VERIFIED  
AT DETAILED DESIGN STAGE



SECTION A-A

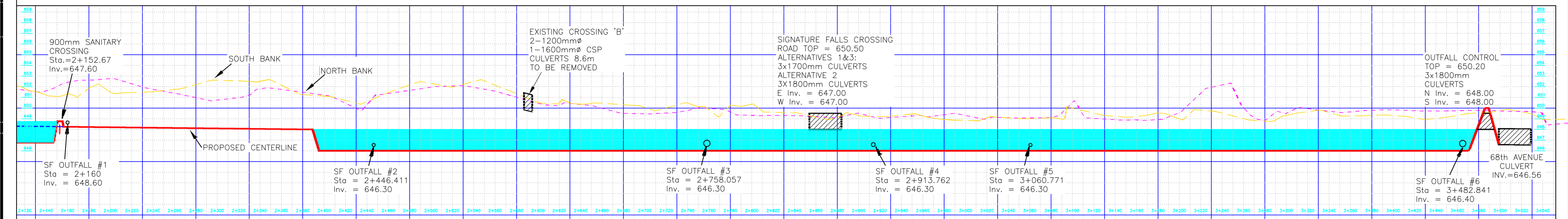
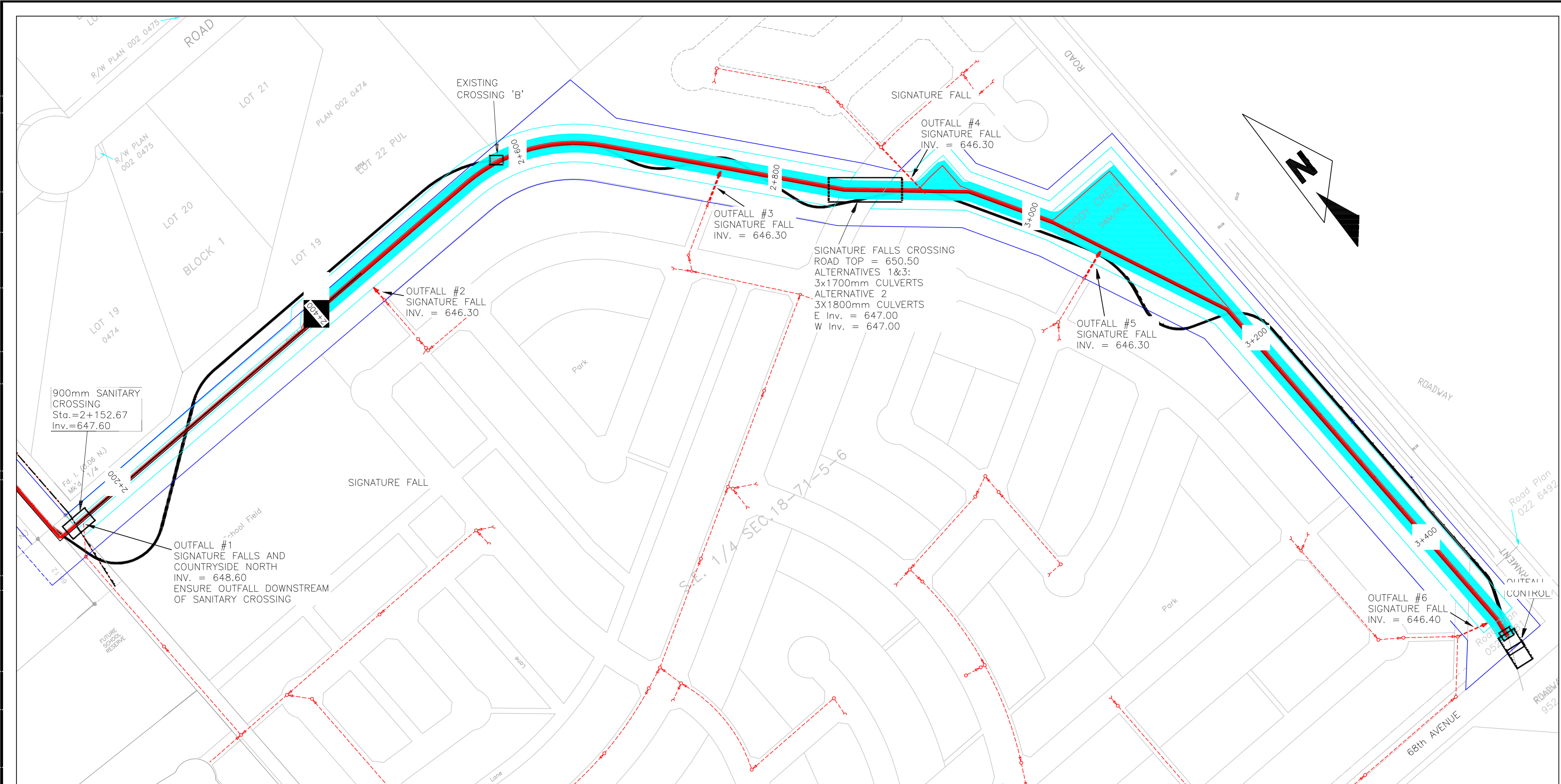
FIGURE 8A

DETAIL -  
ALTERNATIVE 3

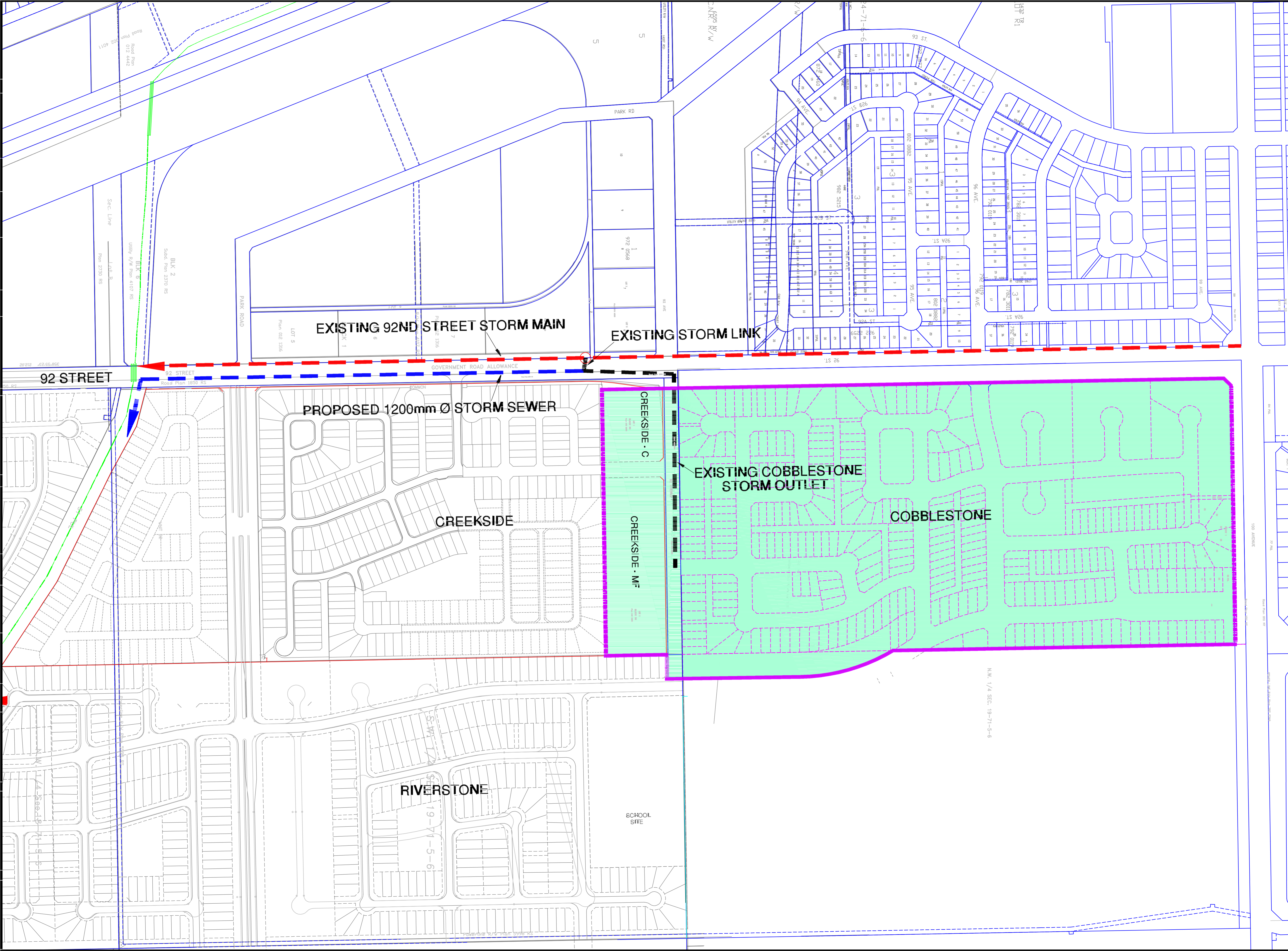


BEAIRSTO LEHNERS KETCHUM  
ENGINEERING LIMITED  
9607 102nd ST. GRANDE PRAIRIE, ALBERTA  
T8V 2T8  
PHONE 532-4919 FAX 532-4735  
CAD FILE  
FINAL/NOV FILE No. 06030

# WOODY CREEK UPGRADES- SIGNATURE FALL



## FIGURE 9



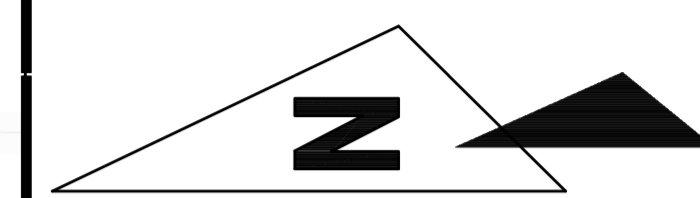
**WOODY CREEK  
SE5 BASIN  
STUDY**



**FIGURE 10**

**PROPOSED 92st  
STORM -  
COBBLESTONE**

**WOODY CREEK  
SE5 BASIN  
STUDY**



LOCATION WHERE EACH COST  
CONTRIBUTION ZONE BEGINS.  
CONTRIBUTIONS FOR UPGRADES  
UP TO 68th AVENUE

CONTRIBUTION ZONE	LOCATION CONTRIBUTIONS START
	①
	①
	②
	③
	④
	⑤
	⑤

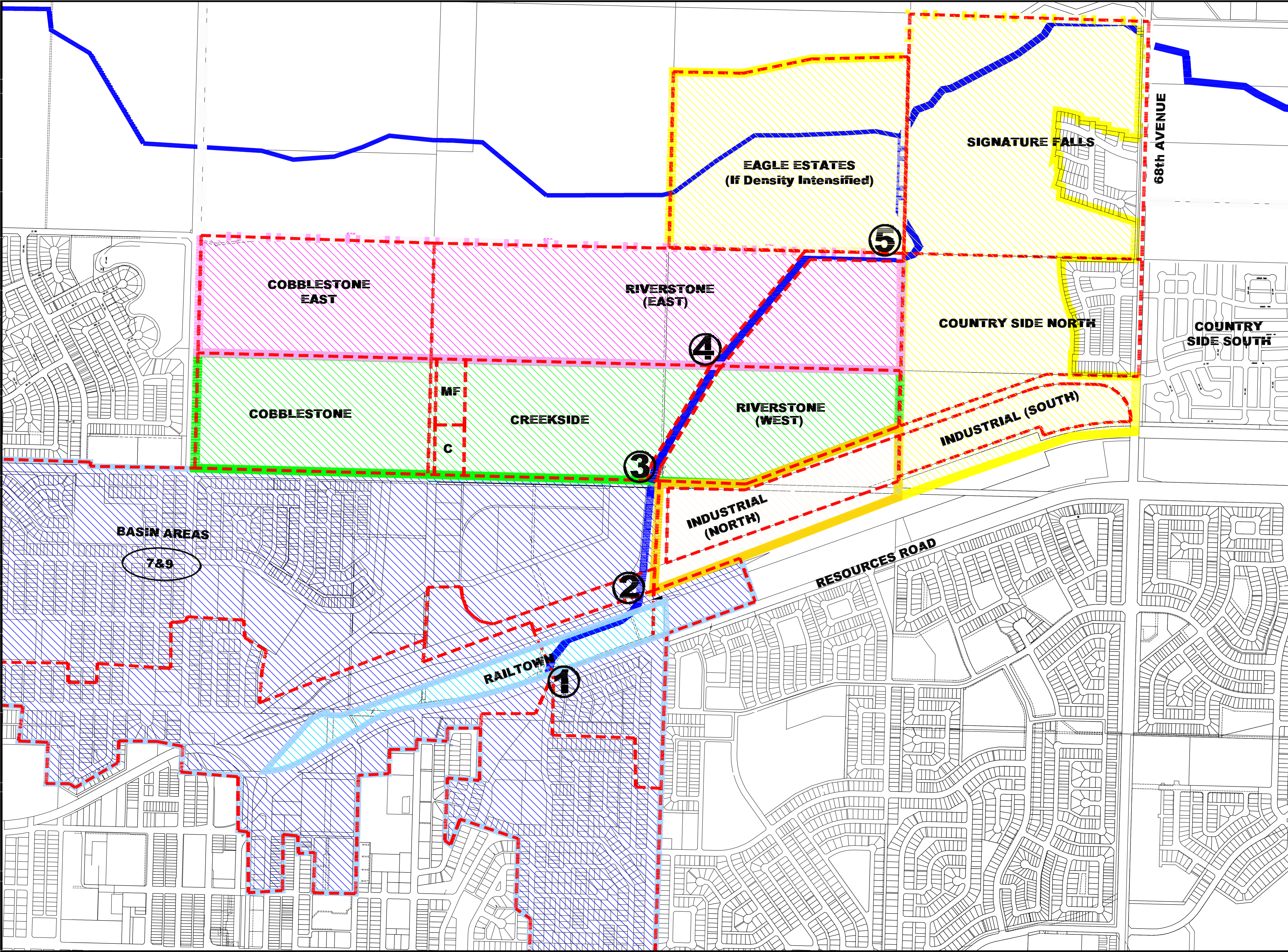
INTERNAL BASIN  
BOUNDARY

EXISTING WOODY  
CREEK CENTERLINE

CITY LIMITS

**FIGURE 11**

**COST  
CONTRIBUTION  
ZONES**



# CREEKSIDE

# RIVERSTONE

# EAGLE ESTATES

**NO WOODY  
CREEK FUL  
WIDENING  
ON EAGLE  
ESTATES**

**WOODY CREEK FULL  
WIDTH VARIES  
WITHIN SIGNATURE  
FALL**

# SIGNATURE FALL

# COUNTRY SIDE NORTH

**CNR RAILWAY**  
CANADIAN NATIONAL

## 92 STREET CROSSING

**NR RAILWAY  
CROSSING**

**SANITARY  
TRUNK**

92 STREET