# Town of Cardston
# Infrastructure Master Plan

## Report

**Update:** December, 2017

TALBERA
CONSULTING I ENGINEERING I MANAGEMENT

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File: 20150911.004

Jeff Shaw
CAO
Town of Cardston
Box 280, 67 - 3rd Avenue West
Cardston, AB. T0K 0K0

**RE: TOWN OF CARDSTON**
**INFRASTRUCTURE MASTER PLAN**

Dear Jeff,

Please find enclosed for six hard copies and USB's containing field photos and .kmz files for Google Earth viewing of the updated Infrastructure Master Plan (IMP) Report for the Town of Cardston. The water, sanitary, storm and roadway infrastructure was reviewed for this report. The existing models for the sanitary, water and storm was also updated and used in ascertaining the capacity levels.

Please review the report and should you have any questions or concerns, please don’t hesitate to contact me at 403-360-9099

Sincerely,

Albert Tagoe, P.Eng.
Civil/Municipal/Water Resource Engineer
Project Manager

AT/kw

# Executive Summary

The Town of Cardston retained Talbera International Technologies(TALBERA) to update the Infrastructure Master Plan completed by AECOM in 2009 by perform a capacity assessment of their water distribution and sanitary sewer and storm systems and provide recommendation on improvements necessary to sustain current and planned future developments. As part of the scope of work, information from the systems assessments were then used to update the Infrastructure Master Plan for the Town of Cardston. A roadway system evaluation performed by Talbera was also included in this updated plan. The full Pavement, Sidewalks, Curb and Gutter review was completed.

The Town has adopted two new area structure and redevelopment plans that present the potential for substantial growth over several years, necessitating a review of the Town's municipal infrastructure systems. This update continues to assess the ability of the Town's infrastructure to meet existing demands and to provide a plan for future development. The water distribution and sanitary sewer systems were re-evaluated to include all the upgrades completed since 2009 and recommended by the 2009 Master Plan Report I in addition to projected full (Ultimate) development condition of the new area structure plans.

The 2016 population census indicated a population of approximately 3,585. Based on planned future developments and land use projection, the population at full development is estimated at 6900.

## Raw Water Supply, Treatment and Distribution System

A model of the water distribution of the Town of Cardston was developed using WaterGEM XM edition.

The major raw water sources for the Town of Cardston are Lee Creek and St. Mary River. The Town of Cardston has a water license for a total maximum diversion of 1,498,688 $m^3$/year from both sources with one source diversion at a time. With additional sources of water, the total raw water available to the town increases to 2,025,388 $m^3$/year. Total raw water diverted (pumped) to the water treatment plant on the average from 2012 to 2016 is 947,450$m^3$ compare to 1,170,600 $m^3$ in 2007. Using 2016 data, raw water requirement for the Town of Cardston at the full development presented in this plan can be met with the current licenses with no extra left for growth past the considered future development.

The report recommends that a study be conducted on the Town's Water Treatment Plant to look into efficient treatment processes that would reduce treatment loses through the plant. This included efforts to reduce filter backwashes by implementing raw water headworks and treatment to improve the raw water quality entering the water treatment plant.

The existing water distribution system was analyzed based on the average water consumption date between 2012 and 2016 per capita; the future systems were analyzed based on the water consumption rates recorded by the Town of Cardston and projected population using the proposed area structure plans. The fire flow requirements were based on the Fire Under-Righter's Survey. The calibration process was completed as part of the Town of Cardston's Infrastructure Study and it was recommended that the existing pipe roughness coefficient be 110 for Asbestos Cement pipe, 120 for PVC, 100 for Cast Iron pipes, and 100 for Steel pipes.

The fire flows available at the high value properties (Hospital and school) located in the north and south areas of the Town are insufficient to meet the required standard. Pressures during peak hour demand are below the recommended minimum pressure in the Northwest section of town.

The existing 9$^{th}$ Avenue booster pump stations requires an additional upgrades in order to provide the required industrial fire flows to the North West Industrial Area.

The storage reservoirs were analyzed using the Alberta Environment water storage requirement. The storage requirements for the future (ultimate) development condition is approximately 7370 $m^3$ and the available storage is 9080 $m^3$. It is therefore unlikely that reservoir expansion will be required.

Several pipe improvements were considered to improve delivery pressure and fire flows. With the proposed pipe improvements, all fire flow requirements for the existing system are satisfied.

The total cost for all recommended upgrades and a summary of the costs for the proposed improvements are summarized in Table ES.1. Costs are in 2017 dollars and include an allowance of 10% for engineering and 15% for contingency.

**Table ES.1: Water Distribution System Upgrades and Improvements - Cost Estimate Summary**

| Proposed Improvement | Total Cost ($) |
|---|---|
| Booster Pump Station and Pipe Loop Upgrades | $ 675,000 |
| Pipe Upgrades | $ 6,174,000 |
| **TOTAL** | **$ 6,849,000** |

Recommendations for the implementation of improvements are based on the number of nodes with inadequate fire flow. Consideration should also be given to other factors, such as stakeholder acceptance, including public consultations and traffic disruptions and roadway maintenance or resurfacing plans

## Sanitary Sewer System

The sanitary sewer system model of Town of Cardston was updated with all the improvements and development installations since 2009 including the completed recommendations from the 2009 IMP report.

The calibration verification consisted of a two-step process: verification of the dry weather flows and verification of the wet weather flows for the selected rainfall events. Through the calibration process completed as part of the Municipal Infrastructure Study, it was determined that a residential flow of 553 L/c/d and a non-residential flow of 6000 L/ha/d best represented the actual flows at the time. These values were used in the model for this study.

The modeled dry weather flow compared quite well to the monitored dry weather flow. For wet weather flow, the infiltration parameters and effective areas used in the previous study were adopted. The modelled wet weather flow also compared well to monitoring data and field observations. The design criteria based on the calibrated model are summarized in Table ES.2.

**Table ES.2: Summary of Sanitary Design Criteria**

| Parameter | Calibration Criteria |
|---|---|
| Residential Sewage Generation Rate | 553 L/c/d |
| Non-Residential Sewage Generation Rate | 6000 L/d/ha |
| Effective Residential infiltration and inflow (I/I) | 0.28 L/s/ha |
| Effective Industrial and commercial I/I | 0.07 L/s/ha |

The impact of the 5, 10 and 25-year, 4-hour and 24-hour design rainfall events on the existing system was evaluated. In general, the 24-hour events are more critical than the 4-hour events. The existing system has sufficient capacity to convey dry weather flow. For the 5-year events, the new North Lee Creek trunk which is connected to the North Siphon does not surcharge or flood. A number of manholes are surcharged to within 1 meter of the ground level along the Central Trunk but does no overflow. The South Siphon pipes are currently no experiencing any flows during a 5-year dry weather flow simulation and this is site verified.

For future development (considering full development of the proposed area structure plans), a residential sewerage generation of 550 L/c/d was adopted. The existing system has sufficient capacity to convey dry weather flow with the West Area development. For the 5-year events, the Central Trunk experience surcharges between 1 and 2.5 meters. Near the connection point the siphon discharge manhole, surcharges occur to within 1 meter of the ground level. The existing system current has adequate capacity to convey the 5 year wet weather flow event with the proposed developments.

The basis for improvements was to maintain the hydraulic grade line at least 2.5 metres below ground and the capacity utilization less than 120% for the 5-year, 24-hour rainfall event for full future development and per the existing and proposed Area Structure Plans. The upgrades recommended to achieve these goals are;

- North Trunk Lee Creek Crossing Twinning (600mm Pipe)
- Upgrade wastewater treatment plant to increase treatment capacity to 8500 $m^3$/day

For the new west development, two alternatives were developed to provide adequate servicing. Alternative 1 involves the provision of a new lift station to convey part of the flow from this area and also the proposed industrial area by a force main (FM) to manhole 7A10. This will provide controlled delivery of flows into the existing system via the Central Sewer Trunk. Alternative 2 involves splitting the flows between the Northwest and Central Sewer trunks.

For the existing system, the estimated cost of improvements is **$4,730,000**. Cost estimates for replacement cost and new installation cost are summarized in Table ES.3. Costs are in 2017 dollars and include an allowance of 10% for engineering and 15% for contingency.

**Table ES.3: Sanitary Sewer System Upgrades and Improvements - Cost Estimate Summary**

| Phases | Upgrades and Improvement Costs – Full Future Servicing | | | | |
|---|---|---|---|---|---|
| | NE Lift Station | North Trunk Twinning | NE Trunk | NW Lift Station & FM | TOTALS |
| Replacement Costs | | | - | - | |
| New Installation Cost | $962,000 | $846,000 | $419,000 | $1,342,000 | **$3,569,000** |

Monitoring should be undertaken to confirm maximum surcharge elevations during rainfall events. If I/I rates in the new areas are determined to be greater than 0.28 L/s/ha as it is now for some areas due to weeping tile connections to the system, the small volume of storage in the trunks may be required. It is therefore recommended that existing weeping tile connections to the sanitary system be disconnected and future developments refrain from such practice. Schedule maintenance of pipes and manholes should be undertaken through CCTV and flash cleaning.

## Storm Sewer System

A Storm Sewer Model was developed for the Town of Cardston's catchment area using CivilStorm V8 XM Edition. Based on the existing contours, the storm water study was delineated into 21 sub-drainage basins (catchment area). For this study, we considered 55% of each sub-catchment to be impervious and used only this portion as the surface. The design rainfall events were based on the City of Lethbridge Municipal Engineering Standards. A two (2) and five (5) year – 4 hour Chicago storm rainfall events were simulated and runoff volumes from catchment areas were conveyed directly into manholes.

The existing storm infrastructure only conveys part of the runoffs from rainfall events and the remaining portion is mainly by overland (sheet) flow. The storm runoff discharges into the Lee Creek through several outfalls or flows overland and discharges directly into Lee Creek. The overland flow is aided by the topography and the fact that a large portion of the terrain slopes towards Lee Creek. There is currently no stormwater management facility for the existing storm drainage system. Storm water management plans that were developed since the 2009 IMP were incorporated into this updated IMP. Storm water management facilities for new development areas must comply with Albert Environment regulations.

The existing storm drainage system cannot convey a 1 in 2 or 5 years – 4-hour Chicago Storm on the Town's catchment to Lee Creek. Major storm trunk and outfall upgrades will be required to achieve full conveyance through conduits. The fact that some sub-catchment areas depend solely on overland drainage would mean additional new storm pipes and catch basins in these areas if full stormwater conveyance in conduits is to be achieved.

It is recommended that a storm management study that focuses on intercepting storm water from the north-west edge of Town and conveying it through a major storm trunk system to Lee Creek completed. A trunk alignment through Town running south east direction and collecting surface runoffs should be greatly considered, since overland (sheet) flow is already an integral part of the current stormwater conveyance mechanism.

It is highly recommended that the existing storm pump that is used to alleviate flooding the Downtown of Cardston be replaced and a second storm pumping system be installed downstream of the existing along the Lee Creek.

| | Existing Storm Pump | New Storm Pump | TOTALS |
|---|---|---|---|
| Replacement Costs | $135,000 | | **$135,000** |
| New Installation Cost | - | $370,000 | **$370,000** |
| | | | |

# TABLE OF CONTENTS

## CONTENTS

# TABLE OF CONTENTS

# TABLE OF CONTENTS

# 1 INTRODUCTIONS

The Town of Cardston has retained Talbera International Technologies Ltd(TALBERA) to conduct a municipal water distribution system, wastewater collection and storm water management systems study and update the Town's existing Infrastructure Master Plan (IMP) adopted by the Town Council in August of 2009. The updated plan would include all upgrades that were recommendations in the 2009 Master Plan and have been implemented. In addition, the upgrades implemented since 2009, this updated study and plan re-evaluates the current status of the Town's existing municipal infrastructure and provide recommendations that when implemented will ensure that an adequate level of service can be achieved that will sustain growth within the Town by meeting current and future demands.

This document will address the overall water, sanitary and storm sewer system capacities for the Town of Cardston. The Town's roadways and streets were also included in this study, focusing on asphalt and sidewalk conditions. Upgrades and repairs required on the Town's roadways have also been included in this report. This document identifies existing system deficiencies, existing system improvements, and recommend improvements that will be necessary to support future development.

## 1.1 Background

The Town of Cardston is a community of approximately 3585(2016) people. Within its boundaries is the existing development area of 605 ha and two interim development areas consisting of the East and the West Cardston Area Structure Plans with a total of approximately 264 ha of planned development. This proposed interim development areas will require conceptual infrastructure planning for water, wastewater and storm water systems to allow development to proceed in the most efficient and cost-effective manner and also provide offsite cost associated with future development.

## 1.2 Scope of Work

The overall objective of this study is to develop and update an existing Infrastructure Master Plan, for the water, wastewater, storm water and roadway systems that will be needed to support both existing and future demands and level of service. This master plan is designed to guide the development, expansion and upgrades to the existing water, wastewater, storm and roadway infrastructure. The purpose of analyzing the existing systems was to identify the current capacity and capabilities of the water, wastewater and storm system, as well as to identify any necessary improvements and or upgrades. The scopes of work on the existing systems are outlined in the follow-up sections of the report.

### 1.2.1 Water Servicing Concept

The water servicing scope of work included:

- Collection and review of all data relevant to the project, including background reports, mapping, review of as-built data for the distribution network, land use data, population data, water consumption data, hydrant location information, existing reservoir capacity, pumping records and pump curves for the existing pumps.

- An evaluation of the existing water supply and distribution system, identification of system deficiencies, and the assessment and recommendations for system improvement needed to support future developments.

- Development of a system model to simulate the existing developed condition, the ultimate development condition, and the existing development condition with recommended improvements. WaterCAD software was used for the modeling

- Preparation of order of magnitude costs for recommended improvements and upgrades to the existing system.

### 1.2.2 Sanitary Servicing Concept

The sanitary servicing scope of work included:

- Review and update the existing model using background reports, mapping, as-built data of the system, pumping records and pump curves for the existing pumps

- Generation of dry weather flow and wet weather flow using existing and future populations, areas,

- Sewage generation rates, population densities, I/I (inflow and infiltration) rates, diurnal flow distribution patterns, and land use data

- Assessment of the capacity of the existing system and recommendations on system improvements for the existing system

- Assessment of the capacity needed to service future development and identification of improvements necessary to service future development

- Include recommendation for twinning the sanitary trunks crossing Lee Creek to the pump lift stations

- Prepare order of magnitude costs estimate for all necessary improvements to the existing system.

### 1.2.3 Storm Sewer Servicing Concept

The storm sewer servicing scope of work included:

- Review and update the storm sewer system model
- Development of a basic master drainage plan with assumed catchment areas for the existing storm sewer system
- Evaluation of the storm systems to identify problem areas and areas that requires improvements
- Evaluation of the impact of Town growth on the storm drainage systems.
- Include recommendation from other projects to upgrade the existing Downtown storm dewatering pumps
- Prepare order of magnitude costs for recommended improvements to the existing system.

# 2 STUDY DATA

## 2.1 GENERAL

The study area encompasses the area within the boundaries of the Town shown on **Figure 2.1**. Currently, the Town boundaries include an area of approximately 605 ha of land south of Highway 5 and west of Highway 501. The Lee Creek traverses through the study area from the Southwest to the Northeast, dividing the Town into two portions. The central area comprises most of the developed area of the Town, whereas the east and west area is only partially developed. The East and West Area Structure plan development are included in this study with emphasis on only the impact on existing infrastructure in order to determine the necessary facility upgrades required to support these interim development areas.

## 2.2 REPORTS

The following reports pertaining to the Town of Cardston's area redevelopment plan have been reviewed and the applicable information incorporated into the study:

- Town of Cardston Infrastructure Master Plan, August 2009.
- "West Cardston Area Structure Plan", Oldman River Regional Service Commission, March 2007.
- "East Cardston Area Redevelopment Plan", Oldman River Regional Service Commission, August 2008.

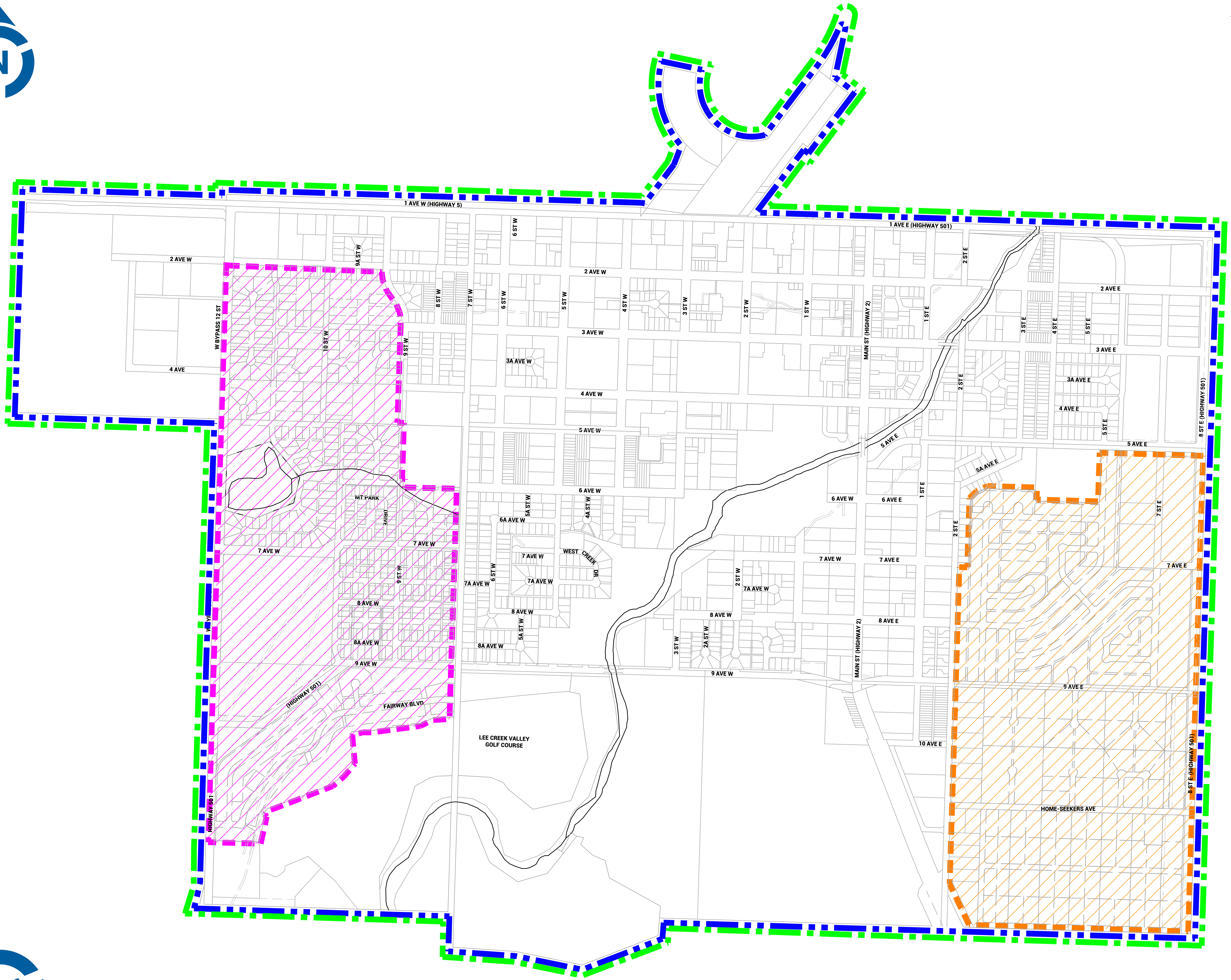
## 2.3 LAND USE

Existing and future land use was developed based on discussions with the Town. **Figure 2.2** shows the existing and proposed future land use plan within the study area.

## 2.4 POPULATION PROJECTIONS

For this study and update, water consumption data from 2012 to 2016 was used to evaluate base consumptions per capita and analyze the trends observed. The population projection for this study plays a key role in the evaluation of the existing infrastructure and the required infrastructure at full build-out. Full build-out was assumed to occur at the time when both proposed East and West redevelopment plans are completed and fully populated.

The current population is estimated at 3585 and a build-out population of 6900. The build-out population was calculated using the mid-range densities in the General Town Plan.




**LEGEND**

- STUDY AREA
- TOWN BOUNDARY
- WEST AREA CONSTRUCTION PLAN
- EAST AREA CONSTRUCTION PLAN

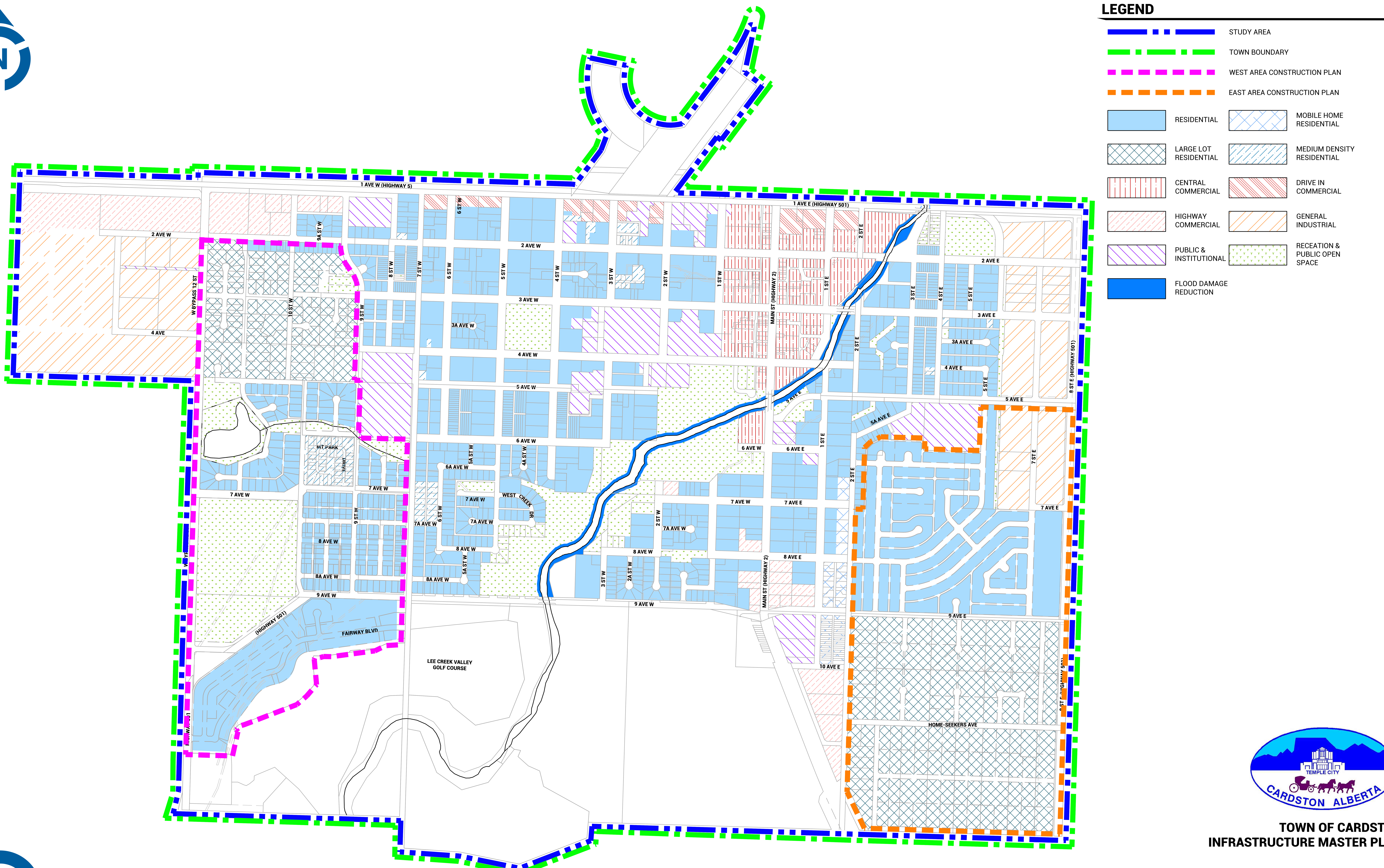
TALBERA

TEMPLE CITY
CARDSTON ALBERTA

**TOWN OF CARDSTON**
**INFRASTRUCTURE MASTER PLAN**

**STUDY AREA**

**FIGURE 2.1**




**TOWN OF CARDSTON**
**INFRASTRUCTURE MASTER PLAN**

## LAND USE PLAN

**FIGURE 2.2**

# 3 WATER SUPPLY AND DISTRIBUTION SYSTEM ASSESSMENT

## 3.1 General

This section assesses the existing water supply and distribution system, identifies existing system deficiencies and recommended improvements, impacts of future development on the existing system, and provides a servicing concept for full build out of the community (Ultimate condition).

### 3.1.1 Reports and Drawings

The following documents pertaining to the Town of Cardston water distribution network have been reviewed and the applicable data incorporated into the study:

- Town of Cardston Existing Water Distribution System drawing
- Water Supply for Public Fire Protection, A Guide to Recommended Practice, Public Fire Protection Survey Services, 1999
- West Cardston Area Redevelopment Plan, Oldman River Regional Services Commission, March 2008
- East Cardston Area Redevelopment Plan, Oldman River Regional Services Commission, August 2008.

## 3.2 Surveys and Field Inspection

AECOM utilized field survey information collected for sanitary system and storm system models and assessments to generate ground elevations. In areas where elevation data was not available, Google Map and contour maps were used to estimate existing ground elevations. This approach was necessary because there was no information provided to AECOM detailing the elevations of nodes, junctions, control valves and pipe layouts in the distribution system.

The water distribution system including pipes, junctions and control valves were assumed to be 2.5 m below existing ground elevation as estimated from survey data.

The Town of Cardston water distribution system is serviced by gravity and two booster pump stations, one located in the west part of the Town, on 7$^{th}$ Avenue, and another located on 9$^{th}$ Avenue West, between 1$^{st}$ and 2$^{nd}$ Street West. There are currently two electrical distribution pumps at each boosterpump station, one serving as a distribution pump and the other as a fire pump. The distribution pumps are set to automatically start and stop depending on the system demands. All distribution and fire pumps are on adjustable speed drives (ASDs). There is room for installation of one additional pump at each booster pump station if pump upgrades are required in the future. There is also space available in both pump station buildings for additional electrical infrastructure which would accompany pump upgrades.

# WATER SUPPLY AND DISTRIBUTION SYSTEM ASSESSMENT

## 3.3 Field Testing

Five hydrant tests and ten static condition pressure readings were collected by SimplexGrinnell on April 21, 2016.

### 3.3.1 Hydrant – Static Condition and Flow Test Readings

Static condition pressure readings were taken at hydrants and the locations of the hydrants are indicated on **Figure 3.1**. **Table 3.1** summarizes the hydrant test results.

**Table 3.1: Hydrant – Static Condition Pressure Readings**

| | STATIC PRESSURE | TEST 1 1 | | TEST 2 | |
|---|---|---|---|---|---|
| Test Number | Test Hydrant | Flow (gpm) | Pressure(Psi) | Flow (gpm) | Pressure(Psi) |
| 1 | 70 Psi | 468 | 64.0 | 694 | 54.0 |
| 2 | J195 | 331 | 40 | 490 | 26.0 |
| 3 | J154 | 406 | 34 | 600 | 20 |
| 4 | J180 | 513 | 44 | 888 | 38 |
| 5 | J84 | 432 | 0 | 640 | 0 |
| 6 | J43 | 554 | 52 | 838 | 35 |
| 7 | J39 | 534 | 0 | 888 | 0 |


TOWN OF CARDSTON
INFRASTRUCTURE MASTER PLAN

## EXISTING WATER DISTRIBUTION SYSTEM

FIGURE 3.1

## 3.4 Design Criteria

The latest (2008) Municipal Engineering Standards for the City of Lethbridge were used in this report since the Town of Cardston does not have its own municipal engineering standards. The following section provides the Municipal Engineering Standard requirements employed in the analysis of the distribution system.

### 3.4.1 Water Consumption Rates

For existing development, water consumption rates were based on the Town of Cardston Average Water Consumption from 2012 to 2016.

**Table 3.3: Water Consumption Rates (2012-2016)**

| Land Use Type | 2012 | 2013 | 2014 | 2015 | 2016 |
|---|---|---|---|---|---|
| Treated Water Demand ($m^3$) | 955,233.5 | 888,313.7 | 865,586.0 | 950,838.4 | 884,030.3 |
| High Volume Users ($m^3$) | 131,523.0 | 130,344.0 | 112,361.0 | 133,252.0 | 111,929.0 |
| Average Population | 3,595 | 3,593 | 3,591 | 3,589 | 3,587 |
| Maximum Day Demand | 4,707 | 4,680 | 4,796 | 4,626 | 4,119 |
| Average Day Consumption L/d/person | 628 | 578 | 575 | 624 | 590 |

Based on the yearly water demand and estimated population from 2012 to 2016, the average day demand for the Town of Cardston for purpose of this study and master plan update is set at 553 L/d/person for strictly residential development. A population estimate of 3585 was obtained from the Statistics Canada website and an additional 300 people was added to account for the population of Moses Lake. Moses Lake currently receives its water supply from the Town of Cardston. The average maximum day demand for the Town of Cardston from 2012 to 2016 was 1178 L/person. The Town of Cardston provided Talbera with a list of high end water users and their total demand on the system from 2012 to 2016. The high-end users which include commercial, industrial, institutional and truck fill station demands, average 123, 882 $m^3$ from 2012 to 2016. This demand was deducted from the total water demands for 2012 to 2016 to obtain the average and maximum day residential water demands presented in **Table 3.3**. Using the 1997 Town of Cardston Land Use Districts Map, a combined area of 44 ha was obtained for commercial, industrial and institutional. The average and maximum day demands for the Town of Cardston are summarized in **Table 3.4**.

**Table 3.4: Existing Water Consumption Rates**

| Land Use Type | Average Day Demand | Maximum Day Demand | Peak Hour Factor |
|---|---|---|---|
| Residential (L/d/person) | 553 | 1178 | 3.5 |
| Commercial/Institutional/Industrial (L/d/ha) | 6,000 | 12,000 | 2.0 |

For all future development, residential water consumption rates are based on the Municipal Engineering Standards for the City of Lethbridge. Non-residential water consumption rates are not specified in the Municipal Engineering Standards for the City of Lethbridge; therefore, commercial institutional and industrial demands of and 6000 L/d/ha was used, with peaking factors of 2.0. The water consumption rates used for estimating demands for the hydraulic analysis of the distribution system are shown in **Table 3.5**.

**Table 3.5: Water Consumption Design Rates**

| Land Use Type | Average Day Demand | Maximum Day Demand | Peak Hour Demand |
|---|---|---|---|
| Residential (L/d/person) | 550 | 2,035 | 3,300 |
| Commercial/Institutional/Industrial (L/d/ha) | 6,000 | 12,000 | 21,000 |

The design criteria for residential average day demands of 700 L/d/person indicated in the Municipal Engineering Standards is a composite value for the City of Lethbridge. For strictly residential developments, a water consumption rate of 415 L/d/person is to be used. Based on further evaluation of the Town's water usage history and municipal design standards comparable communities, average demand for new residential developments was maintained at the set at 550 L/d/ person for the Town of Cardston with a factor of 3.7 and 5.0 for maximum day and peak hour demands respectively. For industrial, commercial and institutional, a factor of 2.0 and 3.5 was use for maximum day and peak hour flows respectively.

### 3.4.2 Fire Flows

The fire flow requirements for the various land uses were not available from the City of Lethbridge Municipal Engineering Standards. Based on the Municipal Engineering Standards of similar communities, the fire flow requirement for commercial areas was expanded to include all non-residential properties in addition to the commercial areas. The water distribution system was evaluated for the following fire flow requirements:

- Single Family Residential 115 L/s
- Multi-Family Residential 135 L/s
- Non-Residential (i.e., commercial, industrial, schools, etc.) 230 L/s

These fire flow requirements are in accordance with the Fire Underwriters Survey "Water Supply for Public Fire Protection, A Guide to Recommended Practice". After discussions with the Town, these flows were used to evaluate the system.

### 3.4.3 Pipe Requirements

For the water distribution system analysis, the Municipal Engineering Standards require that the minimum size of distribution mains shall be 200 mm with a maximum allowable velocity of 3 m/s during any operation condition for all network pipes. The following pipe diameters were established in lieu of the standards:

- For mains servicing 12 lots or fewer, minimum size shall be 150 mm
- For mains servicing more than 12 lots, minimum size shall be 200 mm
- For commercial/industrial development, minimum main size shall be 300 mm.

Distribution lines in cul-de-sacs having more than 21 single residence houses must be looped.

The Town of Cardston water distribution system consists mainly of cast-iron and asbestos cement pipes in the older areas and PVC pipes in the newer areas of the distribution system. The reservoir supplies the system through a 550 mm steel water main down to the 7th Avenue booster pump station. The appropriate Hazen-William coefficients were determined, after the distribution system model was developed and calibrated, as detailed in **Section 3.5.2.2**.

### 3.4.4 Minimum Pressure Requirements

The minimum residual pressure in the system should be 310 kPa during peak hour demand and 345 kPa maximum day demand. During maximum day plus fire flow demand, the minimum residual pressure in the system should be 140 kPa at all node locations.

## 3.5 Existing System

The Town of Cardston existing water distribution system consists of two treated-water reservoirs, two booster pump stations and a looped network of distribution pipes, 100 mm to 550 mm in diameter. The Town has its own water treatment plant located south west of the Town and obtain raw water from the Lee Creek and St. Mary's River.

### 3.5.1 System Description

#### 3.5.1.1 Supply System

The two treated-water reservoirs are filled by the Town of Cardston's Water Treatment Plant which has a maximum treatment capacity of 150 L/s. These two reservoirs are located at the water treatment plant. A 550 mm steel pipe delivers treated water to the 7th Avenue booster station by gravity. From the 7th Avenue booster station, the distribution system can be divided into three zones. Water to the first zone is delivered by the two pumps at the 7th Avenue booster pump station. The 550 mm pipe from the reservoir is reduced to 350 mm and bypasses the 7th Avenue booster pump station and continues to supply water by gravity to the second zone. The 9th Avenue booster pump station supplies water to the third zone. The water distribution system therefore consists of two pressure zones and one gravity zone.

#### 3.5.1.2 Storage Reservoirs

The Town of Cardston has two treated-water reservoirs with a combined storage capacity of 9080 $m^3$ and are located in the NW ¼ Section 3-25-4-W4M, west of Highway 501 and in the southwest section of the Town. The reservoirs are fed by Cardston's water treatment plant, located approximately 100m away from the reservoirs. As per the January 2006 *Alberta Environment Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems*, storage volume requirements for the existing development condition include fire storage, equalization storage and emergency storage; these storage requirements are summarized in **Table 3.6**. The duration of fire storage is determined from the recommendations of the Fire Underwriters Survey.

**Table 3.6: Alberta Environment Water Storage Requirements for Existing Development Condition**

| Description | Volume ($m^3$) |
|---|---|
| Fire Storage (230 L/s for 3.0 hours) | 2,484 |
| Equalization Storage: Approximately 25% of Maximum Day Demand (Maximum Day Demand = 104 L/s) | 2,245 |
| Emergency Storage: Minimum of 15% of Average Day Demand (Average Day Demand = 34.5 L/s) | 455 |
| **TOTAL** | **5,184** |

As per the Alberta Environment Standards and Guidelines, this storage requirement is adequate if the supply source is capable of satisfying the maximum day demands

With a treatment capacity of 12,960 $m^3$/day and a low probability of treatment interruptions, the Town of Cardston's Water Treatment Plant can supply all of the emergency storage required in the reservoirs and maintain an acceptable storage recovery time. Hence, no additional storage is required at the reservoirs to serve the existing development.

#### 3.5.1.3 Pump Station Facilities

The Town of Cardston water distribution system is serviced by two booster pump stations: one located on 7th Avenue West, and one located on 9th Avenue West. The 7th Avenue booster pump station contains three pumps: two electrical distribution pumps and one electrical fire water pump. The three electrical pumps at the 7th Avenue booster pump station, P- 101, P-102 and P-103, are capable of providing 37.8 L/s, 37.8 L/s and 75.7 L/s, respectively with P-103 being the fire water pump for the northwest section of Town. The 9th Avenue booster pump station contains three pumps: Two electrical distribution pump, P-201, P-202 and one electrical fire water pump, P-203. The three electrical pumps are capable of providing 12.6 L/s, 42.9 L/s and 55 L/s, respectively. P-203 serves as a fire water pump to the southeast section of Town. The pumps at the two booster pump stations have identical pump operation philosophies.

At the 7th Avenue West station, P-101 runs until demand reaches 37.8 L/s then P-102 starts. If demand on both P-101 and P-102 exceed 56 L/s, P-101 shuts down and P-103 starts and runs until P-102 and P-103 exceeds 75.7 L/s, then all three (3) pumps P-101, P-102 and P-103 turn on to deliver 96L/s. A pressure of 480 kPa is maintained at the 7th Avenue West booster pump station.

At the 9th Avenue West booster pump station, P-201 runs until demand reaches 12.6 L/s when P-202 starts and P-201 stops. If demand on P-202 exceeds 42.9 L/s, both P-201 and P-202 stay on. All three pumps will be running by the time the demand reached 90.0L/s. A pressure of 641 kPa is maintained at the 9th Avenue West booster pump station. As the flow demand increases, the pumps in both 7th Avenue West and 9th Avenue West booster pump stations respond using the reverse philosophy of their start sequence to stop pumps. A summary of the pumping philosophy is provided in **Table 3.7 and 3.8**.

**Table 3.7: Pumping Philosophy – 7th Avenue West Booster Pump Station**

| Increasing Demand | | Decreasing Demand | |
|---|---|---|---|
| Pumps in Operation | Flow Range (L/s) | Pumps in Operation | Flow Range (L/s) |
| P-101 | < 37.8 | P-101, P-102, P-103 | > 96.0 |
| P-101 + P-102 | 37.8 – 56.0 | P-102+P-103 | 56.0-75.7 |
| P-102 + P-103 | 56.0 – 75.7 | P-101+P-102 | 37.8-56.0 |
| P-102, P-102, P-103 | > 96.0 | P-101 | < 37.8 |

**Table 3.8: Pumping Philosophy– 9th Avenue West Booster Pump Station**

| Increasing Demand | | Decreasing Demand | |
|---|---|---|---|
| Pumps in Operation | Flow Range (L/s) | Pumps in Operation | Flow Range (L/s) |
| P-201 | < 12.6 | P-203, P-202, P-201 | > 90.0 |
| P-202 | 12.6 – 42.9 | P-202, P-201 | >42.9 |
| P-202, P-201 | > 42.9 | P-202 | 12.6-42.9 |
| P-203, P-202, P-201 | > 90.0 | P-201 | < 12.6 |

The pressures maintained at both 7th Avenue West and 9th Avenue West booster pump stations are achieved through the use of Adjustable Speed Drives (ASDs).

#### 3.5.1.4 Water Distribution System

The existing Town of Cardston's water distribution system consists of a looped network with pipe sizes varying from 50 mm to 550 mm in diameter. The water distribution system provides both domestic water supply and fire protection.

## 3.5.2 System Modeling

### 3.5.2.1 Existing Model Development

The water distribution system for the Town of Cardston was modelled using WaterGEMS version 8.0 XM edition, developed by Bentley Systems Inc. This program has the capacity to model both steady state and extended period simulations. The software uses pull-down menus for data entering and can be integrated with an AutoCAD based graphical interface. The software allows review of simulation results graphically on the screen and the graphical results can also be plotted as required.

The program requires physical details of the existing distribution system (pipe diameters, lengths, roughness coefficients, water consumption demands, and ground elevations) to represent the water distribution system through pipes and junction nodes. The distribution system data was obtained from water distribution system drawings. Ground elevations at nodes were estimated from available topographic maps or spot elevations.

The existing water distribution schematic is shown on **Figure 3.1**. The size of the water mains included in the model varies from 100 mm to 550 mm in diameter. Water consumption rates from **Table 3.4** were used to estimate the demands at various nodes in the system for the future development condition. The existing pipe materials in the water distribution system are shown on **Figure 3.2**.

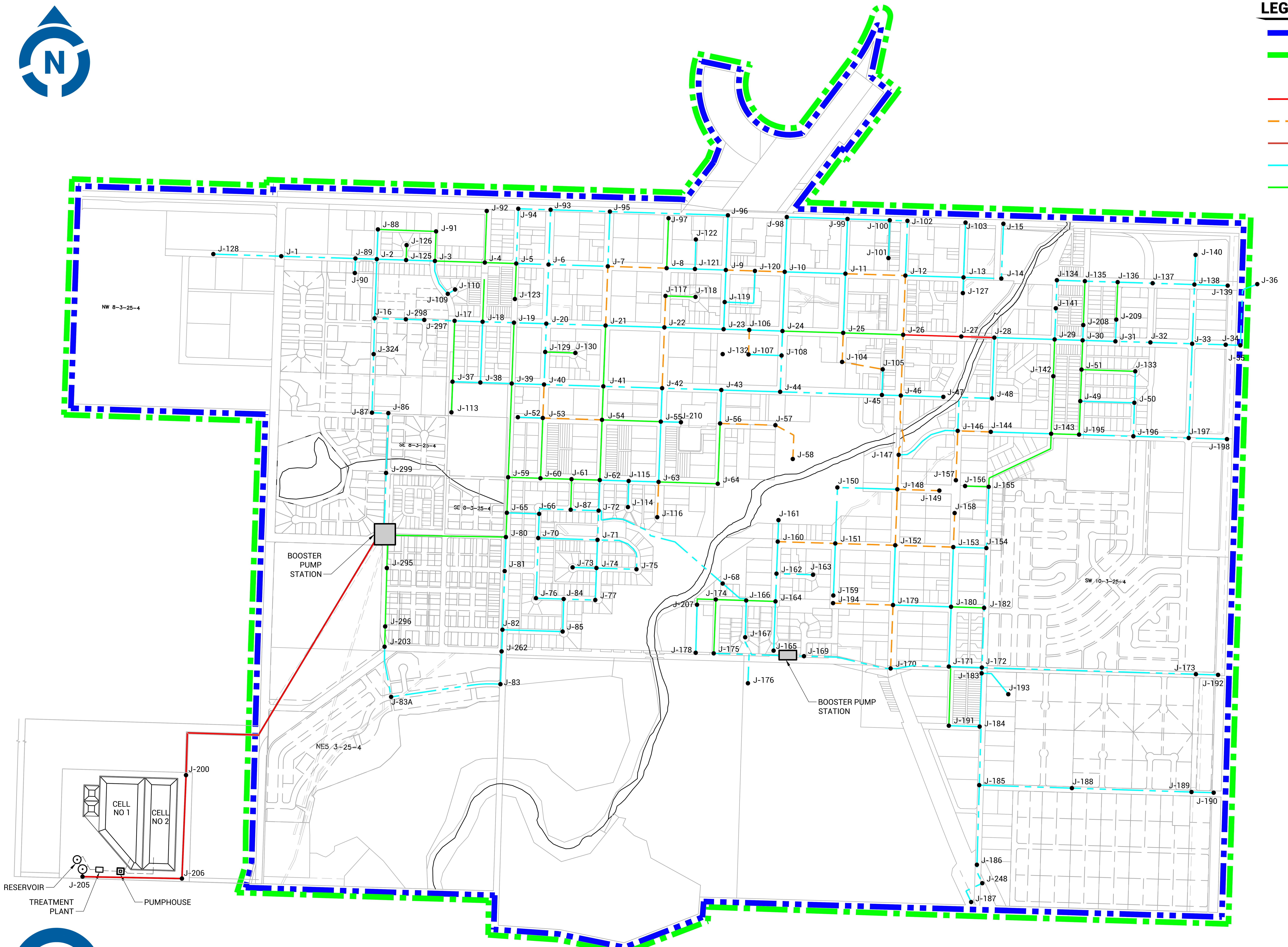
### 3.5.2.2 Model Calibration

The Town of Cardston distribution system pipe material consists primarily of asbestos cement (AC) and cast iron (CI) in the older areas and polyvinyl chloride (PVC) in the newer areas of the distribution system.

The existing model was calibrated using the Darwin Calibrator which is a tool in WaterGEMS. Darwin Calibrator uses the field data collected during average day water use. Data includes hydrant flow test results and hydrant static pressure as recorded in **Table 3.10**. The pump activities with respect to changes in flow rate were also recorded as field test and data collection were performed. An initial Hazen- Williams coefficient (C) shown in **Table 3.9** was assigned to the different pipe groups within the distribution system:

**Table 3.9: Initial Roughness Coefficient**

| Material | Roughness Coefficient |
|---|---|
| Asbestos Cement | 120 |
| Cast Iron | 90 |
| Ductile Iron | 130 |
| Galvanized Iron | 120 |
| Steel | 110 |
| PVC | 130 |




## LEGEND

- STUDY AREA
- TOWN BOUNDARY
- J-173 SCHEMATIC NODE
- STEEL PIPE
- CAST IRON PIPE
- DUCTILE IRON PIPE
- PVC PIPE
- ASBESTOS CEMENT PIPE

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# EXISTING WATER DISTRIBUTION SYSTEM PIPE MATERIALS

**FIGURE 3.2**

The system was analyzed for average day demand with both fire pumps in operation, as these were in operation during the entire duration of the hydrant flow tests. At static pressure conditions, the fire pumps were turned off as this was the case during the average day when the readings were taken. The elevation of water in the reservoirs were also noted and input in the model. An optimized calibration is performed on the model where several adjustments are made to system demands and Hazen-Williams coefficient (C) simultaneously to generate the best possible C that matches the field data. The results were then compared with the field hydrant test data. The comparison of the measured and simulated results is summarized in **Table 3.10**

**Table 3.10: Model Calibration**

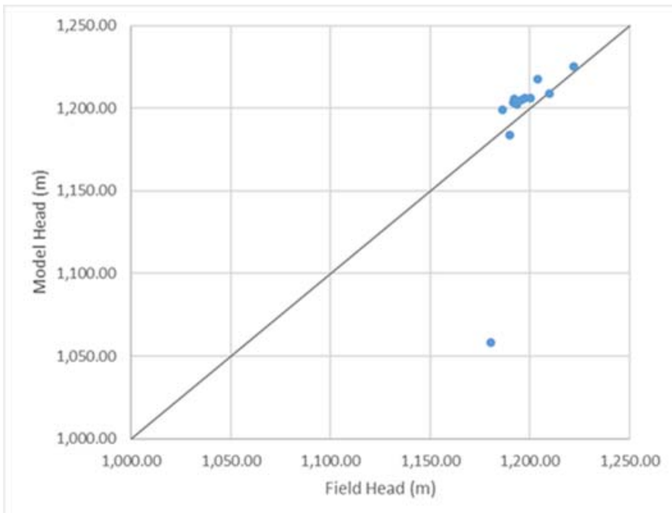
| Field Data Snapshot | Junction | Observed Hydraulic Grade (m) | Simulated Hydraulic Grade (m) | Difference (m) |
|---|---|---|---|---|
| Test#1-Static | J-39 | 1,222.24 | 1,225.28 | 3.04 |
| Test#1-Flow#1 | J-39 | 1,204.00 | 1,217.57 | 13.57 |
| Test#1-Flow#2 | J-39 | 1,192.07 | 1,205.81 | 13.74 |
| Test#2-Static | J-82 | 1,200.13 | 1,206.21 | 6.07 |
| Test#2-Flow#1 | J-82 | 1,195.92 | 1,204.92 | 8.99 |
| Test#2-Flow#2 | J-82 | 1,191.71 | 1,203.23 | 11.52 |
| Test#4-Static | J-152 | 1,197.56 | 1,206.00 | 8.45 |
| Test#4-Flow#1 | J-152 | 1,193.35 | 1,202.23 | 8.88 |
| Test#4-Flow#2 | J-152 | 1,186.33 | 1,198.86 | 12.53 |
| Test#5-Static | J-189 | 1,209.71 | 1,208.99 | -0.72 |
| Test#5-Flow#1 | J-189 | 1,190.07 | 1,183.74 | -6.33 |
| Test#5-Flow#2 | J-189 | 1,180.24 | 1,058.01 | -122.24 |

The simulated results, in **Table 3.11**, represent the best fit generated by the Darwin Calibrator given the existing conditions and specifications of the components of the distribution system. The as-built distribution pipe profiles were not available for this study. Therefore, all junction nodes were assumed to be 2.5 m below ground elevation. The observed and simulated results were almost the same at study junctions or nodes.

For the remaining nodes, the measured flows are either higher or lower and do not appear to be due to the pipe roughness coefficients. The high and low flows at these locations may be due to inaccurate node elevations as a result of elevation assumptions, and also the possibility of some junctions having partially or fully closed valves in the system. It is recommended that a valve operating program be implemented to check the status of each valve, to ensure that the valves are in the appropriate position.

For the subsequent analysis, a roughness coefficient of 120 for asbestos cement, 130 for PVC pipes and 90 for cast iron was adopted as the simulation results indicated a better match with the hydrant flow test results.

**Graph 3.11: Model Calibration**




### 3.5.3 System Evaluation under Existing Development Conditions

Hydraulic analyses for the following demands were carried out for the Town of Cardston water distribution system:

- Peak Hour Demand
- Maximum Day Demand Plus Fire Flow.

#### 3.5.3.1 Peak Hour Demand

The existing water distribution system was analyzed for the peak hour demand, assuming that the fire pumps (P-103 and P-203) were not in operation at the booster pump stations but (P-101, P-102, P-201 and P-202) were in operation. At present, the 7$^{th}$ Avenue booster pump station is set at a maximum pressure of (69.6PSI) 480 kPa and the 9$^{th}$ Avenue booster pump station, (92.8PSI)640 kPa.

With the above assumption, the pressures in the system are all in the range of (15PSI) 108 kPa to (88.33 PSI) 609 kPa. Some of the junction pressures are well above the recommended minimum pressure of (40.8PSI) 280 kPa and others are well below the minimum. The 7$^{th}$ and 9$^{th}$ Avenue pump stations do not have the pumping capacity under this scenario. Some junction pressures in the gravity supplied section of the distribution system were below the required minimum pressure.

The current pumping philosophy has both pumps operating on a pressure start sequence in the event of either peak hour demand or fire flow. Hence, a second peak hour demand scenario was simulated with all pumps being used. The pressure range for this scenario was 271 kPa to 896 kPa. The pumps at the 7th Avenue booster pump station generated pressures ranging from 383 kPa and 503 kPa whilst operating at maximum capacity with adjustable speed drives (ASDs). In comparison, the pumps at 9th Avenue booster pump station utilize the ASDs to reduce the pressure to the recommended minimum limit of 280 kPa. It was concluded from this scenario that the existing system is adequate to supply the peak hour demands, provided sufficient pressure is maintained at the booster pump stations. The results for the existing peak hour demand are illustrated on **Figure 3.3**.

The existing distribution system was analyzed for the maximum day plus fire flow demand based on philosophy stated in **Table 3.7 and 3.8** for the 7th and 9th Avenue booster pump stations, respectively. The maximum discharge capacity of all pumps in correlation with the ASDs was used.

Simulation runs were carried out to establish the available fire flow at a minimum pressure of 140 kPa at all locations within the Town of Cardston water distribution system. The results for the existing maximum day demand plus fire flow are illustrated on **Figure 3.4**. The available fire flows were compared to the recommended minimum required fire flows of 230 L/s for non-residential areas, 135 L/s for multi-family residential, and 115 L/s for single family residential, as indicated in **Section 3.4.2**.

Based on simulations, fire flows were inadequate at 25 locations within the system. **Figure 3.4** shows nodes or junctions with hydrants that failed fire flow tests for 135 L/s. Areas of low flow were primarily in the eastern half of the Town including the school site, commercial/downtown area, and hospital. Also, the northwest quadrant of the Town had a limitation with regard to adequate fire flow.

### 3.5.4 System Deficiencies

Using the Fire Underwriter Survey "Water Supply for Public Fire Protection, A Guide to Recommended Practice", it was assumed that the water distribution system should be able to provide 230 L/s to non-residential areas for fire protection. The existing system cannot provide adequate fire flows to the extreme ends of the distribution system. Most residential areas have adequate fire flows but there are some non-residential areas that still lack adequate fire flows due to close proximity to the residential areas resulting in having smaller pipe sizes.

### 3.5.5 System Improvements

The main deficiencies in the Town of Cardston water distribution system were further evaluated for improvement alternatives. The improvement alternatives for the existing system will focus on providing adequate fire flows through the Town water system including institutional and commercial areas.

The available fire flows in the Town of Cardston range from 40 to 250 L/s. As shown on **Figure 3.4**, most of the residential areas at the center of the Town have adequate fire flows. These areas are mostly gravity fed and would require further improvements to increase fire flows to some neighboring hydrants.

For the existing system, the main upgrades were considered only for main lines in the water distribution system where upgrades would be the most cost effective and provide the greatest benefit. The upgrades required to improve local deficiencies should be considered as secondary upgrades, and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**EXISTING WATER DISTRIBUTION SYSTEM**
**PEAK HOUR DEMAND**
**FIGURE 3.3**


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# EXISTING WATER DISTRIBUTION SYSTEM
# MAXIMUM DAY PLUS FIRE FLOW - 85 PSI
# FIGURE 3.4

could be implemented in conjunction with pipe replacement or local road improvements. Some of the local deficiencies in the existing system are solved in the future scenarios, due to additional looping in the system. Therefore, upgrades are not recommended for these local deficiencies.

Proposed system upgrades required to provide adequate pressure and fire flows to the existing system are shown on **Figure 3.5**. **Table 3.12** summarizes the proposed upgrades to the existing system.

**Table 3.12: Proposed Water Main Upgrades**

| From Node | To Node | Upgraded Pipe Diameter (mm) | Length (m) |
|---|---|---|---|
| J-81 | J-82 | 200 | 199 |
| J-82 | J-262 | 200 | 74 |
| J-262 | J-83 | 200 | 112 |
| J-43 | J-56 | 200 | 114 |
| J-23 | J-119 | 200 | 92 |
| J-119 | J-9 | 200 | 109 |
| J-9 | J-96 | 200 | 186 |
| J-166 | J-174 | 200 | 104 |
| J-143 | J-195 | 200 | 95 |
| J-195 | J-196 | 200 | 185 |
| J-196 | J-197 | 200 | 187 |
| J-197 | J-198 | 200 | 130 |
| J-16 | J-2 | 200 | 201 |
| | | **TOTAL** | **1,788** |

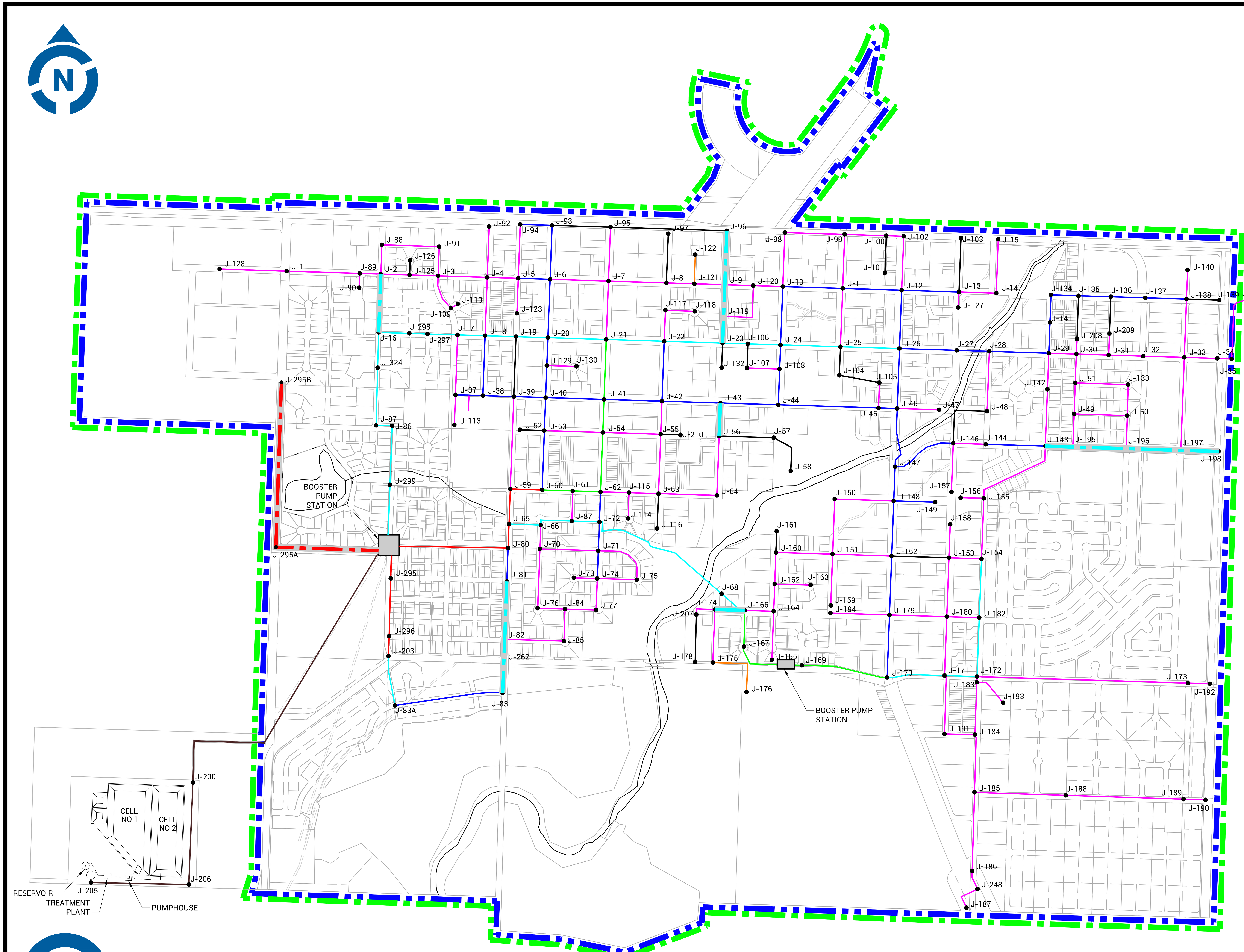
As indicated in **Table 3.12**, approximately 1,788 m of pipe upgrades are required, with the replacement pipe diameters of 200 mm. The existing pipe diameters are 150 mm.

### 3.5.6 Water Treatment Plant

As part of the infrastructure master plan preparation, Talbera reviewed the performance of the Town of Cardston's Water Treatment Plant by conducting an interview with plant operators to ascertain a current operational issue. Recommended upgrades in the 2009 mater plan report has been completed to date and the plant is in good condition and operating at reasonably high efficiency. In order to further improve the plants efficiency, a raw water pre-treatment system is recommended. This would reduce the pressure on the existing rapid sand filters and reduce process chemical use. A feasibility study on a pre-treatment system is recommended.

#### 3.5.6.1 Maximum Day Demand plus Fire Flows - Upgraded System

With the proposed pipe upgrades, indicated in **Figure 3.5**, the water distribution system was analyzed for the maximum day plus fire flow demand. The simulation results are indicated on **Figure 3.6**. The required flow for the existing development conditions supplied by two pumps at the 7$^{th}$ Avenue booster pump station with approximately 55 L/s with 25 m of head each. This boosts up the gravity flow from the reservoir to supply adequate fire flows to the northwest section of Town. It should be noted that




## LEGEND

- STUDY AREA
- TOWN BOUNDARY
- J-173 SCHEMATIC NODE
- LESS THAN 100 mm SCHEMATIC PIPE
- 100 mm SCHEMATIC PIPE
- 150 mm SCHEMATIC PIPE
- 200 mm SCHEMATIC PIPE
- 250 mm SCHEMATIC PIPE
- 300 mm SCHEMATIC PIPE
- 350 mm SCHEMATIC PIPE
- PROPOSED 200 mm SCHEMATIC PIPE
- PROPOSED 250 mm SCHEMATIC PIPE
- UPGRADES

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**EXISTING WATER DISTRIBUTION SYSTEM PLUS IMPROVEMENTS**

**FIGURE 3.5**


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**INFRASTRUCTURE MASTER PLAN**

**EXISTING WATER DISTRIBUTION SYSTEM**
**MAXIMUM DAY PLUS FIRE FLOW WITH IMPROVEMENTS**
**FIGURE 3.6**

existing capacity of the distribution pumps operating at both booster pump stations are sufficient to meet the existing peak hour demand.

For simulating the available fire flows, the upgraded fire pump at the 7th Avenue booster pump station was assumed to be in operation at a maximum pressure of 550 kPa. Based on the simulations, the availability of fire flow is inadequate at 20 out of 61 hydrant locations. As indicated on **Figure 3.6**, several of the nodes fall within the contours showing that they do not have the required fire flows in areas identified for future redevelopment or close to areas planned for new development. Future pipe systems for the new east and west area redevelopment would connect or loop through existing pipe lines with failed fire hydrants to increase fire flows. The remaining nodes are localized problems, with fire flows within approximately 10% of the required flows; the main system deficiencies have been resolved. The simulated fire flows for the upgraded existing system at selected nodes are summarized in **Table 3.13**.

**Table 3.13: Available Fire Flow at Selected Nodes – Existing Development Condition with Upgrades**

| Node Number | Required Fire Flow (L/s) | Existing System | | Upgraded System | |
|---|---|---|---|---|---|
| | | Available Fire Flow (L/s) | Minimum Residual Pressure (kPa) | Available Fire Flow (L/s) | Minimum Residual Pressure (kPa) |
| J-136 | 115 | 117 | 140 | 129 | 140 |
| J-143 | 230 | 105 | 140 | 108 | 140 |
| J-144 | 115 | 141 | 140 | 143 | 140 |
| J-93 | 230 | 30 | 140 | 130 | 140 |
| J-196 | 115 | 99 | 140 | 112 | 140 |

As indicated in **Table 3.13**, although there are nodes still failing the fire flow requirements, the available flow has been significantly improved. The nodes will receive additional flow as future development occurs, providing additional looping in the system.

In areas that receive adequate fire protection from adjacent hydrants, system improvements are not recommended and the nodes are shown to meet the fire flow requirements from the adjacent hydrants.

## 3.6 Future Water Servicing

The future development scenarios were analyzed using the existing system and improved system with recommended upgrades implemented. The future developments included in this study are the East and West Cardston redevelopment areas.

### 3.6.1 Storage Reservoir

As indicated in **Section 2.5.1.2,** the Town of Cardston's reservoir requires a fire storage volume of 2484 $m^3$. The overall storage requirements for the ultimate development conditions are summarized in **Table 3.14**.

**Table 3.14: Water Storage Requirements for Ultimate Development Condition**

| Description | Volume ($m^3$) |
|---|---|
| Fire Storage (230 L/s for 3.0 hours) | 2,484 |
| Equalization Storage: Approximately 25% of Maximum Day Demand (Maximum Day Demand = 193 L/s) | 4,169 |
| Emergency Storage: Minimum of 15% of Average Day Demand (Average Day Demand = 55 L/s) | 713 |
| **TOTAL** | **7,366** |

As indicated in **Table 3.14**, the storage required for the ultimate development condition does not exceed the available storage capacity of 9080 $m^3$. Therefore, it is likely that reservoir expansion will not be required. This corresponds to a population of approximately 6900 people.

### 3.6.2 Booster Station Facilities

The future pumping requirements for the Town of Cardston are based on current population and projected growth estimated from the East and West Area Redevelopment plans. The pumping requirements for the Town are summarized in **Table 3.15.**

**Table 3.15: Pumping Requirements (combined booster pump stations)**

| Demand Scenario | Existing (L/s) | Future (L/s) |
|---|---|---|
| | | Ultimate |
| Average Day Demand | 34.5 | 55 |
| Peak Hour Demand | 172.5 | 275 |
| Maximum Day Demand | 121 | 193 |
| Fire Flow | 230 | 230 |
| MDD Plus Fire Flow | 351 | 423 |

As indicated in **Table 3.15**, the maximum day plus fire flow required for the ultimate development condition is approximately 423 L/s. This flow will be delivered by gravity and the two booster pump stations, which are the current means of distribution.

### 3.6.3 Water Distribution System

The system was evaluated for the ultimate development scenario. The pipe layout for the future water distribution system was based on available area structure plans, as listed in **Section 3.1.1**. It was assumed that the existing area structure will not be restructured to drastically increase the population in this area. The proximity of the booster pump stations to the new area to be redeveloped makes it possible to keep the integrity of most of the existing distribution system.

For the East Area Redevelopment Plan, new water mains will connect to the existing water main at 9$^{th}$ Avenue and 2$^{nd}$ Street. A section of the 150 mm PVC pipe under Sugar Street, currently connected to the 250 mm water main from the 9 Avenue booster pump station will require 250 mm pipe upgrade to provide sufficient capacity for the new east area. The pipe sizes required to service the future development shall comply with the Town's Municipal Engineering Standards. Although the staging of the development may change, the ultimate pipe sizing will remain the same for the existing system with the exception of recommended improvements stated in Section 3.5.5.

The existing pipes close to the West Area Redevelopment have the capacity to supply water to the new development. The 350 mm cast iron pipe that terminates at 11$^{th}$ Street West and 9$^{th}$ Avenue west can provide water supply to the southern section of the west redevelopment. The existing 250 mm water main heading north from the 7$^{th}$ Avenue booster pump station has the capacity to supply water to the northern portions. Once the lands surrounding these areas are developed, additional loops will be provided and the fire flow requirements will be satisfied.

Since the development staging is unknown at this time, the pipes have not been oversized to support additional redevelopment that will result in population increase beyond the estimated 6900 at full build-out. The discharge pressure setting should be approximately 550 kPa and 650 kPa for the 7$^{th}$ Avenue west booster pump station and 9$^{th}$ Avenue east booster pump station, respectively.

In the ultimate development scenario, all fire flow requirements are satisfied. The peak pressure during peak hour demand is approximately 670 kPa.

## 3.7 Cost Estimates

This section details the costs of the improvements. Costs are in order of magnitude and based on 2017 dollars and include installation, cost for all fittings, 15% for contingencies and 10% for engineering.

### 3.7.1 Water Treatment Plant Upgrades

Conduct a Feasibility Study at the Water Treatment Plant to improve the raw water quality entering the plant. This would reduce the burden on the existing rapid sand filters and prolong backwash times. This would be a raw water pre-treatment effort.

Base on future fire flow demands for the West Area development, Talbera is proposing the water service to the industrial area be loop with a 250mm pipeline water distribution system upgrades figure. This would also require additional upgrade to the 7$^{th}$ avenue booster pump station in order to provide industrial fire flows to the West Area. The total estimated cost for the pump upgrades is in the order of $250,000. The pump station upgrade at the 7$^{th}$ Avenue booster pump station is required for future development condition.

### 3.7.2 Distribution Mains & Pumps

Cost estimates for the proposed pipe upgrades are summarized **in Table 3.16**. The improvement costs include the pipe cost, as well as the installation, fittings and restoration costs.

**Table 3.16: Cost Estimates - Proposed Pipe Upgrades**

| Upgrades | Length | Total Cost ($) |
|---|---|---|
| | | **Existing System** |
| Diameter 200mm Pipe | 1778 m | $1,778,000 |
| 7th Avenue Pump Station & Pipe Upgrade | | $675,000 |
| | **Sub-Total** | **$2,453,000** |
| | **15% Contingencies** | **$368,000** |
| | **10% Engineering** | **$244,000** |
| | **Total** | **$3,065,000** |

As indicated in **Table 3.16**, the cost for the pipe upgrades for the existing system, including restoration, is approximately **$3,065,000**. The costs for the pipes required to service new development areas for the ultimate development conditions are assumed to be the developer's cost and are not include.

# 4 SANITARY SYSTEM ASSESSMENT

## 4.1 General

The Town of Cardston has requested an assessment and upgrade requirement of the existing sanitary sewer system including capacity of existing condition. The major recommendation made in the 2009 Infrastructure Master Plan had been completed including those that would support the future interim development areas. The existing sanitary model was updated for the Town to assess the existing system performance under these conditions. Improvements to the sanitary system since 2009 was provided by the Town. New sanitary flow measurements were also taken in 2015 and 2016 and was used to update and calibrate the existing model. This review and update includes analysis of the system to determine its capacity to service future growth areas. This section of the report discusses the sanitary servicing and necessary improvements to the existing sanitary system.

## 4.2 Study Data

The following documents and data were used to define the existing sanitary system of the Town of Cardston:

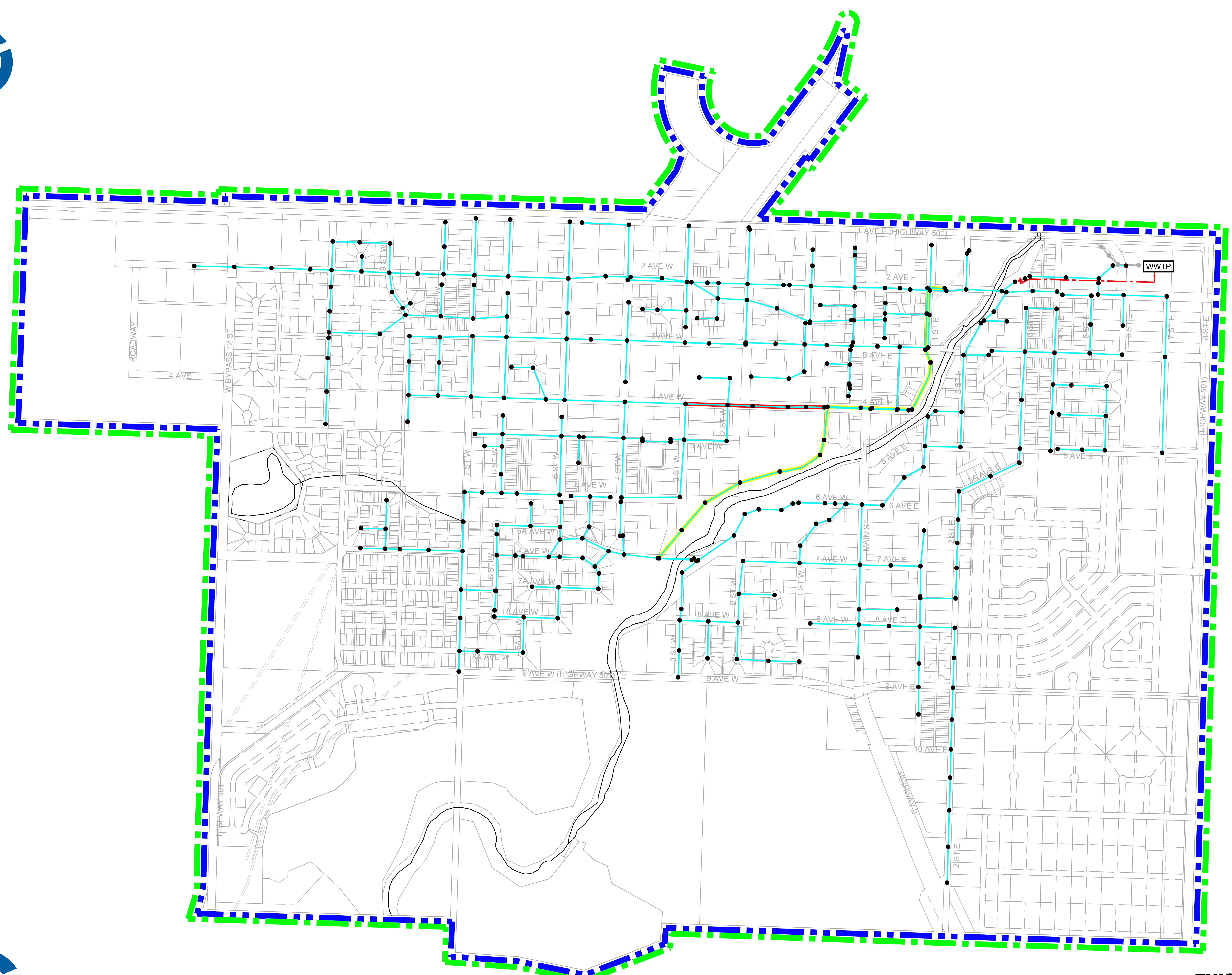
- “Standards and Guidelines for Municipal Waterworks, Wastewater and Storm Drainage Systems” (Alberta Environment Protection, April 2012
- City of Lethbridge Municipal Engineering Standards, February 2016 Edition
- Design drawings supplied by the Town of Cardston
- Aerial photos, and topographical map
- Field survey data of manholes and pipes (Provided by Town of Cardston)
- Sanitary Sewer Flow Monitoring Report (Provided by Town of Cardston., 2015 and 2016).

## 4.3 Existing System Modelling and Assessment

This section outlines the development of a detailed model for the sanitary sewer system and the assessment of the hydraulic performance under existing conditions.

### 4.3.1 Existing System Description

The existing sanitary sewer system and service area is shown on **Figure 4.1A and 4.1B.** The sanitary system consists of approximately 36 km of gravity sewer mains, terminating at a lift station which conveys sewer to the wastewater treatment plant. The lift station is located at the northeast section of Town as indicated on Figure 4.1A.




## LEGEND

- STUDY AREA
- TOWN BOUNDARY
- EXISTING FORCEMAIN
- EXISTING MANHOLE AND PIPE
- EXISTING LIFT STATION
- WWTP — EXISTING WASTEWATER TREATMENT PLANT
- CENTRAL SANITARY TRUNK
- NORTHWEST SANITARY TRUNK

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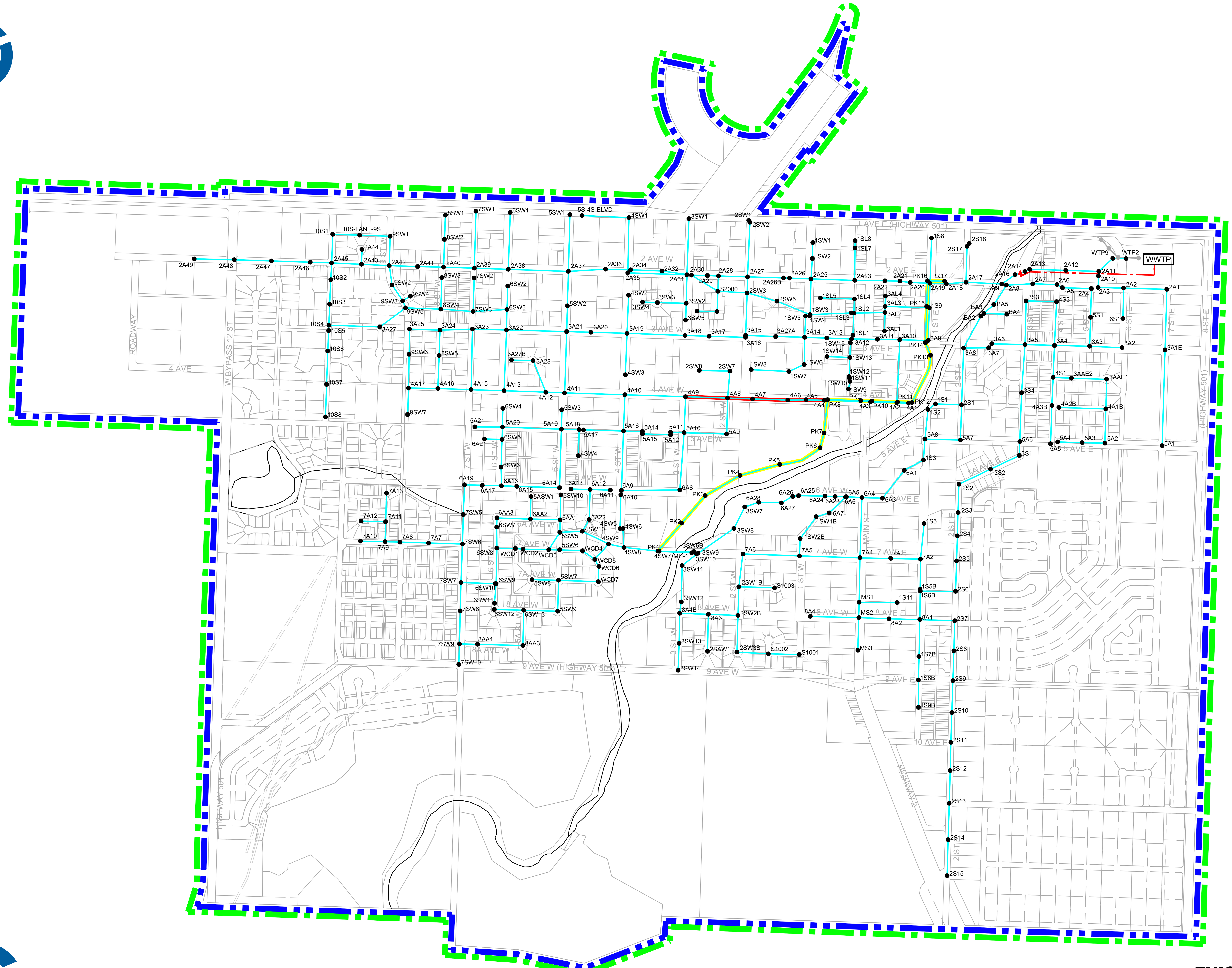
# EXISTING SANITARY SEWER SYSTEM A

**FIGURE 4.1A**




## LEGEND

STUDY AREA
TOWN BOUNDARY
EXISTING FORCEMAIN
EXISTING MANHOLE AND PIPE
EXISTING LIFT STATION
WWTP EXISTING WASTEWATER TREATMENT PLANT
CENTRAL SANITARY TRUNK
NORTHWEST SANITARY TRUNK

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# EXISTING SANITARY SEWER SYSTEM B

FIGURE 4.1B

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File Name: P:\2015-0911-CAR_GENERAL ENGINEERING\004-IMP\400 - WORK IN PROGRESS\CAD&D\02_CIVIL-C\0911-01-C-712 - EXISTING SANITARY B.DWG Saved By: Marnie Nagy Print Date: 8:32 PM August 3, 2017

All three pumps at the lift station servicing the Town have been upgraded since the 2009 IMP Report. The new pump data for the lift station was provided by the Town of Cardston. Each dry well pump (Vaughan SC8B) has a discharge capacity of 0.126 $m^3/s$ (2000 US GPM) at 24.6 m (80.6 ft of head).

The wastewater treatment plant is located northeast of the Town and south of Highway 501 or 1st Avenue East. The plant has a treatment capacity of 4450 $m^3$/day with a peak hydraulic capacity of 11,300 $m^3$/day.

A new pump lift station and force to the St. Mary River was completed in 2011 to discharge treated waste water effluent. The new lift station has four (4) submersible pumps and the force main pipe material is 600 PVC

### 4.3.2 Existing System Model

The model was updated using SewerCAD. The dry weather and wet weather flows, in addition to routing total flows through the sanitary sewer system was updated. The model was built using design drawings of developed areas provided by the Town of Cardston and geodetic survey data of manholes and pipes provided by the Town of Cardston. Approximately 36 km of sewer and 357 manholes have been included in the model.

No new information on the conditions inside the sewer pipes was obtained and the existing information was out of that and not comprehensive so the pipes were assumed to be free of debris, silt and obstructions. Ground elevations and inverts of the manholes were generated from survey and field data. Sanitary pipe diameters were recorded during field surveys at manhole locations and they were assumed to maintain the same diameter from manhole to manhole. Sample The inverts of these sewer lines were determined by measurements, therefore slopes used in the model were actual existing slopes assuming the pipes were on a consistent grade between manholes.

The existing sewage generation rates were based on the average water consumption data from 2012 to 2016 for the Town of Cardston. Meter readings from high end users were analyzed and incorporated into the model. The non- residential sewage generation rate of 6000 L/ha/d was used for this model which is considerably lower than the standard of 30,000 L/ha/d. Existing residential and non-residential peaking factors are defined by the “City of Lethbridge Municipal Engineering Standards”, 2008 Edition. **Table 4.1** outlines the existing sewage generation rates and peaking factors for residential and non-residential areas.

**Table 4.1: Existing Sewage Generation Rates and Peaking Factors**

| Land Use | Existing Sewage Generation Rate | Existing and Future Peaking Factor |
|---|---|---|
| Residential (L/d/person) | 553 | 1 + 14/(4+ (P/1000)0.5) |
| Non-Residential (L/d/ha) | 6000 | 3 |

The model of the existing sanitary system of the Town of Cardston was developed and its performance then analyzed.

### 4.3.3 Dry Weather Flow Model

An average single-family population density of 3.5 people/lot (26 people/ha) was determined based on the 2016 population and service area. As described in **Section 3.4.1**, existing development water consumption rates were based on average water consumption between 2012 and 2016 which also accounts for water supply to Moses Lake on the Blood Indian Reserve. A gross sewage generation rate of 494 L/c/d also was calculated from 2016 wastewater treatment plant data. After discussion with the Town, the non-residential sewage generation rate was lowered from the standard of 30,000 L/d/ha to 6000 L/d/ha due to the type of existing non-residential development.

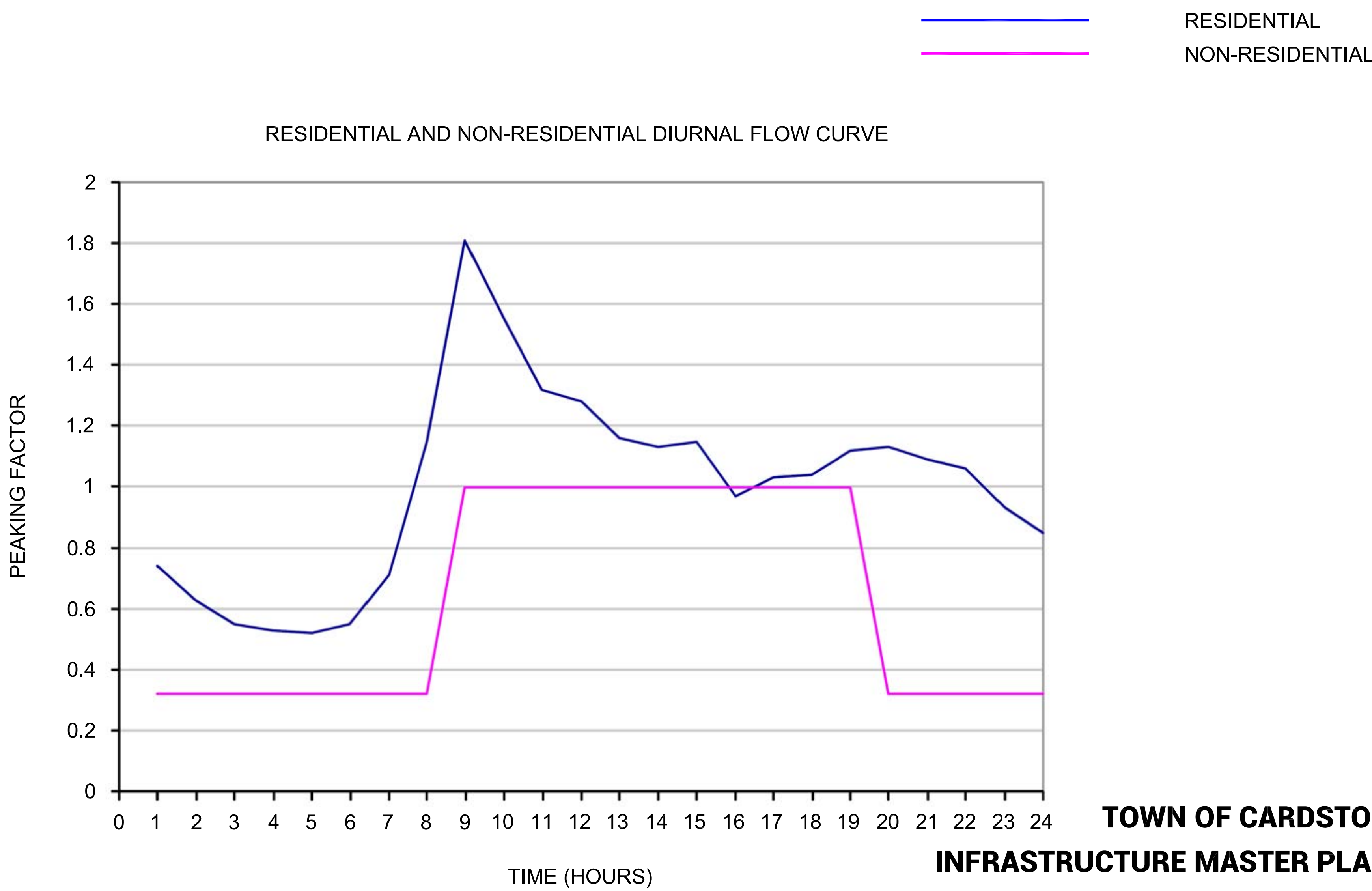
The dry weather flow for the existing residential basins within the Town was generated from a typical residential diurnal flow pattern, the residential sewage flow rate, the residential area, the residential population density and Harman's peaking factor. The modeled dry weather flows were determined for the **non-residential areas** using a typical non-residential diurnal flow pattern, an estimated non-residential sewage flow rate (described in **Table 4.1**), and an existing non-residential peaking factor of 3 was assumed. Diurnal flow patterns for the residential and non-residential areas were developed using flow monitoring data. The diurnal flow patterns are shown in **Figure 4.2**.

### 4.3.4 Wet Weather Flow Model

The Town of Cardston perform sanitary sewer flow monitoring. Data from the flow monitoring report was used for this model. The flow data obtained during the monitoring period (2015) was intended for the wet weather flow model; however, due to a very small rainfall event during the monitoring period, monitoring continued in 2016. The wet weather flows were simulated by generating an infiltration and inflow (I/I) flow component of 0.28 L/s/ha over the residential and neighborhood commercial areas. An industrial and commercial area I/I rate of 0.07 L/s/ha was used based on comparable Town standards.

A second scenario was also simulated by directing two percentage of a 1 in 5-year four-hour Chicago storm into the sanitary system. This was done to simulate the known connection of weeping tiles to the sanitary system which contributes to high flows during rainfall. Field observations reported by the Town of Cardston were incorporated into this scenario as the desired model output. The percentage of 1 in 5-year four-hour Chicago storm being directed into the sanitary system was altered until the observed field results were obtained. This scenario had a greater impact on the capacity of the sanitary system and was therefore used as a wet weather flow model.

## LEGEND

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**INFRASTRUCTURE MASTER PLAN**

**DIURNAL FLOW CURVES**

**FIGURE 4.2**

## 4.4 Existing System Evaluation

The existing system was evaluated to assess the system performance with the proposed sewage generation rates by examining the following parameters:

- The capacity utilization within the system to identify potential locations where pipe flow exceeds pipe capacity
- The hydraulic grade line within the system to identify potential surcharge locations.

The magnitude of surcharging at manholes was calculated by subtracting the maximum hydraulic grade line (HGL) elevation from the ground elevation and was divided into three levels as outlined in **Table 4.2.**

**Table 4.2: Surcharging Levels**

| Rating | Depth of HGL Below Ground |
|---|---|
| Green | > 2.5 (m) |
| Magenta | 1 – 2.5 (m) |
| Cyan | 0 – 1 (m) |

The capacity utilization in the pipes was calculated by taking the ratio of the peak flow in the pipe to the pipe capacity and was divided into three levels as outlined in **Table 4.3**. Red indicates that the pipes are above capacity and should be upgraded, blue is the cautionary range and green indicates that capacity is available.

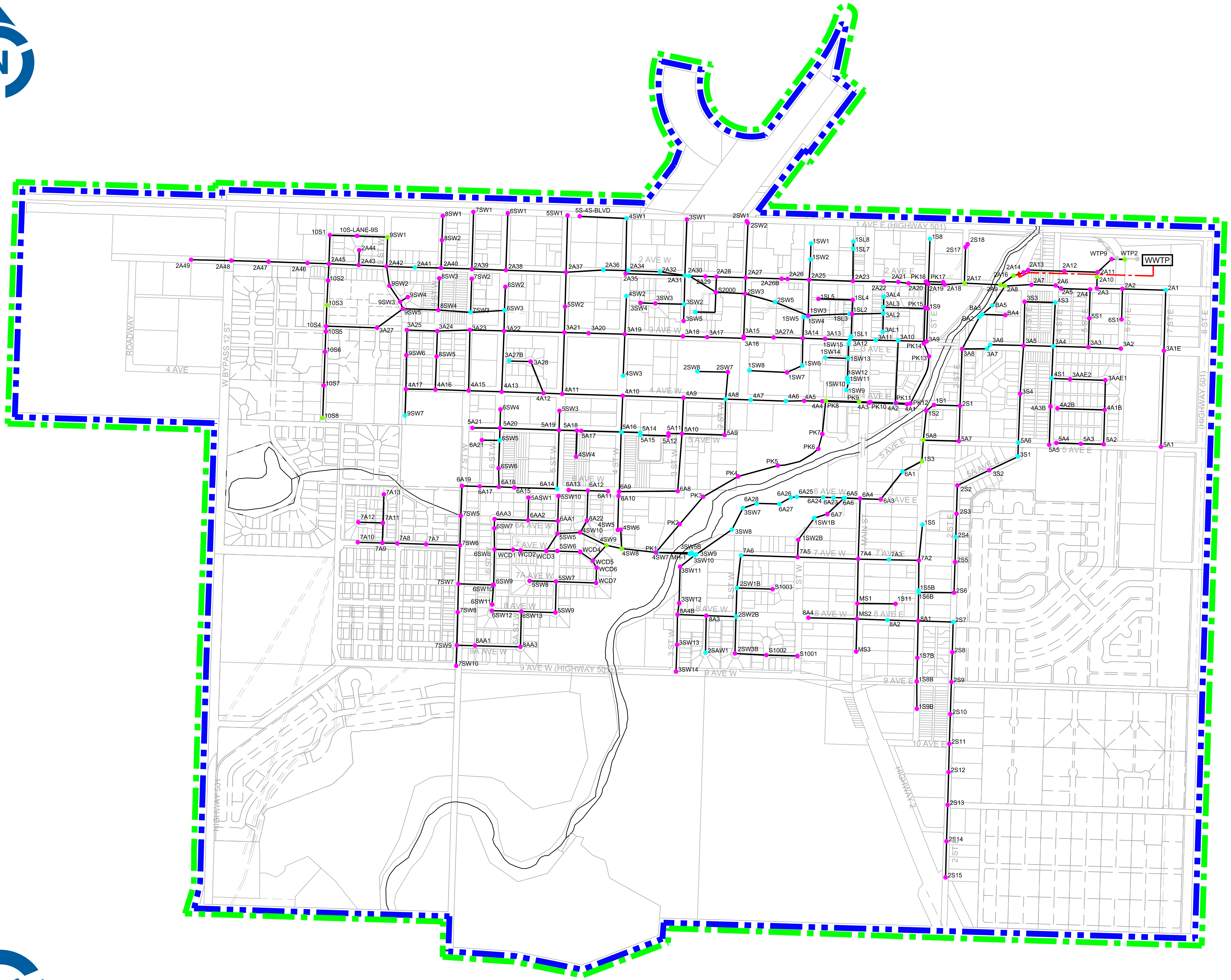
**Table 4.3: Capacity Utilization Levels**

| Rating | Peak Flow / Pipe Capacity |
|---|---|
| Black | 0 – 1.2 |
| Blue | 1.2 – 2 |
| Magenta | > 2 |

The surcharge and capacity utilization levels in the existing system for dry weather flow and wet weather flow are shown in **Figures 4.3 and 4.4**. The colour of the manholes indicates the level of surcharging and the colour of the pipes indicates the capacity utilization.

### 4.4.1 Dry Weather Flow Results

The modelling results for the existing system under dry weather conditions are shown on **Figure 4.3**. **Figure 4.3** show several manholes in magenta and several are cyan, indicating that the hydraulic grade line is between 1 and 2.5 m and less than 1.0 m from the ground level, respectively. However, some sewer manholes are shallow and the maximum hydraulic grade line is still within the depth of the manhole. The existing system has sufficient capacity to convey dry weather flow.



## LEGEND

- STUDY AREA
- TOWN BOUNDARY
- EXISTING FORCEMAIN
- EXISTING LIFT STATION
- WWTP — EXISTING WATER TREATMENT PLANT
- PIPE CAPACITY UTILIZATION 0% - 120%
- PIPE CAPACITY UTILIZATION 120% - 200%
- PIPE CAPACITY UTILIZATION > 200%
- DEPTH BELOW GROUND TO HGL 0 - 1.0m
- DEPTH BELOW GROUND TO HGL 1.0 - 2.5m
- DEPTH BELOW GROUND TO HGL > 2.5m

## NOTES

1. NO MANHOLE IN THE SYSTEM OVERFLOWS.

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TOWN OF CARDSTON
INFRASTRUCTURE MASTER PLAN

## EXISTING SANITARY SEWER SYSTEM
## DRY WEATHER FLOW
## FIGURE 4.3

### 4.4.2 Wet Weather Flow Results

The modelling results for the existing system for wet weather flow, using a small portion of a 1 in 5-year Chicago storm and peak sanitary loads, are shown **on Figure 4.4**. Several nodes are blue indicating that the hydraulic grade line is between 1 and 2.5 m of the ground level. There were also a few red manholes; however, these are shallow sewers and are not surcharging. The wet weather flow model results indicated isolated flooding which is represented by the blue color on **Figure 4.4**.now indicates that the flooded locations include the intersection of Main Street and 6th Avenue West which is also a depression zone, have improved significantly with the model indicating higher surges but no overflows from manholes. In the model, the lift station was replaced with an outfall evaluate pipe sizes and surcharges. This assumption, when used to size the pipes prevented excessive surcharging in pipes connected to the lift station. The pump replacement program for the existing lift station has been completed. This increased the pumping capacity to 32,700m$^3$/day. The higher the pumping capacity at the lift station, the less likely it is for the connecting pipes to surcharge. The total volume of wastewater conveyed to the lift station during wet weather flows cannot be reasonably estimated due to the lack of information on weeping tiles connected to the sewer system. The existing system does not have sufficient capacity to convey the excessive wet weather flow.

In addition to increased pumps and pipe capacity, the Town may want to consider other ways of diverting storm water away from the sanitary system.

## 4.5 Future Development Plan

**Figure 4.5** shows the future development areas, and a conceptual sewer servicing layout in the Eastern and Western sections of the Town. These new developments are mostly residential areas with an industrial area in the northwest sector of the Town. Connections to existing systems were placed where areas could best be serviced by gravity, as well as where capacity is available.

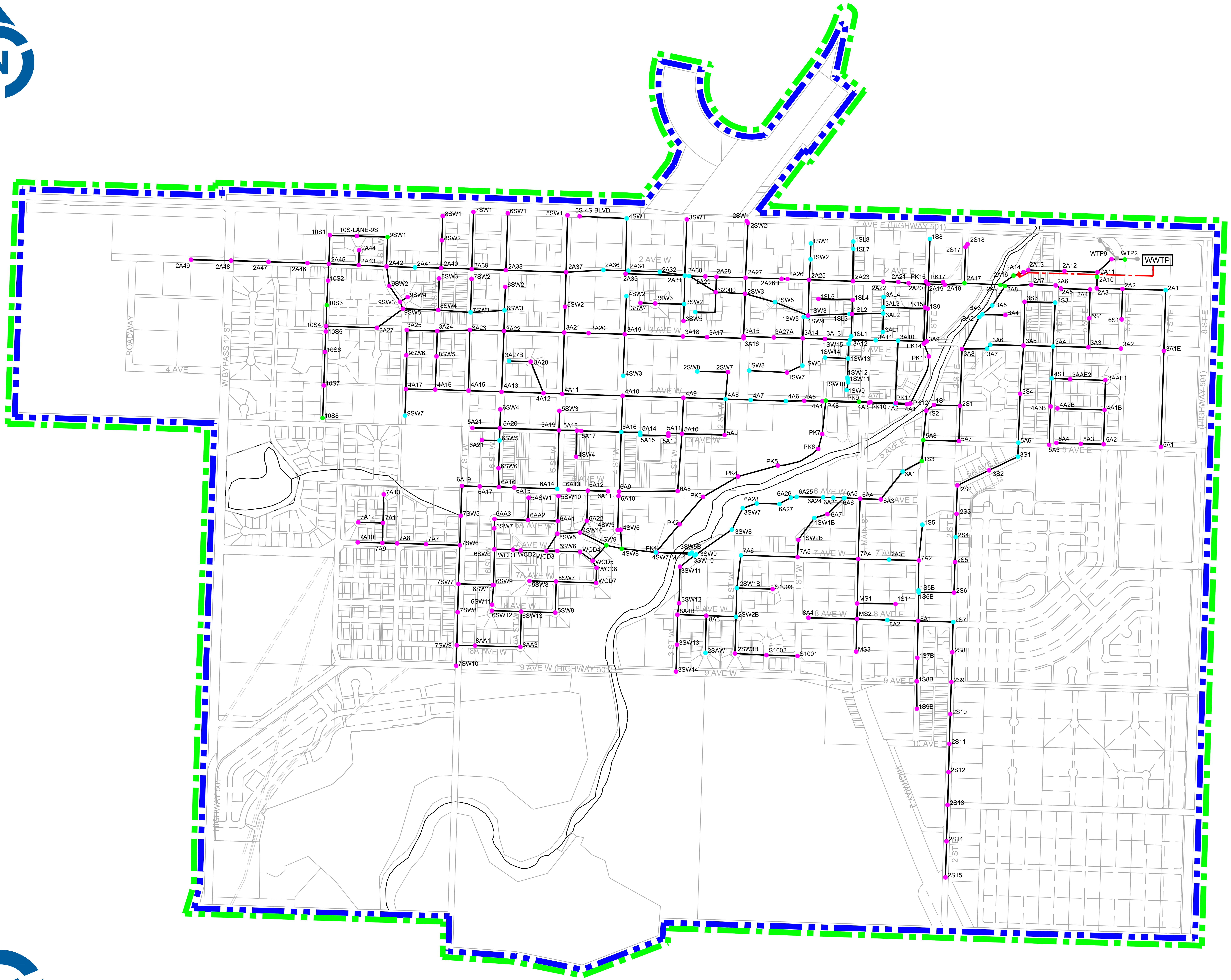
## 4.6 Future Modelling and System Assessment

The surcharge level and capacity utilization for the future development scenarios with no improvements to the existing system were evaluated for dry weather flow or for wet weather flow conditions. The impact of future development was then evaluated using the upgraded scenario.

### 4.6.1 Future System Description

Future development for the Town of Cardston is discussed in **Section 2.3** of the report. The East and West Cardston area redevelopment plans have areas sectioned into A, B, C and D as shown in the West Cardston Area Structure Plan and East Cardston Area Redevelopment Plan prepared by Oldman River Regional Services Commission. The conceptual connections servicing future development to the existing sanitary system are described as follows:

- The future industrial area in the northwest section of Town and south of Highway 501 connects to manhole 2A49 or 10S4 on Second and Third Avenue West, respectively
- Future residential areas A and B of the west redevelopment plan connects to manhole




## LEGEND

| | |
|---|---|
| | STUDY AREA |
| | TOWN BOUNDARY |
| | EXISTING FORCEMAIN |
| | EXISTING LIFT STATION |
| WWTP | EXISTING WATER TREATMENT PLANT |
| | PIPE CAPACITY UTILIZATION 0% - 120% |
| | PIPE CAPACITY UTILIZATION 120% - 200% |
| | PIPE CAPACITY UTILIZATION > 200% |
| | DEPTH BELOW GROUND TO HGL 0 - 1.0m |
| | DEPTH BELOW GROUND TO HGL 1.0 - 2.5m |
| | DEPTH BELOW GROUND TO HGL > 2.5m |

## NOTES

1. NO MANHOLE IN THE SYSTEM OVERFLOWS.

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**INFRASTRUCTURE MASTER PLAN**

# EXISTING SANITARY SEWER SYSTEM WET WEATHER FLOW
# FIGURE 4.4

7A10 on 7th Avenue West

- The future residential areas C of the west redevelopment plan connects to manhole 7SW9 at the intersection of 7th Street West and 8A Avenue West
- The future residential area D of the west redevelopment plan connects to manhole 7SW10 at the intersection of 9th Avenue West and 7th Street West
- The entire future east land redevelopment connects to manhole 5A at the junction of 5th Avenue East and 7th Street East
- A lift station is proposed to service the future industrial and residential areas of section A and B of the West Area Redevelopment. This is optional as the topography, may not provide reasonable depths for gravity pipes to be connected to manhole 7A10. This should be confirmed when deep utility infrastructure for new area plans are designed and grading plans are developed.
- A second lift station is proposed at the wastewater treatment plant to connect to manhole 2A1 at the intersection of 7th Street East and 2nd Avenue East. Flows from the East area redevelopment are proposed to be redirected to this lift station.

The conceptual design to service the future developments is shown in **Figure 4.5**.

### 4.6.2 Future System Model

The future system model used the existing system model as a base. The wet weather flow was estimated using the City of Lethbridge Municipal Design Standards.

**Table 4.4** outlines the existing and future sewage generation rates and peaking factors for residential and non-residential areas. The future sewage generation rates, as well as the future peaking factors, are defined by the “City of Lethbridge Municipal Engineering Standards”, 2016 Edition. The rate was lowered to 6000 L/d/ha after discussions with the Town of Cardston. However, if there is interest in industrial development that generates larger daily quantities of sewage, surcharging is like to occur in areas of existing development without further upgrades. The parameters used in the model for the existing and future servicing sanitary systems are listed in **Table 4.4.**

**Table 4.4: Existing and Future Sewage Generation Rates and Peaking Factors**

| Land Use | Existing Sewage Generation Rate | Future Sewage Generation Rate | Existing and Future Peaking Factor |
|---|---|---|---|
| Residential (L/d/person) | 609 | 550 | $1 + 14/(4+ (P/1000)^{0.5})$ |
| Non-Residential (L/d/ha) | 6000 | 6000 | 3 |


TOWN OF CARDSTON
INFRASTRUCTURE MASTER PLAN

## FUTURE SANITARY SERVICING

**FIGURE 4.5**

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## 4.6.3 Future System Evaluation

### 4.6.3.1 Dry Weather Flow Results

The modelling results for the future system under dry weather conditions are shown on **Figure 4.6**. Blue manholes nodes on the west trunk indicate that the hydraulic grade line is between 1 and 2.5 m below the ground/rim level. Nodes that are red on the west trunk indicate that the hydraulic grade line is less than 1 m from ground level. However, some of the sewers in other areas of the Town are shallow and are not surcharging as the maximum hydraulic grade line is still within the diameter of the pipe. There was very little impact on the existing system done by flows from the East Redevelopment area since it was isolated from the existing system and directed to a proposed new lift station.

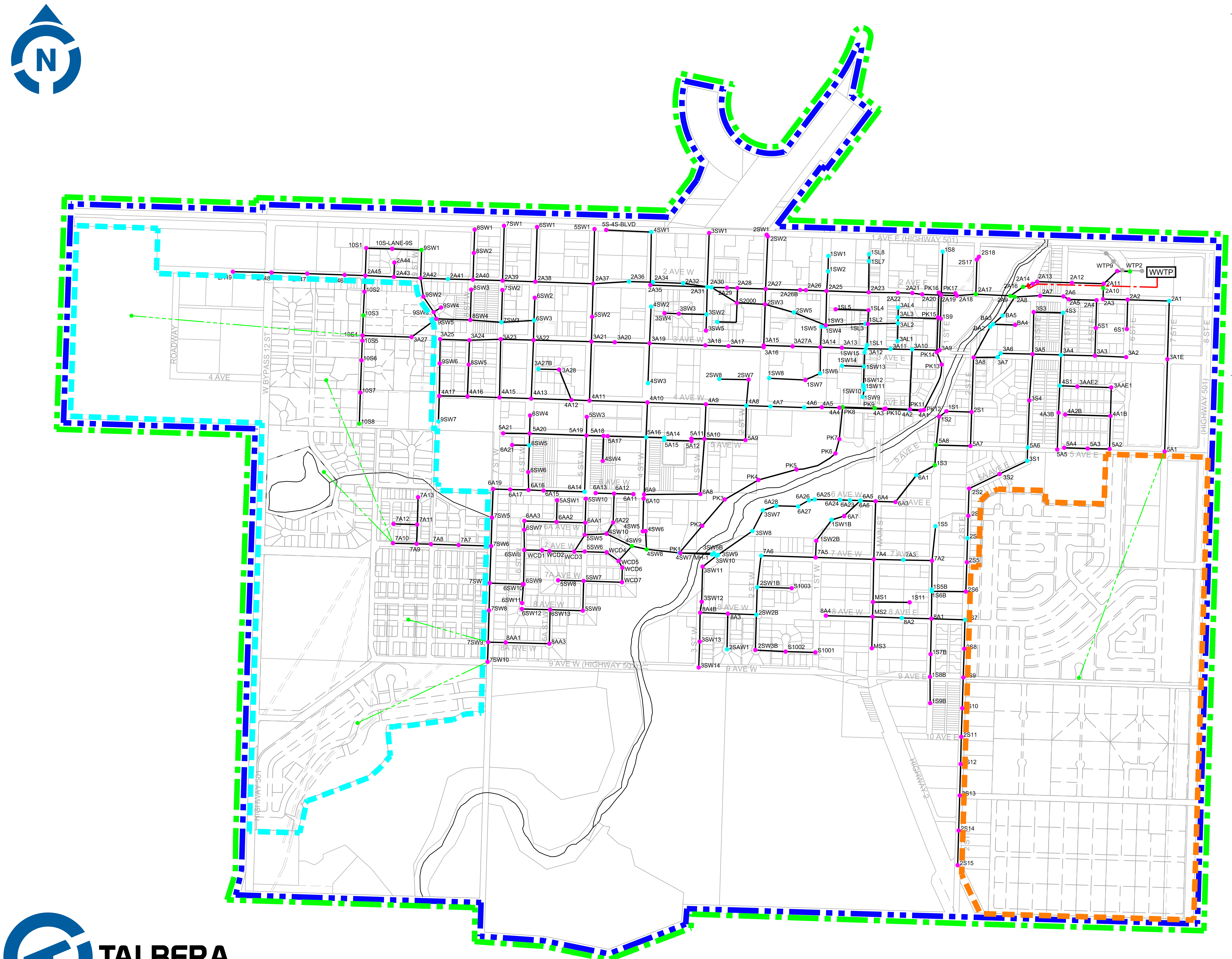
The West Area Redevelopment however, connects to manholes on the west side and has a hydraulic impact to the existing system. The hydraulic grade line increased in manholes between the intake structure of the south siphon and the intersection of 6$^{th}$ Avenue and Main Street. The number of blue colored manholes increased with the additional flow.

### 4.6.3.2 Wet Weather Flow Results

The modelling results for the future system under wet weather conditions are shown on **Figure 4.7**. Blue colored manholes nodes on sanitary trunks indicate that the hydraulic grade line is between 0 and 1.0 m of the ground level. Manholes that are colored blue on the west sanitary trunk running from the intake of the south siphon to Main Street indicate manholes that are surcharging but not overflowing. Other manholes that were colored blue in the dry weather flow scenario are now cyan. The red manholes have a hydraulic grade line of less than 1 m from ground level. The future wet weather flows that exceeded the capacity of the west trunk in the 2009 IMP has now been intercepted and diverted north through a new larger 600mm north sanitary trunk line which was completed in 2012. This has reduced the pressure on the existing siphon as all the sewer current flow north until a set hydraulic grade is reached. The section of the trunk crossing Main Street at 6$^{th}$ Avenue through to the existing lift station now has adequate capacity for estimated flows as a result of the recommended upgrades in the 2009 IMP report. The South syphon and connecting trunk now has adequate capacity for estimated flows since under normal peak hour flows, all the sewer is diverted away from crossing the south syphon, giving the pipe more capacity to handle localized flows with only minor surcharges compared to the 2009 when the manholes flooded and overflowed.

This section identifies system improvements and provides sanitary servicing requirements for future development. The basis for improvements was to maintain the hydraulic grade line at least 2.5 m below ground to prevent basement flooding. This is not true for existing shallow manholes with inverts that are 2.0 m from rim elevation.

The 600mm sanitary trunk crossing the Lee Creek north of the Town of Cardston to the lift station is currently in urgent need for upgrades. The 600mm pipe is clogged with debris to the point that conventional CCTV cameras can't make their way through due excessive high-water levels resulting from years of debris deposition. Since almost all the Town's sewage now takes this route to the lift station, a second redundant pipe crossing is eminent to avoid sewer back up during wet weather flow conditions.




## LEGEND

| | |
|---|---|
| | STUDY AREA |
| | TOWN BOUNDARY |
| | WEST AREA CONSTRUCTION PLAN |
| | EAST AREA REDEVELOPMENT PLAN |
| | EXISTING FORCEMAIN |
| | EXISTING LIFT STATION |
| WWTP | EXISTING WATER TREATMENT PLANT |
| | PIPE CAPACITY UTILIZATION 0% - 120% |
| | PIPE CAPACITY UTILIZATION 120% - 200% |
| | PIPE CAPACITY UTILIZATION > 200% |
| | DEPTH BELOW GROUND TO HGL 0 - 1.0m |
| | DEPTH BELOW GROUND TO HGL 1.0 - 2.5m |
| | DEPTH BELOW GROUND TO HGL > 2.5m |
| | FUTURE MANHOLE |
| | FUTURE CONNECTION |

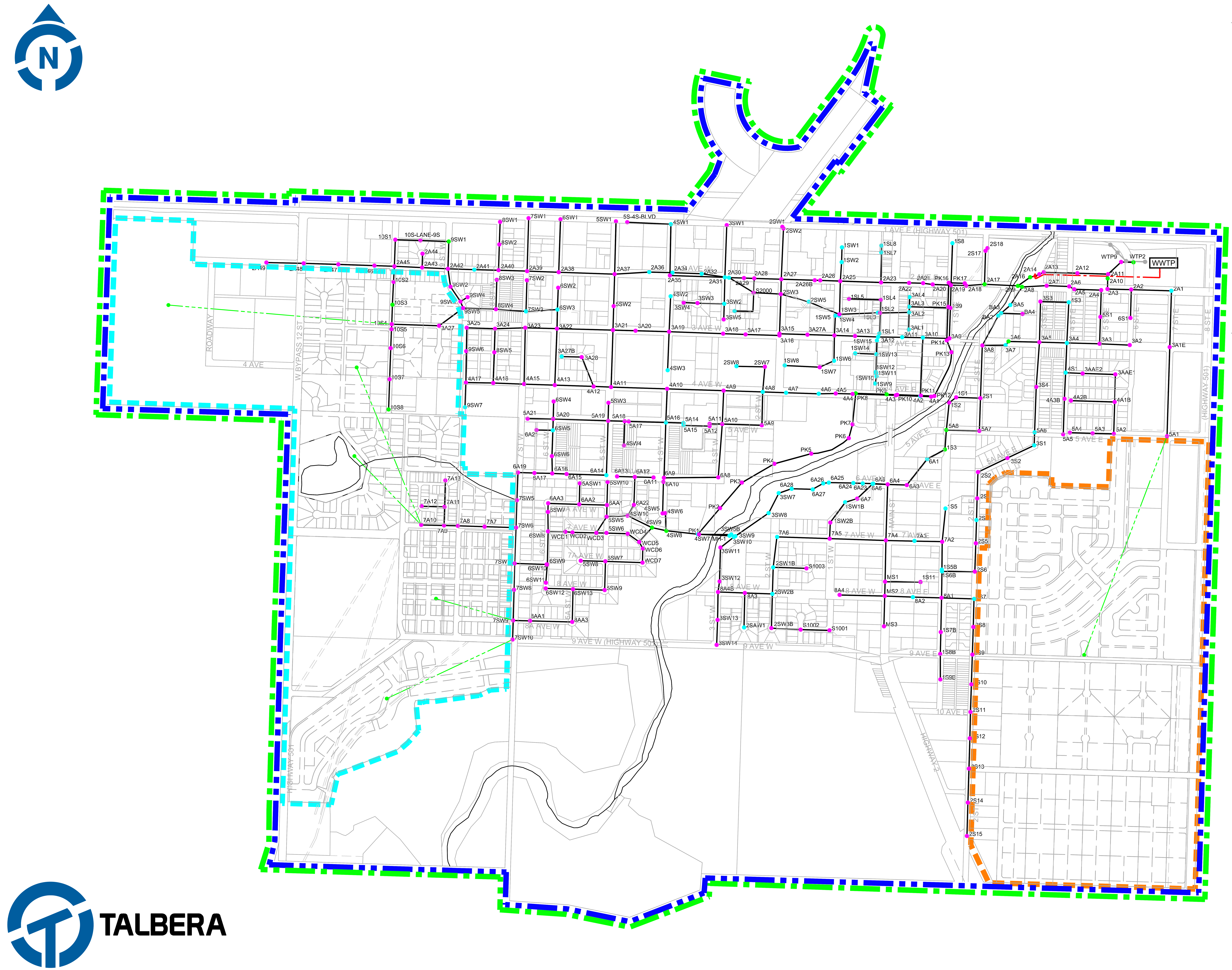
## NOTES

1. NO MANHOLE IN THE SYSTEM OVERFLOWS.

TALBERA

TOWN OF CARDSTON
INFRASTRUCTURE MASTER PLAN

# FUTURE SANITARY SERVICING
# DRY WEATHER FLOW
# FIGURE 4.6




## LEGEND

| | |
|---|---|
| | STUDY AREA |
| | TOWN BOUNDARY |
| | WEST AREA CONSTRUCTION PLAN |
| | EAST AREA REDEVELOPMENT PLAN |
| | EXISTING FORCEMAIN |
| | EXISTING LIFT STATION |
| WWTP | EXISTING WATER TREATMENT PLANT |
| | PIPE CAPACITY UTILIZATION 0% - 120% |
| | PIPE CAPACITY UTILIZATION 120% - 200% |
| | PIPE CAPACITY UTILIZATION > 200% |
| | DEPTH BELOW GROUND TO HGL 0 - 1.0m |
| | DEPTH BELOW GROUND TO HGL 1.0 - 2.5m |
| | DEPTH BELOW GROUND TO HGL > 2.5m |
| | FUTURE MANHOLE |
| | FUTURE CONNECTION |

## NOTES

1. NO MANHOLE IN THE SYSTEM OVERFLOWS.

TEMPLE CITY
CARDSTON ALBERTA

TOWN OF CARDSTON
INFRASTRUCTURE MASTER PLAN

**FUTURE SANITARY SERVICING**
**WET WEATHER FLOW**
**FIGURE 4.7**

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### 4.6.4 Existing System Improvements

Based on the assumed sewage generation rates, the existing sanitary system needs improvements in order to provide capacity for wet weather flows and on top of the list in the North Creek Sanitary Crossing Truck.

### 4.6.5 System Improvements for Future Development

Future development includes all projected future growth for the Town of Cardston as estimated from the new area structure plans.

Improvements on the existing system to service existing and future development are shown on **Figure 4.8.** Cost estimates are discussed in **Section 4.7**. Twinning of the North Creek Sanitary Truck is recommended to not only provide the Wet Weather Flow Capacity but to also provide the redundancy required in a truly resilient infrastructure system. The north creek crossing trunk line is a critical bottle neck in the Town's sanitary sewer collection system and must have redundancy consider the new truck upgrades already conveying sewer to this location.

The future developments east of the Town can be serviced by a lift station. This will reduce the load on the existing lift station and free some pumping capacity in an event of high wet weather flows. The peak flow for the proposed lift station is 53 L/s. The force main would need to be 200 mm in diameter based on a peak velocity of 2 m/s. **Figure 4.8** shows the conceptual location of the proposed lift station and the force main connection to the wastewater treatment plant.

Disconnecting existing weeping tiles from the sanitary sewer system will drastically reduce infiltration and inflow which contributes to the high wet weather sewer volumes. Residents could be asked to convert to sump pumps to convey weeping tile water to the storm system.

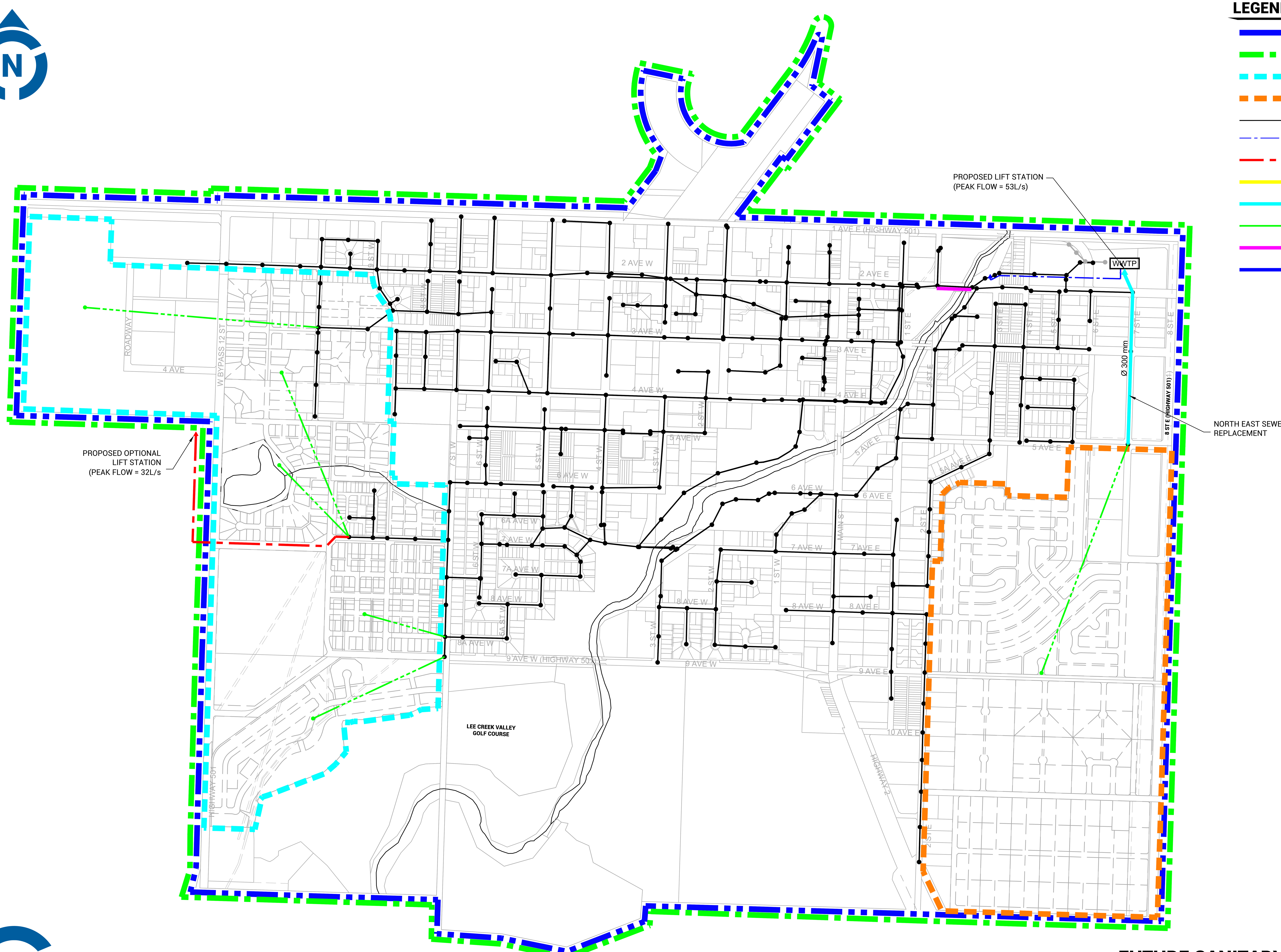
In order to sustain the proposed future development, the Wastewater Treatment Plant (WTP) would need an upgrade to increase its current treatment capacity from 4450m$^3$/day to 8500m$^3$/day.

## 4.7 Cost Estimate

Cost estimates are in 2009 dollars, and include allowances of 10% for engineering and 15% for contingency. There are no existing system improvements necessary to service the existing system. However, the existing system should be improved to service future developed areas. The cost of these improvements is summarized in **Tables 4.5-4.7.**

**Table 4.5: Order-of-Magnitude Cost Summary for Sanitary Sewer Improvements**

| Improvement | All Future Servicing<br>New Installation Cost |
|---|---|
| North Creek Crossing Sanitary Sewer Trunk | $846,000 |
| NE Sanitary Sewer Trunk | $414,000 |
| NE Lift Station | $962,000 |
| NW Lift Station and Force main | $1,342,000 |
| **Totals** | **$3,564,000** |




## LEGEND

- STUDY AREA
- TOWN BOUNDARY
- WEST AREA CONSTRUCTION PLAN
- EAST AREA REDEVELOPMENT PLAN
- EXISTING MANHOLE AND PIPE
- EXISTING FORCEMAIN
- PROPOSED OPTIONAL FORCEMAIN
- PROPOSED SYPHON UPGRADE (2 x Ø 450 mm)
- PROPOSED TRUNK IMPROVEMENTS
- FUTURE CONNECTION
- 600 mm SANITARY TRUCK TWINNING
- ALTERNATE GRAVITY SEWER PIPELINE
- WWTP — EXISTING WASTEWATER TREATMENT PLANT
- EXISTING LIFT STATION
- PROPOSED OPTIONAL LIFT STATION
- PROPOSED LIFT STATION

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**TOWN OF CARDSTON**
**INFRASTRUCTURE MASTER PLAN**

# FUTURE SANITARY SERVICING IMPROVEMENTS

**FIGURE 4.8**

**Table 4.6: Cost Estimate Summary for Northwest Sanitary Trunk Improvements**

| North Lee Creek Crossing Sanitary Sewer Trunk Twinning | |
|---|---|
| ITEM | COST |
| 1. North Creek Crossing Sanitary Sewer Trunk | $400,000 |
| 2. Inlet and Outlet Structures | $250,000 |
| Subtotal | $650,000 |
| 15% Contingency | $98,000 |
| 15% Engineering | $98,000 |
| **TOTAL** | **$846,000** |

**Table 4.7: Cost Estimate Summary for Northeast Sanitary Trunk Improvement**

| NE Sewer Replacement and Extensions (Manhole 5A1 to 2A1) | |
|---|---|
| ITEM | COST |
| 1. 300 mm Sewer Extension, Manholes and Surface Reconstruction (325 m) | $90,000 |
| 2. Remove and Replace with 300 mm Sewer (205 m) | $125,000 |
| 3. Tie to Existing Manholes | $10,000 |
| 4. Reconnect Services | $4,000 |
| 5. 300 mm Sewer Extension to Waste Water Treatment (75 m) | $20,000 |
| 6. Remove and Re-construct Collector Road Structure | $82,000 |
| Subtotal | $331,000 |
| 15% Contingency | $50,000 |
| 10% Engineering | $33,000 |
| **TOTAL** | **$414,000** |
| | |

# 5 STORM SEWER SYSTEM

## 5.1 Data Collection and Review

This section summarizes the information collected and reviewed for the stormwater systems within the Town of Cardston.

The data collected includes:

- Existing reports and studies relevant to the stormwater basin
- Design drawings, as-builds, and survey data for the existing stormwater management facilities
- Existing and future land use maps, and area redevelopment plans (ARP).

### 5.1.1 Existing Reports and Drawings

The following reports and drawings pertaining to the stormwater basin have been reviewed and the applicable data and information incorporated into the study:

- Town of Cardston existing Stormwater Collection System drawing
- Aerial photos, and topographical maps
- Field survey data of manholes and pipes (UMA Engineering Ltd., Spring/Summer 2008)
- Storm Water Management Plans by Associated Engineering

Area redevelopment plans for new development areas were also reviewed.

### 5.1.2 As-Built Data and Survey

Within the stormwater study area, the existing drainage basins are separated into two areas by Lee Creek.

**Figure 5.1** shows the existing stormwater infrastructure within the study area.

Runoff from the section of Town on the Westside of Lee Creek is collected by a series of catch basin manholes located along street curbs. The catch basins are discharged into storm collection systems that eventually convey to outfalls along the banks of Lee Creek. The east section of Town currently does not have an extensive storm collection system. Run-off from this section is mostly routed through ditches along $9^{th}$ Avenue and continues to flow west, eventually discharging via outfalls into Lee Creek. Lee Creek flows northwest, ultimately discharging into the St. Mary River.

The Town of Cardston occupies an area of approximately 605 ha. The existing storm system consists of only minor storm sewer systems. Runoff from the west basin predominantly flows overland through a series of roadway gutters and ditches leading to out falls along Lee Creek. Runoff from the West area is directed South and East through minor systems (conduits) and discharges into Lee Creek and ultimately to the St. Mary River.

As-built drawings for the drainage system in the Town indicated a trunk along 5th Street, from 3rd Avenue West to 6A Avenue west. Conduit lengths and diameters were also indicated on the as-built drawings.

In 2008, AECOM conducted a field survey of all existing storm manholes and catch basins. Pipe sizes and material types were also recorded in the field. Currently, the Town has no Stormwater Management Facilities (SWMF). Catch basins collect runoff from basins and it's conveyed and directly discharged into Lee Creek. In areas without stormwater collection system, overland or sheet flow converges via the existing roadways or pathways down grade to Lee Creek.

### 5.1.3 Topographical Map and Data

The stormwater study area is a relatively undulating area; however, large portion of the terrain slope towards Lee Creek. There are high and low areas with slight ridges located throughout the study area that vary in grade. This information was obtained from a topographical map provided by the Town. A digital copy of the topographical map was not available at the time of study. Catch basin and manhole survey data was utilized to generate digital versions of ground contours of most of the study area. This, together with the topographical map, was used to delineate catchment areas.

Due to the slopes in the study area, stormwater, not captured by catch basins, typically drains to Lee Creek via overland flow. Drainage from the Moses Lake area is conveyed to Lee Creek by the stormwater conduit running along Highway 5.

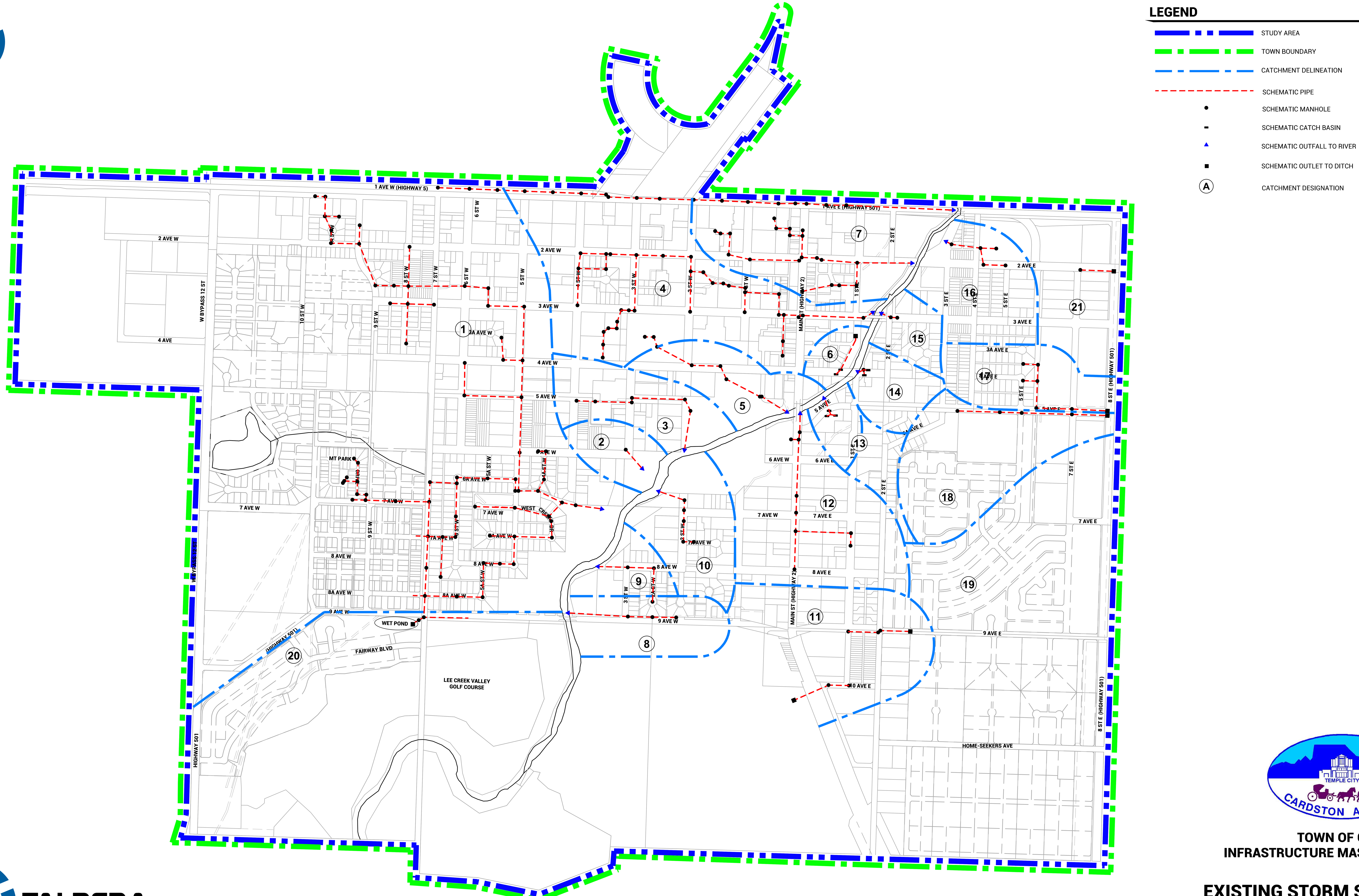
This IMP update maintains the drainage basin that was been delineated in the 2009 study. 21 proposed drainage basins based on existing ground surface contours and drainage systems were identified. The proposed area redevelopment plan (ARP's) has been taken into consideration in the delineation of the drainage catchment areas. The catchments are shown on **Figure 5.1**. The existing stormwater system was analyzed for hydraulic capacity and a stormwater management plan was developed for each of the basins contained within the proposed areas to be redeveloped.

## 5.2 Field Reconnaissance

### 5.2.1 General

A field reconnaissance was conducted in order to obtain a complete understanding of the surface drainage features of the stormwater study area. The field investigation provided the opportunity to confirm overland drainage routes and basins, and identify potential locations for future stormwater management facilities.

The investigation was completed by Talbera. Field observations were then discussed with the Town. This was done to ensure the Talbera project team had a clear understanding of all stormwater issues and that there is a common understanding of specific and basin wide issues.




**TOWN OF CARDSTON**
**INFRASTRUCTURE MASTER PLAN**

## EXISTING STORM SYSTEM

**FIGURE 5.1**

### 5.2.2 Field Program

The field program provided verification of the findings from the data collection and review, and provided clarification on the areas that were not detailed in the available materials.

To confirm or determine the definition of a drainage basin boundary, the direction of overland flow was ascertained visually, where possible. The direction of flow was recorded on a plan and later used to adjust the basins as determined by the desktop assessment. Where possible, a visual inspection of drainage ditches was carried out to verify and confirm the stormwater flow paths.

Areas of significant natural storage, such as wetlands and surface sags, were identified and recorded. Existing natural storage sites were documented to be considered for potential locations of future stormwater management facilities.

## 5.3 Stormwater Management Plan

### 5.3.1 Allowable Discharge Rate

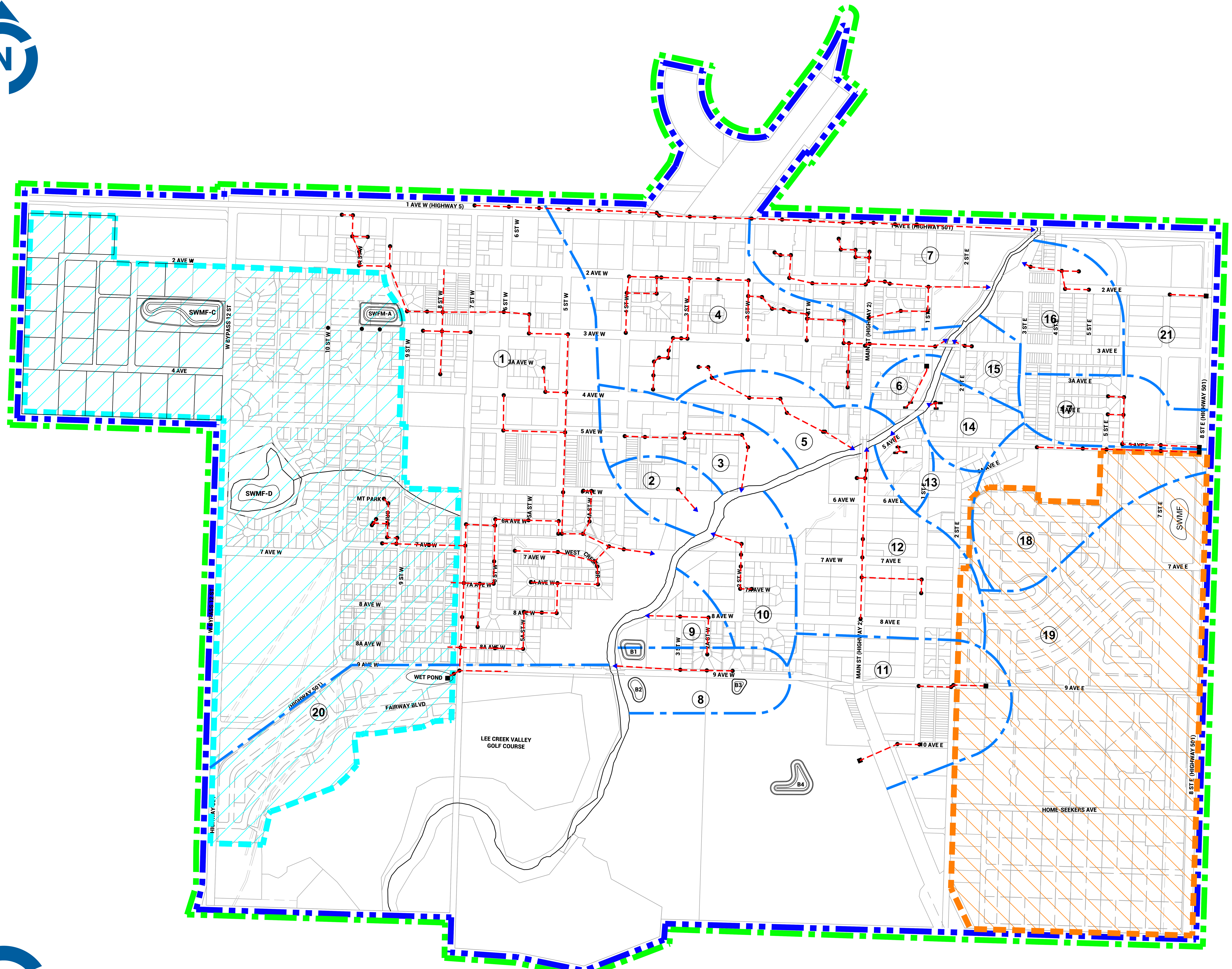
The drainage basin for the stormwater study area at the Town of Cardston was delineated by the existing points of discharge (Lee Creek), and found to be approximately 605 $km^2$. This study assumes that there have been no studies completed on Lee Creek to establish its carrying capacity. We therefore assumed that the major flow events could be discharged to Lee Creek and Lee Creek has the caring capacity for these events.

### 5.3.2 Stormwater Management Plan

Based on existing contours, the stormwater study area was delineated into 21 sub-drainage basins (catchment areas), as shown in **Figure 5.1**. Existing and future land use of the catchment areas was assumed to be residential and a percent imperviousness of 55 was used.

The Town of Cardston currently does not have any stormwater management facilities (e.g. Ponds or wet lands). For this study, the catchments within the stormwater collection system were only analyzed hydraulically based on existing conditions. The catchment areas were identified based on the existing and natural topography of the areas. **Figure 5.2** shows the catchment areas, existing stormwater conduits, the proposed locations for future stormwater management facilities, and proposed drainage routes. Stormwater management facilities have been located in the lowest lying area of the catchment. The locations of the SWMF as shown in **Figure 5.2** are conceptual locations only and will be refined during the design process.

Main Street downtown floods during heavy Lee Creek flood events. This is due to the fact that the elevation at certain areas downtown is lower than the Lee Creek high water level during a big flood events. The Town currently has one old pump that has reached its service life and operates on a tractor drive shaft that has to be hooked up when the pump is needed to operate. In the absence of this storm pump and the associated control structures that prevents storm water from backing up in the Town's storm pipes and surcharging Downtown, **Figure 5.3** shows the potential extent of flooding that occurs Downtown.




## LEGEND

- STUDY AREA
- TOWN BOUNDARY
- FUTURE WEST LAND DEVELOPMENT
- FUTURE EAST LAND DEVELOPMENT
- CATCHMENT DELINEATION
- SCHEMATIC PIPE
- SCHEMATIC MANHOLE
- SCHEMATIC CATCH BASIN
- SCHEMATIC OUTFALL TO RIVER
- SCHEMATIC OUTLET TO DITCH
- (A) CATCHMENT DESIGNATION
- SWMF PROPOSED STORMWATER MANAGEMENT FACILITY

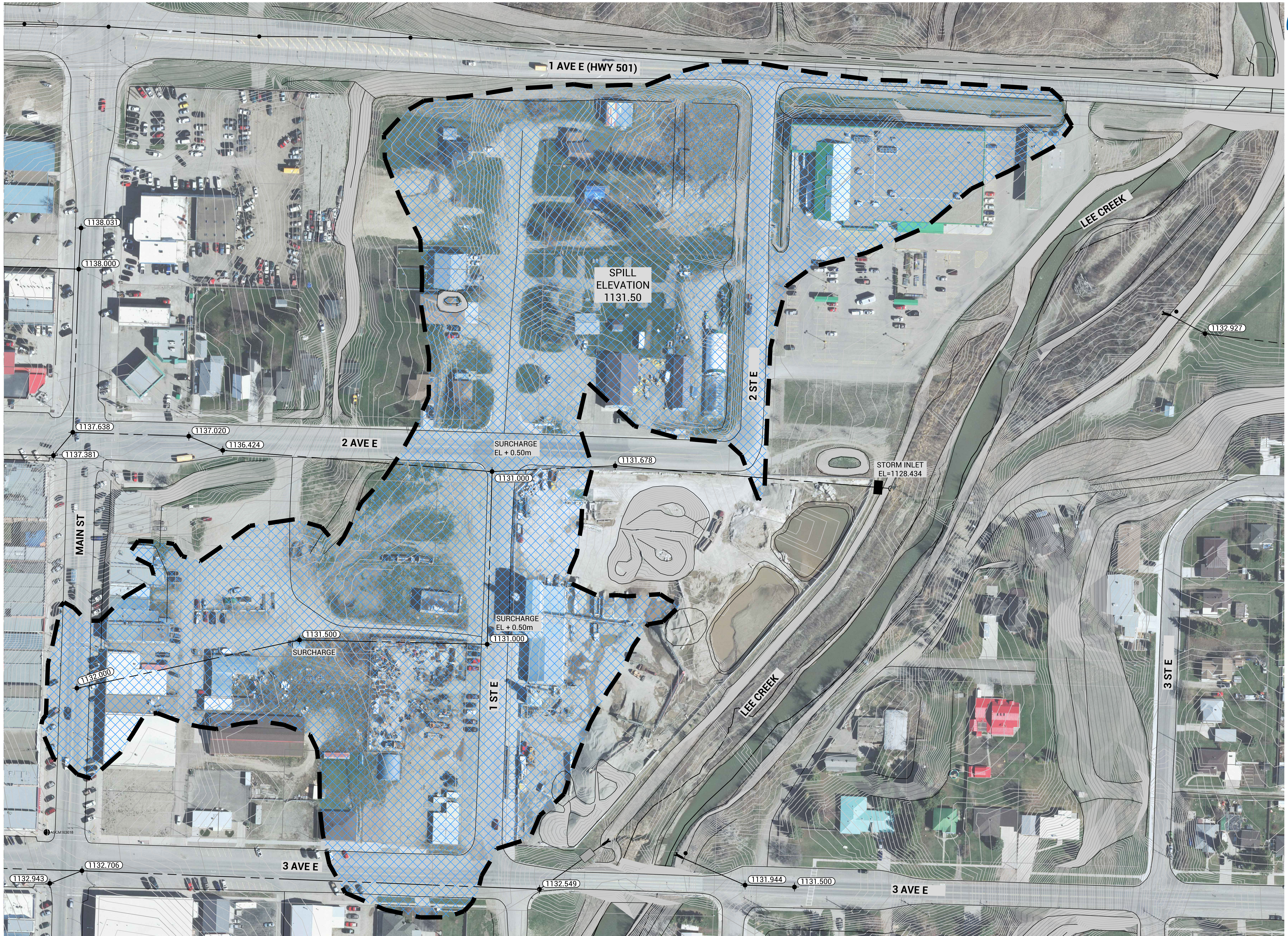
TEMPLE CITY
CARDSTON ALBERTA

TALBERA

**TOWN OF CARDSTON**
**INFRASTRUCTURE MASTER PLAN**

# FUTURE STORM SYSTEM

**FIGURE 5.2**




PLAN

## LEGEND

- EXISTING STORM SEWER
- EXISTING MANHOLE
- EXISTING CATCH BASIN
- TRAPPED LOW BOUNDARY
- TRAPPED LOW EXTENTS
- PROPOSED ADDITIONAL DOWNTOWN STORM WATER DEWATERING PUMP
- EXISTING DOWNTOWN STORMWATER DEWATERING PUMP FOR UPGRADE

TALBERA

TEMPLE CITY
CARDSTON ALBERTA

TOWN OF CARDSTON
INFRASTRUCTURE MASTER PLAN

**FLOODING DUE TO MINOR STORM SYSTEM SURCHARGE**

**FIGURE 5.3**

#### 5.3.2.1 Cost – Downtown Storm Dewatering & Pumping Systems

| Storm Systems | Total Cost ($) |
|---|---|
| | **Existing System** |
| Upgrade Existing Storm Pump System | $135,000 |
| Install New Pumping System Downstream of Existing | $370,000 |
| **Sub-Total** | **$505,000** |
| **15% Contingencies** | $75,750 |
| **10% Engineering** | $50,500 |
| **Total** | **$631,250** |

The primary purpose of a dry pond is to provide temporary stormwater storage to reduce the peak outflow rate. Dry ponds drain down to a dry condition at the end of a rainfall event. Being primarily designed for temporary and short

### 5.3.3 Hydrological Analysis

The proposed catchment areas were modelled using CivilStorm V8 XM Edition. Runoff volumes and peak flows were computed using the CivilStorm V8 XM Edition Runoff Block. For this study, we considered 55% of each catchment area to be impervious and used only this portion as the surface. A manning's n of 0.015 was applied to the surface profile and flows were conveyed directly into storm manholes. Catchment areas were therefore connected directly into manholes and there was no overland sheet flow analysis or computation of flow to inlet structures performed at street or surface level. Overland flow analysis was not performed because there wasn't enough detailed information on streets, roads and ground for this assessment. Design rainfall events were based on the City of Lethbridge Municipal Engineering Standards. The 2 and 5-year rainfall events for the 4-hour Chicago storm were simulated. Runoff volumes from catchment areas were conveyed directly into manholes.

### 5.3.4 Hydraulic Analysis

The hydrographs generated in the runoff block for the short and long duration rainfall events were routed through the existing storm collection system in the model. This exercise was performed on only the section of the study area west of Lee Creek. Since it was apparent from the site survey and investigation that the majority of rainfall in the study area east of Lee Creek is conveyed by sheet flow, a design surface flow analysis would be required for that area.

Since there is no set allowable discharge rate, all outfalls were assumed to be free falling outlet structures. The model results indicate that the major trunks within the existing storm conveyance system cannot handle a 1 in 5 years 4-hour Chicago storm. A second scenario was generated with a 1 in 2 years 4-hour Chicago storm and this generated approximately 245,400 $m^3$ of total inflow volume of which 131,900 $m^3$ was the total system overflow volume (runoff volume).

The new east and west redevelopment areas will require storm water management facilities to comply with Alberta Environment standards for municipal drainage systems. **Figure 5.2** shows the proposed locations of new facilities. Cost estimations for new SWMF was not provided since the cost burden for such infrastructure is usually passed on to developers and are also better estimated during the subdivision design stage. Pumping may be required to discharge the runoff from new stormwater management facilities to the existing or new drainage routes.

### 5.3.5 Water Quality

The primary purpose of stormwater management facilities is to collect the runoff generated by developments and control the outflow to the receiving watercourse to allowable discharge rates. However, a secondary purpose is to provide water quality enhancement. Alberta Environment requires that a minimum of 85% of sediments with a particle size of 75 μm or greater be removed from stormwater runoff.

Stormwater quality enhancement can be provided by preserving and enhancing existing wetlands, creating wetlands, constructing wet ponds and dry ponds, all focusing on reducing sediments and preservation of natural conditions. The method by which the water quality requirement is met will need to be further investigated during preliminary design; for wetlands and wet ponds, meeting the requirement is dependent on the configuration of the pond and forebays, and for a dry pond, other infrastructure would need to be added to achieve sediment removal.

### 5.3.6 Wetlands

Wetlands provide sediment retention, filtration and pollution reduction through biological processes and are suitable for drainage areas greater than 5 ha. As wetlands can reduce soluble pollutants, they are generally applicable to residential, commercial, and industrial areas where the nutrient loading is relatively high.

In general, wetlands have been found to lower BOD, TSS, and nitrogen concentrations to 10- 20% of the level at the inflow point. For total phosphorus, metals and organic compounds, the removal efficiency varies significantly, but is typically between 20% and 90%.

#### 5.3.6.1 Wet Ponds

Wet ponds are water bodies that temporarily store stormwater runoff to promote the settlement of suspended pollutants and to restrict discharge to predetermined levels. Wet ponds have two storage zones: a lower permanent storage and an upper active storage. The permanent storage will always exist irrespective of the inflow while the water level in upper storage will fluctuate in response to the inflow volume.

The deep permanent storage is the wet pond's primary water quality enhancement mechanism. Runoff entering the wet pond will slow down and thus induce the settlement of suspended pollutants. Biological processes, such as nitrogen uptake by algae, are established in the permanent storage and help reduce the concentration of soluble contaminants. However, due to the smaller biological contact area, wet ponds are not as efficient as wetlands in reducing these concentrations.

#### 5.3.6.2 Dry Ponds

The primary purpose of a dry pond is to provide temporary stormwater storage to reduce the peak outflow rate. Dry ponds drain down to a dry condition at the end of a rainfall event. Being primarily designed for temporary and short duration stormwater retention, dry ponds have minimal water quality enhancement capabilities without the inclusion of a small wet pond forebay to trap some of the suspended sediment. The very limited ability to reduce the concentration of soluble contaminants limits the application of dry ponds.

All facilities proposed for the stormwater study area in Cardston are recommended to be wet SWM facilities or wetlands. If another type of facility is proposed in further design stages, and in addition to wet facilities, water quality enhancement can be addressed by using Better Management Practices (BMPs). Several BMPs that should be considered are:

- Vegetative Zones - in and around a wet pond enhances pollutant removal capabilities
- Vegetated Swales – discharge into grassed channels/ditches provides sediment an opportunity to settle out of the stormwater while being conveyed to the receiving water body
- Oil and Grit Separators – locating oil and grit separators downstream of the facility allows the removal of sediment and pollutants to be removed from the stormwater before entering the receiving water body.

# 6 2017 PAVEMENT AND SIDEWALK REVIEW

Talbera completed a condition assessment and evaluation of the Town of Cardston's surface infrastructure including asphalt roads, sidewalks, curbs and gutters. A rating criterion was developed for the conditions of these infrastructure. This exercise was only limited to town owned infrastructure and does not include Alberta Transportation roadways specifically Main Street and Highway 501

The field evaluation and assessment involved detailed visual inspection of the roadways throughout the Town of Cardston, cataloguing photos of the asset conditions. Talbera utilized a camera with GPS capabilities to take photos during the inspections. This allowed Talbera to provide The Town with Google Earth Kmz files of all the photos taken. The Kmz files would provide approximate to accurate geographic location of all the recommended work and also serve as a status asset condition information for the roadway infrastructure in 2017. Over 2000 Photos was logged during the inspection process. Sample photos are presented in **Appendix 6.0. Figure 6.1A and 6.1B** shows the alignments and staging that was followed during the field inspection. This alignments and staging are referenced to subsequent figures for the pavement, sidewalk, and curbs and gutter assessments. A summary of the site inspection deficiencies and locations based on the planned staging for the inspection process for the road right of ways has been presented. Estimate cost of repairs for each deficiency is also presented.

## 6.1 PAVEMENT

Visual inspections were completed on all the roadways in the Town of Cardston to assess the condition roads by observing issues like cracks in the asphalt, excessive asphalt wear and localized settlements. These deficiencies were rated on a scale of 1 to 5 and a station was provided for each deficiency and presented for identification purposes. See **Table 6.1**. For the identified deficiencies and the costs estimates associated with repairs. **Table 6.2** groups all the deficiencies on each street name together and the repair cost estimate is totalized. **Table 6.3** is a group of deficiency types and associated repair costs

## 6.2 SIDEWALKS, CURBS & GUTTERS

For this part of the surface infrastructure analysis, the sidewalks, curbs and gutters were assessed visually to ascertain current conditions with respect to functionality, structural integrity, level of services, associated trip hazards and risks while in use.

The concrete side walk slabs, curb and gutters were observed for cracks and large chips and were rated on a scale from 1 to 5 as presented in **Table 6.4** Condition assessment of wheel chair ramps to sidewalks were also completed and **Figure 6.2** shows the ratings for the ramps.

**FIGURE 6.0**

**1 ST E – (3) = Station 0+185**
**Asphalt – Transverse Cracking**

**4 AVE W = Station 0+601 – 0+703**
**Asphalt – Longitudinal Cracking**

**FIGURE 6.0**

**1 ST E – (2) = Station 0+012**
**Asphalt - Settlement**

**2 ST W – (3) = Station 1+500**
**Asphalt - Pothole**

**FIGURE 6.0**

**5 ST W = Station 0+180**
**Asphalt – Poor Repair**

**5A AVE E = Station 0+055 – 0+163**
**Asphalt – Deterioration**

**FIGURE 6.0**

**4 AVE E – (3) = Station 0+027**
**Concrete – Transverse Cracking**

**4 AVE W – Station 0+090 – 0+099**
**Concrete – Longitudinal Cracking**

**FIGURE 6.0**

**WEST CREEK DRIVE = Station 0+035**
**Concrete - Settlement**

**5 ST E – (2) = Station 0+003**
**Concrete - Spalling**

**FIGURE 6.0**

**4 ST W = Station 0+229 -0+279**
**Concrete – Deterioration**

**5 AVE E = Station – 0+771**
**Curb/Gutter – Deterioration**

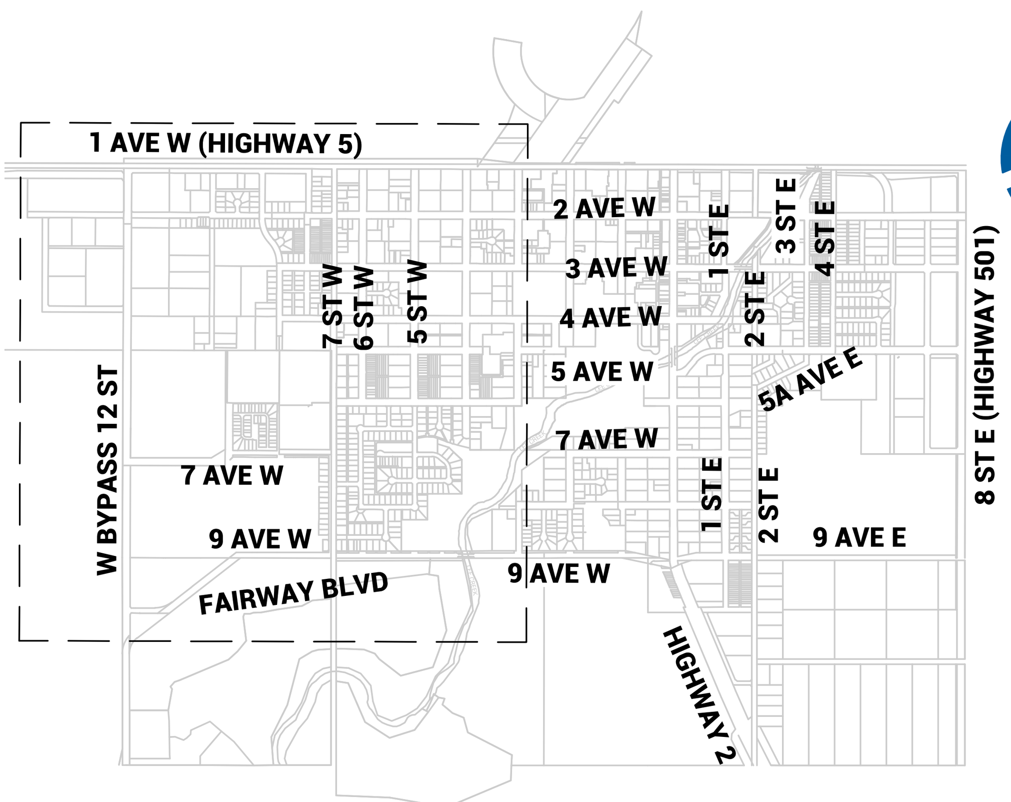
**FIGURE 6.0**

**5 AVE E = Station 0+121**
**Damaged Catch Basin**

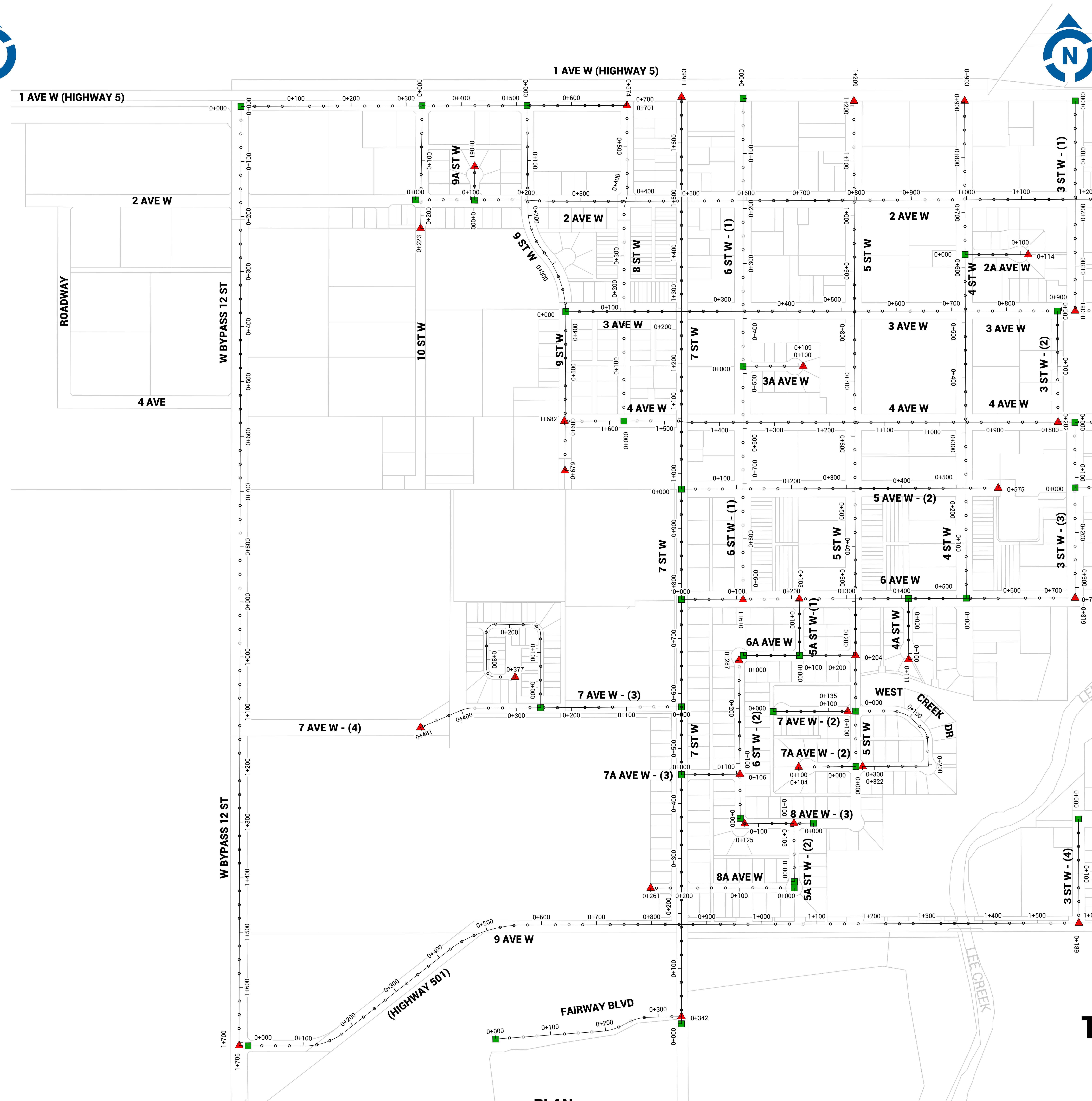
**MAIN A ST W = Station 0+075**
**Settled Valve**

**FIGURE 6.0**

**2 AVE E – (2) = Station 0+081 – 0+181**
**Ground Encroachment**




KEY PLAN




PLAN

N.T.S.

WEST SIDE OF CARDSTON

## LEGEND

| | |
|---|---|
| END OF ROADWAY ALIGNMENT | ▲ |
| START OF ROADWAY ALIGNMENT | ■ |
| ROADWAY ALIGNMENT STATIONING | 0+300 |

TEMPLE CITY

CARDSTON ALBERTA

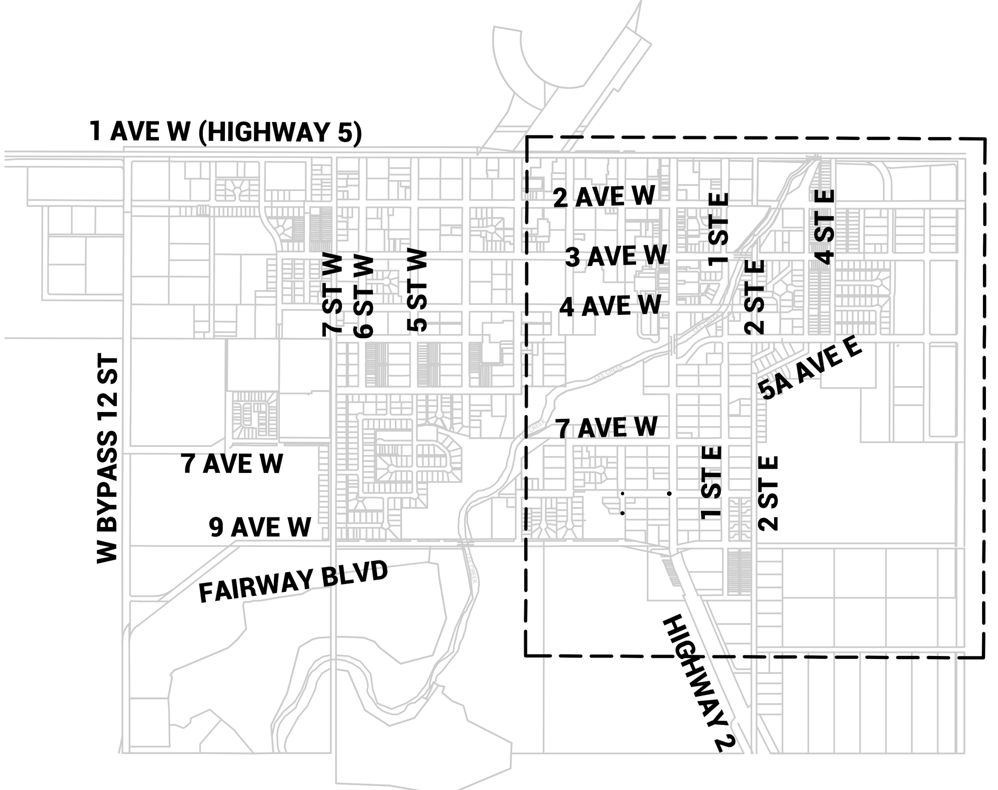
TALBERA

# TOWN OF CARDSTON

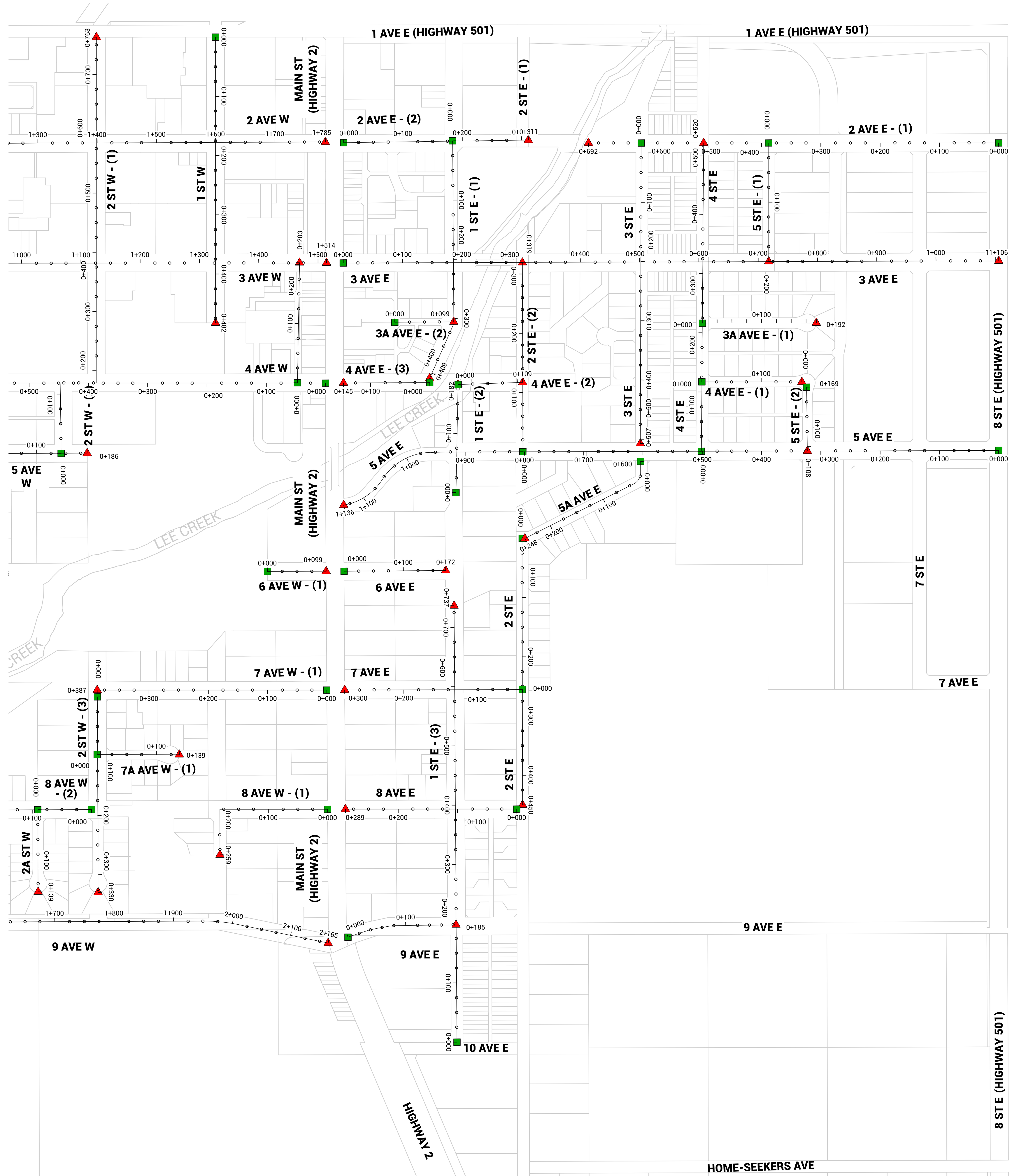
## ROAD ASSESSMENT

## ALIGNMENT STATIONING

## FIGURE 1.2




KEY PLAN




PLAN

N.T.S.
EAST SIDE OF CARDSTON

## LEGEND

END OF ROADWAY ALIGNMENT
START OF ROADWAY ALIGNMENT
ROADWAY ALIGNMENT STATIONING 0+300

TEMPLE CITY
CARDSTON ALBERTA

TALBERA

# TOWN OF CARDSTON
## ROAD ASSESSMENT
## ALIGNMENT STATIONING
## FIGURE 1.3


# TOWN OF CARDSTON

## WHEELCHAIR RAMP LOCATIONS

## FIGURE 1.1

**TABLE 6.1**
**CARDSTON ROAD REPAIR COST**

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 1 AVE W | START | 0+000 | | | | | | | |
| 1 AVE W | | 0+059 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 1 AVE W | | 0+127 | | | | ASPHALT - POTHOLE | ROAD | 1 | $140 |
| 1 AVE W | | 0+155 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 1 AVE W | | 0+162 | | | | ASPHALT - POTHOLE | ROAD | 1 | $140 |
| 1 AVE W | | 0+195 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 1 AVE W | | 0+251 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 1 AVE W | | 0+328 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 1 AVE W | | 0+326 | 0+329 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 1 AVE W | | 0+331 | 0+334 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 1 AVE W | | 0+379 | | | | ASPHALT - SETTLEMENT | ROAD | 4 | $3,000 |
| 1 AVE W | | 0+430 | 0+431 | 1 | SOUTH | CURB/GUTTER - DETERIORATION | GUTTER | 2 | $1,700 |
| 1 AVE W | | 0+451 | | | | ASPHALT - SETTLEMENT | ROAD | 3 | $3,000 |
| 1 AVE W | | 0+476 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 1 AVE W | | 0+503 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 1 AVE W | | 0+525 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 5 | $250 |
| 1 AVE W | | 0+586 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 1 AVE W | | 0+651 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 2 | $250 |
| 1 AVE W | END | 0+701 | | | | | | | |
| 1 ST E - (2) | START | 0+000 | | | | | | | |
| 1 ST E - (2) | | 0+012 | | | | ASPHALT - SETTLEMENT | ROAD | 4 | $3,000 |
| 1 ST E - (2) | | 0+048 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 4 | $120 |
| 1 ST E - (2) | | 0+063 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 1 ST E - (2) | | 0+117 | | | EAST | CONCRETE - SETTLEMENT | SIDEWALK | 2 | $250 |
| 1 ST E - (2) | END | 0+197 | | | | | | | |
| 1 ST E - (3) | START | 0+000 | | | | | | | |
| 1 ST E - (3) | | 0+094 | 0+095 | 1 | WEST | CURB/GUTTER - DETERIORATION | GUTTER | 4 | $1,700 |
| 1 ST E - (3) | | 0+122 | 0+125 | 3 | | ASPHALT - DETERIORATION | ROAD | 1 | $5,700 |
| 1 ST E - (3) | | 0+144 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 1 ST E - (3) | | 0+185 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 4 | $120 |
| 1 ST E - (3) | | 0+215 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 1 ST E - (3) | | 0+263 | 0+266 | 3 | | ASPHALT - DETERIORATION | ROAD | 1 | $5,700 |
| 1 ST E - (3) | | 0+360 | | | WEST | CONCRETE - SETTLEMENT | SIDEWALK | 3 | $250 |
| 1 ST E - (3) | | 0+448 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 1 ST E - (3) | | 0+499 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 4 | $120 |
| 1 ST E - (3) | | 0+550 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 1 ST E - (3) | | 0+569 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 1 ST E - (3) | | 0+574 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 1 ST E - (3) | | 0+582 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 1 ST E - (3) | | 0+589 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 5 | $120 |
| 1 ST E - (3) | | 0+589 | | | WEST | CONCRETE - SETTLEMENT | SIDEWALK | 3 | $250 |
| 1 ST E - (3) | END | 0+613 | | | | | | | |
| 1 ST W | START | 0+000 | | | | | | | |
| 1 ST W | | 0+008 | | | | SETTLED VALVE | ROAD | 2 | $500 |
| 1 ST W | | 0+020 | 0+023 | 3 | | CONCRETE - LONGITUDINAL CRACKING | ROAD | 4 | $1,050 |

## TABLE 6.1
## CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 1 ST W | | 0+030 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 1 ST W | | 0+052 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 5 | $120 |
| 1 ST W | | 0+052 | 0+053 | 1 | EAST | CURB/GUTTER - DETERIORATION | GUTTER | 5 | $1,700 |
| 1 ST W | | 0+122 | 0+125 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 1 ST W | | 0+148 | 0+151 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 3 | $1,050 |
| 1 ST W | | 0+165 | | | EAST | CONCRETE - SPALLING | SIDEWALK | 4 | $500 |
| 1 ST W | | 0+210 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 1 ST W | | 0+247 | 0+248 | 1 | WEST | CURB/GUTTER - DETERIORATION | GUTTER | 4 | $1,700 |
| 1 ST W | | 0+277 | 0+278 | 1 | EAST | CURB/GUTTER - DETERIORATION | GUTTER | 3 | $1,700 |
| 1 ST W | | 0+284 | 0+285 | 1 | EAST | CURB/GUTTER - DETERIORATION | GUTTER | 2 | $1,700 |
| 1 ST W | | 0+319 | | | | ASPHALT - SETTLEMENT | ROAD | 2 | $3,000 |
| 1 ST W | | 0+319 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 1 ST W | | 0+401 | 0+402 | 1 | WEST | CURB/GUTTER - DETERIORATION | GUTTER | 4 | $1,700 |
| 1 ST W | | 0+437 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 4 | $120 |
| 1 ST W | | 0+443 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 1 ST W | | 0+460 | 0+463 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 2 | $30 |
| 1 ST W | | 0+492 | 0+495 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $1,050 |
| 1 ST W | END | 0+492 | | | | | | | |
| 10 ST W | START | 0+000 | | | | | | | |
| 10 ST W | | 0+016 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 10 ST W | | 0+042 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 10 ST W | | 0+060 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 4 | $1,000 |
| 10 ST W | | 0+075 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 10 ST W | | 0+085 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 10 ST W | | 0+103 | 0+106 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $30 |
| 10 ST W | | 0+114 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 10 ST W | END | 0+213 | | | | | | | |
| 2 AVE E - (1) | START | 0+000 | | | | | | | |
| 2 AVE E - (1) | | 0+007 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 2 AVE E - (1) | | 0+034 | | | | ASPHALT - SETTLEMENT | ROAD | 1 | $3,000 |
| 2 AVE E - (1) | | 0+053 | 0+056 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 2 | $30 |
| 2 AVE E - (1) | | 0+096 | | | | ASPHALT - POTHOLE | ROAD | 1 | $140 |
| 2 AVE E - (1) | | 0+122 | 0+125 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 3 | $30 |
| 2 AVE E - (1) | | 0+131 | 0+132 | 1 | SOUTH | CURB/GUTTER - DETERIORATION | GUTTER | 2 | $1,700 |
| 2 AVE E - (1) | | 0+132 | 0+165 | 33 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 2 | $330 |
| 2 AVE E - (1) | | 0+163 | 0+164 | 1 | SOUTH | CURB/GUTTER - DETERIORATION | GUTTER | 2 | $1,700 |
| 2 AVE E - (1) | | 0+238 | | | | ASPHALT - POOR REPAIR | ROAD | 3 | $280 |
| 2 AVE E - (1) | END | 0+262 | | | | | | | |
| 2 AVE E - (2) | START | 0+000 | | | | | | | |
| 2 AVE E - (2) | | 0+004 | 0+005 | 1 | SOUTH | CURB/GUTTER - DETERIORATION | GUTTER | 2 | $1,700 |
| 2 AVE E - (2) | | 0+048 | 0+051 | 3 | NORTH | CONCRETE - DETERIORATION | SIDEWALK | 3 | $3,000 |
| 2 AVE E - (2) | | 0+053 | 0+056 | 3 | NORTH | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 2 AVE E - (2) | | 0+059 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 2 AVE E - (2) | | 0+081 | 0+181 | 100 | NORTH | GROUND ENCROACHMENT | ROAD | 5 | $2,200 |
| 2 AVE E - (2) | END | 0+315 | | | | | | | |
| 2 AVE W | START | 0+000 | | | | | | | |

## TABLE 6.1
## CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 2 AVE W | | 0+192 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 2 AVE W | | 0+214 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 2 AVE W | | 0+222 | | | | CONCRETE - TRANSVERSE CRACKING | ROAD | 2 | $1,000 |
| 2 AVE W | | 0+229 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 2 AVE W | | 0+327 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 3 | $250 |
| 2 AVE W | | 0+329 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 2 AVE W | | 0+426 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 2 AVE W | | 0+445 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 2 AVE W | | 0+477 | 0+480 | 3 | NORTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $1,050 |
| 2 AVE W | | 0+511 | 0+514 | 3 | NORTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 2 AVE W | | 0+599 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 3 | $1,000 |
| 2 AVE W | | 0+649 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 2 AVE W | | 0+675 | 0+678 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 2 AVE W | | 0+705 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 2 AVE W | | 0+711 | 0+755 | 44 | | ASPHALT - DETERIORATION | ROAD | 1 | $83,600 |
| 2 AVE W | | 0+775 | | | | SETTLED VALVE | ROAD | 2 | $500 |
| 2 AVE W | | 0+792 | | | | ASPHALT - POOR REPAIR | ROAD | 3 | $280 |
| 2 AVE W | | 0+828 | 0+831 | 3 | NORTH | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 2 AVE W | | 0+881 | | | | SETTLED VALVE | ROAD | 2 | $500 |
| 2 AVE W | | 0+948 | 0+951 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 2 AVE W | | 0+988 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 2 AVE W | | 1+004 | 1+007 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 2 AVE W | | 1+054 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 2 AVE W | | 1+076 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 2 AVE W | | 1+082 | 1+085 | 3 | NORTH | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 2 AVE W | | 1+364 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 2 AVE W | | 1+385 | 1+386 | 1 | SOUTH | CURB/GUTTER - DETERIORATION | GUTTER | 5 | $1,700 |
| 2 AVE W | | 1+407 | 1+410 | 3 | NORTH | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 2 AVE W | | 1+520 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 2 AVE W | | 1+590 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 2 AVE W | | 1+695 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 2 AVE W | | 1+841 | 1+842 | 1 | SOUTH | CURB/GUTTER - DETERIORATION | GUTTER | 3 | $1,700 |
| 2 AVE W | | 1+977 | 1+980 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $30 |
| 2 AVE W | | 2+035 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 2 AVE W | | 2+058 | 2+061 | 3 | NORTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $1,050 |
| 2 AVE W | END | 2+082 | | | | | | | |
| 2 ST E - (1) | START | 0+000 | | | | | | | |
| 2 ST E - (1) | | 0+008 | | | | ASPHALT - POTHOLE | ROAD | 1 | $140 |
| 2 ST E - (1) | | 0+037 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 2 ST E - (1) | | 0+043 | 0+048 | 5 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 5 | $50 |
| 2 ST E - (1) | END | 0+163 | | | | | | | |
| 2 ST E - (2) | START | 0+000 | | | | | | | |
| 2 ST E - (2) | | 0+003 | 0+012 | 9 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 2 | $90 |
| 2 ST E - (2) | | 0+043 | 0+046 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 2 ST E - (2) | | 0+095 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 4 | $1,000 |
| 2 ST E - (2) | | 0+220 | 0+231 | 11 | WEST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $3,850 |

**TABLE 6.1**
**CARDSTON ROAD REPAIR COST**

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 2 ST E - (2) | END | 0+299 | | | | | | | |
| 2 ST W - (1) | START | 0+000 | | | | | | | |
| 2 ST W - (1) | | 0+017 | 0+091 | 74 | WEST | CURB/GUTTER - DETERIORATION | GUTTER | 3 | $125,800 |
| 2 ST W - (1) | | 0+022 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 2 ST W - (1) | | 0+053 | 0+056 | 3 | EAST | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $30 |
| 2 ST W - (1) | | 0+079 | 0+082 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 2 ST W - (1) | | 0+104 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 2 ST W - (1) | | 0+113 | 0+114 | 1 | WEST | CURB/GUTTER - DETERIORATION | CURB | 3 | $1,700 |
| 2 ST W - (1) | | 0+122 | 0+125 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 2 ST W - (1) | | 0+141 | 0+144 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 2 ST W - (1) | | 0+209 | | | EAST | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 2 ST W - (1) | | 0+209 | 0+217 | 8 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 2 | $8,000 |
| 2 ST W - (1) | | 0+246 | 0+249 | 3 | EAST | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $30 |
| 2 ST W - (1) | | 0+299 | 0+302 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $1,050 |
| 2 ST W - (1) | | 0+320 | 0+323 | 3 | EAST | ASPHALT - LONGITUDINAL CRACKING | ROAD | 2 | $30 |
| 2 ST W - (1) | | 0+340 | 0+341 | 1 | EAST | CURB/GUTTER - DETERIORATION | CURB | 1 | $1,700 |
| 2 ST W - (1) | | 0+381 | 0+384 | 3 | EAST | ASPHALT - DETERIORATION | ROAD | 1 | $5,700 |
| 2 ST W - (1) | | 0+448 | 0+451 | 3 | WEST | ASPHALT - DETERIORATION | ROAD | 1 | $5,700 |
| 2 ST W - (1) | | 0+482 | 0+483 | 1 | EAST | CURB/GUTTER - DETERIORATION | CURB | 2 | $1,700 |
| 2 ST W - (1) | | 0+494 | 0+495 | 1 | EAST | CURB/GUTTER - DETERIORATION | GUTTER | 1 | $1,700 |
| 2 ST W - (1) | | 0+495 | 0+496 | 1 | WEST | CURB/GUTTER - DETERIORATION | CURB | 3 | $1,700 |
| 2 ST W - (1) | | 0+514 | 0+515 | 1 | EAST | CURB/GUTTER - DETERIORATION | CURB | 2 | $1,700 |
| 2 ST W - (1) | | 0+536 | | | WEST | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 2 ST W - (1) | | 0+558 | 0+561 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 2 ST W - (1) | END | 0+579 | | | | | | | |
| 2 ST W - (2) | START | 0+000 | | | | | | | |
| 2 ST W - (2) | | 0+007 | 0+008 | 1 | EAST | CURB/GUTTER - DETERIORATION | GUTTER | 3 | $1,700 |
| 2 ST W - (2) | | 0+007 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 2 ST W - (2) | | 0+007 | | | WEST | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 2 ST W - (2) | | 0+008 | | | WEST | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 2 ST W - (2) | | 0+021 | | | WEST | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 2 ST W - (2) | | 0+021 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 4 | $1,000 |
| 2 ST W - (2) | | 0+034 | | | EAST | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 2 ST W - (2) | | 0+034 | 0+035 | 1 | WEST | CURB/GUTTER - DETERIORATION | GUTTER | 4 | $1,700 |
| 2 ST W - (2) | | 0+034 | 0+049 | 15 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 4 | $15,000 |
| 2 ST W - (2) | | 0+061 | 0+062 | 1 | EAST | CURB/GUTTER - DETERIORATION | GUTTER | 5 | $1,700 |
| 2 ST W - (2) | | 0+078 | | | WEST | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 2 ST W - (2) | | 0+082 | 0+085 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 3 | $3,000 |
| 2 ST W - (2) | END | 0+098 | | | | | | | |
| 2 ST W - (3) | START | 0+000 | | | | | | | |
| 2 ST W - (3) | | 0+156 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 4 | $1,000 |
| 2 ST W - (3) | | 0+261 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 2 ST W - (3) | | 0+281 | 0+284 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 2 ST W - (3) | | 0+306 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 5 | $120 |
| 2 ST W - (3) | | 0+333 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 5 | $120 |
| 2 ST W - (3) | | 0+358 | 0+361 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |

## TABLE 6.1
## CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 2 ST W - (3) | | 0+379 | | | | ASPHALT - POOR REPAIR | ROAD | 2 | $280 |
| 2 ST W - (3) | | 0+389 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 2 ST W - (3) | | 0+395 | | | | ASPHALT - SETTLEMENT | ROAD | 4 | $3,000 |
| 2 ST W - (3) | END | 0+399 | | | | | | | |
| 2A AVE W | START | 0+000 | | | | | | | |
| 2A AVE W | | 0+070 | 0+073 | 3 | SOUTH | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 2A AVE W | | 0+090 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 2A AVE W | END | 0+090 | | | | | | | |
| 3 AVE E | START | 0+000 | | | SOUTH | DAMAGED CATCHBASIN | GUTTER | 4 | $1,500 |
| 3 AVE E | | 0+018 | 0+021 | 3 | NORTH | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 3 AVE E | | 0+044 | 0+047 | 3 | NORTH | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 3 AVE E | | 0+270 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 3 AVE E | | 0+300 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 4 | $120 |
| 3 AVE E | | 2+257 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 3 AVE E | | 0+486 | 0+489 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 2 | $30 |
| 3 AVE E | | 0+661 | 0+664 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 3 AVE E | | 0+753 | 0+756 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 3 AVE E | END | 0+753 | | | | | | | |
| 3 AVE W | START | 0+000 | | | | | | | |
| 3 AVE W | | 0+014 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 3 AVE W | | 0+030 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 3 AVE W | | 0+052 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 3 AVE W | | 0+105 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 3 AVE W | | 0+125 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 3 AVE W | | 0+125 | 0+128 | 3 | SOUTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 4 | $1,050 |
| 3 AVE W | | 0+193 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 3 AVE W | | 0+236 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 3 | $250 |
| 3 AVE W | | 0+261 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 3 AVE W | | 0+378 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 3 AVE W | | 0+411 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 3 AVE W | | 0+418 | 0+421 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 3 | $30 |
| 3 AVE W | | 0+612 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 3 AVE W | | 1+016 | 1+019 | 3 | NORTH | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 3 AVE W | | 1+042 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 3 AVE W | | 1+209 | 1+212 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 3 AVE W | | 1+219 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 3 AVE W | | 1+250 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 3 AVE W | | 1+255 | | | | ASPHALT - SETTLEMENT | ROAD | 2 | $3,000 |
| 3 AVE W | | 1+671 | 1+703 | 32 | NORTH | CONCRETE - DETERIORATION | SIDEWALK | 4 | $32,000 |
| 3 AVE W | | 1+721 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 3 AVE W | | 1+721 | 1+724 | 3 | SOUTH | CONCRETE - DETERIORATION | SIDEWALK | 4 | $3,000 |
| 3 AVE W | | 1+775 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 3 AVE W | END | 1+883 | | | | | | | |
| 3 ST E | START | 0+000 | | | | | | | |
| 3 ST E | | 0+206 | 0+209 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 3 ST E | | 0+206 | 0+209 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 4 | $30 |

## TABLE 6.1
## CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 3 ST E | | 0+230 | 0+344 | 114 | | ASPHALT - DETERIORATION | ROAD | 3 | $216,600 |
| 3 ST E | | 0+244 | 0+247 | 3 | WEST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 3 ST E | | 0+257 | 0+260 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 3 ST E | | 0+280 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 3 ST E | | 0+499 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 3 ST E | END | 0+505 | | | | | | | |
| 3 ST W - (1) | START | 0+000 | | | | | | | |
| 3 ST W - (1) | | 0+003 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 3 ST W - (1) | | 0+005 | 0+008 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 3 | $30 |
| 3 ST W - (1) | | 0+012 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 3 ST W - (1) | | 0+021 | 0+024 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 3 ST W - (1) | | 0+032 | | | | ASPHALT - POTHOLE | ROAD | 1 | $140 |
| 3 ST W - (1) | | 0+047 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 3 ST W - (1) | | 0+062 | 0+065 | 3 | WEST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 3 | $1,050 |
| 3 ST W - (1) | | 0+072 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 3 ST W - (1) | | 0+084 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 4 | $1,000 |
| 3 ST W - (1) | | 0+101 | 0+104 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 3 ST W - (1) | | 0+110 | 0+113 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 3 ST W - (1) | | 0+126 | 0+129 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 3 ST W - (1) | | 0+136 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 3 | $1,000 |
| 3 ST W - (1) | | 0+155 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 3 ST W - (1) | | 0+163 | | | WEST | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 3 ST W - (1) | | 0+231 | 0+234 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 3 ST W - (1) | | 0+241 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 3 ST W - (1) | | 0+241 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 3 ST W - (1) | | 0+253 | 0+254 | 1 | EAST | CURB/GUTTER - DETERIORATION | CURB | 2 | $1,700 |
| 3 ST W - (1) | | 0+293 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 3 ST W - (1) | | 0+306 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 3 ST W - (1) | | 0+323 | 0+326 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $30 |
| 3 ST W - (1) | | 0+327 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 3 | $1,000 |
| 3 ST W - (1) | | 0+332 | 0+335 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $1,050 |
| 3 ST W - (1) | | 0+345 | 0+348 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 3 ST W - (1) | END | 0+375 | | | | | | | |
| 3 ST W - (2) | START | 0+000 | | | | | | | |
| 3 ST W - (2) | | 0+006 | 0+009 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 3 ST W - (2) | | 0+041 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 3 ST W - (2) | | 0+070 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 3 ST W - (2) | | 0+110 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 3 ST W - (2) | END | 0+184 | | | | | | | |
| 3 ST W - (3) | START | 0+000 | | | | | | | |
| 3 ST W - (3) | | 0+015 | 0+018 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 3 ST W - (3) | | 0+040 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 3 ST W - (3) | | 0+061 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 3 ST W - (3) | | 0+116 | 0+119 | 3 | | ASPHALT - DETERIORATION | ROAD | 5 | $5,700 |
| 3 ST W - (3) | | 0+126 | 0+127 | 1 | EAST | CURB/GUTTER - DETERIORATION | CURB | 2 | $1,700 |
| 3 ST W - (3) | | 0+142 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |

# TABLE 6.1
# CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 3 ST W - (3) | | 0+143 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 3 ST W - (3) | | 0+152 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 3 ST W - (3) | | 0+187 | 0+190 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 3 ST W - (3) | | 0+245 | 0+248 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 3 ST W - (3) | END | 0+280 | | | | | | | |
| 3 ST W - (4) | START | 0+000 | | | | | | | |
| 3 ST W - (4) | | 0+090 | 0+093 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 3 | $1,050 |
| 3 ST W - (4) | | 0+106 | 0+109 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 3 ST W - (4) | END | 0+163 | | | | | | | |
| 3A AVE E - (1) | START | 0+000 | | | NORTH | | | | |
| 3A AVE E - (1) | | 0+106 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 3A AVE E - (1) | END | 0+181 | | | NORTH | | | | |
| 3A AVE W | START | 0+000 | | | | | | | |
| 3A AVE W | | 0+010 | 0+013 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 3A AVE W | | 0+015 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 3A AVE W | | 0+015 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 3A AVE W | | 0+060 | 0+063 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 3A AVE W | END | 0+100 | | | | | | | |
| 4 AVE E - (1) | START | 0+000 | | | | | | | |
| 4 AVE E - (1) | | 0+103 | 0+106 | 3 | NORTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 4 | $1,050 |
| 4 AVE E - (1) | | 0+121 | 0+124 | 3 | SOUTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 4 AVE E - (1) | | 0+136 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 4 AVE E - (1) | | 0+148 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 4 AVE E - (1) | END | 0+164 | | | | | | | |
| 4 AVE E - (2) | START | 0+000 | | | | | | | |
| 4 AVE E - (2) | | 0+014 | 0+017 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 4 | $30 |
| 4 AVE E - (2) | END | 0+077 | | | | | | | |
| 4 AVE E - (3) | START | 0+000 | | | | | | | |
| 4 AVE E - (3) | | 0+026 | 0+029 | 3 | NORTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 3 | $1,050 |
| 4 AVE E - (3) | | 0+027 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 3 | $1,000 |
| 4 AVE E - (3) | END | 0+300 | | | | | | | |
| 4 AVE W | START | 0+000 | | | | | | | |
| 4 AVE W | | 0+086 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 4 AVE W | | 0+145 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 4 AVE W | | 0+256 | 0+259 | 3 | NORTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 5 | $1,050 |
| 4 AVE W | | 0+436 | | | | ASPHALT - POOR REPAIR | ROAD | 3 | $280 |
| 4 AVE W | | 0+445 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 4 AVE W | | 0+451 | 0+454 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 3 | $30 |
| 4 AVE W | | 0+465 | | | | ASPHALT - SETTLEMENT | ROAD | 4 | $3,000 |
| 4 AVE W | | 0+771 | 0+787 | 16 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 2 | $160 |
| 4 AVE W | | 0+536 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 4 AVE W | | 0+546 | 0+601 | 55 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $550 |
| 4 AVE W | | 0+601 | 0+703 | 102 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 3 | $1,020 |
| 4 AVE W | | 0+649 | 0+652 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 3 | $30 |
| 4 AVE W | | 0+703 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 4 AVE W | | 1+130 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 3 | $250 |

## TABLE 6.1
## CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 4 AVE W | | 1+148 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 2 | $250 |
| 4 AVE W | | 1+160 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 5 | $250 |
| 4 AVE W | | 1+167 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 3 | $250 |
| 4 AVE W | | 1+220 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 4 AVE W | | 1+347 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 2 | $250 |
| 4 AVE W | | 1+390 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 4 AVE W | | 1+414 | 1+415 | 1 | SOUTH | CURB/GUTTER - DETERIORATION | GUTTER | 4 | $1,700 |
| 4 AVE W | | 1+501 | 1+504 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 4 AVE W | END | 1+586 | | | | | | | |
| 4 ST E | START | 0+000 | | | | | | | |
| 4 ST E | | 0+004 | | | WEST | CONCRETE - SETTLEMENT | SIDEWALK | 5 | $250 |
| 4 ST E | | 0+004 | 0+007 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 4 | $30 |
| 4 ST E | | 0+169 | 0+174 | 5 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 2 | $50 |
| 4 ST E | | 0+173 | 0+176 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 4 ST E | | 0+266 | 0+269 | 3 | WEST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 4 ST E | | 0+475 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 4 ST E | END | 0+498 | | | | | | | |
| 4 ST W | START | 0+000 | | | | | | | |
| 4 ST W | | 0+034 | 0+035 | 1 | EAST | CURB/GUTTER - DETERIORATION | CURB | 1 | $1,700 |
| 4 ST W | | 0+034 | 0+037 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $30 |
| 4 ST W | | 0+053 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 4 ST W | | 0+073 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 4 ST W | | 0+075 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 4 ST W | | 0+088 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 4 ST W | | 0+128 | 0+133 | 5 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $1,750 |
| 4 ST W | | 0+146 | 0+149 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $30 |
| 4 ST W | | 0+151 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 3 | $1,000 |
| 4 ST W | | 0+177 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 4 ST W | | 0+177 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 3 | $1,000 |
| 4 ST W | | 0+191 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 4 ST W | | 0+229 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 4 ST W | | 0+229 | 0+279 | 50 | WEST | CONCRETE - DETERIORATION | SIDEWALK | 3 | $50,000 |
| 4 ST W | | 0+244 | 0+247 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 4 ST W | | 0+306 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 4 ST W | | 0+372 | 0+375 | 3 | WEST | CONCRETE - DETERIORATION | SIDEWALK | 4 | $3,000 |
| 4 ST W | | 0+482 | 0+485 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 4 ST W | | 0+487 | 0+490 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 3 | $3,000 |
| 4 ST W | | 0+506 | 0+509 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 3 | $3,000 |
| 4 ST W | | 0+575 | 0+578 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 4 ST W | | 0+594 | 0+597 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 2 | $30 |
| 4 ST W | | 0+642 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 4 ST W | | 0+797 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 4 ST W | | 0+866 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 4 ST W | END | 0+981 | | | | | | | |
| 4A ST W | START | 0+000 | | | | | | | |
| 4A ST W | | 0+006 | 0+009 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |

## TABLE 6.1
## CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 4A ST W | | 0+006 | | | WEST | CONCRETE - SETTLEMENT | SIDEWALK | 2 | $250 |
| 4A ST W | | 0+008 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 4A ST W | | 0+023 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 4A ST W | | 0+026 | | | | ASPHALT - SETTLEMENT | ROAD | 3 | $3,000 |
| 4A ST W | END | 0+026 | | | | | | | |
| 5 AVE E | START | 0+000 | | | | | | | |
| 5 AVE E | | 0+017 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 5 AVE E | | 0+040 | | | | ASPHALT - SETTLEMENT | ROAD | 5 | $3,000 |
| 5 AVE E | | 0+225 | 0+231 | 6 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $60 |
| 5 AVE E | | 0+275 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 5 AVE E | | 0+282 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 5 AVE E | | 0+282 | 0+294 | 12 | | ASPHALT - DETERIORATION | ROAD | 2 | $22,800 |
| 5 AVE E | | 0+323 | 0+359 | 36 | | ASPHALT - DETERIORATION | ROAD | 2 | $68,400 |
| 5 AVE E | | 0+331 | 0+340 | 9 | SOUTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 4 | $3,150 |
| 5 AVE E | | 0+365 | 0+368 | 3 | NORTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 3 | $1,050 |
| 5 AVE E | | 0+376 | 0+395 | 19 | SOUTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 4 | $6,650 |
| 5 AVE E | | 0+396 | 0+399 | 3 | NORTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $1,050 |
| 5 AVE E | | 0+432 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 5 AVE E | | 0+444 | 0+470 | 26 | | ASPHALT - DETERIORATION | ROAD | 2 | $49,400 |
| 5 AVE E | | 0+529 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 3 | $250 |
| 5 AVE E | | 0+603 | 0+606 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $30 |
| 5 AVE E | | 0+603 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 4 | $1,000 |
| 5 AVE E | | 0+712 | | | SOUTH | CONCRETE - SPALLING | SIDEWALK | 1 | $500 |
| 5 AVE E | | 0+771 | 0+772 | 1 | | CURB/GUTTER - DETERIORATION | CURB | 4 | $1,700 |
| 5 AVE E | | 0+799 | 0+802 | 3 | SOUTH | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 5 AVE E | | 0+818 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 2 | $250 |
| 5 AVE E | | 0+875 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 5 AVE E | | 0+888 | 0+897 | 9 | | ASPHALT - DETERIORATION | ROAD | 4 | $17,100 |
| 5 AVE E | | 0+911 | 0+914 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 4 | $30 |
| 5 AVE E | | 0+922 | | | | ASPHALT - SETTLEMENT | ROAD | 2 | $3,000 |
| 5 AVE E | | 1+074 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 5 AVE E | | 1+084 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 5 AVE E | | 1+121 | | | SOUTH | DAMAGED CATCHBASIN | GUTTER | 4 | $1,500 |
| 5 AVE E | END | 1+131 | | | | | | | |
| 5 AVE W - (1) | START | 0+000 | | | | | | | |
| 5 AVE W - (1) | | 0+010 | | | | ASPHALT - SETTLEMENT | ROAD | 3 | $3,000 |
| 5 AVE W - (1) | | 0+015 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 5 AVE W - (1) | | 0+065 | 0+068 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 5 AVE W - (1) | | 0+065 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 3 | $250 |
| 5 AVE W - (1) | END | 0+170 | | | | | | | |
| 5 AVE W - (2) | START | 0+000 | | | | | | | |
| 5 AVE W - (2) | | 0+045 | 0+048 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 5 AVE W - (2) | | 0+090 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 5 AVE W - (2) | | 0+090 | 0+099 | 9 | SOUTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 4 | $3,150 |
| 5 AVE W - (2) | | 0+090 | | | | ASPHALT - DETERIORATION | ROAD | 3 | $1,900 |
| 5 AVE W - (2) | | 0+156 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |

# TABLE 6.1
# CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 5 AVE W - (2) | | 0+156 | 0+159 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 5 AVE W - (2) | | 0+236 | 0+239 | 3 | NORTH | CONCRETE - DETERIORATION | SIDEWALK | 3 | $3,000 |
| 5 AVE W - (2) | | 0+236 | 0+239 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $30 |
| 5 AVE W - (2) | | 0+333 | | | NORTH & SOU | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 3 | $1,000 |
| 5 AVE W - (2) | | 0+389 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 5 AVE W - (2) | | 0+433 | 0+436 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 5 AVE W - (2) | | 0+433 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 3 | $1,000 |
| 5 AVE W - (2) | | 0+443 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 5 AVE W - (2) | | 0+486 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 5 AVE W - (2) | | 0+486 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 3 | $250 |
| 5 AVE W - (2) | | 0+533 | 0+536 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 5 AVE W - (2) | | 0+533 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 5 AVE W - (2) | | 0+573 | | | | SETTLED VALVE | ROAD | 4 | $500 |
| 5 AVE W - (2) | | 0+633 | 0+636 | 3 | SOUTH | CONCRETE - DETERIORATION | SIDEWALK | 4 | $3,000 |
| 5 AVE W - (2) | | 0+633 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 5 AVE W - (2) | END | 0+643 | | | | | | | |
| 5 ST E - (1) | START | 0+000 | | | | | | | |
| 5 ST E - (1) | | 0+008 | | | | ASPHALT - POOR REPAIR | ROAD | 3 | $280 |
| 5 ST E - (1) | | 0+114 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 3 | $1,000 |
| 5 ST E - (1) | | 0+120 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 4 | $1,000 |
| 5 ST E - (1) | | 0+131 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 3 | $1,000 |
| 5 ST E - (1) | END | 0+176 | | | | | | | |
| 5 ST E - (2) | START | 0+000 | | | | | | | |
| 5 ST E - (2) | | 0+003 | | | WEST | CONCRETE - SPALLING | SIDEWALK | 5 | $500 |
| 5 ST E - (2) | | 0+032 | | | | ASPHALT - SETTLEMENT | ROAD | 4 | $3,000 |
| 5 ST E - (2) | | 0+047 | 0+054 | 7 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 2 | $70 |
| 5 ST E - (2) | | 0+097 | 0+100 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 3 | $30 |
| 5 ST E - (2) | END | 0+097 | | | | | | | |
| 5 ST W | START | 0+000 | | | | | | | |
| 5 ST W | | 0+154 | 0+157 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 5 ST W | | 0+166 | 0+169 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 5 ST W | | 0+180 | | | | ASPHALT - POOR REPAIR | ROAD | 3 | $280 |
| 5 ST W | | 0+201 | 0+204 | 3 | | ASPHALT - DETERIORATION | ROAD | 1 | $5,700 |
| 5 ST W | | 0+232 | | | | ASPHALT - POOR REPAIR | ROAD | 3 | $280 |
| 5 ST W | | 0+290 | 0+297 | 7 | | ASPHALT - DETERIORATION | ROAD | 2 | $13,300 |
| 5 ST W | | 0+357 | 0+363 | 6 | WEST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 3 | $2,100 |
| 5 ST W | | 0+354 | 0+363 | 9 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $3,150 |
| 5 ST W | | 0+390 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 5 ST W | | 0+454 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 5 ST W | | 0+471 | 0+474 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 5 ST W | | 0+491 | 0+494 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 5 ST W | | 0+491 | | | | ASPHALT - SETTLEMENT | ROAD | 1 | $3,000 |
| 5 ST W | | 0+579 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 5 ST W | | 0+614 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 5 ST W | | 0+876 | | | EAST | CONCRETE - SETTLEMENT | SIDEWALK | 1 | $250 |
| 5 ST W | | 0+876 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |

## TABLE 6.1
## CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 5 ST W | | 0+892 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 5 ST W | | 0+945 | | | | ASPHALT - POOR REPAIR | ROAD | 2 | $280 |
| 5 ST W | | 0+972 | 0+975 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 5 ST W | | 1+036 | 1+039 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 5 ST W | | 1+088 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 5 ST W | | 1+116 | 1+119 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 5 ST W | | 1+149 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 5 ST W | | 1+152 | 1+155 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 5 ST W | | 1+158 | | | EAST | CONCRETE - SETTLEMENT | SIDEWALK | 3 | $250 |
| 5 ST W | | 1+177 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 5 ST W | | 1+186 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 5 ST W | | 1+210 | 1+211 | 1 | | CURB/GUTTER - DETERIORATION | CURB | 2 | $1,700 |
| 5 ST W | | 1+224 | | | EAST | CONCRETE - SETTLEMENT | SIDEWALK | 1 | $250 |
| 5 ST W | END | 1+250 | | | | | | | |
| 5A AVE E | START | 0+000 | | | | | | | |
| 5A AVE E | | 0+055 | 0+163 | 108 | | ASPHALT - DETERIORATION | ROAD | 3 | $205,200 |
| 5A AVE E | | 0+095 | 0+098 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 5A AVE E | | 0+183 | | | WEST | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 5A AVE E | | 0+211 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 5A AVE E | | 0+211 | 0+239 | 28 | | ASPHALT - DETERIORATION | ROAD | 4 | $53,200 |
| 5A AVE E | | 0+269 | 0+294 | 25 | | ASPHALT - DETERIORATION | ROAD | 2 | $47,500 |
| 5A AVE E | | 0+331 | | | | ASPHALT - POOR REPAIR | ROAD | 1 | $280 |
| 5A AVE E | | 0+354 | | | | ASPHALT - SETTLEMENT | ROAD | 1 | $3,000 |
| 5A AVE E | | 0+354 | | | | ASPHALT - SETTLEMENT | ROAD | 2 | $3,000 |
| 5A AVE E | | 0+396 | 0+399 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 5A AVE E | | 0+410 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 5A AVE E | | 0+431 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 5A AVE E | | 0+485 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 3 | $1,000 |
| 5A AVE E | | 0+672 | 0+675 | 3 | WEST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 5A AVE E | | 0+709 | 0+712 | 3 | | CONCRETE - LONGITUDINAL CRACKING | ROAD | 4 | $1,050 |
| 5A AVE E | END | 0+709 | | | | | | | |
| 5A ST W - (1) | START | 0+000 | | | | | | | |
| 5A ST W - (1) | | 0+057 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 5A ST W - (1) | END | 0+090 | | | | | | | |
| 6 AVE E | START | 0+000 | | | | | | | |
| 6 AVE E | | 0+000 | 0+003 | 3 | SOUTH | ASPHALT - DETERIORATION | ROAD | 1 | $5,700 |
| 6 AVE E | END | 0+080 | | | | | | | |
| 6 AVE W - (1) | START | 0+000 | | | | | | | |
| 6 AVE W - (1) | | 0+060 | 0+063 | 3 | SOUTH | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 6 AVE W - (1) | | 0+060 | 0+063 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $30 |
| 6 AVE W - (1) | | 0+060 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 6 AVE W - (1) | | 0+060 | 0+063 | 3 | NORTH | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 6 AVE W - (1) | | 0+100 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | ROAD | 2 | $1,000 |
| 6 AVE W - (1) | | 0+100 | 0+103 | 3 | SOUTH | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 6 AVE W - (1) | END | 0+100 | | | | | | | |
| 6 AVE W - (2) | START | 0+000 | | | | | | | |

## TABLE 6.1
## CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 6 AVE W - (2) | | 0+003 | | | | ASPHALT - POOR REPAIR | ROAD | 2 | $280 |
| 6 AVE W - (2) | | 0+040 | 0+043 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 3 | $30 |
| 6 AVE W - (2) | | 0+038 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 6 AVE W - (2) | | 0+088 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 1 | $250 |
| 6 AVE W - (2) | | 0+113 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 6 AVE W - (2) | | 0+113 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 6 AVE W - (2) | | 0+123 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 6 AVE W - (2) | | 0+152 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 6 AVE W - (2) | | 0+171 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 6 AVE W - (2) | | 0+172 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 6 AVE W - (2) | | 0+191 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 3 | $1,000 |
| 6 AVE W - (2) | | 0+213 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 6 AVE W - (2) | | 0+262 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 6 AVE W - (2) | | 0+279 | 0+282 | 3 | SOUTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 6 AVE W - (2) | | 0+283 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 1 | $250 |
| 6 AVE W - (2) | | 0+329 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 6 AVE W - (2) | | 0+370 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 1 | $250 |
| 6 AVE W - (2) | | 0+389 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 6 AVE W - (2) | | 0+440 | 0+443 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 6 AVE W - (2) | | 0+610 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 6 AVE W - (2) | | 0+617 | 0+618 | 1 | NORTH | CURB/GUTTER - DETERIORATION | GUTTER | 4 | $1,700 |
| 6 AVE W - (2) | | 0+638 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 2 | $250 |
| 6 AVE W - (2) | END | 0+686 | | | | | | | |
| 6 ST W - (1) | START | 0+000 | | | | | | | |
| 6 ST W - (1) | | 0+066 | 0+069 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 6 ST W - (1) | | 0+081 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 6 ST W - (1) | | 0+098 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 6 ST W - (1) | | 0+151 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 6 ST W - (1) | | 0+204 | 0+207 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 6 ST W - (1) | | 0+221 | 0+224 | 3 | WEST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 6 ST W - (1) | | 0+221 | 0+224 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 6 ST W - (1) | | 0+238 | 0+239 | 1 | EAST | CURB/GUTTER - DETERIORATION | CURB | 1 | $1,700 |
| 6 ST W - (1) | | 0+282 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 6 ST W - (1) | | 0+326 | | | | ASPHALT - SETTLEMENT | ROAD | 3 | $3,000 |
| 6 ST W - (1) | | 0+354 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 6 ST W - (1) | | 0+427 | 0+430 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 4 | $30 |
| 6 ST W - (1) | | 0+430 | | | WEST | CONCRETE - SETTLEMENT | SIDEWALK | 2 | $250 |
| 6 ST W - (1) | | 0+451 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 6 ST W - (1) | | 0+463 | | | EAST | CONCRETE - SETTLEMENT | SIDEWALK | 3 | $250 |
| 6 ST W - (1) | | 0+482 | | | EAST | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 6 ST W - (1) | | 0+491 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 6 ST W - (1) | | 0+511 | | | EAST | CONCRETE - SETTLEMENT | SIDEWALK | 1 | $250 |
| 6 ST W - (1) | | 0+556 | 0+559 | 3 | WEST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 6 ST W - (1) | | 0+556 | 0+559 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 6 ST W - (1) | | 0+765 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 6 ST W - (1) | | 0+829 | 0+832 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 4 | $30 |

**TABLE 6.1**
**CARDSTON ROAD REPAIR COST**

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 6 ST W - (1) | | 0+860 | 0+863 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 3 | $30 |
| 6 ST W - (1) | END | 0+924 | | | | | | | |
| 6 ST W - (2) | START | 0+000 | | | | | | | |
| 6 ST W - (2) | | 0+015 | 0+016 | 1 | WEST | CURB/GUTTER - DETERIORATION | CURB | 1 | $1,700 |
| 6 ST W - (2) | END | 0+274 | | | | | | | |
| 6A AVE W | START | 0+000 | | | | | | | |
| 6A AVE W | | 0+000 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 6A AVE W | | 0+046 | 0+049 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 6A AVE W | | 0+052 | 0+055 | 3 | SOUTH | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 6A AVE W | | 0+098 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 6A AVE W | | 0+134 | 0+137 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $30 |
| 6A AVE W | | 0+134 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 6A AVE W | | 0+149 | 0+183 | 34 | | ASPHALT - DETERIORATION | ROAD | 3 | $64,600 |
| 6A AVE W | | 0+195 | 0+198 | 3 | | ASPHALT - DETERIORATION | ROAD | 1 | $5,700 |
| 6A AVE W | | 0+195 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 1 | $250 |
| 6A AVE W | END | 0+195 | | | | | | | |
| 7 AVE E | START | 0+000 | | | | | | | |
| 7 AVE E | | 0+114 | 0+115 | 1 | NORTH | CURB/GUTTER - DETERIORATION | CURB | 2 | $1,700 |
| 7 AVE E | | 0+114 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 4 | $250 |
| 7 AVE E | END | 0+314 | | | | | | | |
| 7 AVE W - (1) | START | 0+000 | | | | | | | |
| 7 AVE W - (1) | | 0+016 | 0+019 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 7 AVE W - (1) | | 0+043 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 7 AVE W - (1) | | 0+114 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 7 AVE W - (1) | | 0+132 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 7 AVE W - (1) | | 0+148 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 7 AVE W - (1) | | 0+278 | 0+281 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 7 AVE W - (1) | | 0+320 | 0+323 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 7 AVE W - (1) | | 0+366 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 7 AVE W - (1) | END | 0+391 | | | | | | | |
| 7 AVE W - (2) | START | 0+000 | | | | | | | |
| 7 AVE W - (2) | | 0+000 | | | NORTH | ASPHALT - POTHOLE | SIDEWALK | 2 | $140 |
| 7 AVE W - (2) | | 0+070 | | | SOUTH | ASPHALT - POTHOLE | ROAD | 1 | $140 |
| 7 AVE W - (2) | END | 0+150 | | | | | | | |
| 7 AVE W - (3) | START | 0+000 | | | | | | | |
| 7 AVE W - (3) | | 0+065 | 0+068 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 7 AVE W - (3) | | 0+140 | | | | ASPHALT - POTHOLE | ROAD | 1 | $140 |
| 7 AVE W - (3) | | 0+180 | 0+183 | 3 | SOUTH | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 7 AVE W - (3) | | 0+220 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 7 AVE W - (3) | | 0+267 | 0+270 | 3 | NORTH | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 7 AVE W - (3) | END | 0+485 | | | | | | | |
| 7 ST W | START | 0+000 | | | | | | | |
| 7 ST W | | 0+095 | 0+098 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 7 ST W | | 0+145 | 0+148 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 2 | $30 |
| 7 ST W | | 0+214 | 0+217 | 3 | WEST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 7 ST W | | 0+235 | 0+238 | 3 | WEST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |

**TABLE 6.1**
**CARDSTON ROAD REPAIR COST**

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 7 ST W | | 0+289 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 7 ST W | | 0+296 | 0+299 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 7 ST W | | 0+324 | 0+327 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 7 ST W | | 0+378 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 7 ST W | | 0+486 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 7 ST W | | 0+531 | 0+534 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 3 | $1,050 |
| 7 ST W | | 0+531 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 7 ST W | | 0+568 | | | | ASPHALT - POTHOLE | ROAD | 1 | $140 |
| 7 ST W | | 0+583 | 0+586 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 7 ST W | | 0+616 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 7 ST W | | 0+633 | 0+650 | 17 | | ASPHALT - DETERIORATION | ROAD | 4 | $32,300 |
| 7 ST W | | 0+657 | 0+660 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 7 ST W | | 0+708 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 7 ST W | | 0+747 | 0+750 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 7 ST W | | 0+759 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 7 ST W | | 0+778 | 0+792 | 14 | | ASPHALT - DETERIORATION | ROAD | 4 | $26,600 |
| 7 ST W | | 0+792 | 0+795 | 3 | EAST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 1 | $1,050 |
| 7 ST W | | 0+817 | 0+820 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 7 ST W | | 0+849 | 0+852 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 7 ST W | | 0+890 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 7 ST W | | 0+910 | 0+913 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 7 ST W | | 0+941 | 0+944 | 3 | WEST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $1,050 |
| 7 ST W | | 0+961 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 7 ST W | | 0+998 | 1+001 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 7 ST W | | 1+009 | | | | ASPHALT - POTHOLE | ROAD | 1 | $140 |
| 7 ST W | | 1+124 | 1+127 | 3 | | ASPHALT - DETERIORATION | ROAD | 1 | $5,700 |
| 7 ST W | | 1+185 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 7 ST W | | 1+223 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 7 ST W | | 1+290 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 7 ST W | | 1+314 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 7 ST W | | 1+348 | 1+351 | 3 | WEST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $1,050 |
| 7 ST W | | 1+368 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 7 ST W | | 1+382 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 7 ST W | | 1+397 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 7 ST W | | 1+397 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 7 ST W | | 1+439 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 7 ST W | | 1+473 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 7 ST W | | 1+503 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 7 ST W | | 1+528 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 7 ST W | | 1+544 | 1+547 | 3 | | ASPHALT - DETERIORATION | ROAD | 1 | $5,700 |
| 7 ST W | | 1+544 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 7 ST W | END | 1+650 | | | | | | | |
| 7A AVE W - (1) | START | 0+000 | | | | | | | |
| 7A AVE W - (1) | | 0+021 | 0+024 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 7A AVE W - (1) | | 0+038 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 7A AVE W - (1) | | 0+043 | | | | ASPHALT - POTHOLE | ROAD | 1 | $140 |

**TABLE 6.1**
**CARDSTON ROAD REPAIR COST**

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 7A AVE W - (1) | | 0+070 | 0+073 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 7A AVE W - (1) | | 0+088 | 0+091 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 7A AVE W - (1) | END | 0+123 | | | | | | | |
| 7A AVE W - (2) | START | 0+000 | | | | | | | |
| 7A AVE W - (2) | | 0+053 | 0+054 | 1 | SOUTH | CURB/GUTTER - DETERIORATION | GUTTER | 1 | $1,700 |
| 7A AVE W - (2) | | 0+072 | 0+075 | 3 | SOUTH | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 7A AVE W - (2) | END | 0+100 | | | | | | | |
| 8 AVE E | START | 0+000 | | | | | | | |
| 8 AVE E | | 0+006 | 0+009 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 8 AVE E | | 0+010 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 8 AVE E | | 0+011 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 3 | $250 |
| 8 AVE E | | 0+012 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 8 AVE E | | 0+018 | 0+021 | 3 | NORTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $1,050 |
| 8 AVE E | | 0+019 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 2 | $250 |
| 8 AVE E | | 0+046 | 0+049 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 8 AVE E | | 0+046 | 0+052 | 6 | | ASPHALT - DETERIORATION | ROAD | 3 | $11,400 |
| 8 AVE E | | 0+084 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 8 AVE E | | 0+186 | | | | SETTLED VALVE | ROAD | 4 | $500 |
| 8 AVE E | END | 0+288 | | | | | | | |
| 8 AVE W - (1) | START | 0+000 | | | | | | | |
| 8 AVE W - (1) | | 0+005 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 4 | $1,000 |
| 8 AVE W - (1) | | 0+016 | 0+019 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 8 AVE W - (1) | | 0+023 | 0+026 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 8 AVE W - (1) | | 0+047 | 0+050 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 8 AVE W - (1) | | 0+134 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 4 | $1,000 |
| 8 AVE W - (1) | | 0+184 | 0+187 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 8 AVE W - (1) | END | 0+185 | | | | | | | |
| 8 AVE W - (2) | START | 0+000 | | | | | | | |
| 8 AVE W - (2) | | 0+006 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 8 AVE W - (2) | | 0+052 | 0+055 | 3 | | ASPHALT - DETERIORATION | ROAD | 5 | $5,700 |
| 8 AVE W - (2) | | 0+077 | 0+080 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 8 AVE W - (2) | | 0+077 | 0+078 | 1 | SOUTH | CURB/GUTTER - DETERIORATION | GUTTER | 3 | $1,700 |
| 8 AVE W - (2) | | 0+163 | 0+166 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 8 AVE W - (2) | | 0+175 | | | | ASPHALT - POTHOLE | ROAD | 5 | $140 |
| 8 AVE W - (2) | END | 0+192 | | | | | | | |
| 8 AVE W - (3) | START | 0+000 | | | | | | | |
| 8 AVE W - (3) | | 0+006 | 0+009 | 3 | SOUTH | ASPHALT - DETERIORATION | ROAD | 1 | $5,700 |
| 8 AVE W - (3) | | 0+020 | 0+021 | 1 | SOUTH | CURB/GUTTER - DETERIORATION | CURB | 1 | $1,700 |
| 8 AVE W - (3) | END | 0+105 | | | | | | | |
| 8 ST W | START | 0+000 | | | | | | | |
| 8 ST W | | 0+065 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 8 ST W | | 0+082 | | | WEST | CONCRETE - SETTLEMENT | SIDEWALK | 2 | $250 |
| 8 ST W | | 0+113 | 0+116 | 3 | WEST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 2 | $1,050 |
| 8 ST W | | 0+126 | | | EAST | CONCRETE - SETTLEMENT | SIDEWALK | 1 | $250 |
| 8 ST W | | 0+145 | | | EAST | CONCRETE - SETTLEMENT | SIDEWALK | 1 | $250 |
| 8 ST W | | 0+163 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |

## TABLE 6.1
## CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 8 ST W | | 0+207 | 0+210 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 8 ST W | | 0+246 | 0+249 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 8 ST W | | 0+311 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 8 ST W | | 0+338 | 0+341 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 8 ST W | | 0+360 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 8 ST W | | 0+379 | 0+382 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 8 ST W | | 0+421 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 8 ST W | | 0+436 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 8 ST W | | 0+447 | 0+450 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 1 | $30 |
| 8 ST W | | 0+460 | 0+463 | 3 | | CONCRETE - DETERIORATION | ROAD | 2 | $3,000 |
| 8 ST W | | 0+460 | 0+463 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 8 ST W | | 0+494 | 0+497 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 3 | $30 |
| 8 ST W | | 0+520 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 8 ST W | | 0+553 | 0+556 | 3 | | ASPHALT - DETERIORATION | ROAD | 1 | $5,700 |
| 8 ST W | END | 0+553 | | | | | | | |
| 8A AVE W | START | 0+000 | | | | | | | |
| 8A AVE W | | 0+040 | 0+043 | 3 | SOUTH | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 8A AVE W | | 0+044 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 8A AVE W | END | 0+079 | | | | | | | |
| 9 AVE E | START | 0+000 | | | | | | | |
| 9 AVE E | | 0+040 | 0+043 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 4 | $30 |
| 9 AVE E | | 0+072 | 0+075 | 3 | NORTH | CONCRETE - DETERIORATION | SIDEWALK | 2 | $3,000 |
| 9 AVE E | | 0+102 | | | | ASPHALT - SETTLEMENT | ROAD | 3 | $3,000 |
| 9 AVE E | | 0+114 | 0+117 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 3 | $30 |
| 9 AVE E | | 0+114 | 0+115 | 1 | SOUTH | CURB/GUTTER - DETERIORATION | GUTTER | 3 | $1,700 |
| 9 AVE E | | 0+114 | 0+117 | 3 | SOUTH | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 3 | $1,050 |
| 9 AVE E | END | 0+170 | | | | | | | |
| 9 AVE W | START | 0+000 | | | | | | | |
| 9 AVE W | | 0+024 | 0+034 | 10 | | ASPHALT - DETERIORATION | ROAD | 5 | $19,000 |
| 9 AVE W | | 0+077 | 0+080 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 9 AVE W | | 0+108 | 0+111 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 9 AVE W | | 0+138 | | | | ASPHALT - POTHOLE | ROAD | 4 | $140 |
| 9 AVE W | | 0+295 | 0+298 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 9 AVE W | | 0+368 | 0+371 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 9 AVE W | | 0+389 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 9 AVE W | | 0+459 | 0+462 | 3 | | ASPHALT - DETERIORATION | ROAD | 4 | $5,700 |
| 9 AVE W | | 0+507 | 0+510 | 3 | | ASPHALT - DETERIORATION | ROAD | 5 | $5,700 |
| 9 AVE W | | 0+605 | 0+608 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 9 AVE W | | 0+642 | 0+645 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 9 AVE W | | 0+698 | | | | ASPHALT - POTHOLE | ROAD | 3 | $140 |
| 9 AVE W | | 0+732 | 0+735 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 9 AVE W | | 0+785 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| 9 AVE W | | 0+853 | 0+856 | 3 | | ASPHALT - DETERIORATION | ROAD | 2 | $5,700 |
| 9 AVE W | | 0+869 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 9 AVE W | | 0+969 | 1+122 | 153 | | ASPHALT - DETERIORATION | ROAD | 3 | $290,700 |
| 9 AVE W | | 1+199 | 1+202 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |

# TABLE 6.1
# CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| 9 AVE W | | 1+288 | 1+291 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 5 | $30 |
| 9 AVE W | | 1+569 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 9 AVE W | END | 2+197 | | | | | | | |
| 9 ST W | START | 0+000 | | | | | | | |
| 9 ST W | | 0+029 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 9 ST W | | 0+062 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 9 ST W | | 0+083 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 3 | $120 |
| 9 ST W | | 0+112 | | | WEST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 9 ST W | | 0+175 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 9 ST W | | 0+178 | 0+216 | 38 | | ASPHALT - DETERIORATION | ROAD | 2 | $72,200 |
| 9 ST W | | 0+216 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 9 ST W | | 0+259 | 0+262 | 3 | | ASPHALT - LONGITUDINAL CRACKING | ROAD | 2 | $30 |
| 9 ST W | | 0+290 | | | | ASPHALT - SETTLEMENT | ROAD | 3 | $3,000 |
| 9 ST W | | 0+290 | 0+293 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| 9 ST W | | 0+404 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 9 ST W | | 0+433 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| 9 ST W | | 0+450 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 9 ST W | | 0+450 | | | | ASPHALT - SETTLEMENT | ROAD | 2 | $3,000 |
| 9 ST W | | 0+477 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 1 | $120 |
| 9 ST W | | 0+477 | | | | ASPHALT - SETTLEMENT | ROAD | 1 | $3,000 |
| 9 ST W | | 0+477 | 0+480 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| 9 ST W | | 0+539 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 9 ST W | | 0+562 | | | | ASPHALT - TRANSVERSE CRACKING | ROAD | 2 | $120 |
| 9 ST W | | 0+628 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| 9 ST W | END | 0+690 | | | | | | | |
| FAIRWAY BLVD | START | 0+000 | | | | | | | |
| FAIRWAY BLVD | | 0+086 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| FAIRWAY BLVD | | 0+201 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| FAIRWAY BLVD | | 0+201 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 1 | $250 |
| FAIRWAY BLVD | END | 0+201 | | | | | | | |
| MAIN A ST W | START | 0+000 | | | | | | | |
| MAIN A ST W | | 0+075 | 0+078 | 3 | | CONCRETE - LONGITUDINAL CRACKING | ROAD | 2 | $1,050 |
| MAIN A ST W | | 0+075 | | | | SETTLED VALVE | ROAD | 2 | $500 |
| MAIN A ST W | | 0+120 | 0+123 | 3 | | CONCRETE - LONGITUDINAL CRACKING | ROAD | 2 | $1,050 |
| MAIN A ST W | END | 0+180 | | | | | | | |
| MOUNTAIN PARK DRIVE | START | 0+000 | | | | | | | |
| MOUNTAIN PARK DRIVE | | 0+043 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| MOUNTAIN PARK DRIVE | | 0+370 | | | SOUTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| MOUNTAIN PARK DRIVE | END | 0+420 | | | | | | | |
| WEST CREEK DR | START | 0+000 | | | | | | | |
| WEST CREEK DR | | 0+000 | | | | SETTLED VALVE | ROAD | 3 | $500 |
| WEST CREEK DR | | 0+035 | | | SOUTH | CONCRETE - SETTLEMENT | SIDEWALK | 2 | $250 |
| WEST CREEK DR | | 0+035 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| WEST CREEK DR | | 0+085 | 0+088 | 3 | SOUTH | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| WEST CREEK DR | | 0+094 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| WEST CREEK DR | | 0+119 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |

## TABLE 6.1
## CARDSTON ROAD REPAIR COST

| ROAD | START/END | START OF DEFICIENCY (m) | END OF DEFICIENCY (m) | LENGTH OF DEFICIENCY (m) | SIDE OF ROAD | DEFICIENCY | DESCRIPTION | RATING | EXTENDED |
|---|---|---|---|---|---|---|---|---|---|
| WEST CREEK DR | | 0+137 | 0+140 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| WEST CREEK DR | | 0+140 | 0+143 | 3 | WEST | CONCRETE - LONGITUDINAL CRACKING | SIDEWALK | 3 | $1,050 |
| WEST CREEK DR | | 0+152 | | | EAST | CONCRETE - SETTLEMENT | SIDEWALK | 1 | $250 |
| WEST CREEK DR | | 0+163 | | | EAST | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 1 | $1,000 |
| WEST CREEK DR | | 0+181 | 0+184 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| WEST CREEK DR | | 0+192 | 0+195 | 3 | | ASPHALT - DETERIORATION | ROAD | 3 | $5,700 |
| WEST CREEK DR | | 0+192 | 0+195 | 3 | EAST | CONCRETE - DETERIORATION | SIDEWALK | 1 | $3,000 |
| WEST CREEK DR | | 0+207 | | | NORTH | CONCRETE - TRANSVERSE CRACKING | SIDEWALK | 2 | $1,000 |
| WEST CREEK DR | | 0+277 | | | | ASPHALT - POTHOLE | ROAD | 2 | $140 |
| WEST CREEK DR | | 0+279 | | | NORTH | CONCRETE - SETTLEMENT | SIDEWALK | 1 | $250 |
| WEST CREEK DR | | 0+314 | | | | SETTLED VALVE | ROAD | 3 | $500 |
| WEST CREEK DR | END | 0+315 | | | | | | | |

**Table 6.2**
**ROAD REPAIR COST SUMMARY**

| ITEM | LENGTH (m) | NUMBER OF DEFICIENCIES | REPAIR COST PER ROAD |
|---|---|---|---|
| 1 AVE W | 701 | 17 | $21,050 |
| 1 ST E - (2) | 197 | 4 | $3,490 |
| 1 ST E - (3) | 613 | 15 | $16,600 |
| 1 ST W | 492 | 19 | $21,180 |
| 10 ST W | 213 | 7 | $2,570 |
| 2 AVE E - (1) | 262 | 9 | $7,350 |
| 2 AVE E - (2) | 315 | 5 | $10,150 |
| 2 AVE W | 2,082 | 35 | $123,960 |
| 2 ST E - (1) | 163 | 3 | $310 |
| 2 ST E - (2) | 299 | 4 | $5,990 |
| 2 ST W - (1) | 579 | 22 | $168,830 |
| 2 ST W - (2) | 98 | 12 | $25,800 |
| 2 ST W - (3) | 399 | 9 | $16,200 |
| 2A AVE W | 90 | 2 | $4,000 |
| 3 AVE E | 753 | 9 | $19,290 |
| 3 AVE W | 1,883 | 23 | $50,250 |
| 3 ST E | 505 | 7 | $230,220 |
| 3 ST W - (1) | 375 | 25 | $34,300 |
| 3 ST W - (2) | 184 | 4 | $4,240 |
| 3 ST W - (3) | 280 | 10 | $25,200 |
| 3 ST W - (4) | 163 | 2 | $6,750 |
| 3A AVE E - (1) | 181 | 1 | $1,000 |
| 3A AVE W | 100 | 4 | $13,400 |
| 4 AVE E - (1) | 164 | 4 | $4,100 |
| 4 AVE E - (2) | 77 | 1 | $30 |
| 4 AVE E - (3) | 300 | 2 | $2,050 |
| 4 AVE W | 1,586 | 22 | $15,780 |
| 4 ST E | 498 | 6 | $3,430 |
| 4 ST W | 981 | 25 | $78,190 |
| 4A ST W | 26 | 5 | $8,250 |
| 5 AVE E | 1,131 | 27 | $184,900 |
| 5 AVE W - (1) | 170 | 4 | $9,950 |
| 5 AVE W - (2) | 643 | 20 | $42,000 |
| 5 ST E - (1) | 176 | 4 | $3,280 |
| 5 ST E - (2) | 97 | 4 | $3,600 |
| 5 ST W | 1,250 | 30 | $71,940 |

**Table 6.2**
**ROAD REPAIR COST SUMMARY**

| ITEM | LENGTH (m) | NUMBER OF DEFICIENCIES | REPAIR COST PER ROAD |
|---|---|---|---|
| 5A Ave E | 709 | 15 | $325,280 |
| 5A ST W - (1) | 90 | 1 | $1,000 |
| 6 AVE E | 80 | 1 | $5,700 |
| 6 AVE W - (1) | 100 | 6 | $18,250 |
| 6 AVE W - (2) | 686 | 22 | $19,280 |
| 6 ST W - (1) | 924 | 23 | $35,460 |
| 6 ST W - (2) | 274 | 1 | $1,700 |
| 6A AVE W | 195 | 9 | $81,530 |
| 7 AVE E | 314 | 2 | $1,950 |
| 7 AVE W - (1) | 391 | 8 | $18,660 |
| 7 AVE W - (2) | 150 | 2 | $280 |
| 7 AVE W - (3) | 485 | 5 | $17,380 |
| 7 ST W | 1,650 | 45 | $135,930 |
| 7A AVE W - (1) | 123 | 5 | $18,240 |
| 7A AVE W - (2) | 100 | 2 | $4,700 |
| 8 AVE E | 288 | 10 | $26,130 |
| 8 AVE W - (1) | 185 | 6 | $24,800 |
| 8 AVE W - (2) | 192 | 6 | $19,080 |
| 8 AVE W - (3) | 105 | 2 | $7,400 |
| 8 ST W | 553 | 20 | $43,440 |
| 8A AVE W | 79 | 2 | $4,000 |
| 9 AVE E | 170 | 6 | $8,810 |
| 9 AVE W | 2,197 | 20 | $373,230 |
| 9 ST W | 690 | 20 | $95,010 |
| FAIRWAY BLVD | 201 | 3 | $2,250 |
| MAIN A ST W | 180 | 3 | $2,600 |
| MOUNTAIN PARK DRIVE | 420 | 2 | $1,140 |
| WEST CREEK DRIVE | 315 | 17 | $28,340 |
| **SUB - TOTAL** | **29,876** | **666** | **$2,561,200** |
| NEW WHEELCHAIR RAMP | $1,500 | 69 | 103,500 |
| WHEELCHAIR RAMP REPAIR | $1,500 | 11 | 16,500 |
| **SUB - TOTAL** | | **80** | **120,000** |
| **TOTAL** | | | **$2,681,200** |

## Table 6.3
## ITEM COST BREAKDOWN TABLE

| ITEM | PRICE | UNIT PRICE | QUANTITY | EXTENSION |
|---|---|---|---|---|
| ASPHALT - TRANSVERSE CRACKING | $120 | ea | 81 | $9,720 |
| ASPHALT - LONGITUDINAL CRACKING | $10 | m | 349 | $3,490 |
| ASPHALT - SETTLEMENT | $3,000 | ea | 21 | $63,000 |
| ASPHALT - POTHOLE | $140 | ea | 91 | $12,740 |
| ASPHALT - POOR REPAIR | $280 | ea | 10 | $2,800 |
| ASPHALT - DETERIORATION | $1,900 | m | 973 | $1,848,700 |
| CONCRETE - TRANSVERSE CRACKING | $1,000 | ea | 104 | $104,000 |
| CONCRETE - LONGITUDINAL CRACKING | $350 | m | 185 | $64,750 |
| CONCRETE - SETTLEMENT | $250 | ea | 52 | $13,000 |
| CONCRETE - SPALLING | $500 | ea | 3 | $1,500 |
| CONCRETE - DETERIORATION | $1,000 | m | 243 | $243,000 |
| CURB/GUTTER - DETERIORATION | $1,700 | m | 109 | $185,300 |
| DAMAGED CATCHBASIN | $1,500 | ea | 2 | $3,000 |
| SETTLED VALVE | $500 | ea | 8 | $4,000 |
| GROUND ENCROACHMENT | $22 | m | 100 | $2,200 |
| NEW WHEEL CHAIR RAMP | $1,500 | ea | 69 | $103,500 |
| WHEEL CHAIR RAMP REPAIR | $1,500 | ea | 11 | $16,500 |
| **SUB TOTAL** | | | | **$2,681,200** |

## Table 6.4
## RATING COST BREAKDOWN TABLE

| METHODOLOGY | RATING | QUANTITY | EXTENSION |
|---|---|---|---|
| MINOR DEFECT | 1 | 172 | $305,650 |
| MAJOR DEFECT | 2 | 209 | $629,870 |
| FAILURE | 3 | 150 | $1,244,940 |
| FAILUE POTENTIAL SAFETY HAZARD | 4 | 101 | $329,520 |
| FAILURE - SAFETY HAZARD | 5 | 34 | $51,220 |
| | **TOTAL** | **666** | **$2,561,200** |

# 7 CONCLUSIONS AND RECOMMENDATIONS

## 7.1 Water Distribution System

- Even though there is improvement in the Towns water treatment system as a result of implementing the recommendations set forth in the 2009 IMP, approximately 30% of the nodes within the distribution system fail the fire flow requirements. Therefore, the system does not conform to the level of service required and standards and guidelines set by the Town. The areas with the most locations failing the fire flow requirements are the institutional, industrial, large lot residential in the southeast section of Town and the northwest portion of the Town of Cardston.

- The existing water distribution system has adequate pressure during peak hour demands, but due to localized topographical conditions, pressures in some areas are hovering around the minimum required.

- The improvements recommended for fire flows in the Town of Cardston are pipe upgrades and new pipe installation to increase flow and provide looping of the pipe network.

- Pipe upgrades will help to adequately supply fire flows for the future water distribution system.

- Order of magnitude cost estimates for the proposed water distribution system upgrades are shown in **Table 7.1**. Costs are in 2017 dollars, and include allowances of 10% for engineering and 15% for contingency. Upgrades for the existing system were identified as well as upgrades for ultimate development.
- Due to the age of the existing cast iron pipes, a phased cast iron replacement is recommended and the cost associated is shown in **Table 7.2**

**Table 7.1: Summary of Cost Estimates**

| Description | Existing Upgrades | Ultimate Development |
|---|---|---|
| Pipe upgrades | $425,000 | 4,349,000 |
| 7th Ave Pump Upgrades | $250,000 | |
| **Total** | **$675,000** | **4,349,000** |

**Table 7.2: Summary of Cost Estimates**

| Description | Old Cast Iron Pipe Upgrades (length) | Ultimate Development Upgrades |
|---|---|---|
| 200 mm PVC | 5241 m | 5,241,000 |
| 150 mm PVC | 933 m | 933,000 |
| **Total** | **6174 m** | **6,174,000** |

- If desired, the implementation of these upgrades can be staged. First priority should be given to the pipe upgrades to supply fire flow to institutional buildings.
- For the alignment for pipe upgrades to the existing system, consideration should also be given to other factors, such as potential future developments, in conjunction with roadway resurfacing works, stakeholder acceptance and traffic disruptions.

## 7.2 Sanitary Sewer System

- Flow data for the sanitary model was bases on average water consumption rate between 2012 and 2016 and conservatively reflect 2016 effluent flows measured at the water treatment plant.
- Data on the sanitary system of the Town such as inverts, pipe sizes, and rim elevations were provided by the Town of Cardston and used to develop the sanitary model.
- The existing residential sewage generation rate of 553 L/c/day was established based on flow data provided by the Town. 2016 average sewage generation per capita is 494L/d. The existing non-residential sewage generation rate was adjusted to a lower rate of 6000 L/d/ha in the existing system analysis from the Town standard of 25 000 L/d/ha due to the types of development that exist.
- The existing sanitary system has sufficient capacity to convey dry weather flows but not wet weather flows. This is due to the limitation of the North Creek Crossing capacity as a result of severe siltation that is extremely difficult to clear. There is also the assumption that the pipe could be broken under the Creek bed because the waterlog condition created in the pipe as it crosses the Creek
- In the absence of flow monitoring data on Inflow and Infiltration (I/I), it is difficult to determine the effect of rainfall on the sanitary system. Thus, an I/I rate of 0.28 L/s/ha is the design value typically used to estimate the wet weather component. Older areas with weeping tile or drains connected to the sanitary sewer system may have a higher I/I rate than 0.28 L/s/ha while more recent developed areas may have a lower I/I rate. The Town has areas that experience basement flooding; however, it is recommended to use pumps to

drain ground water away from building structures into the storm system instead of weeping tile connections to the sanitary sewer system.

- For future developments, the Town's Design standards and City of Lethbridge municipal standards were adopted. However, the future non-residential sewage generation rate was adjusted to a lower rate based on discussions with the Town and the type of expected future non-residential development. The sewage generation rates were adjusted from the standard of 25 000 L/d/ha to 6000 L/d/ha. If the future non-residential developments consume more water and generate sewage at a higher rate than the expected 6000 L/d/ha, further system improvements would need to be evaluated.
- The existing system can convey the proposed future or ultimate dry weather flows, with localized surcharging in some manholes and pipes.
- The existing system does not have adequate capacity to convey the wet weather flow with future development.
- Improvements recommended on the existing sanitary system to convey current and future wet weather flows includes the North Lee Creek Crossing Sanitary Trunk (2nd Avenue Lee Creek Crossing Trunk), and Northeast sanitary trunk and lift station at the Wastewater Treatment Plant to service the new East Area development.as shown on **Figure 4.8.**
- It is recommended that the 600mm sanitary trunk crossing Lee Creek to the existing lift station be twinned to provide adequate capacity, redundancy and resiliency to the sanitary system.
- It is recommended that the Town adopt a CCTV inspection program with the intent of CCTV inspection of all sanitary sewer pipes within the Town.
- It is recommended that the Wastewater Treatment Plant be upgraded to increase its treatment capacity to 8500$m^3$/day.
- The order of magnitude cost for the recommended improvements on the existing sanitary system is **$4,730,500**. This includes allowances of 10% for Engineering and 15% for contingency.

## 7.3 Storm Sewer System

- The existing storm water systems were assessed to determine their performance. An overall assessment of the results indicates that the existing system can only convey 54% of a 1 in 2 years 4-hour Chicago Storm on the section of Town west of Lee Creek.
- The east Cardston area is predominantly drained by sheet flow. The existing storm

conveyance systems east of Lee Creek do not have the capacity to effectively drain the area during a 1 in 2 years 4-hour Chicago storm.

- It is recommended that the existing Downtown dewatering pumping system near the 3rd avenue east bridge crossing be upgrades and a second system be installed upstream of the existing pump system at the location shown in **Figure 5.3**
- It is recommended that an exercise be conducted to determine Lee Creek capacity in order to establish an allowable release rate from the study area.
- It is recommended that a more detailed topographic mapping of the Town be acquired to assess the storm water system in more detail.
- A complete analysis of overland and underground conveyance systems should be undertaken to effectively propose recommendations and upgrades to the existing system.
- Installation of storm water management facilities is required for new area developments. It is proposed that a storm management study be completed for the East Area Structure plan development to re-establish a location for a storm management system. Proposed locations of such facilities for the west redevelopment are shown in **Figure 5.2**
- Storm pipelines should be flashed and inspected with CCTV to properly assess required system upgrades.

## 7.4 Roadways

- It is recommended that the improvements identified be incorporated into the operations and maintenance program or capital plans for the Town of Cardston. The order of magnitude cost for the recommended improvements on the existing sanitary system is **$2,681,200**

## 7.5 Implementation Plan

**Table 7.3** shows the implementation plan with recommended improvements and order of magnitude costs over the plan period.

Table 7.3

# Water Infrastructure Implementation Plan

| | | | | | | Reason for Improvement | | | | | Year 2017 Projected Cost (1) | | | Projected Cost by Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STREET/ROAD SEGMENTS | | | INFRASTRUCTURE SPECIFICATION | Pipe Length | Improvement Required? | Water | Sanitary | Storm | Road | Implementation Priority | TOTAL (All Projects) | Short Term 2018 - 2027 | Long Range Through 2033 | 2018 ($) | 2019 ($) | 2020 ($) | 2021 ($) | 2022 ($) | 2023 ($) | 2024 ($) | 2025 ($) | 2026 ($) | 2027 ($) |
| 9 ST. W/ 4 Ave. W. | To | 8 ST. W/ 4 Ave. W. | (U) W.Main - 200mm | 94 | Yes | (C) | | n/a | n/a | 3 | $118,628 | $118,628 | | | | | | | | | | $118,628 | |
| 8 ST. W/ 4 Ave. W. | To | 7 ST. W/ 4 Ave. W. | (U) W.Main - 200mm | 107 | Yes | (C) | | n/a | n/a | 3 | $135,034 | $135,034 | | | | | | | | | | $135,034 | |
| 3 ST. E/ 5 Ave. E. | To | 4 ST. E/ 5 Ave. E. | (U) W.Main - 200mm | 95 | Yes | (C) | | n/a | n/a | 3 | $119,890 | $119,890 | | | | | | | | | | $119,890 | |
| 3ST. W./ 1 Ave W. | To | 3ST. W./ 2 Ave W. | (U) W.Main - 200mm | 186 | Yes | (C) | | n/a | n/a | 3 | $234,732 | $234,732 | | | | | | | | | | | $234,732 |
| 3ST. W./ 2 Ave W. | To | 3ST. W./ 3 Ave W. | (U) W.Main - 200mm | 201 | Yes | (C) | | n/a | n/a | 3 | $253,662 | $253,662 | | | | | | | | | | | $253,662 |
| Main ST./ 3 Ave. | To | 1 ST. E/ 3 Ave. E. | (U) S.Trunk - 450mm | 180 | No | | | n/a | n/a | | $0 | $0 | | | | | | | | | | | |
| 1 ST. E/ 4 Ave. E. | To | 2 ST. E/ 4 Ave. E. | (U) S.Trunk - 450mm | 180 | No | | | n/a | n/a | | $0 | $0 | | | | | | | | | | | |
| 1 ST. W/ 6 Ave. W. | To | Main ST./ 6 Ave. | (U) S.Trunk - 450mm | 207 | No | | | n/a | n/a | | $0 | $0 | | | | | | | | | | | |
| 1ST. E./ 2 Ave E. | To | 1ST. E./ 3 Ave E. | (U) S.Trunk - 450mm | 210 | No | | | n/a | n/a | | $0 | $0 | | | | | | | | | | | |
| 1ST. E./ 4 Ave E. | To | 1ST. E./ 5 Ave E. | (U) S.Trunk - 450mm | 180 | No | | | n/a | n/a | | $0 | $0 | | | | | | | | | | | |
| 2ST. E./ 3 Ave E. | To | 2ST. E./ 4 Ave E. | (U) S.Trunk - 450mm | 215 | No | | | n/a | n/a | | $0 | $0 | | | | | | | | | | | |
| Carriage Lane to Lift station | | | (U) S.Trunk - 450mm | 438 | No | | | n/a | n/a | | $0 | $0 | | | | | | | | | | | |
| MH-4A2 to MH-3A10 | | | (U) S.Trunk - 450mm | 210 | No | | | n/a | n/a | | $0 | $0 | | | | | | | | | | | |
| 2 ST. W/ 4 Ave. W. | To | 1 ST. W/ 4 Ave. W. | (U) S.Trunk - 350mm | 200 | No | | | n/a | n/a | | $0 | $0 | | | | | | | | | | | |
| 1 ST. W/ 4 Ave. W. | To | Main ST./ 4 Ave. | (U) S.Trunk - 350mm | 200 | No | | | n/a | n/a | | $0 | $0 | | | | | | | | | | | |
| Main ST./ 4 Ave. | To | 1 ST. E/ 4 Ave. E. | (U) S.Trunk - 350mm | 100 | No | | | n/a | n/a | | $0 | $0 | | | | | | | | | | | |
| 7ST. E./ 3 Ave E. | To | 7ST. E./ 5 Ave E. | (U) S.Trunk - 300mm | 605 | No | | | n/a | n/a | | $0 | $0 | | | | | | | | | | | |
| Main ST./ 6 Ave. | To | 1 ST. E/ 6 Ave. E. | (R) W.Main - 200mm | 120 | Yes | (D) | | n/a | n/a | | $151,440 | $0 | | | | | | | | | | | |
| 1ST. E./ 5 Ave E. | To | 1ST. E./ 6 Ave E. | (R) W.Main - 150mm | 207 | Yes | (D) | | n/a | n/a | | $261,234 | $0 | | | | | | | | | | | |
| 1 ST. E/ 2 Ave. E. | To | 2 ST. E/ 2 Ave. E. | (U) W.Main - 200mm | 129 | Yes | (C) | | n/a | n/a | | $162,798 | $0 | | | | | | | | | | | |
| 4 ST. E/ 5 Ave. E. | To | 5 ST. E/ 5 Ave. E. | (U) W.Main - 200mm | 185 | Yes | (C) | | n/a | n/a | 2 | $233,470 | $233,470 | | | | | $233,470 | | | | | | |
| 5 ST. E/ 5 Ave. E. | To | 7 ST. E/ 5 Ave. E. | (U) W.Main - 200mm | 187 | Yes | (C) | | n/a | n/a | 2 | $235,994 | $235,994 | | | | | $235,994 | | | | | | |
| 7 ST. E/ 5 Ave. E. | To | 8 ST. E/ 5 Ave. E. | (U) W.Main - 200mm | 130 | Yes | (C) | | n/a | n/a | 2 | $164,060 | $164,060 | | | | | $164,060 | | | | | | |
| 3 ST. W/ 8 Ave. W. | To | 2A ST. W/ 8 Ave. W. | (U) W.Main - 200mm | 104 | Yes | (C) | | n/a | n/a | 2 | $131,248 | $131,248 | | | | | | $131,248 | | | | | |
| 10ST. W./ 2 Ave W. | To | 10ST. W./ 3 Ave W. | (U) W.Main - 200mm | 201 | Yes | (C) | | n/a | n/a | 2 | $253,662 | $253,662 | | | | | | $253,662 | | | | | |
| 7ST. W./ 7A Ave W. | To | 7ST. W./ 8A Ave W. | (U) W.Main - 200mm | 199 | Yes | (C) | | n/a | n/a | 2 | $251,138 | $251,138 | | | | | | $251,138 | | | | | |
| 7ST. W./ 8A Ave W. | To | 7ST. W./ 9 Ave W.+ | (U) W.Main - 200mm | 186 | Yes | (C) | | n/a | n/a | 2 | $234,732 | $234,732 | | | | | | | $234,732 | | | | |
| 3ST. W./ 4 Ave W. | To | 3ST. W./ 5 Ave W. | (U) W.Main - 200mm | 114 | Yes | (C) | | n/a | n/a | 2 | $143,868 | $143,868 | | | | | | | $143,868 | | | | |
| 2ST. E./ 1 Ave E. | To | 2ST. E./ 2 Ave E. | (U) W.Main - 200mm | 186 | Yes | (C) | | n/a | n/a | 2 | $234,732 | $234,732 | | | | | | | $234,732 | | | | |
| 3 ST. E/ 3 Ave. E. | To | 4 ST. E/ 3 Ave. E. | (U) W. Main -200mm | 95 | Yes | (C) | | n/a | n/a | 2 | $119,890 | $119,890 | | | | | | | | $119,890 | | | |
| Lane 3 ST. E/ 3 Ave. E. | To | Lane 4 ST. E/ 3 Ave. E. | (U) S. Trunk -200mm | 101 | Yes | | (D) | n/a | n/a | 1 | $40,000 | $40,000 | | | | $40,000 | | | | | | | |
| 4 ST. E/ 3 Ave. E. | To | 5 ST. E/ 3 Ave. E. | (U) W. Main -200mm | 112 | Yes | (C) | | n/a | n/a | 2 | $141,344 | $141,344 | | | | | | | | $141,344 | | | |
| 5 ST. E/ 3 Ave. E. | To | 6 ST. E/ 3 Ave. E. | (U) W. Main -200mm | 119 | Yes | (C) | | n/a | n/a | 2 | $150,178 | $150,178 | | | | | | | | $150,178 | | | |
| 5ST. E./ 2 Ave E. | To | 5ST. E./ 3 Ave E. | (U) W. Main - 200mm | 202 | Yes | (C) | | n/a | n/a | 3 | $254,924 | $254,924 | | | | | | | | | $254,924 | | |
| 7 ST. W/ 2 Ave. W. | To | 6 ST. W/ 2 Ave. W. | (R) W.Main - 200mm | 115 | Yes | (D) | | n/a | n/a | 3 | $145,130 | $145,130 | | | | | | | | | $145,130 | | |
| 1 ST. W/ 2 Ave. W. | To | Main ST./ 2 Ave. | (R) W.Main - 200mm | 207 | Yes | (D) | | n/a | n/a | 3 | $261,234 | $261,234 | | | | | | | | | $261,234 | | |
| 1 ST. E/ 5 Ave. E. | To | 2 ST. E/ 5 Ave. E. | (R) W.Main - 200mm | 120 | Yes | (D) | | n/a | n/a | 1 | $151,440 | $151,440 | | $22,500 | | | | | | | | $128,940 | |
| 6ST. W./ 1 Ave W. | To | 6ST. W./ 2 Ave W. | (R) W.Main - 200mm | 186 | Yes | (D) | (D) | n/a | n/a | 1 | $234,732 | $234,732 | | | | $190,000 | | | | | | $44,732 | |
| 6ST. W./ 2 Ave W. | To | 6ST. W./ 3 Ave W. | (R) W.Main - 200mm | 201 | Yes | (D) | (D) | n/a | n/a | 1 | $253,662 | $253,662 | | | | $190,000 | | | | | | $63,662 | |
| 6ST. W./ 3 Ave W. | To | 6ST. W./ 4 Ave W. | (R) W.Main - 200mm | 207 | Yes | (D) | | n/a | n/a | 3 | $261,234 | $261,234 | | | | | | | | | | | $261,234 |
| 6ST. W./ 4 Ave W. | To | 6ST. W./ 5 Ave W. | (R) W.Main - 200mm | 115 | Yes | (D) | | n/a | n/a | 3 | $145,130 | $145,130 | | | | | | | | | | | $145,130 |
| Main ST./ 2 Ave. | To | Main ST./ 3 Ave. | (R) W.Main - 200mm | 201 | Yes | (D) | | n/a | n/a | 3 | $253,662 | $253,662 | | | | | | | | | | | $253,662 |
| Main ST./ 3 Ave. | To | Main ST./ 4 Ave. | (R) W.Main - 200mm | 207 | Yes | (D) | | n/a | n/a | 3 | $261,234 | | $261,234 | | | | | | | | | | |
| Main ST./ 4 Ave. | To | Main ST./ 5 Ave. | (R) W.Main - 200mm | 201 | Yes | (D) | | n/a | n/a | 3 | $253,662 | | $253,662 | | | | | | | | | | |
| Main ST./ 5 Ave. | To | Main ST./ 6 Ave. | (R) W.Main - 200mm | 115 | Yes | (D) | | n/a | n/a | 3 | $145,130 | | $145,130 | | | | | | | | | | |
| Main ST./ 6 Ave. | To | Main ST./ 7 Ave. | (R) W.Main - 200mm | 207 | Yes | (D) | | n/a | n/a | 3 | $261,234 | | $261,234 | | | | | | | | | | |
| Main ST./ 8 Ave. | To | Main ST./ 9 Ave. | (R) W.Main - 200mm | 207 | Yes | (D) | | n/a | n/a | 3 | $261,234 | | $261,234 | | | | | | | | | | |
| 6 ST. W/ 2 Ave. W. | To | 5 ST. W/ 2 Ave. W. | (R) W.Main - 150mm | 207 | Yes | (D) | | n/a | n/a | 3 | $261,234 | | $261,234 | | | | | | | | | | |
| 5 ST. W/ 2 Ave. W. | To | 4 ST. W/ 2 Ave. W. | (R) W.Main - 150mm | 202 | Yes | (D) | | n/a | n/a | 3 | $254,924 | | $254,924 | | | | | | | | | | |
| 3 ST. W/ 2 Ave. W. | To | 2 ST. W/ 2 Ave. W. | (R) W.Main - 150mm | 202 | Yes | (D) | | n/a | n/a | 3 | $254,924 | | $254,924 | | | | | | | | | | |
| 7 ST. W/ 4 Ave. W. | To | 6 ST. W/ 4 Ave. W. | (R) W.Main - 150mm | 115 | Yes | (D) | | n/a | n/a | 3 | $145,130 | | $145,130 | | | | | | | | | | |
| 6 ST. W/ 4 Ave. W. | To | 5 ST. W/ 4 Ave. W. | (R) W.Main - 150mm | 207 | Yes | (D) | | n/a | n/a | 3 | $261,234 | | $261,234 | | | | | | | | | | |
| 6 ST. W/ 5 Ave. W. | To | 5 ST. W/ 5 Ave. W. | (R) W.Main - 150mm | 207 | Yes | (D) | | n/a | n/a | 3 | $261,234 | | $261,234 | | | | | | | | | | |
| 2 ST. W/ 7 Ave. W. | To | 1 ST. W/ 7 Ave. W. | (R) W.Main - 150mm | 202 | Yes | (D) | (D) | n/a | n/a | 1 | $254,924 | $190,000 | $64,924 | | $190,000 | | | | | | | | |
| 1 ST. W/ 7 Ave. W. | To | Main ST./ 7 Ave. W. | (R) W.Main - 150mm | 210 | Yes | (D) | (D) | n/a | n/a | 1 | $265,020 | $190,000 | $75,020 | | $190,000 | | | | | | | | |
| Main ST./ 7 Ave. | To | 1 ST. E/ 7 Ave. E. | (R) W.Main - 150mm | 207 | Yes | (D) | | n/a | n/a | 3 | $261,234 | | $261,234 | | | | | | | | | | |
| 1 ST. W/ 8 Ave. W. | To | Main ST./ 8 Ave. W. | (R) W.Main - 150mm | 201 | Yes | (D) | | n/a | n/a | 3 | $253,662 | | $253,662 | | | | | | | | | | |
| 7ST. W./ 1 Ave W. | To | 7ST. W./ 2 Ave W. | (R) W.Main - 150mm | 186 | Yes | (D) | | n/a | n/a | 3 | $234,732 | | $234,732 | | | | | | | | | | |
| 5ST. W./ 1 Ave W. | To | 5ST. W./ 2 Ave W. | (R) W.Main - 150mm | 186 | Yes | (D) | | n/a | n/a | 3 | $234,732 | | $234,732 | | | | | | | | | | |
| 5ST. W./ 2 Ave W. | To | 5ST. W./ 3 Ave W. | (R) W.Main - 150mm | 201 | Yes | (D) | | n/a | n/a | 3 | $253,662 | | $253,662 | | | | | | | | | | |
| 4ST. W./ 2 Ave W. | To | 4ST. W./ 3 Ave W. | (R) W.Main - 150mm | 115 | Yes | (D) | | n/a | n/a | 3 | $145,130 | | $145,130 | | | | | | | | | | |
| 4ST. W./ 3 Ave W. | To | 4ST. W./ 4 Ave W. | (R) W.Main - 150mm | 207 | Yes | (D) | | n/a | n/a | 3 | $261,234 | | $261,234 | | | | | | | | | | |
| 1ST. E./ 7 Ave E. | To | 1ST. E./ 8 Ave E. | (R) W.Main - 150mm | 207 | Yes | (D) | | n/a | n/a | 3 | $261,234 | | $261,234 | | | | | | | | | | |
| Miscellaneous (J-106 to J-107/J-25 to J-105/J-63 to J-116) | | | (R) W.Main - 150mm | 400 | Yes | (D) | | n/a | n/a | 3 | $504,800 | | $504,800 | | | | | | | | | | |
| 10 ST. W/ 1 Ave. W. | To | 9 ST. W/ 1 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 9 ST. W/ 1 Ave. W. | To | 8 ST. W/ 1 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 8 ST. W/ 1 Ave. W. | To | 7 ST. W/ 1 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7 ST. W/ 1 Ave. W. | To | 6 ST. W/ 1 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 6 ST. W/ 1 Ave. W. | To | 5 ST. W/ 1 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5 ST. W/ 1 Ave. W. | To | 4 ST. W/ 1 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4 ST. W/ 1 Ave. W. | To | 3 ST. W/ 1 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 3 ST. W/ 1 Ave. W. | To | 2 ST. W/ 1 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2 ST. W/ 1 Ave. W. | To | 1 ST. W/ 1 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1 ST. W/ 1 Ave. W. | To | Main ST./ 1 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |

Table 7.3

# Water Infrastructure Implementation Plan

| | | | | | | Reason for Improvement | | | | | Year 2017 Projected Cost (1) | | | Projected Cost by Year | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STREET/ROAD SEGMENTS | | | INFRASTRUCTURE SPECIFICATION | Pipe Length | Improvement Required? | Water | Sanitary | Storm | Road | Implementation Priority | TOTAL (All Projects) | Short Term 2018 - 2027 | Long Range Through 2033 | 2018 ($) | 2019 ($) | 2020 ($) | 2021 ($) | 2022 ($) | 2023 ($) | 2024 ($) | 2025 ($) | 2026 ($) | 2027 ($) |
| Main ST. 1 Ave. | To | 1 ST. E/ 1 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1 ST. E/ 1 Ave. E. | To | 2 ST. E/ 1 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2 ST. E/ 1 Ave. E. | To | 3 ST. E/ 1 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 3 ST. E/ 1 Ave. E. | To | 4 ST. E/ 1 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4 ST. E/ 1 Ave. E. | To | 5 ST. E/ 1 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5 ST. E/ 1 Ave. E. | To | 6 ST. E/ 1 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 6 ST. E/ 1 Ave. E. | To | 7 ST. E/ 1 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7 ST. E/ 1 Ave. E. | To | 8 ST. E/ 1 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 12 ST. W/ 2 Ave. W. | To | 11 ST. W/ 2 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 11 ST. W/ 2 Ave. W. | To | 10 ST. W/ 2 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 10 ST. W/ 2 Ave. W. | To | 9 ST. W/ 2 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 9 ST. W/ 2 Ave. W. | To | 8 ST. W/ 2 Ave. W. | (R) W.Main - 150mm | 181 | Yes | (D) | (D) | n/a | n/a | 1 | $228,422 | $132,500 | $95,922 | | $132,500 | | | | | | | | |
| 8 ST. W/ 2 Ave. W. | To | 7 ST. W/ 2 Ave. W. | (R) W.Main - 150mm | 105 | Yes | (D) | (D) | n/a | n/a | 1 | $132,500 | $132,500 | | | $132,500 | | | | | | | | |
| 4 ST. W/ 2 Ave. W. | To | 3 ST. W/ 2 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2 ST. W/ 2 Ave. W. | To | 1 ST. W/ 2 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| Main ST. 2 Ave. | To | 1 ST. E/ 2 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2 ST. E/ 2 Ave. E. | To | 3 ST. E/ 2 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5 ST. E/ 2 Ave. E. | To | 6 ST. E/ 2 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 6 ST. E/ 2 Ave. E. | To | 7 ST. E/ 2 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7 ST. E/ 2 Ave. E. | To | 8 ST. E/ 2 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 12 ST. W/ 3 Ave. W. | To | 11 ST. W/ 3 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 11 ST. W/ 3 Ave. W. | To | 10 ST. W/ 3 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 10 ST. W/ 3 Ave. W. | To | 9 ST. W/ 3 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 9 ST. W/ 3 Ave. W. | To | 8 ST. W/ 3 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 8 ST. W/ 3 Ave. W. | To | 7 ST. W/ 3 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7 ST. W/ 3 Ave. W. | To | 6 ST. W/ 3 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 6 ST. W/ 3 Ave. W. | To | 5 ST. W/ 3 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5 ST. W/ 3 Ave. W. | To | 4 ST. W/ 3 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4 ST. W/ 3 Ave. W. | To | 3 ST. W/ 3 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 3 ST. W/ 3 Ave. W. | To | 2 ST. W/ 3 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2 ST. W/ 3 Ave. W. | To | 1 ST. W/ 3 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1 ST. W/ 3 Ave. W. | To | Main ST./ 3 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1 ST. E/ 3 Ave. E. | To | 2 ST. E/ 3 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 6 ST. E/ 3 Ave. E. | To | 7 ST. E/ 3 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7 ST. E/ 3 Ave. E. | To | 8 ST. E/ 3 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 3 ST. W/ 4 Ave. W. | To | 2 ST. W/ 4 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7 ST. W/ 5 Ave. W. | To | 6 ST. W/ 5 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5 ST. W/ 5 Ave. W. | To | 4 ST. W/ 5 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4 ST. W/ 5 Ave. W. | To | 3 ST. W/ 5 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 3 ST. W/ 5 Ave. W. | To | 2 ST. W/ 5 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7 ST. W/ 6 Ave. W. | To | 6 ST. W/ 6 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 6 ST. W/ 6 Ave. W. | To | 5 ST. W/ 6 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5 ST. W/ 6 Ave. W. | To | 4 ST. W/ 6 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4 ST. W/ 6 Ave. W. | To | 3 ST. W/ 6 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 8ST. W./ 3 Ave W. | To | 8ST. W./ 4 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4 ST. W/ 4 Ave. W. | To | 3 ST. W/ 4 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5 ST. W/ 4 Ave. W. | To | 4 ST. W/ 4 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2 ST. E/ 3 Ave. E. | To | 3 ST. E/ 3 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 3ST. E./ 2 Ave E. | To | 3ST. E./ 3 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 3 ST. E/ 2 Ave. E. | To | 4 ST. E/ 2 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4 ST. E/ 2 Ave. E. | To | 5 ST. E/ 2 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| Main ST./ 7 Ave. | To | Main ST./ 8 Ave. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1ST. W./ 7 Ave W. | To | 1ST. W./ 8 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 6A Ave. W. | | | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7 Ave. W. | | | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7A Ave. W. | | | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| West Creek Drive | | | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 6 ST. W/ 8 Ave. W. | To | 5A ST. W/ 8 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5A ST. W/ 8 Ave. W. | To | 5 ST. W/ 8 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 8A Ave. W. | | | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 3A Ave. E. | | | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4 Ave. W. | | | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| Main St 5 Ave. E. | To | 1 ST. E/ 5 Ave. E. | (R) W.Main - 200mm | 228 | Yes | (D) | | n/a | n/a | 1 | $287,736 | $22,500 | $265,236 | $22,500 | | | | | | | | | |
| 2 ST. E/ 5 Ave. E. | To | 3 ST. E/ 5 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1 ST. E/ 7 Ave. E. | To | 2 ST. E/ 7 Ave. E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7A Ave. W. | | | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2A ST. W/ 8 Ave. W. | To | 2 ST. W/ 8 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| Main ST./ 8 Ave. | To | 1 ST. E./ 8 Ave.E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1 ST. E./ 8 Ave.E. | To | 2 ST. E./ 8 Ave.E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 3 ST. W/ 9 Ave. W. | To | 1A ST. W/ 9 Ave. W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1A ST. W/ 9 Ave. W. | To | Main ST./ 9 Ave. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 10ST. W./ 1 Ave W. | To | 10ST. W./ 2 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 9ST. W./ 1 Ave W. | To | 9ST. W./ 2 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |

Table 7.3

# Water Infrastructure Implementation Plan

| STREET/ROAD SEGMENTS | | | INFRASTRUCTURE SPECIFICATION | Pipe Length | Improvement Required? | Reason for Improvement: Water | Sanitary | Storm | Road | Implementation Priority | Year 2017 Projected Cost (1): TOTAL (All Projects) | Short Term 2018 - 2027 | Long Range Through 2033 | Projected Cost by Year: 2018 ($) | 2019 ($) | 2020 ($) | 2021 ($) | 2022 ($) | 2023 ($) | 2024 ($) | 2025 ($) | 2026 ($) | 2027 ($) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9ST. W./ 2 Ave W. | To | 9ST. W./ 3 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 9ST. W./ 3 Ave W. | To | 9ST. W./ 4 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 8ST. W./ 1 Ave W. | To | 8ST. W./ 2 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 8ST. W./ 2 Ave W. | To | 8ST. W./ 3 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7ST. W./ 2 Ave W. | To | 7ST. W./ 3 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7ST. W./ 3 Ave W. | To | 7ST. W./ 4 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7ST. W./ 4 Ave W. | To | 7ST. W./ 5 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7ST. W./ 5 Ave W. | To | 7ST. W./ 6 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7ST. W./ 6 Ave W. | To | 7ST. W./ 7 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7ST. W./ 7 Ave W. | To | 7ST. W./ 7A Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 6ST. W./ 5 Ave W. | To | 6ST. W./ 6 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 6ST. W./ 6A Ave W. | To | 6ST. W./ 7A Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 6ST. W./ 7A Ave W. | To | 6ST. W./ 8 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5A ST. W./ 6 Ave W. | To | 5A ST. W./ 6A Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5A ST. W./ 8 Ave W. | To | 5A ST. W./ 8A Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5ST. W./ 3 Ave W. | To | 5ST. W./ 4 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5ST. W./ 4 Ave W. | To | 5ST. W./ 5 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5ST. W./ 5 Ave W. | To | 5ST. W./ 6 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5ST. W./ 6 Ave W. | To | 5ST. W./ 6A Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5ST. W./ 6A Ave W. | To | 5ST. W./ 7 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5ST. W./ 7 Ave W. | To | 5ST. W./ 8 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4ST. W./ 1 Ave W. | To | 4ST. W./ 2 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4ST. W./ 4 Ave W. | To | 4ST. W./ 5 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4ST. W./ 5 Ave W. | To | 4ST. W./ 6 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4ST. W./ 6 Ave W. | To | 4ST. W./ 6A Ave W. | (R) W.Main - 100mm | 120 | Yes | (D) | | n/a | n/a | 1 | $60,000 | $60,000 | | | | $60,000 | | | | | | | |
| 3ST. W./ 3 Ave W. | To | 3ST. W./ 4 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 3ST. W./ 5 Ave W. | To | 3ST. W./ 6 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2ST. W./ 1 Ave W. | To | 2ST. W./ 2 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2ST. W./ 2 Ave W. | To | 2ST. W./ 3 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2ST. W./ 3 Ave W. | To | 2ST. W./ 4 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1ST. W./ 1 Ave W. | To | 1ST. W./ 2 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1ST. W./ 2 Ave W. | To | 1ST. W./ 3 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1ST. W./ 3 Ave W. | To | 1ST. W./ 4 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1ST. W./ 6 Ave W. | To | 1ST. W./ 7 Ave W. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| Main ST./ 1 Ave. | To | Main ST./ 2 Ave. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1ST. E./ 1 Ave E. | To | 1ST. E./ 2 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1ST. E./ 6 Ave E. | To | 1ST. E./ 7 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1ST. E./ 8 Ave E. | To | 1ST. E./ 9 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 1ST. E./ 9 Ave E. | To | 1ST. E./ 10 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2ST. E./ 4 Ave E. | To | 2ST. E./ 5 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2ST. E./ 7 Ave E. | To | 2ST. E./ 8 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2ST. E./ 8 Ave E. | To | 2ST. E./ 9 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2ST. E./ 9 Ave E. | To | 2ST. E./ 10 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 2ST. E./ 10 Ave E. | To | 2ST. E./ Home S Ave. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 3ST. E./ 3 Ave E. | To | 3ST. E./ 5 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 3ST. E./ 5 Ave E. | To | 2ST. E./ 7 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4ST. E./ 2 Ave E. | To | 4ST. E./ 3 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4ST. E./ 3 Ave E. | To | 4ST. E./ 3A Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4ST. E./ 3A Ave E. | To | 4ST. E./ 4 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 4ST. E./ 4 Ave E. | To | 4ST. E./ 5 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 5ST. E./ 4 Ave E. | To | 5ST. E./ 5 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 6ST. E./ 2 Ave E. | To | 6ST. E./ 3 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7ST. E./ 2 Ave E. | To | 7ST. E./ 3 Ave E. | | | No | | | n/a | n/a | | $0 | | | | | | | | | | | | |
| 7 Avenue Booster Pump Station & Pipe Upgrades | | | (U) Booster Pump Station | - | Yes | (A) | | - | - | | $675,000 | | | | | | | | | | | $675,000 | |
| Storm Pump System Replacement | | | (U)/(N) | | Yes | | | (R / GF) | | | $631,250 | | | $631,250 | | | | | | | | | |
| North Creek Crossing Sanitary Trunk Twinning | | | (N) | | Yes | | (R / GF) | | | | $846,000 | | | $846,000 | | | | | | | | | |
| NW Lift Station and Force Main | | | (N) Lift Station | | Yes | | (A) | | | | $1,342,000 | | | | | | $1,342,000 | | | | | | |
| Water Treatment Plant - NE Lift Station | | | (N) Lift Station | - | Yes | | (A) | - | - | | $962,000 | | | | | | | $962,000 | | | | | |
| Storm Drainage pond by 9 st and 3 Ave W | | | (N) Drainage Pond | | | | | | | | $110,000 | | | | | $110,000 | | | | | | | |
| Replace blower in pumphouse #1 | | | (R) Pumphouse | | | (D) | | | | | $35,000 | | | | $35,000 | | | | | | | | |
| Storm Pipe Bursting 7-8 Ave E and 1st to 2nd St E | | | (R) Storm Pipe | | Yes | | | (D) | | | $75,000 | | | $75,000 | | | | | | | | | |
| **Total (All Projects)** | | | | | | | | | | | $16,669,328 | $10,561,160 | $5,532,696 | $1,597,250 | $680,000 | $590,000 | $1,975,524 | $1,598,048 | $613,332 | $411,412 | $661,288 | $1,285,886 | $1,148,420 |

(U) - Upgrade
(R) - Replacement
(N) - New
**Note :** Cost estimates includes Engineering and contingencies

(A) - Growth Related Improvement
(B) - Regulatory Related Improvement
(C) - Capacity Related Improvement
(D) - Reliability/Life Cycle Related Improvement
(GF) - Project Supported by Grant Funding
(R ) - Risk