VILLAGE OF CAROLINE

CAPITAL INFRASTRUCTURE PLAN

Prepared for:
The Village of Caroline

Prepared by:
Stantec Consulting Ltd.
600, 4808 Ross St.
Red Deer, AB T4N 1X5

September 2009
113929151-07

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1.0 GROWTH RATE

1.1 PROJECTED GROWTH

To assist in predicting future growth, the *Growth and Infrastructure Master Plan* completed by Stantec and Parkland Community Planning in 2004 was reviewed. This study determined a low growth scenario rate of 1.21%, a medium growth scenario rate of 1.40% and a high growth scenario rate of 2.49%.

The population of Caroline decreased from 556 in 2001 to 515 in 2006. Although a decline in population has been noted between the two most recent census years it is not probable that the Village will experience a continuing population decline over the next 10 years. Therefore a static population estimation (0% growth) is used in this study, unless noted otherwise.

The water system in Caroline will require a current analysis and also a future analysis. For the future analysis it was determined to use the high growth rate as developed in the *2004 Growth and Infrastructure Master Plan*. Ultimately the upgrades as recommended in this report will be based on the population of the Village. The high growth rate was used to provide a conservative demand estimation for the future water treatment and distribution system, as Villages the size of Caroline can fluctuate in population quite significantly from year to year.

1.2 REPLACEMENT PRIORITY & FUTURE DEVELOPMENT

As a result of the static population the impact of future development on this Capital Infrastructure Plan is negated or used selectively as needed. For the purpose of this report the proposed infrastructure rehabilitation is based on priority of required replacements and upgrades to the sanitary sewer, roadways, and water distribution networks as apposed to the typical population horizons.

The growth areas selected for required situations (ie. water modeling) have been obtained from the 2004 Growth and Infrastructure Master Plan.

2.0 METHODOLOGY

2.1 TIME FRAME

For this report, the total time frame is 2009 to 2018.

2.2 DATA SOURCES

In order to evaluate the existing infrastructure and to create a strategy for future infrastructure improvements, the following information has been gathered:

- All of the previous studies completed including the 2004 Village of Caroline Growth and Infrastructure Master Plan;
- Sanitary sewer ratings for each pipe section based on the CCTV review;
- Information, documents and records provided by Village staff;
- Site visits and analysis including the Village water treatment plan, lagoons, and roadway network.

2.3 REPLACEMENT RATES

The following replacement rates can be utilized to determine the budget for annual infrastructure rehabilitation. The unit rates for replacements can be found in Appendix F. These rates are in 2009 dollars and were obtained from projects completed in the area during 2008 and 2009. Cost breakdowns for the replacement of each infrastructure category are included in Appendices B, C, D and E with summary found in Appendix A. Please note that all prices include 35% for professional services and contingency.

Sanitary Sewers

Pipe Size & Type	**Estimated Unit Rate** (per lineal metre)
200mm PVC DR35	$676.00
250mm PVC DR35	$726.00
300mm PVC DR35	$776.00

Note: Costs do not include roadway trench repair

Roadways

Rehabilitation Alternative	Estimated Unit Rate (per square metre)
Mill & 40mm Overlay	$30.09
Local Road Total Road Reconstruction	$90.18
Local Road Trench Repair	$90.18
Arterial Road Total Reconstruction	$150.42
Arterial Road Trench Repair	$150.42

Watermains

Pipe Size & Type	Estimated Unit Rate (per lineal metre)
150mm PVC DR18	$747.00
200mm PVC DR18	$803.00
250mm PVC DR18	$846.00
300mm PVC DR18	$937.00

Note: Costs do not include roadway trench repair

Storm Sewer

Pipe Size & Type	Estimated Unit Rate (per lineal metre)
450mm PVC DR35	$368.00

Note: Costs do not include roadway trench repair

3.0 SANITARY SYSTEM

3.1 INVENTORY

The Village of Caroline's current inventory of sanitary sewers is as follows:

- Gravity Sewer: 5,280m
- Pressure Mains: 291m
- Trailer Park (Gravity): 318m

3.2 PREVIOUS STUDIES

3.2.1 Growth and Infrastructure Master Plan – Stantec Consulting Ltd. (2004)

The following milestones were noted for the sanitary sewer system:

- Sewage treatment facility has a current capacity for a population of approximately 1000 persons (approximately 2019);
- The entire lagoon system is to be desludged when the population reaches 622 persons (approximately 2005) and prior to aeration system upgrades;
- Existing lift station will not need to be upgraded prior to a population of 1122 persons (approximately 2026).

The following recommendations were made to address current issues:

- Upgrade WWTP aeration system. This was completed in 1998 by Nelson River;

Since the entire sanitary sewer system (with the exception of a few sanitary mains) was evaluated as part of this study, these previously proposed upgrades will be used as a reference only.

3.3 EXISTING INFRASTRUCTURE

3.3.1 Lagoon Influent Gravity Main

There is approximately 820m of existing lagoon influent gravity main carrying all raw sewage from the Village to the lagoons, consisting of 750m of VCT pipe from manhole 9 (corner of 49 St. and 48 Ave) to manhole 1 (lagoons), and an additional length of pipe to carry flows directly into the lagoons. The Village has been experiencing sewer back-up during high use periods and rainfall events. It is probable that there is some infiltration into the sewer system and that various upgrades throughout the Village will reduce this problem; however the lagoon influent main is 30 plus years old and replacement with a larger pipe will provide an immediate solution to the ongoing problem.

It is recommended to replace this sewer main as a top priority. As no other utilities or roads are in the vicinity of the pipeline, this main will be replaced without the need to coordinate with other utility or road upgrades.

3.3.2 Lagoon Dredging & Lift Station Pump Upgrades

The original design of the wastewater lagoon system has the capacity to treat the wastewater for 1000 people with a total design flow of 400 m^3/d. The per capita design rate is 400 Lcpd.

In the past four years (2005-2008), the maximum daily flow was recorded at 255 m3/d in 2008 with 515 people residing in the Village. Based on the past four annual wastewater reports that were sent to AENV, the average maximum month, average daily flow rate is 455 Lcpd. The average Biological Oxygen Demand (BOD) concentration is 191 mg/L which is close to the design BOD concentration 193 mg/L. Therefore, the design capacity can handle 879 people based on the four year maximum month, daily average flow. The Village could carry out a sanitary sewer rehabilitation program or water conservation program to reduce the per capita flow rate which would increase the service capacity of the lagoons.

Based on annual reports 2005-2008 that were sent to AENV, the discharge effluent has met the 25 mg/L target except for one instance in April 2006 (28 mg/L). To resolve this problem, the Village had the aeration liner replaced in 2006. After the air liner replacement, the BOD removal has met the effluent standard.

In addition to the two 10 HP Blowers, a backup diesel driven Blower was installed. The diesel driven Blower can supply air to the aeration liner during power outages. This function is critical when power is down in winter when ice can clog the liner pores. The backup diesel driven Blower has eliminated the ice clog problem. The aeration system is currently operating at 7 PSI pressure.

The Village lagoon cell was de-sludged by Lambourne Environmental in 2005. The next sludge removal program is scheduled to be undertaken in 2015.

3.4 REHABILITATION STRATEGY

3.4.1 Methodology

The Village provided CCTV video footage and reports for all sanitary sewer pipes with a preliminary review undertaken by Cues High Pressure Flushing. The videos were reviewed by Stantec and a rating was given to each section of pipe between manholes based on the condition as shown in the CCTV inspection and reports. The condition of each pipe section is based on the rating system listed below.

Rating	Description
5	Sound physical condition. Asset likely to perform adequately without major work for 25 years.
4	Acceptable physical condition; minimal short term failure risk and minimal potential for deterioration within 10 years. Minor work required.
3	Acceptable physical condition with occasional deterioration evident. Failure unlikely in the short term (next two years) but further deterioration likely and major replacement likely in 10 to 15 years. Minor components or isolated sections need replacement or repair in the short term but asset still serviceable.
2	Significant deterioration evident; failure possible in the short term (next two years) and further deterioration and major replacement likely within 10 years. Minor components or isolated sections need replacement or repair in the short term but asset still serviceable.
0 - 1	Failure is likely in the short term. Likely need to replace a large amount of the asset within two years. Substantial work required in the short term; asset barely serviceable.
N/A	Asset not assessed due to lack of information.

Since sections with a rating of 3 or higher pose minimal risk for the next 10 years, the report will focus on the sections with a rating of 2 or lower. These sections are outlined in Figure 3.1 of Appendix B along with a complete list of the sanitary sewer condition ratings.

It should be noted that for the sanitary sewer replacement method, a blended rating was given for each Village block of sanitary main rather than a rating between each manhole. This was due to the fact that it is not cost efficient to replace pipe sections between manholes and increased efficiency can be achieved if an entire block is completed as part of the same upgrades.

3.4.2 Rehabilitation Schedule

The Sanitary Sewer System Drawing in Appendix B outlines the sanitary sewer conditions. The approximated construction costs for the sanitary sewer replacement are based on the schedule provided in Appendix B. Where possible; sanitary sewer replacements for specific locations will be coordinated with watermain and roadway replacements.

3.5 REHABILITATION COSTS

The unit prices used to estimate the rehabilitation costs for each segment of sanitary sewer have been taken from 2009 tender prices from various communities in Central Alberta. The unit prices used can be found in Appendix F. The unit prices provided have been broken down into costs per linear metre based on size of pipe to be installed for the sanitary sewer replacement. Unit prices have also been provided for miscellaneous items related to the sanitary sewer replacement and calculated as part of the total cost. These miscellaneous items were calculated based on a typical 100 meters of utility replacement. Roadway trench repair including subbase, base and asphalt have not been included in the sanitary sewer replacement costs but can be found in the roadway unit price schedule and can be added as required.

4.0 ROADWAY NETWORK

4.1 OBJECTIVE

The Village of Caroline commissioned Stantec Consulting Ltd. to complete the following:

- Complete a visual inspection of the entire roadway network to analyze the overall condition and type of deficiencies in each area;
- Summarize the findings of the inspection; and
- Provide a recommended staging plan for roadway rehabilitation that will be incorporated into this 10 year Capital Infrastructure Plan.

4.2 VISUAL ROADWAY INSPECTION & RATING

In April 2009, Stantec was on site in the Village of Caroline to complete an analysis of the Village Roadway Network. During this site visit the Village Public Works Forman, Ron Landry, provided a tour of the Village while providing some historical roadway information.

In addition Mr. Landry provided his list of the five roadway segments most in need of improvements. The list provided is shown below:

- 48 Street from 50 Avenue to 51 Avenue;
- 51 Avenue from 48 Street to 50 Street;
- 49 Street from 50 Street to 52 Street;
- 52 Avenue from 50 Street to 51 Street; and
- 52 Street from 51 Ave to the northern limits of 52 Street (also including all of 52 Street Crescent).

Upon completion of the Village tour, Stantec completed a detailed visual pavement inspection of the entire roadway network. Pavement distresses were measured, recorded, photographed, and the severity of each pavement distress was noted. The visual inspection also included measurements of all roadway widths, curb and gutter dimensions, sidewalks, and boulevards.

The majority of the roadway network has been divided up per block of roadway; however some sections include multiple blocks of roadway in one segment based on the continuity of the existing type of asphalt, curb & gutter, and sidewalks.

Table 4.1 in Appendix C provides an overview of the visual pavement inspection and a condensed list of the type of pavement distress noted on each segment of roadway along with

the measurements taken. Also provided are the overall visual assessment ratings for each segment of roadway.

To better understand Table 4.1 and the details provided in it, an outline has been provided below which describes the data and provides the necessary definitions to interpret the findings.

Note: N/A indicates that there is Nothing Applicable in that section ie. If Boulevard = N/A there is no boulevard in that segment of roadway.

Location – The roadway specific roadway segment being evaluated.

From/To – Limits of the specific roadway segment being evaluated.

Int – Is the intersection at each limit included in the evaluation of that segment of roadway (Y = Yes), (N = No). Note: Each intersection has been evaluated as part of the adjacent segment with the most similar qualities.

Width (m) – Is the measured average roadway width in metres. All measurements are taken from the lip of the existing concrete gutter or from the shoulder edge in locations with no curb & gutter.

Length (m) –Each length has been measured to the edge of property adjacent to the intersection and is shown in metres. (If the intersection has been evaluated as part of that segment of roadway, the length shown includes the intersection). All lengths have been measured from the existing Village legal plan.

Existing Surface – Is constructed of Asphalt Concrete Pavement (ACP), gravel, or a combination of the two surface types.

Primary Distresses – Are generally the most notable distresses in each segment of roadway which are found in multiple locations or continually found throughout the entire segment being evaluated. These distresses may also include extremely severe distresses found in isolated locations.

Secondary Distresses – Are minor to moderate distress and are found in isolated locations or scattered locations throughout the segment being evaluated.

Note: A definition and a photo of each distress type can be found in Section 5.3.

Curb & Gutter (Side-Type-Width)

- Side – is the side of the roadway the curb is located (N,E,S,W – North, East, South, West).

- Type – Two types of curb and gutter exist in Caroline (S = Standard Curb & Gutter, R = Rolled Curb & Gutter). If either the S or R is accompanied by an M this indicates that

the sidewalk is Monolithic (The curb is attached to the sidewalk ie. MR – Monolithic Rolled Curb & Gutter).

- Width - Is the width of the curb and gutter not including any attached sidewalk.

Sidewalk (Side-Width)

- Side – is the side of the roadway the sidewalk is located (N,E,S,W – North, East, South, West)
- Width - Is the width of the sidewalk not including any attached curb and gutter.

Boulevard (Side-Width)

- Side – is the side of the roadway the boulevard is located (N,E,S,W – North, East, South, West)
- Width - Is the width of the boulevard in metres measured from the back of the curb (or road shoulder) to the sidewalk.

Overall Ratings

This is an objective rating of the overall roadway condition for each roadway segment based on the visual inspection completed. The overall rating takes into account the types, severity, and frequency of distresses found on each segment of roadway. In addition to the distresses observed the overall shape and apparent condition of the roadway has been taken into account and engineering judgment has been implemented to provide the final rating. The pavement assessment rating scale used for the paved roadways is outlined below.

Rating	Description
5	Excellent Condition – Generally only found on a freshly paved roadway, no need for any improvements.
4	Good Condition – Only minor distresses identified with few or no isolated moderate distresses, no immediate need for roadway improvements.
3	Average Condition – Minor distresses throughout with some moderate distresses identified and no or few severe distresses, may need to be improved within the next 5-10 years.
2	Poor Condition – Many severe distresses or moderate and minor distresses identified throughout, will need to be rehabilitated within the next 10 years.
1	Very Poor Condition – Many severe and moderate distresses identified throughout, severe need for roadway rehabilitation.
0	Severely deteriorated roadway with little evidence of any ACP.

All gravel roadways are rated on a scale of 0 - 3. The ratings are outlined below.

Rating	Description
3	Excellent Condition – Gravel roadway is in excellent condition, typical of a newly constructed gravel roadway.
2	Average Condition – This rating is given to gravel roads that are characteristic of aged roadways in acceptable condition with some minor intermittent distresses. The general shape and ride of the road is in acceptable condition.
1	Poor Condition – Continuous distresses throughout the roadway section. Generally resulting in potholes and poor ride conditions.
0	No granular surface – ie. dirt road or path.

The curb, gutter and sidewalks (concrete) were also inspected during the visual assessment. No direct ratings for the concrete inspected are provided due to the variation in concrete conditions within each identified section of roadway. Overall, Caroline's concrete was found to be generally in good condition.

4.3 DISTRESS TYPES

The following is a brief summary and an photographic examples of each type of pavement distress identified in Table 4.1.

Fatigue Cracking

Occurs in areas subjected to repeated traffic loadings and can be a series of smaller interconnected cracks in early stages development which further develop into many sided pieces usually less then 0.3 metres on the longest side. In later stages chicken wire/alligator patter cracking is generally apparent. In extreme cases of fatigue cracking individual pieces of asphalt may move when subjected to traffic loading. The photo below is an example of moderate to severe fatigue cracking.

Transverse Cracking

Cracks that are predominantly perpendicular to the centerline of the roadway. The photo below is an example of moderate transverse cracking.

Longitudinal Cracking

Cracks that are predominantly parallel to the roadway centre line. The photo below is an example of moderate longitudinal cracking.

Pumping (Water Bleeding)

Seeping or ejection of water from beneath the pavement through cracks. In some cases, detectable by deposits of fine material residue on the pavement surface where were eroded (pumped) from the granular support structure of the roadway onto the surface. The photo below is an example of moderate pumping.

Edge Deterioration

Applies to areas typically within 0.6 metres of the pavement edge. This type of distresses is typically found in locations where on street parking lanes have been provided. The photo below is an example of moderate to severe edge deterioration.

Patching & Patch Deterioration

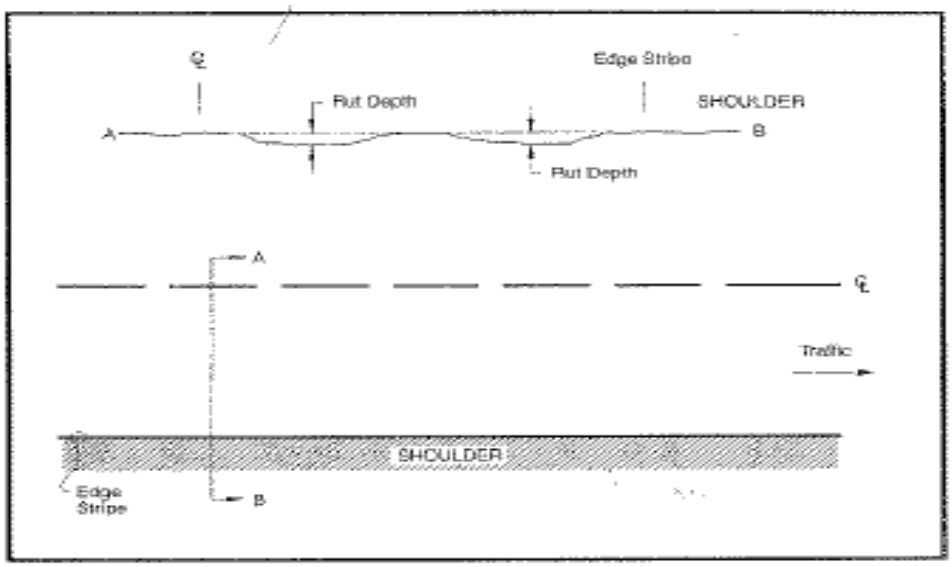
Portions of the pavement surface, greater then 0.1 square metres that have been removed and replaced or additional material applied after the original construction. The photo below is an example of patching with minor deterioration.

Potholes

Bowl-shaped holes of various sizes in the surface, often resulting in standing water and water infiltration in to the base of the road structure. The photo below is an example of a roadway with many moderate to severe potholes where the roadway surface is heavily deteriorated.

Rutting

A rut is a longitudinal surface depression in the wheel path which may have associated transverse displacements.



The photo below is an example of severe rutting.

4.4 REHABILITATION STRATEGY

4.4.1 Methodology

The visually assessed roadway sections should be improved in order of priority based on the ratings provided for each section. However the purpose of this Capital Infrastructure Plan is to provide the most economic strategy for total infrastructure replacements within the Village. This strategy will employ logical tactics for infrastructure rehabilitation which will help ensure that underground infrastructure will not fail shortly after a roadway has been rehabilitated, requiring removal and reconstruction of the roadway in order to repair the underground infrastructure.

The roadway rehabilitation strategy is heavily dependant on the required underground infrastructure rehabilitation that is required. As a result the recommended roadway rehabilitation strategy and schedule generally coincides with the planned underground infrastructure upgrades recommended.

In some locations with extremely deteriorated roadway conditions, roadway repairs have been recommended prior to underground repairs or in locations where no immediate underground work is needed. Recommendations provided by Village staff have also been taken into account to help identify these locations.

4.4.2 Rehabilitation Schedule

The Transportation Network Drawing, located in Appendix C, outlines the priority of roadway sections identified for rehabilitation. The overall rehabilitation priority schedule based on the underground infrastructure and roadway ratings is presented in the Summary (Section 7) and the associated drawing is located in Appendix A.

4.5 REHABILITATION COSTS

The unit prices used to estimate the rehabilitation costs for each segment of roadway have been taken from 2009 tender prices in various communities in central Alberta and Alberta Transportation unit price listings. The unit prices used can be found in Appendix F. The unit prices provided have been broken down into cost per square metre of roadway to be rehabilitated. Unit prices have also been provided for concrete work and other miscellaneous items.

4.5.1 Roadway Structure & Pavement Surfacing

The roadway structure and driving surface rehabilitation costs for each section of roadway are shown in Table 4.2 in Appendix C and are based on the per square metre costs estimations provided in Appendix F. At this time it is not possible to determine the precise type of rehabilitation that will be required for each section of roadway due to a lack of geotechnical information. As such two cost estimates for roadway rehabilitation have been included for each roadway segment:

- Full reconstruction of the roadway including an entirely new granular base and asphalt road structure; and
- Edge milling with asphalt overlay.

In addition to the two cost estimations provided a third estimate has been developed to approximate the cost of roadway reconstruction required where trenching has taken place for replacement of deep utilities. For this estimation the same unit price as full roadway reconstruction has been utilized and the area is equivalent to the total length of trenching multiplied by a standard five metre wide trench. In most locations where trench repair is required it would be advisable to also complete milling and overlay of the full roadway once the trench repair has been completed.

The cost estimates provided include a standard contingency plus professional services estimated at approximately 35% of the total construction cost. The two options presented are considered an upper and lower approximation of what the potential roadway rehabilitation costs will be (in 2009 dollars).

Prior to any roadway rehabilitation design a geotechnical investigation should be competed determine the existing roadway structure and in-situ conditions. At that time it will be determined whether an overlay, full roadway reconstruction, or a combination of the two options will be required. The costs for a geotechnical investigation are included in the 35% professional services and contingency estimate provided. The geotechnical investigation will be completed as part of the preliminary and detailed design for the particular section of roadway to be rehabilitated.

It should be noted that the edge milling and overlay option is not available for gravel roadways. In addition any paved roadway that is severely deteriorated will not likely be a candidate for the

milling and overlay option, however this will have to be confirmed upon completion of the geotechnical investigations to be completed.

4.5.2 Concrete & Miscellaneous Items

The curb, gutter, and sidewalks will require replacement or new construction only in select locations which should be identified as part of the design of a roadway section to be rehabilitated. A list of unit prices have been provided in Appendix F for concrete replacement and construction which could be added to the total estimated roadway rehabilitation costs provided. In addition to concrete items other miscellaneous item unit prices (ie. valve adjustments, grass seeding, ect.) are also provided in Appendix F which could be added to the total rehabilitation costs depending on the number or area of items affected by the proposed construction. The total number or area of each miscellaneous item will vary from one section of roadway to the next.

4.5.3 Gravel Roadways

Grading of graveled roadways should be completed on a yearly basis at minimum, and more often if wet whether and/or large traffic volumes deteriorate the road surface on a consistent basis. Regular grading will help to maintain the roadway shape and ability to shed water which will in turn help prolong and maintain the structure and subgrade conditions. In addition regular maintenance will remove potholes, improve ride quality, and reduce damage to vehicles. Yearly grading should be completed as part of the Village's general maintenance program and therefore this report does not provide costs associated with grading of gravel roadways.

4.5.4 Roadway Rehabilitation Economics

When roadway reconstruction is planned it is recommended that the potential to reuse existing materials be explored. In situations when a full or partial rebuild of the roadway is required, a large percentage of the existing road structure material could potentially be reused, if found to be in acceptable condition, to help lower the total roadway rehabilitation costs.

It must be noted that due to the present economic climate in 2009, many of the unit prices for construction noted in Table 4.3 are lower then they have been in the past several years as a result of competitive bids from contractors. Should the economic climate rebound from its current state it is probable that construction costs will increase significantly over the next few years.

5.0 WATER SYSTEM

5.1 PREVIOUS STUDIES

5.1.1 Village of Caroline Growth and Infrastructure Master Plan

The water system issues and recommendations noted in this study are:

Raw Water Supply

- The raw water supply will be adequate for a population of 911 people corresponding to approximately the year 2019.
- The Village Water Treatment Plant has three raw water wells 401[1], 402 and 403, and three pumps 410, 402 and 403. At a population of 792 people, pumps 401 and 402 will need to be replaced with a pump of similar or greater flow capacity than pump 403.
- The raw water filters (green sand filters for iron and manganese) will not need to be replaced until the population reaches 911 persons.

Water Treatment Plant, Storage and Pumping

- No additional distribution pumps will be required until the population reaches 1122 persons (approximately 2026), however the motor should be upgraded from a 10 hp to 15 hp when the population reaches 736 persons. It is also noted that the distribution pumps will exceed there life expectancy prior to 2026 and should be tested, serviced and replaced as necessary.
- The existing storage reservoir will require an upgrade to increase the usable water capacity from 820 m^3 to 945 m^3 prior to a population of 847 persons in approximately 2016.
- The Fire Pump will need to be upgraded to 235 L/s prior to reaching a population of 640 to fulfill the commercial and industrial fire flow requirements.

Water Distribution Network

- Provide watermain loops as recommended in this study. This looping is required to improve the servicing and fire protection and to meet the minimum Alberta Environment water distribution system design guidelines.

[1] Since completion of the *2004 Village of Caroline Growth and Infrastructure Master Plan* report; well 401 has been abandoned.

5.2 WATER SUPPLY AND TREATMENT SYSTEM

5.2.1 Existing infrastructure

The studies listed in Section 5.1 as well as various information provided by the Village were reviewed to gather information pertaining to the water wells, Water Treatment Plant, and existing pumping systems.

Raw Water Supply

Formerly, Caroline had three water wells, numbered 401, 402, and 403. Well 401 was abandoned and the casing pulled in 2007. Currently Well 402 is only pumping approximately an hour a week in order to meet Alberta Environment requirements to remain in service. The primary water source for the Village is well 403, which is pumped approximately 5 hours per day (varying by season) producing about 300 cubic meters per day, and meets the Village water requirements without difficulty. Water is treated to remove slightly excessive iron and manganese.

The population of Caroline peaked at about 560 people in 2006, but has declined slightly since then. However there has been a consistent drop in total water demand from 2001 to 2008, from 118,000 to 88,000 cubic meters per year. Because of the reduced demand, the documented water levels in Well 403 have risen from an initial 12 meters below ground in 2003 to about 6 meters below ground in the fall of 2008.

The water in Well 402 has a higher manganese concentration than Well 403, so the manganese removal process which works well for 403 does not work well for 402. For this reason the Village pumps from Well 402 as little as possible, only to meet Environment requirements.

With one well not in use and the other in use just over twenty percent of the time, Caroline has a more than adequate supply of water. The Village foreman indicated that there has been no decline in pumping or non-pumping water levels in Well 403, and no evidence of a decline of productive capacity. The water supply wells have sufficient capacity for the population of the Village to more than 1000 persons and therefore future review of the system will not be required for sometime.

Water Treatment Plant, Storage and Pumping

The Water Treatment Plant (WTP) is located on 52 Avenue between 50 and 50A Street. The WTP treats raw water from the raw water wells at a current treatment capacity 655 m^3/day (144,080 ImpGal/day). Treated water is stored in a reservoir near the WTP and has a capacity of 818 m^3 (180,000 ImpGal).

There are currently two 10 hp vertical turbine distribution pumps located at the WTP along with one 125 hp fire flow pump connected to an eight cylinder diesel engine.

Water Demand Review

For this study it was deemed appropriate that the future demand on the water treatment and distribution system be analyzed using the high growth rate of 2.49% as a conservative estimate. A conservative estimate was considered appropriate due to the fact that the Villages the size of Caroline can fluctuate in population quite significantly from year to year. It should be noted that in the case that the high growth rate is not achieved by the Village, upgrades based on population should, on the whole, be considered priority over the recommended year.

The *Growth and Infrastructure Master Plan* study for the Village references various areas for future development. Areas 3, 7 & 9 are allocated for residential, Area 4 for commercial and Area 5 for industrial use. In this report Stantec carries forward the previous recommendations for the future development areas associated watermain looping to accommodate this growth.

The available raw water and potable water consumption data from the previous four years (2005-2008) was complied into Table 5.1 located in Appendix D. **From this table, the average daily raw water flow rate is 471 Lcpd (Liter per capita per day), and the Average Day Demand (ADD) of treated water consumption is 470 Lcpd.** When comparing to a similar community in Alberta, the Village of Elnora (338 people), with an average daily treated water consumption rate of 306 Lcpd, Caroline has a substantially higher demand. Generally the water consumption rate is determined by the climate condition, lifestyle, and the ratio of industrial and commercial development to residential development. Higher per capita consumption rate might indicate that the industrial to residential ratio is higher in the Village of Caroline than in Elnora.

Also to be noted is that the raw water consumption rate (471 Lcpd) is almost equal to the treated water consumption rate (470 Lcpd) and therefore very little water is wasted in the treatment process. The water that is wasted is due to filter backwashing which occurs on a biweekly basis.

If there is no large industrial or commercial development in the Village in the short term (two years), the per capita water consumption rate will remain at 470 Lcpd for this study horizon (2009 - 2019). The Maximum Day peaking flow for smaller communities like Caroline is assumed to be twice the Average Day flow, whereas the Peak Hour flow is four times the Average Day flow. The backwash time and backwash water volume depends on the iron and manganese concentration of the raw water. Typically the backwashing process takes approximately 15 minutes for one filter (with the plant having two filters total) and therefore a 5% allowance will be applied in the calculations for the backwash water volume. Based on the above criteria, the treated water demand associated to the population levels of the Village is calculated in Table 5.2 found in Appendix D:

Treatment process

Oxidation/Filtration

Each filter tank has a capacity of 329 m^3/day (227.5 Liters per minute), with the combined capacity of the two filters being 655 m^3/d. As illustrated in Table 5.2, the filters have sufficient capacity to handle the maximum daily demand for this study horizon.

The average raw water and treated water Manganese (Mn) concentration in years 2006-2008 is 0.053 mg/L and 0.018 mg/L respectively. The Mn concentration in treated water complies with the Canadian drinking water standard (A.O. < 0.05 mg/L). The treatment results indicate that the oxidation and filtration process is functioning very well.

As mentioned previously, backwashing of the filters are conducted on a biweekly basis. The backwash process consumes approximately 22 m^3 per cycle with each cycle lasting15 minutes for each filter. In order to avoid using too much water in the reservoir during the day time, the operators always schedule the timing of the backwash for each filter on different days. As seen in Table 5.2, when the population reaches 670, the treated water capacity will meet and exceed the maximum daily demand but cannot meet the backwash volume requirement. Hence, the filter backwash should be scheduled to avoid maximum demand days.

The timer for backwash controls is currently not used by Village operators. Instead, the backwash is controlled manually as preferred by the operators. At this time the method is acceptable, however a more advanced control system should be considered in the future.

Chlorination

As required by AENV 2006 Guidelines, the disinfection process in the Caroline WTP should be able to achieve a 4 log reduction of virus. The drinking water standard *National Sanitation Foundation (NSF) 60* requires a 12% concentration of Sodium Hypochlorite (NaClO). This concentration is achieved by the Village of Caroline's WTP and is used as the primary and only disinfectant in the WTP. The free Chlorine residuals before entering the distribution system are controlled at an average value of 0.5 mg/L, with upper limit of 1 mg/L and lower limit of 0.2 mg/L. According to the operators, the water temperature is about 6ºC and the PH value is approximately 7-8 throughout the year.

Based on the above parameters, and assuming the baffle factor of 10% in the treated water reservoir, the CT (Chlorine Concentration Contact Time) value in 2008 was calculated to be 29 at the Peak Hour flow rate. This CT value is much larger than the required value of 10 and therefore confirms the ability to claim the 4 log virus reduction credit (Code of practice 2009).

Projected flow rates in Table 5.2 were used to verify the CT value. The calculated CT values are shown in Table 5.3 in Appendix D. The CT values range from 29 with a population of 550 people to 23 with a population of 680 people. These values indicate that the free Chlorine is at the average value of the acceptable range (0.2 – 1.0 as mentioned above) and the disinfection process can meet the 4 log virus reduction.

Process mechanical

Overall, the mechanical components in the WTP are very well maintained. Regular painting on the pumps, pipeline and other mechanical parts protect the metals from corrosion keeping them in good working order. The operators have replaced the pressure meters as recommended in the 2004 report.

5.3 WATER DISTRIBUTION SYSTEM

5.3.1 Existing Infrastructure

The studies listed in Section 5.1 as well as various information as provided by the Village were reviewed to gather information pertaining to the water distribution system for the Village.

Distribution Mains

The Village of Caroline's current inventory of water mains are constructed primary of Asbestos Cement (AC) pipe. The total length of known water pipeline in the Village is as follows:

- Watermain (majority is Asbestos Cement): 5,456m
- Trailer Park to Property Line (150 mm PVC): 330m

No fire hydrant leads or service connections have been incorporated into these totals. The above totals assume all existing water lines in the Village are AC pipe, with exception of the lines in the trailer park and main connecting the trailer park to the Village network.

Asbestos Cement Pipe

Asbestos Cement (AC) Pipe is lightweight pipe made of asbestos fibers, silica sand, and Portland cement. AC pipe was installed throughout Canada primarily in the 1940's -1970's as a strong, lightweight, non-corrosive, cost effective alternative to cast iron. AC piping has since been all but eliminated from standard production as a result of the readily available PVC pipe as well as health and safety concerns relating to asbestos contamination in drinking water.

The Village has indicated that the majority of the water distribution network was installed in 1962 with some watermains later installed at 51 Street Close in 1978. This would indicate that the majority of the watermain network is 45+ years old. The typical life expectancy for AC pipe is 40 to 60 years depending on several factors including acidity of the surrounding soils, exposure to ground water, and softness of the enclosed water. It has been noted by Village operations that only two (2) watermain breaks (recorded) have occurred in the past twelve years indicating that the relatively old water distribution network is currently in acceptable condition.

Although the water distribution network within the Village is currently functioning at acceptable levels the majority of the existing water distribution network is in the last 25% of the expected service life (60 years). It is not expected that numerous major failures will be experienced within

the next ten years, however it is probable that the majority of the AC pipe installed in 1962 will experience major failures throughout the system simultaneously (over a period of 5 -10 years) near the end of the AC pipe design life.

Keeping in mind that the majority of the water distribution network was installed in a the span of a couple of years, it would be prudent to replace the majority of watermain network prior to the end of the AC design life, and thus, a replacement program commencing in the near future is recommended.

5.3.2 Water Model Analysis

Modeling Parameters

Treated water is distributed from the Reservoir to the Village via the distribution network which consists of the distribution pump station and 150 mm Asbestos Cement pipes and fire hydrants. Bently WaterCad simulations were carried out to evaluate both the existing system and study the future network extension. A model was built to evaluate whether the existing network meets the current AENV requirements. The existing system was simulated with WaterCad under Peak Hour Demand (PHD) and Maximum Day Demand (MDD) plus Fire Flow (MDD+Fire) scenarios. A future network was also proposed and simulated to study the upgrade needs to meet the future growth of the study horizon (2019).

Table 5.4 in Appendix D illustrates the parameters that were input into the model for hydraulic calculation.

Design Criteria for Servicing and Fire Flow

The criteria used to evaluate the water network system are listed as following:

- The minimum pressure at each water use point is to be 300 kPa (43 psi) with the PHD scenario.
- The acceptable pressure range for the distribution network is to be 275 kPa (40 psi) to 690 kPa (100 psi). The town is currently running at 400 kPa (58 psi) at the distribution header.
- The minimum residual line pressure that the Village will experience for the duration of a fire is 150 kPa (21 psi).
- In PHD scenario, the maximum flow velocity in pipes is to be 1.5 m/s.
- In the MDD + Fire scenario, the maximum flow velocity in pipes is to be 2.5 m/s.
- Minimum fire flow is to be 75 L/s for residential areas. As the majority of existing areas are single family houses, this fire flow rate is acceptable for current conditions.
- It is desirable to supply fire flow at a rate of 230 L/s at MDD conditions for Industrial, Commercial and Institute (ICI) areas.

Note that, in *Water supply for Public Fire Protection* by Fire Underwriters Survey (1999), the required flow, for each large residential and ICI building or area, is a function of the building

structure, floor area, height, density as well as other factors. For this stage of the study the upper desirable flow rate is set to be 230 L/s in the WaterCad model.

Model Analysis – Existing System

The existing water demand for the developed Village areas are assigned to the nearest nodes in the water network and illustrated in Figures 5.2 and 5.3 in Appendix D. The existing water distribution system was analyzed to identify any capacity issues that are currently occurring, including high or low pressure zones that occur under both normal operation and fire flow conditions. The model was analyzed using the existing distribution pump data. The system was evaluated with current populations and found that the existing watermain network is sufficient to provide residential fire flow (75 L/s) to the entire Village.

As noted in the *Village of Caroline Growth and Infrastructure Master Plan* Study, watermain loops are recommended to improve the servicing and fire protection and to meet the minimum Alberta Environment water distribution system design guidelines. In this report Stantec carries forward the previous recommendations for the watermain looping. **In addition to the looping, at the time of watermain upgrades it is recommended to upsize the mains from 150mm to 200mm and in some cases 250mm. This will increase the available fire flow throughout the Village and will also allow for future expansion while still meeting the Alberta Environment fire flow guidelines.** The cost implications to upsize the mains are only approximately 7% of the total and therefore the benefits outweigh the marginal additional costs.

The existing distribution network was found to be capable of meeting the PHD scenario requirements with pressures varying from 41.9 psi to 60.3 psi throughout the village. This is illustrated in Figure 5.2.

Although Peak Hour Demand requirements are met, the available fire flow under Max Day Demand conditions is lower than desired (75 L/s) in most of the residential areas. This is mainly due to the lack of watermain looping in the north part of the Village. The fire pump has sufficient capacity to supply the required fire flow. Proposed watermains are recommended to provide looping and thus, increase the available fire flow. Figure 5.4 illustrates the proposed upgrades to the water network to increase the available fire flow to the Village.

It should be noted that the Trailer Park in the Northeast portion of the Village is included in the WaterCad model with a total PHD flow of 0.83 L/s based on an ADD of 300 Lcpd.

Model Analysis – Future Growth

The future development plan for the Village is assumed to be grow equally in Areas 3, 7, and 9 for residential and Areas 4 and 5 for industrial and commercial developments respectively. The future demands are based on this assumption and the proposed extension of the water network for the future servicing of the Village is shown in Figures 5.5 and 5.6 which illustrate two water demand scenarios; PHD and MDD+Fire flow demands.

In addition to water distribution expansion, a new duty pump with higher capacity (Design point Q=15 L/s at T.D.H=40 m) should replace the current duty pump when the existing two pumps approach the end of their expected life span.

According to the modeling results and as mentioned above, the existing fire pump can supply sufficient fire flow to developed areas. For future areas, the existing fire pump can deliver 123-137 L/s fire flow through the proposed water network. Three (3) possible upgrades will provide increased fire flows to meet the ICI building requirements of 230 L/s; 1) upsize existing mains, 2) upgrade fire pump capacity, and 3) increase reservoir volume. However, since the above noted recommended upgrades to provide 230 L/s fire flow would be very costly, and the current conditions with proposed looping upgrades meet the 75 L/s fire flow requirement, upgrades to achieve the 230 L/s fire flow requirements would require further investigation and follow-up by the municipality in the future.

Reservoir Volume Requirements

As discussed in Section 5.2, the reservoir has enough capacity for the chlorination process. The reservoir also plays a critical role in public fire protection which is to have reliable water available for providing the required fire flow demands to the Village. According to the *Fire Underwriters Survey* (FUS) requirement, the reservoir should supply sufficient volume for 2.0 hours of continual fire flow demands. In addition to the fire flow demand volume, the reservoir should have an equalization storage and emergency storage with the total required volume of the reservoir being the sum of the three storage volumes. Table 5.5 in Appendix D shows the total required volume (m^3) of the reservoir for increasing population milestones and fire flow levels.

It can been seen in Table 5.5, that if the Village wants to supply a fire flow rate larger than 75 L/s, the existing reservoir (effective volume of 820 m^3) does not have enough storage volume for the 2.0 hour fire flow demand requirement. **The reservoir will require an additional 400 m^3 of storage volume to supply 137 L/s fire flow demand until the termination of the study horizon.**

5.4 REHABILITATION STRATEGY – DISTRIBUTION MAINS

5.4.1 Methodology

It is recommended that a full scale water distribution main replacement strategy be carried out by the Village of Caroline. Typical strategies of this nature would focus on initially replacing pipe segments where the most historical problems have occurred, followed by areas with less or no past problems. However there is little known historical data (only two recorded breaks) within the Village making it impractical to complete the water main replacement strategy in the usual way.

It is therefore recommended that the watermain replacement strategy in the Village be subject to required maintenance of other infrastructure in the area as well as priorities of the Village.

As per previous discussions with Village operators, the watermain along 50 Avenue has required repairs in the past and will require additional repairs to the service connections in the near future. As this main services the vast majority of the commercial property in the Village, the replacement is recommended to be a top priority. Due to this watermain being on the main street through the Village (Highway 54), and the road surface in good condition, it is recommended that only one block be replaced initially. The existing watermain along 50 Avenue can then be evaluated and scheduling for further watermain replacement along this primary roadway can be determined at that time. The recommended looping is to be completed in conjunction with road and sanitary improvements in the area however should be given special consideration before Village expansion. **As noted above, 150mm mains should be upsized to 200mm or 250mm mains as recommended.** The size of the watermain will be confirmed at the detailed design phase and additional modeling is recommended to verify the existing conditions at the time of design.

In addition to the recommendation provided above, watermain replacements should be completed in conjunction with other infrastructure work in the area, mainly with the sanitary sewer replacement, and will be assessed by the following priority rating for each segment of watermain:

1. Replacement or new installation of sanitary sewer in the area;
2. Prior to any paving or roadway construction in the area;
3. Replacement or new installation of storm sewer in the area.

To elaborate; in any area were sanitary or storm sewer upgrades are being completed, the watermain parallel to the other utility being upgraded is recommended to be replaced at the same time. This system will allow for the most cost effective replacement strategy as the mobilization, trenching, and backfilling costs for the watermain replacement can be shared between multiple utilities. Likewise, watermain replacement should be completed prior to roadway construction or paving to ensure that new road structures or asphalt will not have to be removed for replacement or maintenance of watermains.

5.4.2 Rehabilitation Schedule

The Watermain Network Drawing, located in Appendix D, outlines the water system in the Village of Caroline. The priority of watermain sections to be replaced was not identified in detail as there have only been 2 recorded breaks in the past 10 years. As mentioned previously, the watermain along 50 Avenue has had some problems and should be considered a high priority for replacement.

5.5 REHABILITATION COSTS

The unit prices used to estimate the rehabilitation costs for each segment of watermain have been taken from 2009 tender prices from various communities in central Alberta. The unit prices used can be found in Appendix F. The unit prices provided have been broken down into costs per lineal metre based on size of pipe to be installed for the watermain replacement. Unit prices have also been provided for miscellaneous items related to watermain replacement and have been calculated as part of the total cost. These miscellaneous items were calculated based on a typical 100 meters of utility replacement. Roadway trench repair including subbase, base and asphalt have not been included in the watermain replacement costs but can be found in the roadway unit price schedule and can be added as required.

6.0 STORM SYSTEM

6.1 INVENTORY

The existing length of storm sewers in the Village of Caroline is approximately 980 metres composed primarily of Corrugated Metal Pipe (CMP) with some newer areas constructed from PVC pipe. The two primary outfall drainage locations are:

- The west ditch of 50 Street, North of 51 Avenue which flows north out of the Village; and
- The drainage ditch east of 49 Street and 48 Avenue intersection which disperses east and south into the adjacent fields.

6.2 ANALYSIS

Typical of most small communities, Caroline relies heavily on overland drainage with a segmented system of underground stormwater infrastructure and strategically located ditches. For smaller communities the cost to fully implement underground stormwater infrastructure is not economical to complete due to a relatively small infrastructure spending to population ratio.

The current drainage conditions within the Village appear to be adequate at this time. A drawing of the Village storm system can be found in Appendix E.

6.3 REHABILITATION STRAGETY & FUTURE STORM IMPROVEMENTS

The current outfall east of the 49 Street and 48 Avenue intersection releases approximately 40% of the Village drainage. At this time the outfall location and ditch appear to be providing adequate dispersion of the stormwater collected; however this ditch is restricting the potential development of the adjacent land. It is recommended that a storm line be installed extending the sewer from the intersection of 49 Street and 48 Avenue south to the Village boundary, and east to where it would outfall into the ditch of 50 Street (Range Road 61). These upgrades should be completed with the proposed upgrades and re-alignment of the sanitary sewer in the same location. The estimated cost to complete the recommended upgrade is found in Appendix E and an average cost per linear metre for the proposed storm upgrade is found in Appendix F.

Further storm sewer upgrades could be implemented throughout the Village, however it is recommended that available capital funds be used for higher priority upgrades needed for the sanitary, water, and roadway networks.

Upgrades will be required with future development areas within the Village. Since storm system improvements and stormwater management requirements are a direct result of new land development, future areas cannot be predicted. New developments are required to provide a stormwater management plan; at which time any stormwater issues created by the development should be addressed.

7.0 CONCLUSIONS & RECOMMENDATIONS

This Village of Caroline Capital Infrastructure Plan has provided a full review of each vital piece of the Village's existing infrastructure. We are pleased to announce this review has concluded that the most vital parts of any community such as water well supply, water treatment and sewage treatment are currently in very good condition within the Village of Caroline.

Conversely, this infrastructure review has lead to the conclusion that some of the slightly less critical, but still very important portions of the Village infrastructure such as the water distribution network, select sanitary mains, and many roadways are deteriorating due to age, and are in serious need of rehabilitation.

In general terms, the entire water distribution network within the Village is due for replacement within the next 15 years, when comparing the pipe type to the typical design life. Due to available funds it may not be feasible to complete replacement of the entire water distribution network within this timeframe; however the low level of maintenance that has been required to date indicates that the existing water distribution mains may last several years beyond the typical design life. Never the less, it is still recommended that watermain replacement program commence immediately to avoid multiple repairs simultaneously. It is also recommended to complete watermain replacement in conjunction with sanitary sewer replacements and prior to roadway rehabilitation. In addition it is recommended that each watermain be upsized from the existing 150mm to either 200mm or 250mm as recommended to ensure adequate fire flow to various areas in the Village is achieved and to provide the opportunity for future Village expansion without need additional upgrades in the future. The extra cost for installing larger water pipeline is approximately $56/metre (or 7% of the total construction cost)

The recommendations provided in this report are focused on the vital portions of the deteriorating infrastructure which include the required water and sanitary sewer upgrades (deep utilities). The majority of the roadway upgrades are recommended to take place following completion of the deep utilities in any given area. However consideration was also given to the avoidance of removing roadways in good condition simply to replace deep utilities that may be in poor condition. Some areas with extreme roadway deterioration have also been considered for rehabilitation prior to the deep utility replacement while some areas have been considered for deep utility replacement where no roadway work is needed.

In some circumstances, paving that may be needed in an area where little or no deep utility work is required or deep utility replacement where no roadway work is required has been presented as an area of special consideration (covered in Section 7.1.5).

7.1 OVERALL PRIORITY RATING

The following is a description of each proposed rehabilitation and a list of the work to be completed in the area, based on the priority rankings developed (Table 7.1 of Appendix A and illustrated on Figure 7.1). A top priority number indicates degraded or inadequate infrastructure in the area. In addition, the areas top priority will generally provide enhancements for larger portions of the Village, conversely areas with lower priority ratings will generally only result in enhancements to the localized area where the improvement is completed.

The ratings established are:

Priority Level	Description
1	Immediate Attention Required
2	Critical Rehabilitation Required
3	Standard Upgrades Required
4	Future Upgrades Required
5	Long Term Upgrades
*	Areas of special consideration

The upgrades recommended in each priority category are listed sequentially and are generally based on condition of existing infrastructure. At the time of design it is recommended that the Village monitor local conditions to properly decipher which upgrades should be completed in that given year. If an increased number of issues are noticed in a single location the urgency for upgrades in that area could push that location to the top issue within the priority category, or even move it up to a higher priority ranking. This idea should be strongly taken into account with regards to the watermains.

It is known that most of the AC pipe within the Village is in the last 25% of its design life; however the actual condition of the pipe is unknown. Each time a section of the AC water pipe is removed for replacement, a careful inspection of the pipe should be completed to help determine the overall condition of the pipe removed as well as the pipe in the adjacent locations.

A cost breakdown for each section of recommended upgrades is presented in Table 7.1 of Appendix A and a list of the top priority items is presented in Table 7.2.

Note: All costs provided in this section of the report include the cost for total roadway reconstruction. Following the completion of a geotechnical investigation, it may be determined that only trench repairs and/or an overlay may be required, which would significantly reduce the cost of each project.

In some locations the sanitary sewer appears to be in good condition however costs are still included into the total cost for the rehabilitation recommended. It is recommended that an additional camera inspection be completed on each section of sewer before rehabilitation is completed in the area to verify the condition of the sewer main. In cases where the infrastructure will not need upgrading the allocated funds can be used for additional upgrades or distributed elsewhere.

7.1.1 Priority 1 - Immediate Attention Required

1. 49 Street, from 48 Avenue to the Lagoons

    - Upgrade the sanitary sewer from the intersection of 48 Avenue and 49 Street, south, to the Village lagoon. This upgrade should significantly reduce or eliminate the sewer backups that have been occurring within the Village.

    - Replace the watermain along 49 Street.

    - Install a storm sewer in this location to eliminate the drainage ditch on the east side of the roadway. The extension of the storm sewer will provide the opportunity to outfall the storm system in the ditch of Range Road 61 which will in turn provide the opportunity to develop the land east of 49 Street. The eradication of the existing drainage ditch will also eliminate potential negative effects on the roadway and surrounding areas such as minor flooding and undermining of the roadway.

    - Paving the roadway to be completed after the deep utility installation.

    - The total approximated cost for these upgrades is $1,082,384.

7.1.2 Priority 2 - Critical Rehabilitation

2. 51 Avenue from 49 Street to 48 Street & 48 Street from 50 Avenue to 51 Avenue

    - Looping of the watermain in this area will improve fire flow demands and assist in servicing future developments.

    - Paving of the roadway should be completed from 50 Avenue to the location of the bulk fueling station, at very least. This road structure should also be enhanced beyond standard local roadway. If the Village feels it would be beneficial to the transportation network this entire roadway could be paved after the installation of the watermain.

    - Special consideration should be given to 51 Avenue from 50 Street to 49 Street. The watermain in this location could be replaced and the roadway is in very poor condition and should be reconstructed.

- The total approximated cost for these upgrades is $383,033. The approximated cost to include the area of special consideration is an additional $158,348.

3. 49 Avenue from 52 to 51 Street

    - The sanitary sewer is this area is in critical need of repair.
    - This watermain should be replaced during the reconstruction of the sanitary sewer.
    - This roadway has never been paved and is in very poor condition. Full reconstruction of this roadway upon completion of the deep utility rehab will likely be needed. Paving of this roadway will help reduce degradation of the newly paved 52 Street by eliminating the gravel and debris migration from the unpaved 49 Avenue.
    - The total approximated cost for these upgrades is $402,254.

4. 50 Avenue from 50 Street to 51 Street

    - The sanitary sewer in this location is in very poor condition and should be replaced.
    - As noted in this report the watermain along 50 Avenue is a major concern as a result of corroded services that have been replaced in the recent past. The replacement of this watermain would provide the opportunity to inspect the adjacent sections of the water network to assess the condition of the distribution main along 50 Avenue. If the water pipe removed as part of this rehab is found to be in poor condition contemplation should be given to the possibility of promoting the remainder 50 Avenue to Priority 2.
    - Roadway repair will be required after replacement of the deep utilities;
    - The total approximated cost for these upgrades is $606,024.

5. 52 Avenue from 50 Street to 51 Street

    - This roadway is in very poor condition and will likely require full reconstruction.
    - The sanitary sewer in this location is in fairly good condition and a CCTV inspection should be completed prior to design. If found in poor condition at that time it should be replace, if found in good condition the funds could be distributed elsewhere.

- Watermain replacement will be needed as part of the rehabilitation in this area. The watermain replacement will also provide the opportunity to replace the intake pipe which provides the flow corridor from well 402 to the water treatment plant.

- As a portion of this work, special consideration should also be given to the potential completion of the sewer, roadway, and watermain upgrades along the northern 45m of 50 A Street in order to complete full upgrades from well 402 (52 Avenue) to the water treatment plant.

- This area has also been proposed for water main looping. It is recommended that the extension of the watermain be completed to 50 Street during this stage.

- The total approximated cost for these upgrades is $531,903. The total approximated cost to include the area of special consideration is $119,967.

7.1.3 Priority 3 - Standard Upgrades

6. 51 Street from 51 Avenue to 52 Avenue

    - The sanitary sewer in this location is in very poor condition and will require replacing.

    - Watermain replacement will be needed as part of the rehabilitation in this area.

    - The roadway in this area ranges from average condition at the southern end and degrades to very poor condition at the northern end. Roadway repair will be needed once replacement of the deep utilities has been completed.

    - If this work is not completed in conjunction with these recommended 51 Street repairs, this special consideration item should be considered a top Priority 3 item.

    - The total approximated cost for these upgrades is $672,704.

7. 51 Street Close

    - The sanitary sewer in this location is in poor condition and will require replacing. Upgrades in this area would allow replacement of the sanitary sewer running from west of 51 Street Close to 52 Street.

    - Watermain replacement will be needed as part of the rehabilitation in this area and watermain looping from 52 Street to 51 Street is recommended. At this time the watermain looping is shown in the back alley north of 51 Street Close however if room is available, consideration should be given to installing the watermain loop in the same location as the sanitary sewer. The common trench and shorter pipe distance would result in cost saving if the watermain could be

added in the same location as the sanitary sewer (note that the price shown below does not include this potential cost reduction).

- The roadway in this area is also in poor condition. Roadway repair will be needed once replacement of the deep utilities has been completed.

- The total approximated cost for these upgrades is $456,646.

8. 52 Street from 51 Avenue to the North End

    - The visual roadway assessment completed pointed out that this section of the roadway is the worst stretch of pavement in Village, especially at the northern end of the roadway.

    - The VCT sanitary sewer in this location should be replaced during construction but the PVC sewer in the area appears to be in good condition so it should be further evaluated at the time of repair. The VCT sanitary sewer extending north of 52 Street Crescent (north leg) should be abandoned and any services connected to that pipeline should be attached to the adjacent PVC sewer line.

    - Watermain replacement will be needed as part of the rehabilitation in this area.

    - The total approximated cost for these upgrades is $704,203.

9. 48 Avenue from 52 Street to 51 Street

    - This sanitary sewer is in very poor condition and should be replaced.

    - The watermain in this section should be replaced as part of the upgrades to be completed.

    - Currently this roadway is slightly below average condition, however this upgrade will not likely occur for several years and it is anticipated that this roadway will degrade to poor condition by the time these upgrades are implemented.

    - The total approximated cost for these upgrades is $445,749.

10. 49 Street from 50 Avenue to 51 Avenue

    - The watermain in this location has been identified as having a previous breakage. This likely indicates that the watermain in this area is in poor condition; therefore this is an important area for watermain replacement.

    - This roadway has been identified as the second worst section of pavement in the Village. As such roadway rehabilitation should take place.

- This sanitary sewer is currently in good condition. Ideally this sewer will not have to be replaced at the time of construction; however the sewer should be inspected prior to the rehabilitation of the area to determine if it is still in good condition.

- The total approximated cost for these upgrades is $310,872.

11. 51 Avenue from 50 Street to 51 Street

- The sanitary sewer is in very poor condition and should be replaced.

- The watermain should be replaced during rehabilitation of the sanitary sewer.

- Once the deep utilities replacements are completed the roadway will have to be repaired.

- The total approximated cost for these upgrades is $382,974.

12. 49 Avenue from 50 Street to 51 Street

- This roadway is in very poor condition and has never been paved. Full reconstruction of this roadway will likely be required.

- The watermain should be replaced prior to the roadway reconstruction.

- Currently the sanitary sewer is average condition. Camera review of this sewer should be completed prior to upgrades in this area to ensure that sanitary replacement is not needed during this rehabilitation.

- The total approximated cost for these upgrades is $380,357.

7.1.4 Priority 4 & 5 - Future / Long Term Upgrades

All priority 4 and 5 locations are displayed on Figure 7.1. Although portions of the infrastructure in these areas do require rehabilitation it is anticipated that the Village will not have the available capital funds to complete the upgrades needed within the ten year scope of this Capital Infrastructure Plan. It is important to note that all areas of the Village should be monitored for deficiencies and adequate records of all repairs be documented. If multiple problems are encountered in a single area it is likely that the area of reoccurring problems should be moved up in the priority ranking. All approximated costs for the infrastructure replacement for each priority 4 and 5 area are listed in Table 7.1.

7.1.5 Areas of Special Consideration

Several areas of special consideration have been outlined throughout Section 7.1. Most areas of special consideration noted are in a location were a generally smaller and slightly less important area of infrastructure rehabilitation is needed, or only select parts of the overall rehabilitation schedule are required (ie. only paving is required with no deep utilities).

Three categories of special consideration have been developed which are outlined below and presented with the approximated cost to construct in Table 7.3.

1. Primary Areas of Special Consideration

These areas have been identified with the top priority items listed in Sections 7.1.1 to 7.1.3. The critical areas of special consideration include areas that would not be required as a part of the particular rehabilitation but are strongly recommend and would enhance the effectiveness of the work being completed. Completing the recommended upgrades in these areas while completing the recommended top priority rehabilitation would allow for the construction to be completed in a cost effective manner.

2. General Areas of Special Consideration

For each of these general areas of special consideration could be included in the planned repairs of the adjacent location if extra capital funds are available in the given year. These areas could be ideal for upgrades should the planned construction costs come in lower then expected in a given year. Completing infrastructure repairs in these locations will allow the Village to accomplish rehabilitation of the infrastructure of these smaller areas in the most cost effective way.

However; all areas of special consideration should have a final review completed by the Village and the engineer prior to initiating design for the rehabilitation in any given year. This final assessment will be to ensure the area of special consideration recommended is a satisfactory usage of capital funds for the given year, and that there is not a more critical area where the funds could be allocated.

3. Coordinated Areas of Special Consideration

The coordinated areas of special consideration are along 50 Street and 50 Avenue, in locations were no underground utilities are currently located (near the edges of the Village). Roadway rehabilitation should be coordinated in these areas when the Province or County is competing general maintenance to the Highway or County roadway network. This will likely allow the Village to have roadway repairs completed in these locations only requiring the Village to pay for a fraction of the total construction costs. Watermain looping that may be required in any area of special consideration should also be completed prior to any roadway upgrades.

8.0 CORPORATE AUTHORIZATION

This document entitled "Village of Caroline Capital Infrastructure Plan" was prepared by Stantec Consulting Ltd. for the Village of Caroline. The material in it reflects Stantec Consulting Ltd.'s best judgment in light of the information available to it at the time of preparation. Any use which a third party makes of this report, or reliance on or decisions made based on it, are the responsibilities of such third parties. Stantec Consulting Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

PERMIT TO PRACTICE
STANTEC CONSULTING LTD.
Signature
Date Aug 28, 2009
PERMIT NUMBER: P 0258
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

CORPORATE AUTHORIZATION

PROFESSIONAL ENGINEER ALBERTA
TIMOTHY J. AINSCOUGH
090828

RESPONSIBLE ENGINEER

Appendix A

Rehabilitation Strategy

VILLAGE OF CAROLINE: OVERALL PRIORITY RATING

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By: DMH

JUNE 2009
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Legend

- Long Term Upgrades
- Future Upgrades
- Standard Upgrades
- Critical Upgrades
- Immediate Attention Required
- Areas of Special Consideration

Village of Caroline

Client/Project:
VILLAGE OF CAROLINE

Figure No:
7.1

Title:
OVERALL PRIORITY RATING

Table 7.1 - Priority Rating

Overall Section #	Location	From	To	Sanitary Rating	Overall Visual Pavement Assessment Rating	Overall Gravel Roadway Rating	Overall Rating	Watermain Replacement Required (Y/N)	Additional Information & Considerations	Relative Priority Rating	Rehabilitation Costs				
											Sanitary	Roadway	Water	Storm	Total
1.1	52 St	48 Ave	49 Ave	N/A	4.5	N/A	4.5	Y		5	$0	$86,200	$89,374	$0	$175,574
1.2	52 St	49 Ave	50 Ave	N/A	4.5	N/A	4.5	Y		5	$0	$90,500	$81,344	$0	$171,844
1.3	52 St	50 Ave	51 Ave	N/A	4.5	N/A	4.5	Y		5	$0	$111,800	$72,832	$0	$184,632
1.4	52 St	51 Ave	52 St Cr S	3	1.5	N/A	2.25	Y		3	$62,890	$71,200	$79,497	$0	$213,587
1.5	52 St	52 St Cr S	52 St Cr N	3	1.0	N/A	2	Y		3	$68,807	$69,400	$47,618	$0	$185,825
1.6	52 St	52 St Cr N	North End	5	0.5	N/A	2.75	Y		3	$93,568	$94,700	$116,523	$0	$304,791
2.1	51 St	48 Ave	49 Ave	N/A	2.0	N/A	2	N		*	$0	$80,300	$0	$0	$80,300
2.2	51 St	49 Ave	50 Ave	N/A	3.0	N/A	3	N		*	$0	$78,500	$0	$0	$78,500
2.3	51 St	50 Ave	51 Ave	N/A	3.0	N/A	3	N		*	$0	$102,800	$0	$0	$102,800
2.4	51 St	51 Ave	52 Ave	1	2.0	N/A	1.75	Y	South 2/3 of Sanitary = 1 North 1/3 of Street = 3	3	$228,232	$221,800	$222,672	$0	$672,704
3.1	51 St. CL	51 St	52 St	2	N/A	1.5	1.75	Y	Sanitary Line Includes Line Running in the NW Lots, Water Main Looping Included	3	$132,513	$124,587	$199,546	$0	$456,646
4.1	50 A St	51 Ave	52 Ave	2	2.0	N/A	2	Y		4	$158,073	$254,300	$216,730	$0	$629,103
5.1	50 St	South End	48 Ave	N/A	2.0	N/A	2	Y		*	$0	$288,800	$175,616	$0	$464,416
5.2	50 St	48 Ave	49 Ave	4	4.0	N/A	4	Y		5	$67,147	$171,300	$75,161	$0	$313,608
	50 St	49 Ave	50 Ave	4	4.0	N/A	4	Y		5	$52,776	$216,800	$81,264	$0	$350,840
5.3	50 St	50 Ave	51 Ave S	3	2.5	N/A	2.75	Y		5	$112,338	$338,400	$72,752	$0	$523,490
5.4	50 St	51 Ave S	52 Ave	3	3.0	N/A	3	Y	Sanitary & Water Line Only Runs From 51 Ave to 51 Ave in this location	*	$0	$290,300	$58,779	$0	$349,079
6.1	Lagoon Intake	Lagoon	South End of 49 St.	NR	N/A	N/A	N/A	Y	No Roadway In this Section, Sewer is Undersized, Storm Sewer to be Installed as	1	$431,377	$0	$81,665	$44,110	$557,152
6.2	49 St	South End	48 Ave	3	N/A	2	2.5	Y	Storm Sewer to be Installed as Part of Upgrades, Sanitary Sewer is Undersized	1	$133,788	$165,000	$160,279	$66,165	$525,232
6.3	49 St	48 Ave	50 Ave	2	3.0	N/A	2.5	Y		4	$138,831	$153,300	$171,681	$0	$463,812
6.4	49 St	50 Ave	51 Ave	3	1.0	N/A	2	Y	South 1/3 of Sanitary = 3 North 2/3 of Sanitary = 4	3	$33,284	$130,800	$146,788	$0	$310,872
6.5	49 St	51 Ave	North End	N/A	N/A	0.5	0.5	Y		N/A	$84,093	$110,000	$129,042	$0	$323,135
7.1	48 St	50 Ave	51 Ave	N/A	N/A	1	1	N	Watermain Looping Included	2	$0	$137,100	$98,368	$0	$235,468

Table 7.1 - Priority Rating

Overall Section #	Location	From	To	Sanitary Rating	Overall Visual Pavement Assessment Rating	Overall Gravel Roadway Rating	Overall Rating	Watermain Replacement Required (Y/N)	Additional Information & Considerations	Relative Priority Rating	Rehabilitation Costs				
											Sanitary	Roadway	Water	Storm	Total
8.1	52 Ave	50 St	50 A St	5	N/A	1	3	N	Sanitary Price Includes Replacement of Sanitary Line to Lift Station, Watermain	2	$82,945	$38,700	$210,704	$0	$332,349
8.2	52 Ave	50 A St	51 St	5	N/A	1	3	Y	Replace Intake Line From Well	2	$71,884	$66,800	$79,818	$0	$218,502
9.1	52 St Cr	52 St N	East Leg	5	N/A	1.5	3.25	N		*	$47,806	$81,200	$61,028	$0	$190,034
9.2	52 St Cr	North Leg	South Leg	5	N/A	1	3	N		*	$45,676	$42,400	$46,890	$0	$134,966
9.3	52 St Cr	52 St S	East Leg	5	N/A	1	3	N		*	$24,813	$81,200	$61,189	$0	$167,202
10.1	51 Ave	52 St	51 St	2	2.5	N/A	2.25	Y		2	$116,648	$123,500	$138,999	$0	$379,147
10.2	51 Ave	51 St	50 A St	1	4.0	N/A	2.5	Y		3	$75,271	$67,600	$79,417	$0	$222,288
10.3	51 Ave	50 A St	50 St	1	3.5	N/A	2.25	Y		3	$57,787	$44,200	$58,699	$0	$160,686
10.4	51 Ave	50 St	49 St	N/A	N/A	1		Y		*	$0	$76,600	$81,745	$0	$158,345
10.5	51 Ave	49 St	48 St	N/A	N/A	0.5		N	Watermain Looping Included	2	$0	$71,200	$71,808	$0	$143,008
11.1	Alley	49 St	48 St	3	N/A	N/A	3	Y		5	$64,825	$0	$71,788	$0	$136,613
12.1	50 Ave	West of 52 St	51 St	3	3.5	N/A	3.25	Y		*	$116,292	$564,100	$122,136	$0	$802,528
12.2	50 Ave	51 St	50 St	1	3.0	N/A	2	Y	Watermain Replacement in this Location will Help Determine if Other Watermain	2	$116,663	$344,500	$144,861	$0	$606,024
12.3	50 Ave	50 St	49 St	3	3.0	N/A	3	Y		5	$68,779	$275,300	$72,431	$0	$416,510
12.4	50 Ave	49 St	48 St	N/A	3.5	N/A	3.5	N		5	$0	$194,000	$0	$0	$194,000
12.5	50 Ave	48 St	East	N/A	4.0	N/A	4.5	N		*	$0	$1,368,800	$0	$0	$1,368,800
13.1	49 Ave	52 St	51 St	1	N/A	1	1	Y		2	$116,224	$144,300	$141,730	$0	$402,254
13.2	49 Ave	51 St	50 St	3	N/A	1	2	Y		3	$116,731	$144,300	$119,326	$0	$380,357
14.1	48 Ave	West End	52 St	NR	N/A	1	1	Y	The Sewer in this Area is Dry	5	$0	$100,100	$73,073	$0	$173,173
14.2	48 Ave	52 St	51 St	1	2.5	N/A	1.75	Y		3	$116,165	$184,000	$145,584	$0	$445,749
14.3	48 Ave	51 St	50 St	2	2.0	N/A	2	Y		2	$116,790	$223,600	$125,027	$0	$465,417
14.4	48 Ave	50 St	49 St	4	4.0	N/A	4	Y		5	$68,987	$73,000	$82,227	$0	$224,214
15.1	Alley	49 St	48 Ave	3	N/A	N/A	3	Y	Watermain Looping Included	*	$55,052	$8,000	$191,998	$0	$255,050

Table 7.2 - Top Priority List

Report Section #	Overall Section #	Location	From	To	Relative Priority Rating	Rehabilitation Costs				
						Sanitary	Roadway	Water	Storm	Total
1	6.1	Lagoon Intake	Lagoon	South End of 49 St.	**1**	$431,377	$0	$81,665	$44,110	**$557,152**
1	6.2	49 St	South End	48 Ave	**1**	$133,788	$165,000	$160,279	$66,165	**$525,232**
Total # 1						$565,165	$165,000	$241,944	$110,275	**$1,082,384**
2	7.1	48 St	50 Ave	51 Ave	**2**	$0	$137,100	$101,002	$0	**$238,102**
2	10.5	51 Ave	49 St	48 St	**2**	$0	$71,200	$73,731	$0	**$144,931**
Total # 2						$0	$208,300	$174,733	$0	**$383,033**
3	13.1	49 Ave	52 St	51 St	**2**	$116,224	$144,300	$141,730	$0	**$402,254**
Total # 3						$116,224	$144,300	$141,730	$0	**$402,254**
4	12.2	50 Ave	51 St	50 St	**2**	$116,663	$344,500	$144,861	$0	**$606,024**
Total # 4						$116,663	$344,500	$144,861	$0	**$606,024**
5	8.1	52 Ave	50 St	50 A St	**2**	$82,945	$38,700	$191,756	$0	**$313,401**
5	8.2	52 Ave	50 A St	51 St	**2**	$71,884	$66,800	$79,818	$0	**$218,502**
Total # 5						$154,829	$105,500	$271,574	$0	**$531,903**
6	2.4	51 St	51 Ave	52 Ave	**3**	$228,232	$221,800	$222,672	$0	**$672,704**
Total # 6						$228,232	$221,800	$222,672	$0	**$672,704**
7	3.1	51 St. Cl	51 St	52 St	**3**	$132,513	$124,587	$199,546	$0	**$456,646**
Total #7						$132,513	$124,587	$199,546	$0	**$456,646**
8	1.4	52 St	51 Ave	52 St Cr S	**3**	$62,890	$71,200	$79,497	$0	**$213,587**
8	1.5	52 St	52 St Cr S	52 St Cr N	**3**	$68,807	$69,400	$47,618	$0	**$185,825**
8	1.6	52 St	52 St Cr N	North End	**3**	$93,568	$94,700	$116,523	$0	**$304,791**
Total # 8						$225,265	$235,300	$243,638	$0	**$704,203**
9	14.2	48 Ave	52 St	51 St	**3**	$116,165	$184,000	$145,584	$0	**$445,749**
Total # 9						$116,165	$184,000	$145,584	$0	**$445,749**
10	6.4	49 St	50 Ave	51 Ave	**3**	$33,284	$130,800	$146,788	$0	**$310,872**
Total # 10						$33,284	$130,800	$146,788	$0	**$310,872**
11	10.2	51 Ave	51 St	50 A St	**3**	$75,271	$67,600	$79,417	$0	**$222,288**
11	10.3	51 Ave	50 A St	50 St	**3**	$57,787	$44,200	$58,699	$0	**$160,686**
Total # 11						$133,058	$111,800	$138,116	$0	**$382,974**
12	13.2	49 Ave	51 St	50 St	**3**	$116,731	$144,300	$119,326	$0	**$380,357**
Total #12						$116,731	$144,300	$119,326	$0	**$380,357**

Table 7.3 - Areas of Special Consideration

Special Consideration Type	Overall Section #	Location	From	To	Rehabilitation Costs				
					Sanitary	Roadway	Water	Storm	Total
Primary	4.1	50 A St	51 Ave	52 Ave	$30,420	$38,958	$50,589	$0	$119,967
Primary	10.4	50 A St	50 St	49 St	$0	$76,600	$81,745	$0	$158,345
General	2.1	51 St	48 Ave	49 Ave	$0	$80,300	$0	$0	$80,300
General	2.2	51 St	49 Ave	50 Ave	$0	$78,500	$0	$0	$78,500
General	2.3	51 St	50 Ave	51 Ave	$0	$102,800	$0	$0	$102,800
General	6.5	Alley	48 St	North End	$84,093	$8,000	$129,042	$0	$221,135
General	9.1	52 St Cr	52 St N	East Leg	$47,806	$81,200	$61,028	$0	$190,034
General	9.2	52 St Cr	North Leg	South Leg	$45,676	$42,400	$46,890	$0	$134,966
General	9.3	52 St Cr	52 St S	East Leg	$24,813	$81,200	$61,189	$0	$167,202
General	11.1	Alley	49 St	48 St	$64,825	$5,000	$71,788	$0	$141,613
General	15.1	Alley	49 St	48 Ave	$55,052	$8,000	$191,998	$0	$255,050
Coordinated	5.1	50 St	South End	48 Ave	$0	$288,800	$175,616	$0	$464,416
Coordinated	5.4	50 St	51 Ave	52 Ave	$0	$290,300	$0	$0	$290,300
Coordinated	12.1	50 Ave	West of 52 St	52 Street	$0	$160,516	$0	$0	$160,516
Coordinated	12.5	50 Ave	48 St	East	$0	$1,368,800	$0	$0	$1,368,800

Appendix B

Sanitary System

VILLAGE OF CAROLINE: SANITARY SYSTEM

\Arcview\MXD\Sanitary.mxd
By: DMH

JUNE 2009
113929151

Legend

Sanitary (Gravity Mains) - By Rating

- Not Rated
- 0 - 1 - Very Poor Condition
- 2 - Poor Condition
- 3 - Average Condition
- 4 - Good Condition
- 5 - Excellent Condition

- Sanitary (Forcemain)
- Sanitary Manholes
- Sanitary Lift Station

Client/Project:
VILLAGE OF CAROLINE

Figure No:
3.1

Title: **SANITARY SYSTEM (PIPE RATING)**

Table 3.1 - Sanitary Sewer Evaluation

ID No.	From MH	To MH	Pipe Size	Length (m)	Condition Assessment
1	2	1	200	108	0
2	3	2	200	100	0
3	4	3	200	42	0
4	5	4	200	101	0
5	6	5	200	100	0
6	7	6	200	97	0
7	END	65	200	14	5
8	END	66	200	29	6
9	END	19	200	22	4
10	END	31	200	25	0
11	64	19	200	25	4
12	65	39	200	94	6
13	42	49	200	41	5
14	43	7	200	4	5
15	END	13	200	7	5
16	49	50	200	80	2
17	50	51	200	63	2
18	51	52	200	43	5
19	END	38	200	93	3
20	38	7	200	53	4
21	61	62	200	96	3
23	55	13	200	233	6
24	25	11	200	102	3
25	13	12	200	85	4
26	12	62	200	32	4
27	62	11	200	49	3
28	11	10	200	106	2
29	10	9	200	99	2
30	9	8	200	105	3
31	8	7	200	93	3
32	18	17	200	87	1
33	17	39	200	64	1
34	66	18	200	77	6
35	39	16	200	21	1
36	16	15	200	87	3
37	15	14	200	85	3
38	14	9	200	102	4
39	19	20	200	32	4
40	20	14	200	99	4
41	21	20	200	85	3
42	22	21	200	87	3
43	23	22	200	88	1
44	24	23	200	84	1
45	29	28	200	86	3
46	28	27	200	86	3
47	27	26	200	87	0

Table 3.1 - Sanitary Sewer Evaluation

ID No.	From MH	To MH	Pipe Size	Length (m)	Condition Assessment
48	26	25	200	85	0
49	58	60	200	175	2
50	53	55	200	123	5
51	52	53	200	106	5
52	30	25	200	93	3
53	32	30	200	73	3
54	35	34	200	86	2
55	34	33	200	86	2
56	33	31	200	87	0
57	31	30	200	85	0
58	42	41	200	108	6
59	41	40	200	102	3
60	40	35	200	93	3
61	60	60	200	16	2
62	60A	53	200	43	2
63	END	37	200	80	3
64	37	36	200	90	1
65	36	33	200	125	1
66	48	47	200	37	5
67	47	46	200	68	5
68	46	45	200	71	5
69	45	44	200	138	5
70	END	54	200	0	6
71	57	59	200	216	6
72	55	54	200	13	6
73	67	55	200	53	6
74	68	67	200	89	6
75	68	69	200	68	6
76	69	70	200	77	6
77	70	55	200	19	6
78	59	54	200	216	6

Table 3.2 - Sanitary Sewer Replacement Strategy

							Existing Pipe			Replacement Pipe			
ID No.	Location	From	To	From MH	To MH	Length (m)	Material	Diameter	Rating	Material	Diameter	Unit Price	Replacement Cost
1	To Lagoon	47 Ave	End	2	1	108.4	VCT	200	0	PVC	300	776	$84,132
2	To Lagoon	47 Ave	End	3	2	100.2	VCT	200	0	PVC	300	776	$77,778
3	To Lagoon	47 Ave	End	4	3	42.0	VCT	200	0	PVC	300	776	$32,569
4	To Lagoon	47 Ave	End	5	4	101.2	VCT	200	0	PVC	300	776	$78,561
5	To Lagoon	47 Ave	End	6	5	100.3	VCT	200	0	PVC	300	776	$77,796
6	To Lagoon	47 Ave	End	7	6	96.6	VCT	200	0	PVC	300	776	$74,926
14	To Lagoon	47 Ave	End	7	43	3.9	VCT	200	0	PVC	300	776	$3,002
59	52 St	North End	52 St Cr S	41	40	101.8	VCT	200	3	PVC	200	676	$68,807
60	52 St	51Ave	52 St Cr S	40	35	93.0	VCT	200	3	PVC	200	676	$62,890
69	52 St	52 St Cr N	North End	45	44	138.4	PVC	200	5	PVC	200	676	$93,568
64	51 St	52 Ave	51 Ave	37	36	89.7	VCT	200	1	PVC	200	676	$60,628
65	51 St	52 Ave	51 Ave	36	33	124.7	VCT	200	1	PVC	200	676	$84,271
63	51 St	52 Ave	51 Ave	END	37	80.3	VCT	200	3	PVC	200	676	$54,258
18	51 St	51 St Cl	52 Ave	51	52	43.0	PVC	200	5	PVC	200	676	$29,075
49	50A St	Alley	52 Ave	58	60	175.2	PVC	200	2	PVC	200	676	$118,424
61	50A St	Alley	52 Ave	END	60	15.6	PVC	200	2	PVC	200	676	$10,571
62	50A St	Alley	52 Ave	60A	53	43.0	PVC	200	2	PVC	200	676	$29,078
52	50 St	51 Ave	50 Ave	30	25	93.0	VCT	200	3	PVC	200	676	$62,855
53	50 St	51 Ave	51 Ave	32	30	73.2	VCT	200	3	PVC	200	676	$49,483
9	50 St	50 Ave	49 Ave	END	19	21.7	VCT	200	4	PVC	200	676	$14,677
11	50 St	50 Ave	49 Ave	64	19	24.7	VCT	200	4	PVC	200	676	$16,666
39	50 St	50 Ave	49 Ave	19	20	31.7	VCT	200	4	PVC	200	676	$21,433
40	50 St	49 Ave	48 Ave	20	14	99.3	VCT	200	4	PVC	200	676	$67,147

Table 3.2 - Sanitary Sewer Replacement Strategy

ID No.	Location	From	To	From MH	To MH	Length (m)	Existing Pipe			Replacement Pipe			
							Material	Diameter	Rating	Material	Diameter	Unit Price	Replacement Cost
28	49 St	50 Ave	48 Ave	11	10	106.1	VCT	200	2	PVC	200	676	$71,740
29	49 St	50 Ave	48 Ave	10	9	99.2	VCT	200	2	PVC	200	676	$67,091
27	49 St	51 Ave	50 Ave	62	11	49.2	VCT	200	3	PVC	200	676	$33,284
30	49 St	48 Ave	47 Ave	9	8	105.2	VCT	200	3	PVC	200	676	$71,084
31	49 St	48 Ave	47 Ave	8	7	92.8	VCT	200	3	PVC	200	676	$62,704
25	49 St	51 Ave	50 Ave	13	12	85.1	VCT	200	4	PVC	200	676	$57,514
26	49 St	51 Ave	50 Ave	12	62	31.8	VCT	200	4	PVC	200	676	$21,525
15	49 St			END	13	7.5	VCT	200	5	PVC	200	676	$5,054
16	51 St CL	52 St	51 St	49	50	80.3	PVC	200	2	PVC	200	676	$54,255
17	51 ST CL	52 St	51 St	50	51	62.6	PVC	200	2	PVC	200	676	$42,304
50	52 Ave	50A St	Lift Sta.	53	55	122.7	PVC	200	5	PVC	200	676	$82,945
51	52 Ave	51 St	50A St	52	53	106.3	PVC	200	5	PVC	200	676	$71,884
10	51 Ave	50 A St	50 St	END	31	24.8	VCT	200	0	PVC	200	676	$16,751
56	51 Ave	51 St	50A St	33	31	86.6	VCT	200	0	PVC	200	676	$58,520
57	51 Ave	50 A St	50 St	31	30	85.5	VCT	200	0	PVC	200	676	$57,787
54	51 Ave	52 St	51 St	35	34	86.1	VCT	200	2	PVC	200	676	$58,177
55	51 Ave	52 St	51 St	34	33	86.5	VCT	200	2	PVC	200	676	$58,471
66	52 St Cr	East Leg	52 St S	48	47	36.7	PVC	200	5	PVC	200	676	$24,813
67	52 St Cr	North Leg	South Leg	47	46	67.6	PVC	200	5	PVC	200	676	$45,676
68	52 St Cr	East Leg	52 St N	46	45	70.7	PVC	200	5	PVC	200	676	$47,806
47	50 Ave	51 St	50 St	27	26	87.1	VCT	200	0	PVC	200	676	$58,876
48	50 Ave	51 St	50 St	26	25	85.5	VCT	200	0	PVC	200	676	$57,787
24	50 Ave	50 St	49 St	25	11	101.7	VCT	200	3	PVC	200	676	$68,779
45	50 Ave	52 St	51 St	29	28	85.9	VCT	200	3	PVC	200	676	$58,049
46	50 Ave	52 St	51 St	28	27	86.2	VCT	200	3	PVC	200	676	$58,243

Table 3.2 - Sanitary Sewer Replacement Strategy

							Existing Pipe			Replacement Pipe			
ID No.	Location	From	To	From MH	To MH	Length (m)	Material	Diameter	Rating	Material	Diameter	Unit Price	Replacement Cost
43	49 Ave	52 St	51 St	23	22	88.1	VCT	200	1	PVC	200	676	$59,525
44	49 Ave	52 St	51 St	24	23	83.9	VCT	200	1	PVC	200	676	$56,699
41	49 Ave	51 St	50 St	21	20	85.5	VCT	200	3	PVC	200	676	$57,787
42	49 Ave	51 St	50 St	22	21	87.2	VCT	200	3	PVC	200	676	$58,944
32	48 Ave	52 St	51 St	18	17	86.6	VCT	200	1	PVC	200	676	$58,539
33	48 Ave	52 St	51 St	17	39	63.9	VCT	200	1	PVC	200	676	$43,182
35	48 Ave	52 St	51 St	39	16	21.4	VCT	200	1	PVC	200	676	$14,444
36	48 Ave	51 St	50 St	16	15	87.3	VCT	200	3	PVC	200	676	$59,003
37	48 Ave	51 St	50 St	15	14	85.5	VCT	200	3	PVC	200	676	$57,787
38	48 Ave	50 St	49 St	14	9	102.1	VCT	200	4	PVC	200	676	$68,987
7	N/A	End	52 St	END	65	14.3	VCT	200	5	PVC	200	676	$9,667
												676	
19	Alley (49St)	Alley S	Alley N	END	38	93.2	VCT	200	3	PVC	200	676	$62,970
21	Alley	48 St	49 St	61	62	95.9	VCT	200	3	PVC	200	676	$64,825
20	Alley	Alley	49 St	38	7	53.2	VCT	200	4	PVC	200	676	$35,954
13	Alley	52 St	51 St	42	49	41.4	VCT	200	5	PVC	200	676	$27,990

Notes: Replacement Costs are Based on 2009 Dollars and Include 35% for Professional Services and Contingency
Costs do not include roadway trench repair

Appendix C

Roadway Network

VILLAGE OF CAROLINE: TRANSPORTATION NETWORK

\Arcview\MXD\Storm.mxd
By: DMH

JUNE 2009
113929151

Legend

Roadway (ACP)

- 0 - Pavement Ruined
- 0.5
- 1 - Very Poor Condition
- 1.5
- 2 - Poor Condition
- 2.5
- 3 - Average Condition
- 3.5
- 4 - Good Condition
- 4.5
- 5 - Excellent Condition

Roadway (Gravel)

- 0 - No Granular Surface
- 0.5
- 1 - Poor Condition
- 1.5
- 2 - Average Condition
- 2.5
- 3 - Excellent Condition

Client/Project:
VILLAGE OF CAROLINE

Figure No:
4.1

Title:
TRANSPORTATION NETWORK (ROADWAY RATING)

Table 4.1 - Roadway Evaluation

Roadway Section #	Location	From	Int	To	Int	Width (m)	Length (m)	Existing Surface	Primary Distresses	Secondary Distresses	Additional Notes	Curb & Gutter Type-Width (m))	(Side-	Sidewalk (Side-Width(m))		Boulevard (Side-Width(m))	Overall Gravel Roadway Rating	Overall Visual Pavement Assessment Rating
1.1	52 St	48 Ave	N	50 Ave	N	11	178.6	ACP	N/A	N/A	Roadway Rebuilt 2008	W-N/A	E-N/A	W-N/A	E-N/A	N/A	N/A	4.5
1.2	52 St	50 Ave	N	51 Ave	Y	12.5	99.5	ACP	N/A	N/A	Roadway Rebuilt 2008	W-R-0.6	E-R-0.6	W-N/A	E-N/A	N/A	N/A	4.5
1.3	52 St	51 Ave	N	52 St Cr S	N	10	79.3	ACP	Fatigue Cracking, Potholes	Rutting	ACP Over Lip of Gutter in South East Section	W-MR-0.65	E-R-0.6	W-1.1	E-N/A	N/A	N/A	1.5
1.4	52 St	52 St Cr S	Y	52 St Cr N	Y	10	77.3	ACP	Fatigue Cracking, Missing ACP, Potholes	Rutting, Pumping	Standing Water in Areas of Missing ACP	W-MR-0.65	E-S-0.375	W-1.1	E-N/A	N/A	N/A	1.0
1.5	52 St	52 St Cr N	N	North End	N/A	8	131.1	ACP/Gravel	Areas of No ACP, Fatigue Cracking	Deteriorated Patch Work Pot Holes	Extensive Pavement Removal (~40%)	W-N/A	E-R-0.6	W-N/A	E-N/A	N/A	N/A	0.5
2.1	51 St	48 Ave	N	49 Ave	Y	9	99.4	ACP	Longitudinal Cracking, Potholes, Fatigue Cracking	Pumping	Sections of Broken Sidewalk, Deteriorated Patch Work	W-S-0.375	E-S-0.375	W-N/A	E-1.3	E-3.2	N/A	2.0
2.2	51 St	49 Ave	N	50 Ave	N	11	79.3	ACP	Fatigue Cracking	Potholes, Longitudinal Cracking	N/A	W-S-0.375	E-S-0.375	W-N/A	E-1.3	E-3.2	N/A	3.0
2.3	51 St	50 Ave	N	51 Ave	Y	11.5	99.4	ACP	Transverse Cracking	Patching, Fatigue Cracking	1.0m Wide Concrete Swale E-W at North End of Street	W-R-0.6	E-M-0.65	W-N/A	E-1.1	N/A	N/A	3.0
2.4	51 St	51 Ave	N	52 Ave	N	9	273.7	ACP	Fatigue Cracking, Transverse Cracking, Edge Deterioration	Patching, Potholes	Majority of Deterioration is on the North 1/2 of the Block	W-RM-0.6	E-RM-0.6	W-1.1	E-1.1	N/A	N/A	2.0
3.1	51 St. CL	51 St	N	N/A	N/A	10	70	Gravel	Potholes	N/A	Potholes and some roadway surface deflections, over all shape has been maintained	N-R-0.65	S-R-0.65	N-N/A	S-N/A	N/A	1.5	N/A
4.1	50 A St	51 Ave	Y	52 Ave	N	9.6	293.9	ACP	Edge Deterioration, Fatigue Cracking	Potholes, Rutting	Majority of Deficiencies are Located Near each Intersection, Severe Fatigue Cracking Along the Majority of the Gutter Lengths.	W-RM-0.65	E-R-0.65	W-1.1	E-N/A	N/A	N/A	2.0
5.1	50 St (RR61)	South End	N/A	48 Ave	N	10 to 13	192.3	ACP	Transverse Cracking, Fatigue Cracking	Potholes, Rutting	Grade Separated Side Walk at North End of West Side, Remainder of Roadway has a Rural Cross Section with 2-3m gravel shoulders	W-S-0.375	E-N/A	W-1.1	E-N/A	W-1.3	N/A	2.0
5.2	50 St (RR61)	48 Ave	Y	50 Ave	N	13	198.7	ACP	Longitudinal Cracking	Transverse Cracking	Partial Reconstruction and Overlay 2006, West Curb (50 Ave - 49 Ave) Extends Only 1/2 Block South of 50 Ave (Deteriorated)	W-S-0.375	E-MS-0.375	W-N/A	E-1.1	N/A	N/A	4.0
5.3	50 St (RR61)	50 Ave	N	51 Ave	Y	13	172.8	ACP	Transverse Cracking, Longitudinal Cracking	Rutting, Fatigue Cracking	N/A	W-S-0.375	E-S-0.375	W-N/A	E-1.1	E-1.9	N/A	2.5
5.4	50 St (RR61)	51 Ave	Y	52 Ave	Y	8.5	227.3	ACP	Rutting Throughout	Fatigue Cracking, Transverse Cracking, Longitudinal Cracking	N/A	W-N/A	E-N/A	W-N/A	E-N/A	N/A	N/A	3.0
6.1	49 St	South End	N/A	48 Ave	N	9.5	192.4	Gravel	N/A	N/A	Large pothole at the southern end of the roadway which is in otherwise acceptable shape	W-MR-0.65	E-N/A	W-1.1	E-N/A	N/A	2	N/A
6.2	49 St	48 Ave	N	50 Ave	N	9.5	178.6	ACP	Transverse Cracking, Localized Edge Deterioration	Fatigue Cracking, Potholes, Pumping, Patching	Access on South East portion of Road in Poor Condition	W-MR-0.65	E-S-0.375	W-1.1	E-N/A	N/A	N/A	3.0
6.3	49 St	50 Ave	N	51 Ave	N	9.5	152.4	ACP	Transverse Cracking, Fatigue Cracking, Potholes	Pumping, Patching	N/A	W-MR-0.65	E-MR-0.65	W-1.1	E-1.1	N/A	N/A	1.0
6.4	49 St	51 Ave	N	North End	N/A	8	153.1	Gravel	Potholes	N/A	Appears to Provided Access to only 2 Residents and Looks to be Constructed as a Lane	N-N/A	S-N/A	N-N/A	S-N/A	N/A	0.5	N/A
7.1	48 St	50 Ave	N	51 Ave	N	13 to 9	152.4	Gravel	Potholes	N/A	Has Never Been Paved, Used by Many Heavy Trucks to Access Refueling Station	N-N/A	S-N/A	N-N/A	S-N/A	N/A	1	N/A

Table 4.1 - Roadway Evaluation

Roadway Section #	Location	From	Int	To	Int	Width (m)	Length (m)	Existing Surface	Primary Distresses	Secondary Distresses	Additional Notes	Curb & Gutter Type-Width (m)) (Side-		Sidewalk (Side-Width(m))		Boulevard (Side-Width(m))	Overall Gravel Roadway Rating	Overall Visual Pavement Assessment Rating
8.1	52 Ave	50 St	N	51 St	Y	7	167.4	Gravel	Potholes	N/A	Has Never Been Paved, Some Minor Evidence of Very Old Pavement	N-N/A	S-R-0.6	N-N/A	S-N/A	N/A	1	N/A
9.1	52 St Cr	52 St N	N	East Leg	Y	10	78.5	Gravel/ACP	Potholes, Fatigue Cracking	Rutting	Some Evidence of Old Cold mix Asphalt Binder, Grass Growing in South Gutter	N-R-0.6	S-S-0.375	N-N/A	S-N/A	N/A	1.5	N/A
9.2	52 St Cr	North Leg	N	South Leg	N	10	46.9	Gravel	No ACP, Potholes	N/A	Grass Growing on SE Section of the Roadway	E-R-0.6	W-S-0.375	N-N/A	S-N/A	N/A	1	N/A
9.3	52 St Cr	52 St S	N	East Leg	Y	10	78.5	Gravel/ACP	Many Severe Potholes	N/A	Some Evidence of Old Cold mix Asphalt Binder, Grass Growing in North Gutter	N-S-0.375	S-R-0.6	N-N/A	S-N/A	N/A	1	N/A
10.1	51 Ave	52 St	N	51 St	N	9	152.4	ACP	Transverse Cracking, Rutting, Deteriorated Patching	Rutting, Fatigue Cracking, Longitudinal Cracking, Pumping	Some Aged Crack Repairs	N-MR-0.65	S-MR-0.65	N-1.1	S-1.1	N/A	N/A	2.5
10.2	51 Ave	51 St	N	50 A St	N	9	82.9	ACP	Transverse Cracking	Potholes, Patching	N/A	N-MR-0.65	S-MR-0.65	N-1.1	S-1.1	N/A	N/A	4.0
10.3	51 Ave	50 A St	N	50 St	N	9	54.2	ACP	Transverse Cracking	Longitudinal Cracking	N/A	N-N/A	S-N/A	N-N/A	S-N/A	N/A	N/A	3.5
10.4	51 Ave	50 St	N	49 St	Y	8	106.4	Gravel	Potholes, Rutting	N/A	Evidence of Very Old ACP	N-N/A	S-N/A	N-N/A	S-N/A	N/A	1	N/A
10.5	51 Ave	49 St	N	48 St	Y	8	99.3	Gravel	Potholes, Rutting	N/A	Appears to be Constructed as a Lane.	N-N/A	S-N/A	N-N/A	S-N/A	N/A	0.5	N/A
11.1	50 Ave (Hwy 54)	W of 52 St	Y	51 St	Y	15	249.8	ACP	Transverse Cracking	Fatigue Cracking, Potholes, Pumping, Rutting	Highway 22 & 54, Some Areas Have Had Patching	N-MS-0.375	S-MS-0.375	N-1.5	S-1.5	N/A	N/A	3.5
11.2	50 Ave (Hwy 54)	51 St	N	50 St	N	15	152.4	ACP	Transverse Cracking	Fatigue Cracking, Rutting, Pumping, Edge Deterioration	Highway 22 & 54, Some Areas Have Had Patching	N-MS-0.376	S-MS-0.376	N-1.5	S-1.5	N/A	N/A	3.0
11.3	50 Ave (Hwy 54)	50 St	Y	49 St	Y	15	121.9	ACP	Localized Edge Deterioration	Transverse Cracking, Fatigue Cracking	Highway 22 & 54, Some Areas Have Had Patching	N-MS-0.375	S-MS-0.375	N-1.5	S-1.5	N/A	N/A	3.0
11.4	50 Ave (Hwy 54)	49 St	N	48 St	Y	13	99.3	ACP	Transverse Cracking	Rutting	Highway 22 & 54	N-N/A	S-N/A	N-N/A	S-N/A	N/A	N/A	3.5
11.5	50 Ave (Hwy 54)	48 St	N	East	N/A	13	700	ACP	Longitudinal Cracking	Fatigue Cracking, Rutting, Extensive Crack Repairs in Good Condition	Highway 22 & 54	N-N/A	S-N/A	N-N/A	S-N/A	N/A	N/A	4.0
12.1	49 Ave	52 St	N	51 St	N	10.5	152.4	Gravel	Significant Roadway Surface Deterioration	Continuous Potholes	1.0m Concrete Swale on East End, Roadway Shape is Intact	N-RM-0.65	S-RM-0.65	N-1.1	S-1.1	N/A	1	N/A
12.2	49 Ave	51 St	N	50 St	N	10.5	152.4	Gravel	Significant Roadway Surface Deterioration	Continuous Potholes	Roadway Shape is Intact	N-RM-0.65	S-RM-0.65	N-1.1	S-1.1	N/A	1	N/A
13.1	48 Ave	West End	N/A	52 St	N	7.5	147.5	Gravel	Large Pothole	Some Surface Deterioration	Standing Water	N-N/A	S-N/A	N-N/A	S-N/A	N/A	1	N/A
13.2	48 Ave	52 St	Y	51 St	N	11.8	172.5	ACP	Fatigue Cracking, Longitudinal Cracking, Fatigue Cracking	Patched Areas, Pumping	Major Deficiencies in Localized Areas	N-RM-0.65	S-N/A	N-1.1	S-N/A	N/A	N/A	2.5
13.3	48 Ave	51 St	Y	50 St	N	14.4	172.5	ACP	Fatigue Cracking, Transverse Cracking	Longitudinal Cracking, Rutting, Patches	Some Distress Have Been Patched	N-R-0.6	S-SM-0.375	N-1.1	S-1.1 to 2.2	N-1.4	N/A	2.0
13.4	48 Ave	50 St	N	49 St	Y	8	101.8	ACP	N/A	Transverse, Longitudinal, and Fatigue Cracking, Pumping	Partial Rebuild and Overlay 2006	N-RM-0.65	S-0.6	N-1.1	S-N/A	N/A	N/A	4.0

Table 4.2 - Roadway Rehabilitation Costs

Roadway Section #	Location	From	Int	To	Int	Width (m)	Length (m)	Approximate Area (m^2)	Existing Surface	Roadway Designation	Approximate Full Reconstruction Costs	Approximate Mill & Overlay Costs	Approximate Trench Repair Costs
1.1	52 St	48 Ave	N	50 Ave	N	11	178.6	1960	ACP	Local	$176,700	$61,000	$80,500
1.2	52 St	50 Ave	N	51 Ave	Y	12.5	99.5	1240	ACP	Local	$111,800	$38,500	$44,900
1.3	52 St	51 Ave	N	52 St Cr S	N	10	79.3	790	ACP	Local	$71,200	$24,700	$35,800
1.4	52 St	52 St Cr S	Y	52 St Cr N	Y	10	77.3	770	ACP	Local	$69,400	$24,100	$34,900
1.5	52 St	52 St Cr N	N	North End	N/A	8	131.1	1050	ACP/Gravel	Local	$94,700	N/A	N/A
2.1	51 St	48 Ave	N	49 Ave	Y	9	99.4	890	ACP	Local	$80,300	$27,900	$44,800
2.2	51 St	49 Ave	N	50 Ave	N	11	79.3	870	ACP	Local	$78,500	$27,100	$35,800
2.3	51 St	50 Ave	N	51 Ave	Y	11.5	99.4	1140	ACP	Local	$102,800	$35,500	$44,800
2.4	51 St	51 Ave	N	52 Ave	N	9	273.7	2460	ACP	Local	$221,800	$77,000	$123,400
3.1	51 St. CL	51 St	N	N/A	N/A	10	70	850	Gravel	Local	$76,600	N/A	N/A
4.1	50 A St	51 Ave	Y	52 Ave	N	9.6	293.9	2820	ACP	Local	$254,300	$88,100	$132,500
5.1	50 St	South End	N/A	48 Ave	N	10 to 13	192.3	1920	ACP	Arterial	$288,800	$59,900	$144,600
5.2	50 St	48 Ave	Y	50 Ave	N	13	198.7	2580	ACP	Arterial	$388,100	$79,900	$149,400
5.3	50 St	50 Ave	N	51 Ave	Y	13	172.8	2250	ACP	Arterial	$338,400	$69,700	$130,000
5.4	50 St	51 Ave	Y	52 Ave	Y	8.5	227.3	1930	ACP	Arterial	$290,300	$60,600	$170,900
6.1	49 St	South End	N/A	48 Ave	N	9.5	192.4	1830	Gravel	Local	$165,000	N/A	N/A
6.2	49 St	48 Ave	N	50 Ave	N	9.5	178.6	1700	ACP	Local	$153,300	$53,200	$80,500
6.3	49 St	50 Ave	N	51 Ave	N	9.5	152.4	1450	ACP	Local	$130,800	$45,300	$68,700
6.4	49 St	51 Ave	N	North End	N/A	8	153.1	1220	Gravel	Local	$110,000	N/A	N/A
7.1	48 St	50 Ave	N	51 Ave	N	13 to 9	152.4	1520	Gravel	Local	$137,100	N/A	N/A

Table 4.2 - Roadway Rehabilitation Costs

Roadway Section #	Location	From	Int	To	Int	Width (m)	Length (m)	Approximate Area (m^2)	Existing Surface	Roadway Designation	Approximate Full Reconstruction Costs	Approximate Mill & Overlay Costs	Approximate Trench Repair Costs
8.1	52 Ave	50 St	N	51 St	Y	7	167.4	1170	Gravel	Local	$105,500	N/A	N/A
9.1	52 St Cr	52 St	N	52 St Cr East Leg	Y	10	78.5	900	Gravel/ACP	Local	$81,200	N/A	N/A
9.2	52 St Cr	52 St Cr North Leg	N	52 St Cr South Leg	N	10	46.9	470	Gravel	Local	$42,400	N/A	N/A
9.3	52 St Cr	52 St	N	52 St Cr East Leg	Y	10	78.5	900	Gravel/ACP	Local	$81,200	N/A	N/A
10.1	51 Ave	52 St	N	51 St	N	9	152.4	1370	ACP	Local	$123,500	$42,900	$68,700
10.2	51 Ave	51 St	N	50 A St	N	9	82.9	750	ACP	Local	$67,600	$23,500	$37,400
10.3	51 Ave	50 A St	N	50 St	N	9	54.2	490	ACP	Local	$44,200	$15,400	$24,400
10.4	51 Ave	50 St	N	49 St	Y	8	106.4	850	Gravel	Local	$76,600	N/A	N/A
10.5	51 Ave	49 St	N	48 St	Y	8	99.3	790	Gravel	Local	$71,200	N/A	N/A
11.1	50 Ave	West of 52 St	Y	51 St	Y	15	249.8	3750	ACP	Arterial	$564,100	$115,600	$187,900
11.2	50 Ave	51 St	N	50 St	N	15	152.4	2290	ACP	Arterial	$344,500	$70,700	$114,600
11.3	50 Ave	50 St	Y	49 St	Y	15	121.9	1830	ACP	Arterial	$275,300	$56,500	$91,700
11.4	50 Ave	49 St	N	48 St	Y	13	99.3	1290	ACP	Arterial	$194,000	$40,000	$74,700
11.5	50 Ave	48 St	N	East	N/A	13	700	9100	ACP	Arterial	$1,368,800	$281,400	$526,500
12.1	49 Ave	52 St	N	51 St	N	10.5	152.4	1600	Gravel	Local	$144,300	N/A	N/A
12.2	49 Ave	51 St	N	50 St	N	10.5	152.4	1600	Gravel	Local	$144,300	N/A	N/A
13.1	48 Ave	West End	N/A	52 St	N	7.5	147.5	1110	Gravel	Local	$100,100	$35,000	$66,500
13.2	48 Ave	52 St	Y	51 St	N	11.8	172.5	2040	ACP	Local	$184,000	$63,300	$77,800
13.3	48 Ave	51 St	Y	50 St	N	14.4	172.5	2480	ACP	Local	$223,600	$76,600	$77,800
13.4	48 Ave	50 St	N	49 St	Y	8	101.8	810	ACP	Local	$73,000	$25,500	$45,900

Appendix D

Water System

VILLAGE OF CAROLINE: WATER SYSTEM

\Arcview\MXD\Water.mxd
By: DMH

JUNE 2009
113929151

Legend

- Existing Watermain
- Proposed Watermain Looping
- Existing Watermain - Priority Replacement
- Watermain Breaks Since 1997
- Fitting
- Hydrant
- Plug
- Valve
- Well
- Well (Abandoned)

Village of Caroline

Client/Project:

VILLAGE OF CAROLINE

Figure No:

5.1

Title:

WATER SYSTEM

VILLAGE OF CAROLINE: WATER MODEL

\Arcview\MXD\Water.mxd
By: DMH

JUNE 2009
113929151

Legend

- Pipes - PHD
- Nodes - PHD

Client/Project:
VILLAGE OF CAROLINE

Figure No:
5.2

Title:
WATER MODEL
EXISTING PHD

VILLAGE OF CAROLINE: WATER MODEL

\Arcview\MXD\Water.mxd
By: DMH

JUNE 2009
113929151

Legend

- Pipes - PHD
- Hydrants Existing

Node - Color Code Available Fire Flow

- < 50 L/s
- 50 psi - 75 L/s
- > 75 L/s

Client/Project:
VILLAGE OF CAROLINE

Figure No:
5.3

Title:
WATER MODEL
EXISTING MDD +FIRE

VILLAGE OF CAROLINE: WATER MODEL

\Arcview\MXD\Water.mxd
By: DMH

JUNE 2009
113929151

Legend

- Existing Hydrant

Node - Color Code Available Fire Flow

- < 50 L/s
- 50 L/s - 75 L/s
- > 75 L/s

Client/Project:
VILLAGE OF CAROLINE

Figure No:
5.4

Title: **WATER MODEL UPDATED EXISTING MDD +FIRE**

VILLAGE OF CAROLINE: WATER SYSTEM

\Arcview\MXD\Water.mxd
By: DMH

JUNE 2009
113929151

Legend

- Pipe: Future PHD
- Pipe (Upgraded Section): Future PHD
- Pipe (Proposed Section): Future PHD

Client/Project:
VILLAGE OF CAROLINE

Figure No:
5.5

Title:
WATER MODEL
FUTURE PHD

VILLAGE OF CAROLINE: WATER SYSTEM

\Arcview\MXD\Water.mxd
By: DMH

JUNE 2009
113929151

Legend

- Hydrant
- Pipe: Future MDD + Fire Flow
- Pipe (Upgraded Section): Future MDD + Fire Flow
- Pipe (Future Section): Future MDD + Fire Flow

Node - Color Code Available Fire FLow

- < 50 L/s
- 50 L/s - 75 L/s
- > 75 L/s

Client/Project:
VILLAGE OF CAROLINE

Figure No:
5.6

Title: **WATER MODEL FUTURE MDD + FIRE FLOW**

Table 5.1 - Raw Water & Treated Water Consumption

Year	Population	Raw water m3/yr	Raw water Lcpd	Treated water m3/d	Treated water Lcpd
2005	556	100,009	493	273	491
2006	556	86,808	428	238	428
2007	515	93,612	498	256	497
2008	515	87,348	465	238	462
Average			471	251	470

Table 5.2 - Water Demand Flow Projection

People	Lcpd	ADD m3/d	MDD m3/d	Peak Hour l/s	Treated water maximum daily m3/d
550	470	258	517	12.0	542
560	470	263	526	12.2	552
570	470	268	535	12.4	562
580	470	272	545	12.6	572
590	470	277	554	12.8	582
600	470	282	563	13.0	592
610	470	286	573	13.3	602
620	470	291	582	13.5	611
630	470	296	592	13.7	621
640	470	301	601	13.9	631
650	470	305	610	14.1	641
660	470	310	620	14.3	651
670	470	315	629	14.6	661
680	470	319	639	14.8	671

Note: In 2008, the peak flow is estimated at 11 L/s at population level of 515.

Table 5.3 - Calculated CT Value

People	Lcpd	ADD m3/d	MDD m3/d	Peak Hour l/s	Peak Hour m3/min	T contact time (min)	CT value
550	470	258	517	12.0	0.72	57	29
560	470	263	526	12.2	0.73	56	28
570	470	268	535	12.4	0.74	55	28
580	470	272	545	12.6	0.76	54	27
590	470	277	554	12.8	0.77	53	27
600	470	282	563	13.0	0.78	52	26
610	470	286	573	13.3	0.80	52	26
620	470	291	582	13.5	0.81	51	25
630	470	296	592	13.7	0.82	50	25
640	470	301	601	13.9	0.83	49	25
650	470	305	610	14.1	0.85	48	24
660	470	310	620	14.3	0.86	48	24
670	470	315	629	14.6	0.87	47	23
680	470	319	639	14.8	0.89	46	23

Notes:

1. The baffle factor is 0.15 in the treated water reservoir (820 m^3).
2. The free chlorine entering the distribution system is 0.5 mg/L.
3. Half of the effective volume is used to calculate the hydraulic retention time.

Table 5.4 - Water model Parameter Values

Parameter	Value
ADD Lcpd	470
MDD/ADD factor	2
PHD/MDD factor	2
People per lot	2.3
Hazen-William C (old PVC)	130
Hazen-William C (old AC)	120
Hazen-William C (new PVC)	140
Current population	515
Future population	680

Table 5.5 - Required Reservoir Volume (m^3)

Population	Fire flow 75 L/s	Fire flow 123 L/s	Fire flow 137 L/s
550	708	1054	1154
560	711	1057	1157
570	714	1060	1161
580	717	1063	1164
590	720	1066	1167
600	723	1069	1170
610	726	1072	1173
620	729	1075	1176
630	732	1078	1179
640	736	1081	1182
650	739	1084	1185
660	742	1087	1188
670	745	1090	1191
680	748	1093	1194

Table 5.6 - Watermain Replacement Strategy

Location	From	To	Length (m)	Existing Pipe		Replacement Pipe			
				Material	Diameter	Material	Diameter	Unit Price	Replacement Cost
52 St	End	52 St Cr N	145.1	AC	150	PVC	200	803	$116,523
52 St	52 St Cr N	52 St Cr S	59.3	AC	150	PVC	200	803	$47,618
52 St	52 St Cr S	51 Ave	99.0	AC	150	PVC	200	803	$79,497
52 St	51 Ave	50 Ave	90.7	AC	150	PVC	200	803	$72,832
52 St	50 Ave	49 Ave	101.3	AC	150	PVC	200	803	$81,344
52 St	49 Ave	48 Ave	111.3	AC	150	PVC	200	803	$89,374
51 St	52 Ave	51 Ave	277.3	AC	150	PVC	200	803	$222,672
51 St Cl	51 St	End	75.9	AC	150	PVC	200	803	$60,948
50A St	52 Ave	51 Ave	269.9	AC	150	PVC	200	803	$216,730
50 St	51 Ave	51 Ave	73.2	AC	150	PVC	200	803	$58,779
50 St	51 Ave	50 Ave	90.6	AC	150	PVC	200	803	$72,752
50 St	50 Ave	49 Ave	101.2	AC	150	PVC	200	803	$81,264
50 St	49 Ave	48 Ave	93.6	AC	150	PVC	200	803	$75,161
50 St	48 Ave	South End	218.7	AC	150	PVC	200	803	$175,616
49 St	North End	51 Ave	160.7	AC	150	PVC	200	803	$129,042
49 St	51 Ave	50 Ave	182.8	AC	150	PVC	200	803	$146,788
49 St	50 Ave	48 Ave	213.8	AC	150	PVC	200	803	$171,681
49 St	48 Ave	South End	199.6	AC	150	PVC	200	803	$160,279
49 St	South Alley	North End	113.3	AC	150	PVC	200	803	$90,980
52 Ave	50A St	51 St	99.4	AC	150	PVC	200	803	$79,818
51 Ave	52 St	51 St	173.1	AC	150	PVC	200	803	$138,999
51 Ave	51 St	50A St	98.9	AC	150	PVC	200	803	$79,417
51 Ave	50A St	50 St	73.1	AC	150	PVC	200	803	$58,699
51 Ave	50 St	49 St	101.8	AC	150	PVC	200	803	$81,745
52 St Cr	52 St N	East Leg	76.0	PVC	150	PVC	200	803	$61,028
52 St Cr	North Leg	South Leg	58.4	PVC	150	PVC	200	803	$46,895
52 St Cr	52 St S	East Leg	76.2	PVC	150	PVC	200	803	$61,189

Table 5.6 - Watermain Replacement Strategy

Location	From	To	Length (m)	Existing Pipe		Replacement Pipe			
				Material	Diameter	Material	Diameter	Unit Price	Replacement Cost
50 Ave	52 St	51 St	152.1	AC	150	PVC	200	803	$122,136
50 Ave	51 St	50 St	180.4	AC	150	PVC	200	803	$144,861
50 Ave	50 St	49 St	90.2	AC	150	PVC	200	803	$72,431
49 Ave	52 St	51 St	176.5	AC	150	PVC	200	803	$141,730
49 Ave	51 St	50 St	148.6	AC	150	PVC	200	803	$119,326
48 Ave	West End	52 St	91.0	AC	150	PVC	200	803	$73,073
48 Ave	52 St	51 St	181.3	AC	150	PVC	200	803	$145,584
48 Ave	51 St	50 St	155.7	AC	150	PVC	200	803	$125,027
48 Ave	50 St	49 St	102.4	AC	150	PVC	200	803	$82,227
48 Ave	48 Ave	Arena	82.4	AC	150	PVC	200	803	$66,167
Alley	48 St	49 St	89.4	AC	150	PVC	200	803	$71,788
Alley (49St)	Alley S	Alley N	113.3	AC	150	PVC	200	803	$90,980
Alley	49 St S	Alley	47.7	AC	150	PVC	200	803	$38,303
Watermain Looping									
Alley (49St)	Alley	48 Ave	86.3	N/A	N/A	PVC	200	803	$69,299
51 Ave & 48 St	49 St	50 Ave	217.6	N/A	N/A	PVC	200	803	$174,733
52 Ave / Alley	50A St	49 St	238.8	N/A	N/A	PVC	200	803	$191,756
Alley (52 Ave)	52 St	51 St	172.6	N/A	N/A	PVC	200	803	$138,598

Replacement Costs are Based on 2009 Dollars and Include 35% for Professional Services and Contingency.

Costs do not include roadway trench repair.

Appendix E

Storm System

VILLAGE OF CAROLINE: STORM SYSTEM

\Arcview\MXD\Storm.mxd
By: DMH

JUNE 2009
113929151

Legend

- Storm Mains
- Storm Culverts
- Primary Storm Ditches
- Proposed
- CatchBasin/Manhole
- Catchbasin
- Manhole
- Outlet

Client/Project:

VILLAGE OF CAROLINE

Figure No:

6.1

Title:

STORM SYSTEM

Appendix F

Unit Cost Breakdown

Water and Sanitary Replacement Unit Cost Breakdown

Item No.	Item of Work	Measurement Unit	Est. Quantity	Unit Price	Amount
A. WATERMAIN REPLACEMENT					
Notes:	All prices are in 2009 dollars Assume a 5.0m wide trench is required to determine road and excavation quantities Costs are per lineal meter Costs do not include roadway trench repair				
150mm PVC DR18					
0.1	Mobilization	% of Total Cost	1.0	~12%	$60.00
0.2	Traffic Accomodation	% of Total Cost	1.0	~4%	$20.00
0.3	Remove and dispose of ex. pipe	m	1.0	$10.00	$10.00
0.4	Miscellaneous Items	L.S.	1.0	$208.00	$208.00
0.5	Excavate, backfill and compact	m	1.0	$225.00	$200.00
0.6	Install pipe and bedding	m	1.0	$60.00	$55.00
	Subtotal				**$553.00**
	Professional Services and Contingency (35%)				$193.55
	Total 150mm Water Main Replacement				**$747.00**
200mm PVC DR18					
0.1	Mobilization	% of Total Cost	1.0	~12%	$65.00
0.2	Traffic Accomodation	% of Total Cost	1.0	~4%	$22.00
0.3	Remove and dispose of ex. pipe	m	1.0	$10.00	$10.00
0.4	Miscellaneous Items	L.S.	1.0	$208.00	$208.00
0.5	Excavate, backfill and compact	m	1.0	$225.00	$210.00
0.6	Install pipe and bedding	m	1.0	$80.00	$80.00
	Subtotal				**$595.00**
	Professional Services and Contingency (35%)				$208.25
	Total 200mm Water Main Replacement				**$803.00**
250mm PVC DR18					
0.1	Mobilization	% of Total Cost	1.0	~12%	$70.00
0.2	Traffic Accomodation	% of Total Cost	1.0	~4%	$24.00
0.3	Remove and dispose of ex. pipe	m	1.0	$10.00	$10.00
0.4	Miscellaneous Items	L.S.	1.0	$208.00	$208.00
0.5	Excavate, backfill and compact	m	1.0	$225.00	$210.00
0.6	Install pipe and bedding	m	1.0	$105.00	$105.00
	Subtotal				**$627.00**
	Professional Services and Contingency (35%)				$219.45
	Total 250mm Water Main Replacement				**$846.00**
300mm PVC DR18					
0.1	Mobilization	% of Total Cost	1.0	~12%	$75.00
0.2	Traffic Accomodation	% of Total Cost	1.0	~4%	$26.00
0.3	Remove and dispose of ex. pipe	m	1.0	$10.00	$10.00
0.4	Miscellaneous Items	L.S.	1.0	$208.00	$208.00
0.5	Excavate, backfill and compact	m	1.0	$225.00	$235.00
0.6	Install pipe and bedding	m	1.0	$140.00	$140.00
	Subtotal				**$694.00**
	Professional Services and Contingency (35%)				$242.90
	Total 300mm Water Main Replacement				**$937.00**

Water and Sanitary Replacement Unit Cost Breakdown

Item No.	Item of Work	Measurement Unit	Est. Quantity	Unit Price	Amount
B. SANITARY SEWER REPLACEMENT					
Notes:	Assume a 5.0m wide trench is required to determine road and excavation quantities Costs are per lineal meter Costs do not include roadway trench repair				
200mm PVC DR35					
0.1	Mobilization	% of Total Cost	1.0	~12%	$55.00
0.2	Traffic Accomodation	% of Total Cost	1.0	~4%	$18.00
0.3	Remove and dispose of ex. pipe	m	1.0	$10.00	$10.00
0.4	Miscellaneous Items	L.S.	1.0	$133.00	$133.00
0.5	Excavate, backfill and compact	m	1.0	$225.00	$235.00
0.6	Install pipe and bedding	m	1.0	$50.00	$50.00
	Subtotal				**$501.00**
	Professional Services and Contingency (35%)				$175.35
	Total 200mm Sanitary Sewer Replacement				**$676.00**
250mm PVC DR35					
0.1	Mobilization	% of Total Cost	1.0	~12%	$60.00
0.2	Traffic Accomodation	% of Total Cost	1.0	~4%	$20.00
0.3	Remove and dispose of ex. pipe	m	1.0	$10.00	$10.00
0.4	Miscellaneous Items	L.S.	1.0	$133.00	$133.00
0.5	Excavate, backfill and compact	m	1.0	$225.00	$245.00
0.6	Install pipe and bedding	m	1.0	$70.00	$70.00
	Subtotal				**$538.00**
	Professional Services and Contingency (35%)				$188.30
	Total 250mm Sanitary Sewer Replacement				**$726.00**
300mm PVC DR35					
0.1	Mobilization	% of Total Cost	1.0	~12%	$65.00
0.2	Traffic Accomodation	% of Total Cost	1.0	~4%	$22.00
0.3	Remove and dispose of ex. pipe	m	1.0	$10.00	$10.00
0.4	Miscellaneous Items	L.S.	1.0	$133.00	$133.00
0.5	Excavate, backfill and compact	m	1.0	$225.00	$255.00
0.6	Install pipe and bedding	m	1.0	$90.00	$90.00
	Subtotal				**$575.00**
	Professional Services and Contingency (35%)				$201.25
	Total 300mm Sanitary Sewer Replacement				**$776.00**

Water and Sanitary Replacement Unit Cost Breakdown - Miscellaneous Items

Item No.	Item of Work	Measurement Unit	Est. Quantity	Unit Price	Amount

Notes: All prices are in 2009 dollars

A. WATER MAIN REPLACEMENT

The following items are assumed for a typical length of **100m** of water main replacement. The purpose is to calculate an accurate miscellaneous items cost to be incorporated in to the rehab and replacement unit rates.

Miscellaneous Items

0.1	Adjust valve prior to paving	each	2.0	$275.00	$550.00
0.2	Temp. water service (100m / 20m = 5)	each	5.0	$1,000.00	$5,000.00
0.3	Hydrovac existing utilities	each	1.0	$500.00	$500.00
0.4	Remove & dispose existing hydrant (1 per 150m)	each	0.67	$500.00	$335.00
0.5	Hydrant	each	0.67	$3,500.00	$2,345.00
0.6	Fittings	each	2.0	$300.00	$600.00
0.7	Valves	each	1.0	$1,500.00	$1,500.00
0.8	Connection to existing pipe	each	1.0	$2,000.00	$2,000.00
0.9	Main stops	each	5.0	$300.00	$1,500.00
0.10	Service connections	each	5.0	$1,000.00	$5,000.00
0.11	Screened Rock	m^3	25.0	$60.00	$1,500.00
	Total for 100m				$20,830.00
	Miscellaneous Cost per metre of pipe				**$208.00**

B. SANITARY SEWER REPLACEMENT

The following items are assumed for a typical length of **100m** of sanitary sewer replacement. The purpose is to calculate an accurate miscellaneous items cost to be incorporated in to the rehab and replacement unit rates.

Miscellaneous Items

0.1	Adjust manhole prior to paving	each	2.0	$425.00	$850.00
0.2	Hydrovac existing utilities	each	1.0	$500.00	$500.00
0.3	Remove & dispose of existing manhole	each	1.0	$700.00	$700.00
0.4	Manhole	v.m.	3.5	$1,050.00	$3,675.00
0.5	Sanitary service in-line tee	each	5.0	$150.00	$750.00
0.6	Frame & Cover	each	1.0	$300.00	$300.00
0.7	Service connections	each	5.0	$1,000.00	$5,000.00
0.8	Screened Rock	m^3	25.0	$60.00	$1,500.00
	Total for 100m				$13,275.00
	Miscellaneous Cost per metre of pipe				**$133.00**

Roadway Rehabilitation Cost Breakdown

Item No.	Item of Work	Measurement Unit	Est. Quantity	Unit Price	$ / m2 of Roadway
Notes:	All prices are in 2009 dollars				
ROADWAY REHABILITATION					
A. EDGE MILLING & OVERLAY					
0.1	Mobilization	% of Total Cost	1.0	~12%	$3.00
0.2	Traffic Accommodation	% of Total Cost	1.0	~4%	$1.00
0.3	Edge & End Asphalt Milling ($3m^2$ per m of Road)	m^2	1.0	$5.32	Not Extended
0.4	Asphalt Leveling Course	tonne	0.028	$133.00	$3.66
0.5	Asphalt - 40mm Lift	tonne	0.11	$133.00	$14.63
	Subtotal				$22.29
	Engineering & Contingency (~35%)				$7.80
	Total Edge Milling & Overlay				**$30.09**
	Note: Required edge milling has Not been included in the total $/m2 but has been included in the overall Costs				
B. LOCAL ROADWAY RECONSTRUCTION					
0.1	Mobilization	% of Total Cost	1.0	~12%	$6.90
0.2	Traffic Accommodation	% of Total Cost	1.0	~4%	$2.30
0.3	Remove & Dispose Asphalt	m^2	1.0	$6.20	$6.20
0.4	Waste excavation	m^3	1.0	$14.50	$5.10
0.5	Subgrade preparation	m^2	1.0	$2.90	$2.90
0.6	Pitrun Sub base - 250mm	tonne	0.6463	$19.60	$12.67
0.7	Gravel base - 100mm	tonne	0.2585	$26.80	$6.93
0.8	Asphalt - 65mm lift	tonne	0.1788	$133.00	$23.78
	Subtotal				$66.78
	Engineering & Contingency (~35%)				$23.40
	Total Reconstruction - Local Road				**$90.18**
C. ARTERIAL ROADWAY RECONSTRUCTION					
0.1	Mobilization	% of Total Cost	1.0	~12%	$11.30
0.2	Traffic Accommodation	% of Total Cost	1.0	~6%	$5.70
0.3	Remove & Dispose Asphalt	m^2	1.0	$6.20	$6.20
0.4	Waste excavation	m^3	1.0	$14.50	$8.00
0.5	Subgrade preparation	m^2	1.0	$2.90	$2.90
0.6	Pitrun Sub base - 350mm	tonne	0.9048	$19.60	$17.73
0.7	Gravel base - 200mm	tonne	0.5170	$26.80	$13.86
0.8	Asphalt - 125mm lift	tonne	0.3438	$133.00	$45.73
	Subtotal				$111.42
	Engineering & Contingency (~35%)				$39.00
	Total Reconstruction - Arterial Road				**$150.42**

Roadway Rehabilitation Cost Breakdown

Item No.	Item of Work	Measurement Unit	Est. Quantity	Unit Price	$ / m2 of Roadway
D. ADDITIONAL MISCELLANEOUS COSTS					
	1.0 CONCRETE				
	Construct New				
1.1	Standard Curb & Gutter	m	1.0	$82.00	
1.2	Rolled Curb & Gutter	m	1.0	$95.00	
1.3	Monolithic Standard Curb & Gutter with Sidewalk	m	1.0	$230.00	
1.4	Monolithic Rolled Curb & Gutter with Sidewalk	m	1.0	$245.00	
1.5	Separate Sidewalk	m	1.0	$144.00	
	Remove & Replace				
1.6	Standard Curb & Gutter	m	1.0	$115.00	
1.7	Rolled Curb & Gutter	m	1.0	$138.00	
1.8	Monolithic Standard Curb & Gutter with Sidewalk	m	1.0	$241.50	
1.9	Monolithic Rolled Curb & Gutter with Sidewalk	m	1.0	$255.00	
1.10	Separate Sidewalk	m	1.0	$155.50	
	2.0 UTILITY ADJUSTMENTS				
2.1	Hydrovac Utilities	hr	1.0	$500.00	
2.2	Adjust Manhole	each	1.0	$425.00	
2.3	Adjust Valve	each	1.0	$275.00	
2.4	Adjust Catch Basin	each	1.0	$500.00	
	3.0 LANDSCAPING & EARTHWORKS				
3.1	Common Excavation	m^3	1.0	$6.63	
3.2	Import Fill	m^3	1.0	$19.01	
3.3	Import Topsoil and Fine Grading	m^3	1.0	$8.80	
3.4	Grass Seeding	m^2	1.0	$7.70	

Storm Sewer Unit Cost Breakdown

Item No.	Item of Work	Measurement Unit	Est. Quantity	Unit Price	Amount

NOTE: All prices are in 2009 dollars

A. STORM SEWER UPGRADES

Notes: All prices are in 2009 dollars
Assume a 5.0m wide trench is required to determine road and excavation quantities
Costs are per lineal meter
Costs do not include roadway trench repair

450mm PVC DR35

0.1	Mobilization	% of Total Cost	1.0	~12%	$8,500.00
0.2	Traffic Accommodation	% of Total Cost	1.0	~4%	$2,800.00
0.3	Excavate, backfill and compact	m	1.0	$255.00	$255.00
0.4	Connection to existing pipe or Manhole	each	1.0	$2,000.00	$2,000.00
0.5	Install pipe and bedding (450mm)	m	300.0	$120.00	$36,000.00
0.6	Screened Rock	m^3	25.0	$60.00	$1,500.00
0.7	Manhole	v.m.	9.0	$1,050.00	$9,450.00
0.8	Frame & Cover	each	3.0	$300.00	$900.00
0.9	Catch Basin	each	4.0	$4,800.00	$19,200.00
0.10	Catch Basin Leads	m	24.0	$45.00	$1,080.00
	Subtotal				**$81,685.00**
	Professional Services and Contingency (35%)				$28,589.75
	Total 450mm Storm Sewer Installation				**$110,275.00**
	Average Cost Per Linear Metre of Storm Sewer				**$367.58**