COUNTY OF MINBURN NO. 27

BYLAW NO. 1261-17

A BYLAW OF THE COUNTY OF MINBURN NO. 27, VEGREVILLE, IN THE PROVINCE OF ALBERTA BEING A BYLAW TO ADOPT THE HAMLET OF LAVOY AREA STRUCTURE PLAN.

WHEREAS The Council of the County of Minburn No. 27 considers it necessary to adopt, in accordance with Sections 633 and 636 of the Municipal Government Act, the Hamlet of Lavoy Area Structure Plan, being Bylaw No. 1261-17, to specify policy and regulatory direction for the Hamlet of Lavoy;

AND WHEREAS The Council of the County of Minburn No. 27 deems it advisable to adopt the Hamlet of Lavoy Area Structure Plan, being Bylaw No. 1201-09, to refine and further specify the general policy direction applicable to this area in the County of Minburn No. 27 Municipal Development Plan, being Bylaw No. 1253-16, and amendments thereto;

NOW THEREFORE Under the authority of the *Municipal Government Act*, the Council of the County of Minburn No. 27, in the Province of Alberta, duly assembled enacts as follows:

1. That First Reading of proposed Bylaw 1201-09 is rescinded.
2. That Bylaw No. 1261-17, being the Hamlet of Lavoy Area Structure Plan, be adopted.
3. That this Bylaw shall come into full force and effect upon the final passing thereof.
4. **SEVERABILITY**

    4.1 If any Section or parts of this bylaw are found in any court of law to be illegal or beyond the power of Council to enact, such Section or parts shall be deemed to be severable and all other Sections or parts of this Bylaw shall be deemed to be separate and independent there from and to be enacted as such.

Read a first time this 20th day of February 2018.

Public Hearing Held on the 16th day of April 2018 held at Vegreville, Alberta.

Read a second time this 16th day of April 2018.

Read a third time and finally passed, this 16th day of April 2018.

Reeve

County Manager

County of Minburn No. 27

HAMLET OF LAVOY
AREA STRUCTURE PLAN

BYLAW #1261-17
Adopted April 16, 2018

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1.0 INTRODUCTION

1.1 Location

The Hamlet of Lavoy is located on the north side of Highway 16 approximately 10 km east of Vegreville and approximately 5 km west of the intersection of Highway 36 and Highway 16. The northern mainline of CN Rail runs parallel with Highway 16 along the Hamlet's southwest border. Lavoy is gently sloped generally draining from the northeast to the southwest (toward the rail line and Highway 16). There is one main access to Lavoy from Highway 16 which is lighted and sign controlled.

1.2 Plan Purpose

The Hamlet of Lavoy Area Structure Plan (the Lavoy ASP) serves two important functions. The first is to articulate a vision for the community. The second is to establish sound land use planning policies that support and implement the direction established. The Lavoy ASP Plan Area is illustrated in **Map 1 Hamlet of Lavoy ASP Area.**

1.2 Plan Objectives

Over the life-span of this ASP, a period of approximately 25 years, key objectives are:

1. To stabilize, diversify and grow the community, the primary purpose being to keep and attract people and businesses both in and surrounding Lavoy.
2. To take full advantage of Lavoy's close proximity to the intersection of Highways 16 and 36 as well as the Town of Vegreville to grow its residential and business industrial base. This will help to ensure that existing and future community infrastructure (e.g. water treatment/distribution, sewage collection/treatment, community facilities, former school site, etc.) is utilized and/or extended in an efficient and economical manner.
3. To ensure an improved standard of development both for existing and future uses to ensure that adequate amenities are afforded to the existing and future community of Lavoy.
4. To ensure that the use, subdivision and development of land in Lavoy is governed by sound planning so that all of the above objectives can be fully realized.

1.3 Municipal Policy/Regulatory Context

The Lavoy ASP is consistent with the County's recently updated Municipal Development Plan and Land Use Bylaw. The proposed vision and future land uses in the Lavoy ASP are consistent with the MDP as can be seen in the following policies related to Hamlets found in Section 3 of the MDP:

3.3.1 The Developer shall be responsible for all costs associated with the servicing of all new subdivisions and developments including infill of existing lots (see also MDP Section 3.6 Transportation & Utilities).

3.3.2 In the case of infill lots, notwithstanding Policy 3.3.1, the County may consider covering the costs associated with providing one water and one sanitary sewer connection from the property line to any immediately adjacent trunk line existing at the time of the passing of this Bylaw.

3.3.3 The Developer shall bear any costs associated with relocating an existing water and/or sanitary sewer connection to another location on the same lot.

MAP 1

Hamlet of Lavoy ASP Area

3.3.4 The County shall consider developing and adopting an off-site levy bylaw to collect fees from subdivision and development to assist in the costs of upgrading and/or expanding off-site infrastructure in accordance with the *Municipal Government Act*.

3.3.5 The County shall support orderly and economic development in the Hamlets of Lavoy, Ranfurly, Minburn and any future hamlet(s).

3.3.6 The County shall support the provision or extension of infrastructure including roads, sanitary sewer systems, water systems or stormwater management systems in any existing or future hamlet(s) where there is sufficient justification for such infrastructure supported by planning, engineering and fiscal analysis.

3.3.7 The Developer shall be responsible for the construction of public roads to County standards if the timing of the proposed development does not correspond to the established road construction priorities of the County in order to access a proposed development. A non-negotiable form of security shall be provided by the Developer to ensure that road construction is to the required standard of the County.

3.3.8 The County shall prepare area structure plans for the Hamlets of Lavoy, Ranfurly, Minburn and any future hamlet(s) in accordance with the policies of this Plan, and the area structure plans shall be adhered to by the County when deciding upon land use, subdivision and development applications.

3.3.9 The County should ensure that hamlet development occurs in general order of 1) in-filling of vacant lots, 2) rehabilitation, restoration or redevelopment of deteriorating buildings, 3) relocation and redevelopment of inappropriate uses, 4) expansion into the unsubdivided and undeveloped areas within the hamlet and, 5) lastly, expansion of the hamlet.

3.3.10 The Hamlets of Lavoy, Ranfurly and Minburn, or any future hamlet(s), shall not expand onto arable land unless no alternative exists.

3.3.11 The County shall not permit growth that may jeopardize groundwater supplies or quality in hamlets not serviced by regional water. Further, the Developer shall bear the costs to expand or improve the water supply to support growth.

3.3.12 The County shall ensure that the Hamlets of Lavoy, Ranfurly and Minburn, and any future hamlet(s), are planned and designed so that new lots are of a size and configuration and located such that they maximize the use of existing or proposed municipal services.

3.3.13 The County shall require that new developments, and existing developments that have on-site servicing needing to be replaced and are in proximity to the servicing available to new developments, connect and contribute to the support of municipal servicing where municipal servicing is available to new developments.

3.3.14 The County shall not permit development in hamlets dependent on on-site water supply and/or sewage treatment in areas with soil limitations for effluent disposal in situations where municipal servicing is not available.

3.3.15 The County may not permit development dependent on groundwater in areas of inadequate groundwater water supply and/or poor quality or require potable water provision through the use of cisterns in such cases. Where the County accepts water provision through the use of cisterns, an appropriate notation on each title within the subdivision shall be required alerting the prospective owner that a cistern will be required in perpetuity to provide the household with potable water.

3.3.16 The County shall consider commercial and industrial activities in the Hamlets of Lavoy, Ranfurly, and Minburn, or any future hamlet(s), where the development(s) will serve to provide basic commercial and industrial services to the residents and the surrounding agricultural area.

3.3.17 The County may require that the owner/developer undertake a conceptual scheme prepared/compiled by a qualified person (e.g. Registered Professional Planner) prior to any substantial new development or subdivision in the Hamlets of Lavoy, Ranfurly, and Minburn, or any future hamlet(s), addressing the following:

a. the logical and orderly sequence of development;

b. proposed land uses;

c. provision of municipal services (water, sewer, roads, and utilities);

d. consideration of soil, topography, drainage, and other physical constraints to development;

e. location and extent of reserve lots;

f. impact on adjacent land uses; and,

g. any other matters the County considers necessary.

3.3.18 The County shall, in the Hamlet of Ranfurly, consider any dwellings lawfully in existence as of February 16, 2010, as a “permitted use” for the purposes of the direct control land use districting applied to the Hamlet of Ranfurly insofar as authorizing minor renovations, additions, and so forth. In authorizing major renovations and additions to such dwellings, or where such dwellings are proposed to be rebuilt or replaced with a new dwelling, or in the case of a proposed subdivision, the County must be satisfied by means it considers necessary (e.g. sewage treatment system inspection, water well capacity/quality testing, etc.), that the subject dwelling is or can be serviced with an on-site supply of potable water and that sewage effluent is or can be properly treated on-site. The foregoing does not allow the development of a new dwelling on a lot where a dwelling did not lawfully exist at the time this Plan came into effect.

3.3.19 Further to Policy 3.3.18, the County shall encourage the enlargement of existing residential lots via lot consolidation, reconfiguration, replotting and so forth, for the purposes of providing increased opportunities to improve on-site servicing wherever and whenever possible.

3.3.20 Further to Policy 3.3.19, and notwithstanding policy 3.3.18, where enlargement of existing residential lots via consolidation, reconfiguration, replotting and so forth, has taken place,

and/or where existing lots are large enough to accommodate private servicing, consideration for granting approval for a new residence may be given if access to private on-site water and sanitary servicing can be proven, to the written satisfaction of the County.

The lands within the Hamlet, a total of 66.09ha, have been divided into six land use districts in the LUB as illustrated in **Map 2 Hamlet of Lavoy Land Use Districts**. Most of the developed land falls within the HR – Hamlet Residential District. The vast majority of the undeveloped land is zoned HUR – Hamlet Urban Reserve. The lands within the Lavoy ASP are broken out by land use district as summarized below in Table 1. Land Use District Areas.

Table 1. Land Use District Areas

LAND USE DISTRICT	AREA (ha)
Hamlet Reserve (HR)	10.39
Hamlet Urban Reserve (HUR)	28.17
Hamlet Business Industrial (HBI)	5.99
Hamlet of Lavoy Direct Control Residential (HLDCR)	4.88
Hamlet of Lavoy Direct Control Transitional (HLDCT)	0.65
Direct Control (DC)	6.70
Total Area	56.78

Note: Road ROW Area = 9.31ha

1.4 Provincial Policy/Regulatory Context

It is important that this Plan be endorsed by Alberta Transportation pursuant to Section 14 of the *Municipal Government Act* Subdivision and Development Regulation to facilitate subsequent subdivision and development approvals and to ensure consistency with important Provincial policy. Having this specific area well managed and planned out in relation to Highway 16 will contribute significantly to the Hamlet attracting investment and developing to its potential.

MAP 2

Hamlet of Lavoy Land Use Districts

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2.0 PLAN AREA CHARACTERISTICS

2.1 Population

Based on the 2016 Municipal Census, the population of Lavoy was approximately 105. Residents occupy about 60 private dwellings, 11 of which are modular/mobile homes. These dwellings are, for the most part, in good condition with well-maintained yards. Based on the 2016 population and number of occupied private dwellings, average household density is 1.75 persons per dwelling. This number is significantly lower than the 2016 Federal Census household density data for the County of Minburn as a whole, which is 2.5 persons per dwelling.

Lavoy is a community that is important to the local rural population having postal service, a well-kept community hall, seniors centre and municipal water and sanitary sewer services. The County's Public Works Department operates a storage facility at the former school site.

2.2 Land Ownership

Though the vast majority of the land within the Hamlet is privately owned, the County is also a landowner. It owns the water reservoir site, the old Public Works site and the community hall property. It also owns serviced land in Block 8, unserviced land in Block B, as well as a number of unserviced, vacant lots. The County recently acquired the former school site located at the north end of the Hamlet and has developed part of the site for a storage compound for some of its public works vehicles. Most of the remainder of the former school site is available and appears suitable for redevelopment.

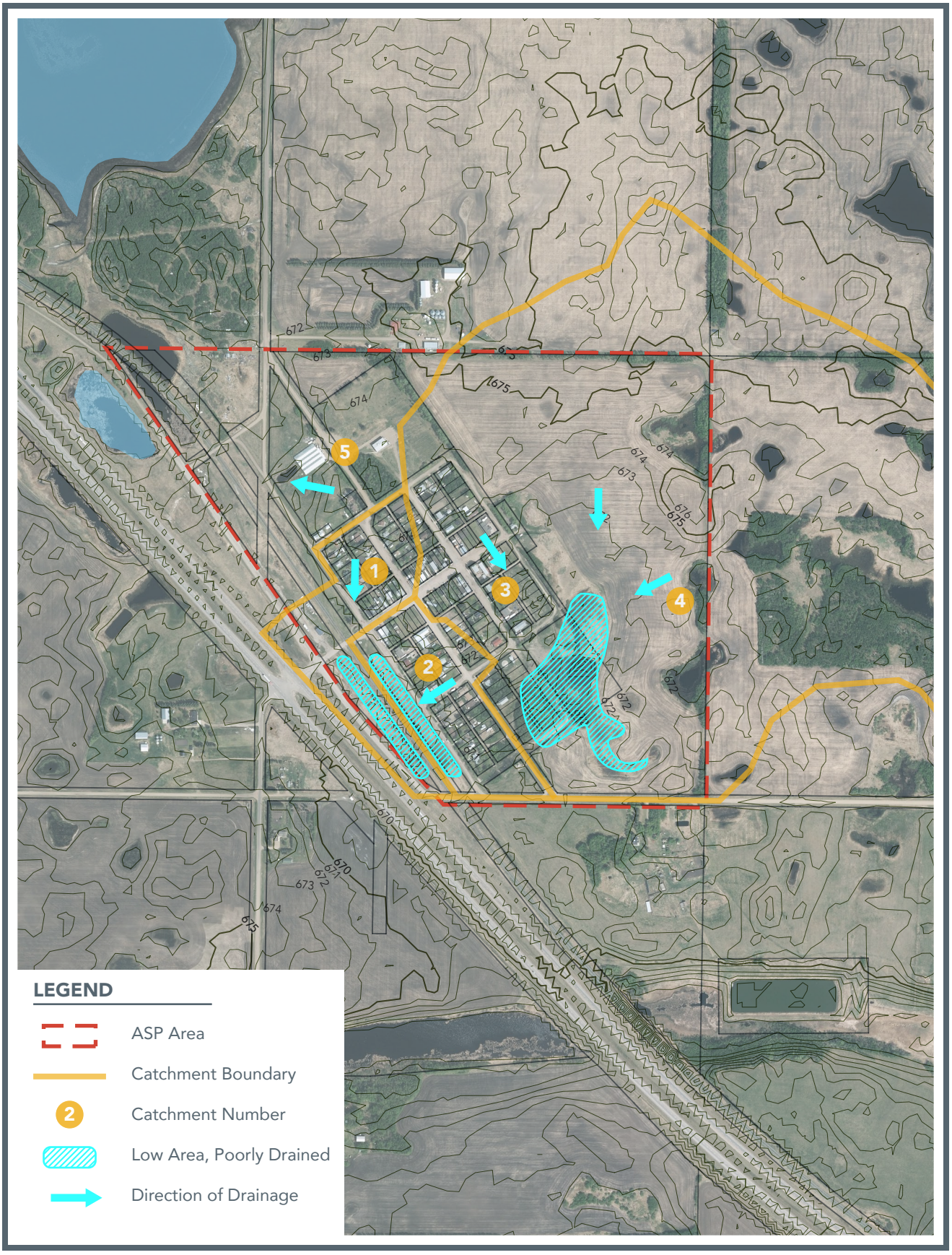
2.3 Topography & Drainage

Map 3 General Site Drainage illustrates the topography and drainage patterns for the Lavoy ASP lands. Contour intervals are set at one meter. The height of land is 676m, located in the northeastern area of the ASP boundary, along the eastern hamlet boundary. The lands tend to slope from north-north east diagonally across the plan area towards the CN Railway line, south-south west.

According to the Province's Soil Information Viewer database, Lavoy is located within Polygons 16085 and 17134. Polygon 16085 covers the existing built-up hamlet site, and has the following attributes: Eluviated Black Chernozem on medium textured materials over medium or fine textured till. The polygon includes poorly drained and Solonetzic soils, featuring undulating high relief landform with a limiting slope of 4%. Polygon 17134 also features Eluviated Black Chernozem on medium textured till, with some poorly drained soils and undulating, high relief landform with a limiting slope of 4%.

South of 51st Avenue water tends to drain toward the CN Railway line. North of 51st Avenue, water tends to drain south and east toward a low lying area contained mostly within the undeveloped area of the Hamlet Reserve lands west of Spruce Street and south of what would be the eastern extension of 53rd Avenue. In fact, Block B contains a dugout that receives runoff from Block 8. Though developable in theory, a more long term stormwater management solution for Block 8's stormwater (and, ultimately, that of the entire Hamlet) will be required should the County wish to develop Block B for serviced residential lots. It would be prudent to investigate current costs to contract the provision of a wetland assessment and stormwater management plan for the Hamlet.

Future development will want to take into consideration the presence of poorly draining soils and ensure positive drainage and stormwater management are established.



MAP 3

General Site Drainage

2.4 Waterbodies

There are pockets of low lying land within Lavoy that likely collect spring runoff and rainfall event water see Map 3). The status of these low lying areas has not been confirmed by way of a formal wetland assessment. Therefore, prior to development of undeveloped land, it would be prudent to have the lands assessed by a qualified professional for significant wetland/waterbody features.

2.5 Limiting Distances

There are two developments adjacent to Lavoy that require limiting distances. This means that certain uses, such as residential, are not allowed to be developed within the limiting distance. The first is the old land fill, located just south of Lavoy on the south side of Highway 16. The second is the sewage lagoons site located southeast of Lavoy, north of Highway 16 and south of Township Road 250. Each of these sites has limiting distances set at 300m offset from their perimeters. These limiting distances are set by the Province of Alberta in the Subdivision and Development Regulations.

The lagoons' limiting distance does not appear to affect any existing or future residential areas within the Hamlet of Lavoy (see Map 1). However, the landfill's limiting distance includes a number of existing residential properties in the Hamlet (see Map 1).

Lots 3-13, Block 1, Plan 949Q are all located within, or just touching, the limiting distance of the landfill. These properties include three existing houses. Any new and/or intensification of residential uses proposed on these affected properties will require prior approval from the Province in addition to County development approval, as may be required.

3.0 POPULATION PROJECTION & LAND ABSORPTION

3.1 Population Projection

Population projections are inherently inaccurate because they rely on many assumptions that may or may not hold true beyond a certain moment in time. However, they can be useful in illustrating future need for land use planning purposes. The projections contained herein are rudimentary and are for land use planning discussion purposes only. More rigorous projections would want to be used for capital planning and/or engineering decision-making processes.

Population changes between 1986 and 2016 were used to analyze growth rates over the same period. This data is summarized in **Table 2. Population Statistics** below. All data in Table 2 are from Municipal Censuses.

Table 2. Population Statistics

YEAR	POPULATION	RATE OF CHANGE	ANNUAL GROWTH RATE
1986	126		
1991	100	-20.6%	-4.1%
1996	122	22.0%	4.4%
1999	119	-2.5%	-0.8%
2001	108	-9.2%	-4.6%
2006	115	6.5%	1.3%
2011	125	8.7%	1.7%
2016	105	-16.0%	-3.2%

Population growth in Lavoy has been uneven; perhaps cycling with Alberta's boom/bust economic cycles. However, since 1986 the overall population growth trend for Lavoy has been generally downward, with an annual growth rate over the 30-year period of -0.6%.

The largest drop in population occurred between 1986 and 1991. During this five year period the community lost over 20% of its residents, bringing the population down from 126 to 100 residents. Remarkably, in the following five year period between 1991 and 1996, Lavoy gained 22% more residents, bringing the population back up to 122.

The next ten years brought the population down to 108 by 2001. But by 2011 the population was back up to 125. The most recent Municipal Census data shows a 16% drop in population between 2011 and 2016.

Projecting population growth for Lavoy over the next 25 years, we would expect a continuation of the downward trend punctuated with cyclic population increases and decreases. For the purposes of this ASP, we will assume two growth scenarios: 1) trend at -0.6% annual growth and 2) modest growth at 1.0% annual growth.

Scenario 1: Trend

In the trend scenario, over the next 25 years we expect the population to steadily decrease at a rate of -0.6% per year. Projecting from the most recent census year of 2016, the 25-year future population is just over 90 people.

This projection does not take into account cyclic jumps in population between the year 2016 and 2041, and is therefore likely very low.

Scenario 2: Modest Growth

In the modest growth scenario, over the next 25 years we expect the population to steadily increase at a rate of 1% per year. Projecting from the 2016 census year, the 25-year future population is just over 134 people.

This projection does not take into account cyclic jumps in population between 2016 and 2041, and is therefore likely very low. That being said, the 30-year trend for Lavoy's population is negative annual growth at a rate of -0.6%, so the 1% annual growth rate in scenario 2 may be optimistic. It is reasonable to suggest that the population of Lavoy will likely continue to ebb and flow between 100 and 125 people given the historic trend.

3.2 Land Absorption

Currently the County has ten serviced residential lots available for sale and development. An additional 11 unserviced lots are for sale. It is important to note that only lots with building sites outside the 300m landfill limiting distance will be candidates for new residential development. Regardless, the County's existing lot inventory appears to be sufficient to accommodate the projected future additional population.

To keep a limit on municipal servicing demands, this ASP promotes the redevelopment and infill of existing built up residential areas that are already serviced. To the extent possible, expanding services to undeveloped land should be avoided as long as existing serviced residential lots are available for development or redevelopment.

Scenario 1 Land Absorption

If the population in 25 years' time is around 90 people given a -0.6% annual rate of growth, then current housing stock and servicing levels will be sufficient, notwithstanding the need for housing renewal of existing stock over time, and no new serviced lots would need to be brought online. Additional serviced residential lots would also be available for purchase from the County.

Scenario 2 Land Absorption

If a 1% growth rate results in Lavoy's population reaching 134 by 2041, then it is prudent to assess the lot availability for the increase in population. At 1.75 persons per household and a population of 134, Lavoy by 2041 will need 17 new dwellings to house the additional 29 residents, assuming all existing housing stock remains occupied. With a current stock of 10 serviced lots and eight unserviced lots, the existing County supply could meet future demand. However, if demand for serviced lots exceeds the 10 available lots, consideration of the costs and benefits of bringing new serviced residential lots will be

necessary. The most logical location to bring on new serviced lots is near the Public Works Shop, as discussed in Section 4.3 below.

4.0 GENERALIZED FUTURE LAND USE CONCEPT

4.1 Overview

Lavoy, like many other small communities located along or near the rail line and highway, enjoyed much more commercial/institutional activity in the past and served a greater surrounding area in terms of providing services to people. Though many of the previous businesses have closed, there are existing businesses. In fact, there has been some resurgence of commercial and other activity in recent years.

Thus, the potential is there for Lavoy to retain and attract population with redevelopment/infill opportunities, as discussed in Section 3.0 above.

As discussed in Section 5.0 below, expanding or growing the Hamlet more significantly beyond limited redevelopment/infill opportunity is constrained by the corresponding servicing improvement costs.

Map 4 Generalized Future Land Use Concept, can be summarized as follows:

- promotes the existing residential area to be in-filled as servicing permits. Lot reconfiguration (ie: resubdivision/consolidation) is encouraged to attract new residents by providing affordable lot sizes larger than those offered in the Town of Vegreville.
- promotes the continuation and further development of home occupations, bed and breakfast operations and other such uses ancillary/subordinate to existing and future residential uses.
- promotes opportunities related to institutional development, retirement services and so forth (all of which being either publicly and/or privately operated).
- provides for the infilling of a business industrial area to build upon the existing land use/reuse already occurring. Providing land for and being 'development ready' to attract suitable business industrial development is key to sustaining and growing Lavoy.
- identifies a centrally located and compact area along Main Street as a direct control transitional area tied to a specifically tailored direct control land use district in the Land Use Bylaw. This is the best mechanism to take the existing uses into account and deal with future proposals on a case-by-case basis. The overall purpose of this transitional designation is to achieve an appropriate mix of commercial and residential development over time on Main Street.

The area within the Direct Control Transitional District is in transition and should consist of a mix of residential and commercial uses that are compatible and complementary. Live-work developments (specialty shop in the front with a resident owner living in behind) and other forms of mixed-use commercial/ residential developments would be appropriate and are encouraged by this Plan.

4.2 Residential

4.2.1 Infill

To reduce servicing costs and make the most efficient use of existing infrastructure, residential infill and redevelopment within the R – Residential Infill Area is encouraged. The R – Residential Infill Area represents the existing developed areas of the Hamlet, including the downtown area. This downtown area is designated Direct Control Transitional, as discussed below.

MAP 4

Generalized Future Land Use Concept

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Within this designation a number of lots, Lots 4-10, Block 1, are within the 300m limiting distance. Two other lots, Lots 3 and 11, Block 1, are touched by the 300m limiting distance although the majority of the lot areas remain outside the limiting distance. Development of residential uses where the building site is within the limiting distance is not allowed. As discussed in Section 2.5 above, additional approval from the Province may be required on lots within the limiting distance.

4.2.2 Expansion Area

The residential expansion area represents the very, very long term location for future residential once most redevelopment/infill opportunities within the R – Residential Infill Area have been realized and the existing vacant lots have been developed.

Development in the R – Residential Expansion Area should not occur unless a clear case for the logical and efficient and economic extension of existing services is proven to the satisfaction of the County, who will bear the long term operation, maintenance and upgrading costs of the services.

4.3 Direct Control

Residential

Should existing serviced lot demand be exceeded, additional serviced lots could be brought on line near the existing Public Works Shop (see **Map 5 Possible Residential Layout for DCR Area**). Additionally, some consideration should be given to providing for up to 8 unserviced residential lots on the remaining area of the former school site and to the northwest of the former school site (see Map 3). Though not connected to municipal water and sanitary sewer services, developing these additional unserviced lots could bring Lavoy's population to approximately 200 should demand for land outstrip supply.

Transitional

The area within the DCT – Direct Control Transitional designation is in transition and should consist of a mix of residential and commercial uses that are compatible and complementary. Live-work developments (specialty shop in the front with a resident owner living in behind) and other forms of mixed-use commercial/ residential developments would be appropriate and are encouraged by this Plan.

4.3 Business Industrial

The BI – Business Industrial designation takes advantage of good visibility from Highway 16 and possible rail line access. Appropriate buffers between non-residential uses and existing residential properties need to be established.

4.5 Municipal Reserve

Any municipal reserve owing for the lands within this ASP will be taken either in the form of land or cash-in-lieu of reserve land. No municipal reserve land is proposed to be deferred by caveat within the Plan area.

4.6 Sequence of Development

As is normally the case, development sequence will be dependent on the logical extension of municipal services, fiscal realities, market demand and landowner willingness.

MAP 5

Possible Residential Layout for DCR Area

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4.7 Highway Design Policies

Development adjacent to Highway 16 should exhibit a good standard of appearance to further the image of the Hamlet. It is recommended that appearance, screening, landscaping and siting of development be attended to in approving any subdivision or development along the highway interface.

5.0 SERVICING & UTILITIES

Associated Engineering Alberta Ltd. prepared a Master Stormwater Management Plan and a Master Servicing Plan for Lavoy in 2008 and 2009 respectively. Both documents are attached to this ASP for information in Appendix A.

5.1 Stormwater

The Master Stormwater Plan examined the existing drainage system in Lavoy and found that it currently provides an adequate level of service with some upgrades identified to improve drainage conditions and reduce the risk of potential flooding of private properties in several areas. The Master Servicing Plan examined all water and sanitary sewer facilities in terms of their current capacities as well as the improvements that would be required based on various projected population levels. Though a small population increase can be absorbed and serviced without major improvements to the Hamlet's servicing infrastructure, significant population growth in the Hamlet will require correspondingly significant improvements. Though the Master Servicing Plan did not provide cost estimates, it is safe to say that the cost of the improvements required would not be insignificant.

5.2 Sanitary & Lagoon

The existing sanitary system is depicted in **Map 6 Sanitary Sewer System**. The existing sewage lagoon facilities may need to be upgraded to meet current provincial standards regardless of population growth. Current water storage capacity is sufficient for a population of up to 145 people. Neither population projection scenario from Section 3.0 above results in a population of 145.

5.3 Water

Lavoy's water supply is provided via the ACE Regional Waterline as shown in **Map 7 Water Distribution System**. Water demand is assumed to be 365 L/c/d (liters per capita per day), using the Associated Engineering Municipal Servicing Study figures. With a projected population of up to 134 by 2025, water demand for Lavoy will be 48,910 L/d. This demand should be easily met by the ACE Regional Waterline.

5.4 Utility Services

Utility easements will be established where necessary for all franchised utilities at the time of subdivision. Any existing utility ROW's significantly hindering future subdivision/development will be encouraged to be relocated.

MAP 6

Sanitary Sewer System

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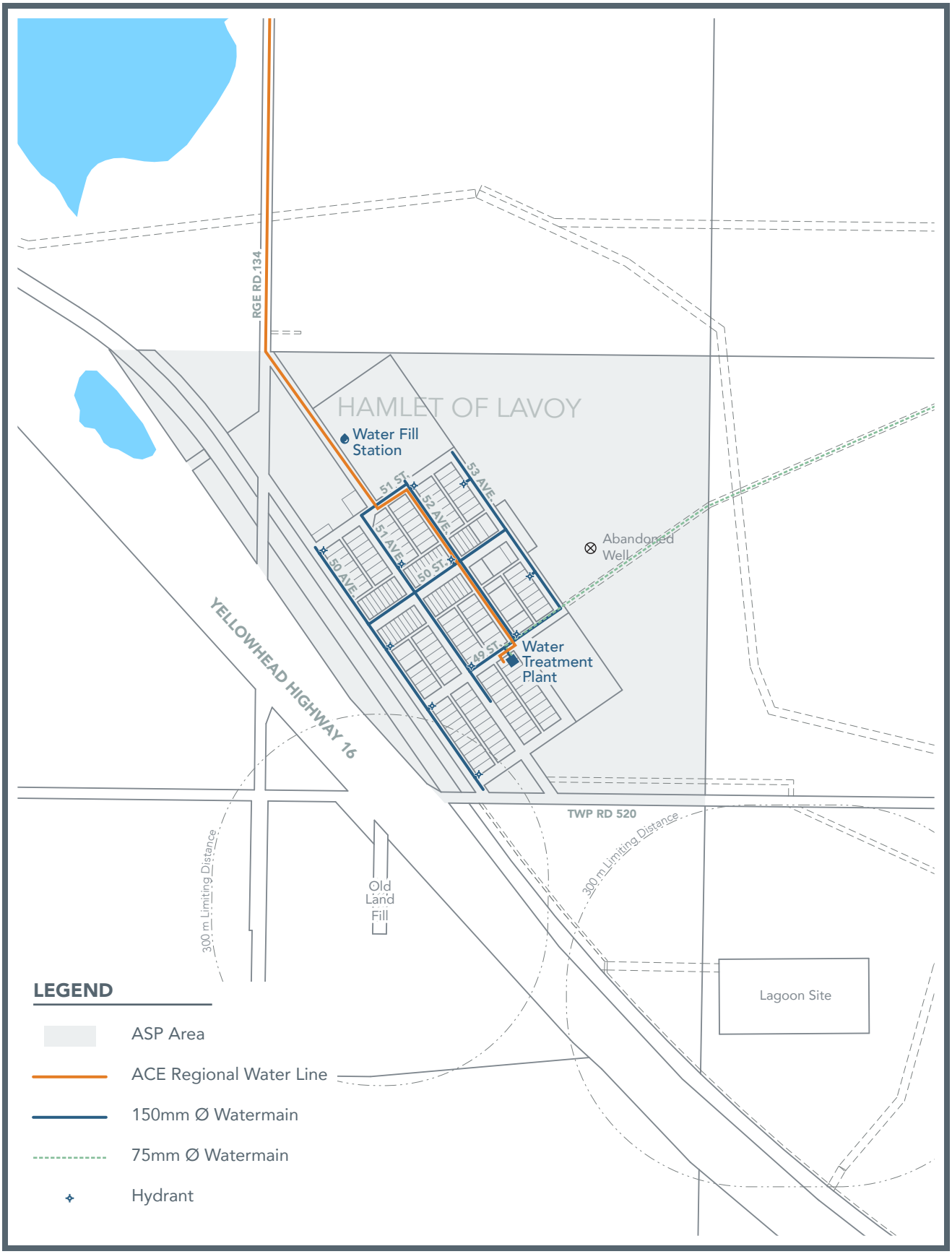

MAP 7

Water Distribution System

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6.0 ROADS & ACCESS

6.1 Internal Road System and Pedestrian Movement

All new roads provided within this ASP will be constructed to County standards. Also, it is important that the safe and efficient movement of pedestrians is accounted for in the design and development of the Plan area.

6.2 Highway 16 Access Management

Alberta Transportation (AT) commenced an access management study exercise in 2010 for Highway 16 between Elk Island National Park and Highway 36. Associated Engineering was retained to prepare the study document (the Study).

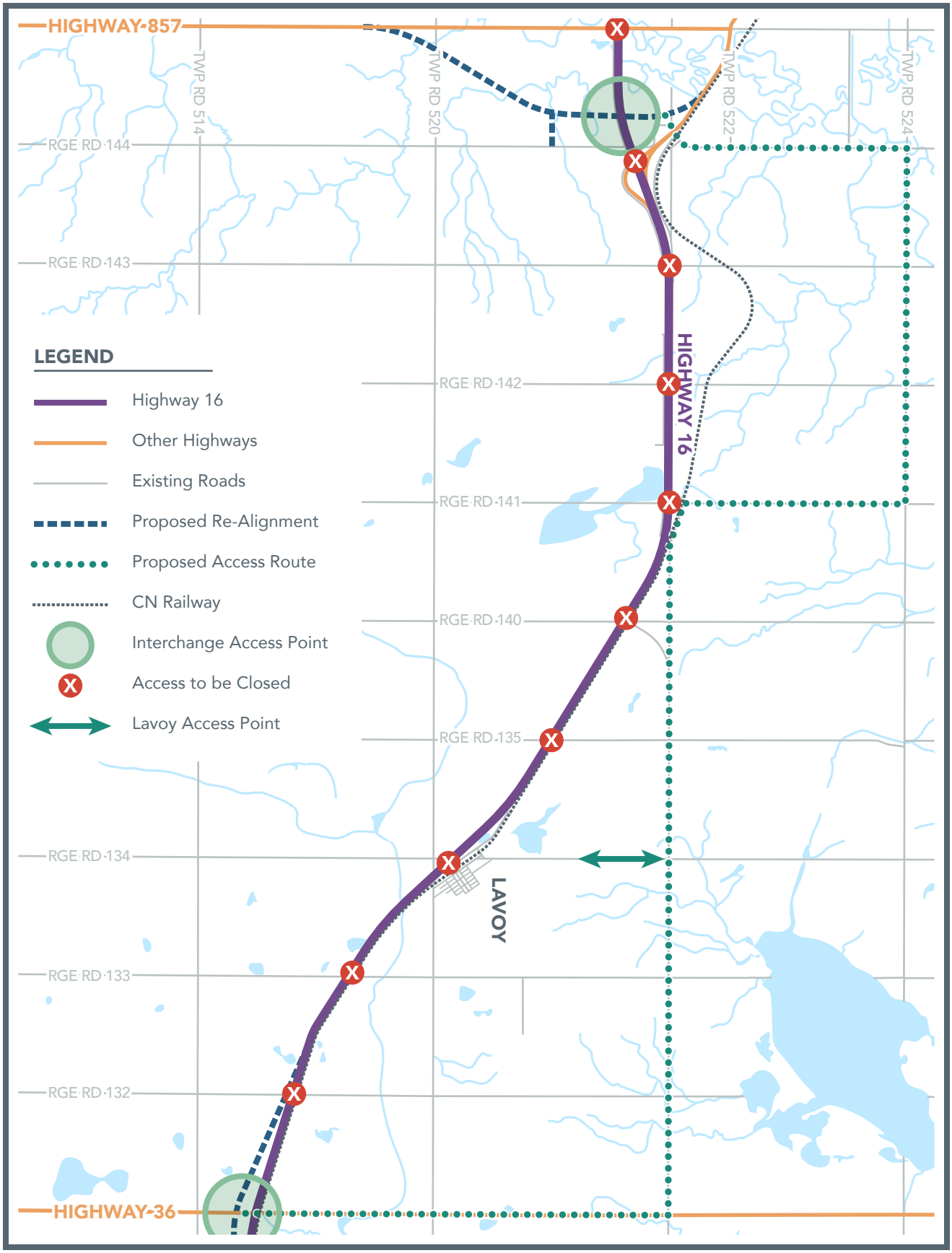
Around Lavoy, the Study shows all at-grade access points removed and Highway 16 converted to freeway status (see **Map 8 Highway 16 Access Plan**). In practice what this means is that access to Highway 16, in the very long term, will be limited to existing and proposed interchange locations. Further, it means that new direct accesses onto Highway 16 will not be allowed. Last, it means that upon removal of the at-grade accesses to Highway 16 in the very long term, primary access to Lavoy will be from the north along Range Road 134, or from the east along Township Road 520.

According to open house display panels accessed from the Alberta Transportation webpage related to this project, the two closest future interchange locations to Lavoy will be at Highway 857 in Vegreville and at Highway 36, east of Lavoy. Access to these interchanges from Lavoy requires travel on the existing local road network. The local roads used for primary access routes may need be upgraded to support the proposed additional usage.

Presumably removal of the at-grade access at Lavoy will be dependent upon completion of the interchanges at Highways 857 and 36 to provide alternative access to Highway 16. According to the 2017-2020 Provincial Construction Plan on AT's website, neither interchange is slated for development. It is likely the at-grade access will remain in place at Lavoy into the very long term. However, it is worthwhile considering the implications of its removal in this Plan.

6.3 Traffic Impact Assessment (TIA)

This ASP acknowledges that, at some point, a Traffic Impact Assessment (TIA) may be required as part of subsequent subdivision and development within the Plan area. It is further understood that any TIA conducted must be to the satisfaction of the County as well as Alberta Transportation.



MAP 8

Highway 16 Access Plan

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7.0 FORCE & EFFECT

The Hamlet of Lavoy Area Structure Plan (Lavoy ASP) is intended to refine existing general policy direction and land use designations assigned to these lands within the County's Municipal Development Plan, guide/confirm the assignment and implementation of land use districts to the lands within the County's Land Use Bylaw as well as establish a sound framework for future decisions on land use, subdivision, servicing and development permits. It must be noted that in making future decisions concerning the use, subdivision and development of the lands within the Lavoy ASP, the County will need to remain mindful of and monitor the capacities of both on and off-site services and make any necessary adjustments to uses, densities and lots sizes within the Lavoy ASP accordingly.

Policy 1 The County shall ensure that all future land use, subdivision, development, amendment and servicing decisions made regarding lands within the Hamlet of Lavoy Area Structure Plan (Lavoy ASP) comply with the provisions contained in the Lavoy ASP including Map 4 Generalized Future Land Use Concept. Should such a decision require or amount to a major deviation from or relaxation/variation of the provisions of the Lavoy ASP, an amendment to this Plan shall be required. Decisions that would result in or amount to a minor deviation from or relaxation/variation of the provisions of the Lavoy ASP may be considered without an amendment where it can be demonstrated to the satisfaction of the County that the deviation, relaxation or variation does not substantively alter the intent, force or effect of the provisions of the Lavoy ASP.

Policy 2 It is intended that the Lavoy ASP, its concepts and provisions are used in tandem with the relevant provisions of the County of Minburn No. 27 Municipal Development Plan and Land Use Bylaw, particularly in guiding the exercise of discretion in rendering decisions on subdivision and development permit applications. The Lavoy ASP will be used to guide any required amendments to the provisions or land use designations or districts in the County of Minburn No. 27 Municipal Development Plan or Land Use Bylaw.

Policy 3 The exercise of discretion and variance related to any matter or decision rendered with respect to the Lavoy ASP as well as the amendment of the Lavoy ASP shall be guided by the following principles:

a) The exercise of variance or discretion in deciding an application or an amendment to the Lavoy ASP must be both reasonable and defensible within the letter and spirit of the Lavoy ASP as well as widely accepted planning principles.
b) If a requirement or provision of the Lavoy ASP is to be deviated from or if an amendment is to be made, it is essential that those exercising the discretion or deciding upon variance or making the amendment clearly understand the rationale behind the requirement or provision they are being asked to vary or amend.
c) Discretion, variance and amendment shall only be considered if it can be demonstrated that the discretion, variance or amendment being considered will, at a minimum, not jeopardize the policies of the Lavoy ASP and, at best, better serve them.
d) Any variance or discretion exercised or any amendment made shall be fully documented so that the reasons and rationale for the variance or discretion exercised or the amendment are accurately recorded and clearly understood.

Policy 4 Should an owner/developer make repeated applications to amend the Lavoy ASP once it is in effect, the County may undertake or require that the owner/developer undertake an overall review of the Lavoy ASP instead of continuing to entertain individual, isolated amendment applications so that the implications of the revisions to the Lavoy ASP can be considered and evaluated, at a minimum, in the context of the entire Lavoy ASP area and, if warranted, beyond the Lavoy ASP area.

Policy 5 With respect to all new development or any redevelopment in proximity to Highway 16 within the Lavoy ASP, the County will ensure an elevated standard both with respect to landscaping and screening standards as well as architectural appearance. This will be achieved using the various mechanisms at their disposal in the Land Use Bylaw. Pedestrian connectivity shall also be considered as part of any decision being made at the subdivision level.

Policy 6 For the purposes of Section 638 of the *Municipal Government Act*, notwithstanding anything to the contrary, the provisions of the Lavoy ASP, being Bylaw No. 1261-17 and any amendments thereto, serve to refine, articulate, specify and otherwise constitute the provisions of the County of Minburn No. 27 Municipal Development Plan as it applies to the lands within the Lavoy ASP.

Policy 7 Should the County consider it appropriate to do so, a prerequisite of which being the submission of an application to amend the County of Minburn No. 27 Land Use Bylaw and a subdivision application, both of which deemed by the County to be in their complete form with all required tests and supporting information (including a conceptual scheme) consistent with the HLDCR - District, the County may assign the HLDCR - District to and consider subsequent subdivision of a portion or all of the land designated R – Residential Expansion on Map 4, being the Generalized Future Land Use Concept.

Policy 8 All site preparation, public utilities, public roads, pedestrian walkways and any other public facilities/improvements shall be constructed to the satisfaction of the County in accordance with the County's standards.

Policy 9 Subdivision and development permit applications shall comply with the current Alberta Environment & Parks (or its successor) requirements for stormwater management. There shall be no change between pre- and post-development off-site flows except where the application conforms to an approved stormwater management plan approved in conjunction with the County.

Policy 10 Subdivision and development permit applicants shall be responsible for making all necessary arrangements regarding the disposal/management of stormwater off-site and providing to/for the County all required documentation, permission, approvals and/or other forms of authorization from all relevant agencies having jurisdiction in relation thereto.

Policy 11 As a condition of subdivision or development approval pursuant to the Lavoy ASP, the applicant/owner/developer may be required to prepare, at their sole expense, a Traffic

Impact Assessment (TIA), the need, timing and scope of which as determined by the County and Alberta Transportation. The TIA prepared shall be to the satisfaction of the County as well as Alberta Transportation.

Policy 12 Any engineering, requirements or improvements identified in or resulting from the TIA approved by the County and Alberta Transportation, or any other engineering, requirement or improvement specified by Alberta Transportation in relation to Highway 16 as a result of or that is attributable to the development of the Lavoy ASP area must be undertaken to the satisfaction of Alberta Transportation, in consultation with the County, at the sole cost of the applicant/owner/developer.

Policy 13 The County shall pursue whatever actions are deemed appropriate or necessary to secure compliance with the provisions of the Lavoy ASP.

Policy 14 The County may require owner(s)/developer(s) to enter into an agreement with the County as a condition of an approved subdivision or development permit application pursuant to the *Municipal Government Act*.

Policy 15 The County may require caveats, performance bonds, letters of credit, restrictive covenants or any other available mechanisms to secure performance of any requirement stipulated in the provisions of the Lavoy ASP.

Policy 16 Any amendments to the County of Minburn No.27 Municipal Development Plan or Land Use Bylaw required as a result of the adoption of the Lavoy ASP will be undertaken by the County.

Policy 17 The County will monitor the Lavoy ASP on an on-going basis. Notwithstanding, the ASP will be reviewed within five years of being adopted (by 2023).

Policy 18 The County of Minburn No. 27 shall require landowners of the lots affected by the 300m limiting distance around the landfill to obtain approval from the Province for any intensification of use prior to obtaining municipal approval for the same.

APPENDIX A
(not forming part of this Bylaw)

Report

Associated Engineering
GLOBAL PERSPECTIVE. LOCAL FOCUS.

County of Minburn No. 27

Hamlet of Lavoy
Master Servicing Plan

December 2010

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

Associated Engineering Alberta Ltd.
1000, 10909 Jasper Avenue
Edmonton, Alberta, Canada T5J 5B9

TEL 780.451.7666
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www.ae.ca

December 14, 201010
File: 2009-3779.E03.02

Mr. Ryan Hall
Director, Development Services
County of Minburn No. 27
4909 - 50 Street
Box 550
Vegreville, AB T9C 1R6

Re: HAMLET OF LAVOY SUBDIVISION (20 LOTS)
LAVOY, ALBERTA
PROFESSIONAL ENGINEERING SERVICES

Dear Sir:

We are pleased to submit our final report for the Master Services Plan for the Hamlet of Lavoy.

The report contains an assessment of the Hamlet's sewer and water supply systems, to complement the Stormwater Management Master Plan completed previously. The study concludes that the raw water supply system is operating at capacity and should be replaced with a regional line as soon as possible. The existing sewage lagoon has capacity for another 15 homes, at which time the storage cell will need to be expanded and a facultative cell will need to be added.

Associated Engineering sincerely appreciates the opportunity to have assisted you in this project. Should you have any questions or require additional information regarding the report, please do not hesitate to contact the undersigned.

Respectfully Submitted,

ASSOCIATED ENGINEERING ALBERTA LTD.

Larry Bodnaruk, P.Eng.
Project Manager
Discipline Lead - Water Resources

LB/ja

Enclosures

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List of Tables

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ABBREVIATIONS

AC	asbestos cement
AE	Associated Engineering Alberta Ltd.
AEP	Alberta Environmental Protection
CCTV	closed circuit television
PVC	polyvinyl chloride
fps	feet per second
ft^3	cubic feet
ft^3/s	cubic feet per second
ha	hectare
igpad	imperial gallons per acre day
igpm	imperial gallons per minute
ig	imperial gallons
igpcd	imperial gallons per capita day
km	kilometre
kPa	kilopascal
L	Litre
L/s	Litres per second
L/c/d	Litres per capita per day
Lpcd	Litres per capita per day
Lphad	Litres per hectare daily
Lpm^2d	Litres per square metre daily
mm	millimetre
m	metre
m^3	cubic metre
m^3/s	cubic metre per second
m/s	metres per second
m^3phad	cubic metres per hectare daily
usgm	US gallons per minute

List of Photos

1 Introduction

1.1 BACKGROUND

The County of Minburn requested Associated Engineering to prepare a Master Services Plan for the Hamlet of Lavoy. The Hamlet of Lavoy is located south east of Highway 16, within the boundaries of the County of Minburn No. 27, approximately 12 kilometres east of the Town of Vegreville.

Figure 1.1 shows the general outline of the existing Hamlet. The Hamlet includes the following:

- A population of approximately 110 people living in 50 homes;
- 16 lots that have been developed with a building but do not contain occupied dwelling units;
- 37 vacant lots that have been serviced but have not been developed;
- 20 lots that remain to be serviced in the south part of the Hamlet, between 1 Avenue and 2 Avenue, and south of Spruce Street;
- 7 lots in the Block 8 area that have been serviced and are planned to be offered for sale once 3 Avenue and Spruce Street are completed.

The objective of the Master Services Plan is to assess how many lots can be developed with the existing capacity of the sewer and water systems. The assessment will also include a general assessment of the system expansion that would be required to accommodate future growth of the Hamlet as anticipated in the draft Area Structure Plan recently completed in December 2009.

1.2 STUDY AREA

The Hamlet of Lavoy area is comprised of 51 single residential homes, the Antique Collectible Store, and Health Retreat and Spa, Senior's Centre, Community Hall and Public Works yard. There are approximately 110 residents living in the Hamlet at present according to the 2009 draft Area Structure Plan.

The County specified that the Master Services Plan would provide for growth of the Hamlet to a population of 187 people. This would accommodate the following areas:

- 7 lots in Block 8 that were developed in 2009.
- 6 lots in Block B that are yet to be developed.
- 11 serviced lots on the former school site that are yet to be developed (plus Public Works yard which is a minor water user and can be ignored in the analysis).
- 10 infill lots within the currently developed areas.

This growth scenario represents development of 34 additional lots or an additional population of 75 people based on current population densities.

In addition, the ASP provides for the option of developing 8 unserviced lots to the north of Lavoy which would not be connected to the sewer or water distribution systems and therefore can be neglected in the system analysis.

The Area Structure Plan, provided by the County of Minburn (Figure 1.2) represents a long term plan for the Hamlet. In the long term, new developments are planned to the north east of Highway 16. No provision is made in the Master Services Plan for the long term development.

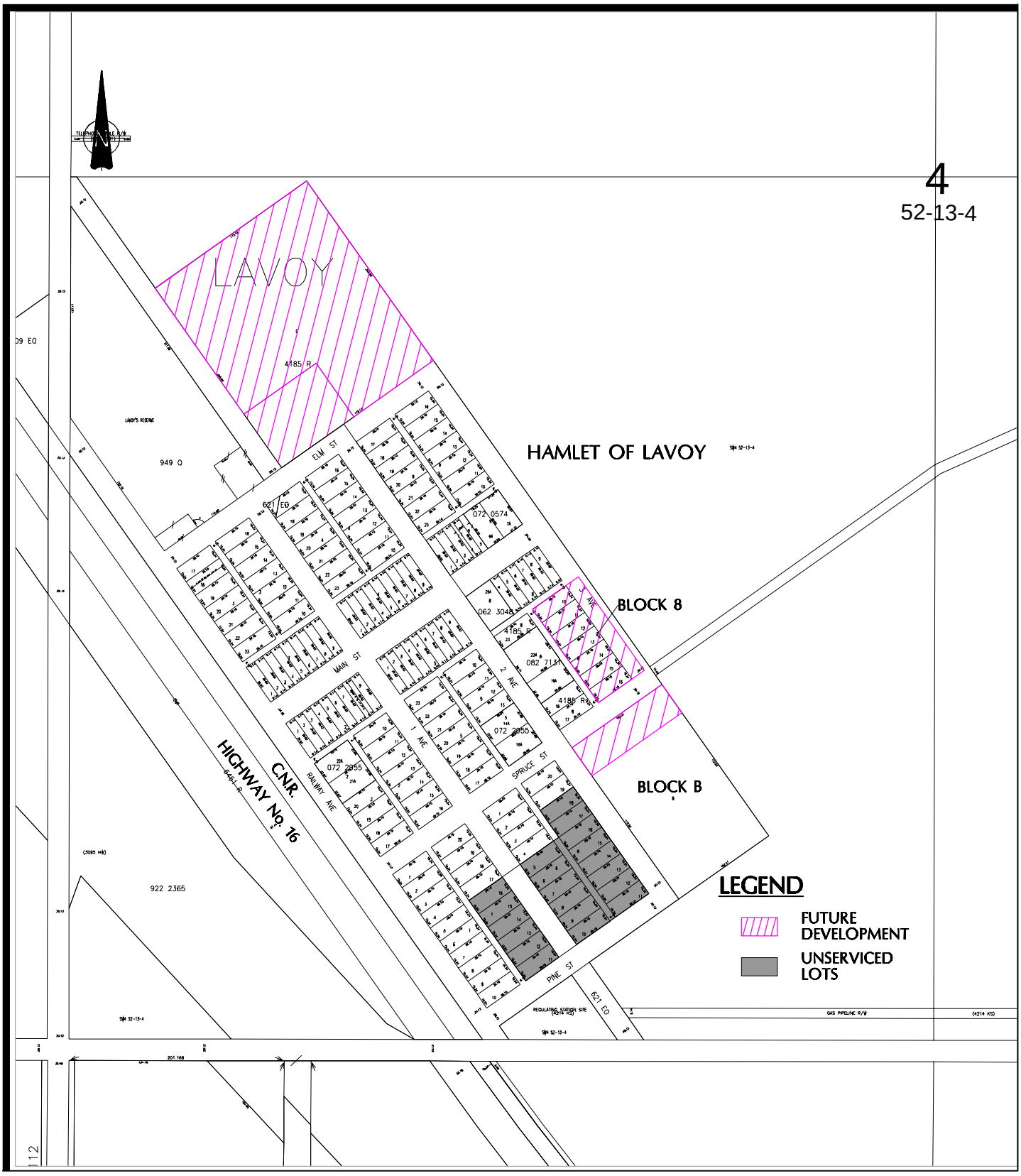
1.3 PROJECT SCOPE

The Master Services Plan will include:

- Review the capacity of the sanitary sewer system using current design standards for the new development and the best estimates of flow rates from the existing developed areas.
- Determine how many lots can be developed with the existing servicing capacity.
- Estimate the increased flow with the proposed infill development.
- Identify whether upgrading is required to service the existing and proposed new development.

The MSP includes a review of the water supply/distribution system to confirm that it has enough capacity for the existing and future development. It includes a review of the source water supply.

Associated Engineering completed a separate review of the overall stormwater management requirements for the Hamlet in 2007 published in the “Hamlet of Lavoy Storm Water Management Plan”, November 2008.



COUNTY OF MINBURN No.27
HAMLET OF LAVOY

MASTER SERVICING PLAN

LOCATION PLAN

SCALE 1 : 5000

Associated Engineering

FIGURE 1.1

Date: Jun 25, 2010
File: P:\20093779\00_Lavoy_Hamlet_MSP\Working_Dwgs\100_Civil\REPORT\DRAFT-REPORT\3779-FG-11.dwg by
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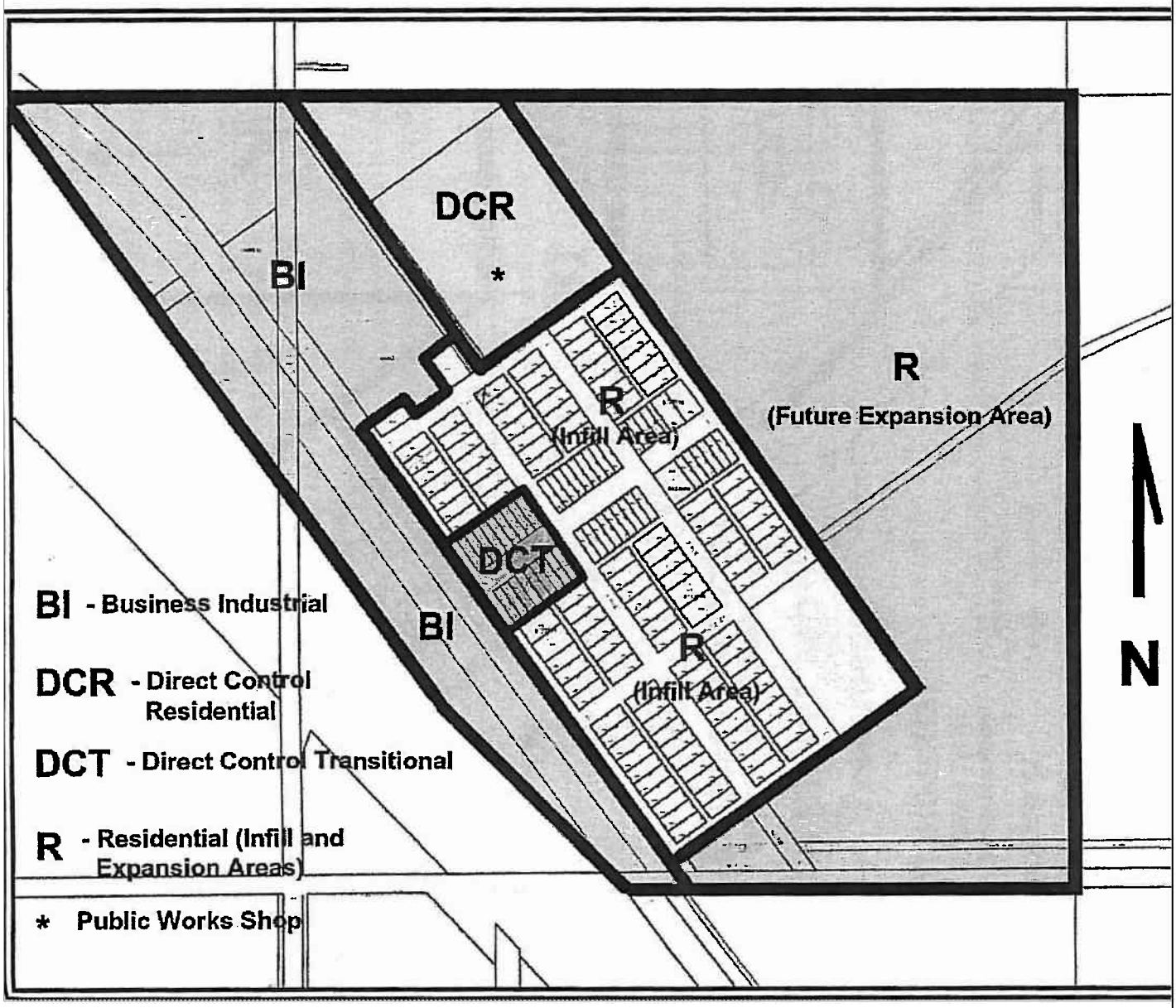


COUNTY OF MINBURN No.27
HAMLET OF LAVOY

MASTER SERVICING PLAN

FUTURE LAND USE PLAN

Associated Engineering

FIGURE 1.2

2 Water Supply and Distribution

2.1 SYSTEM OVERVIEW

The water system for Hamlet of Lavoy consists of the following components (Figure 2.1):

- Raw Water Supply
- Water Treatment Plant (WTP)
- Treated Water Reservoir
- Water Distribution System

2.1.1 Raw Water Supply

Raw water is supplied to Lavoy from three (3) existing wells, located approximately 2 km northeast of the Hamlet. Based on the report by Hydrological Consultants Ltd., "County of Milburn No. 27, Hamlet of Lavoy Groundwater Availability – Phase 3", September 2002, the three water supply wells are licensed by Alberta Environment (AENV) for a total annual diversion of 32,000 cubic metres per year (87.9m^3 /day). Photo 2.1 shows well No. 1.

Photo 2.1
Raw Water Well No. 1

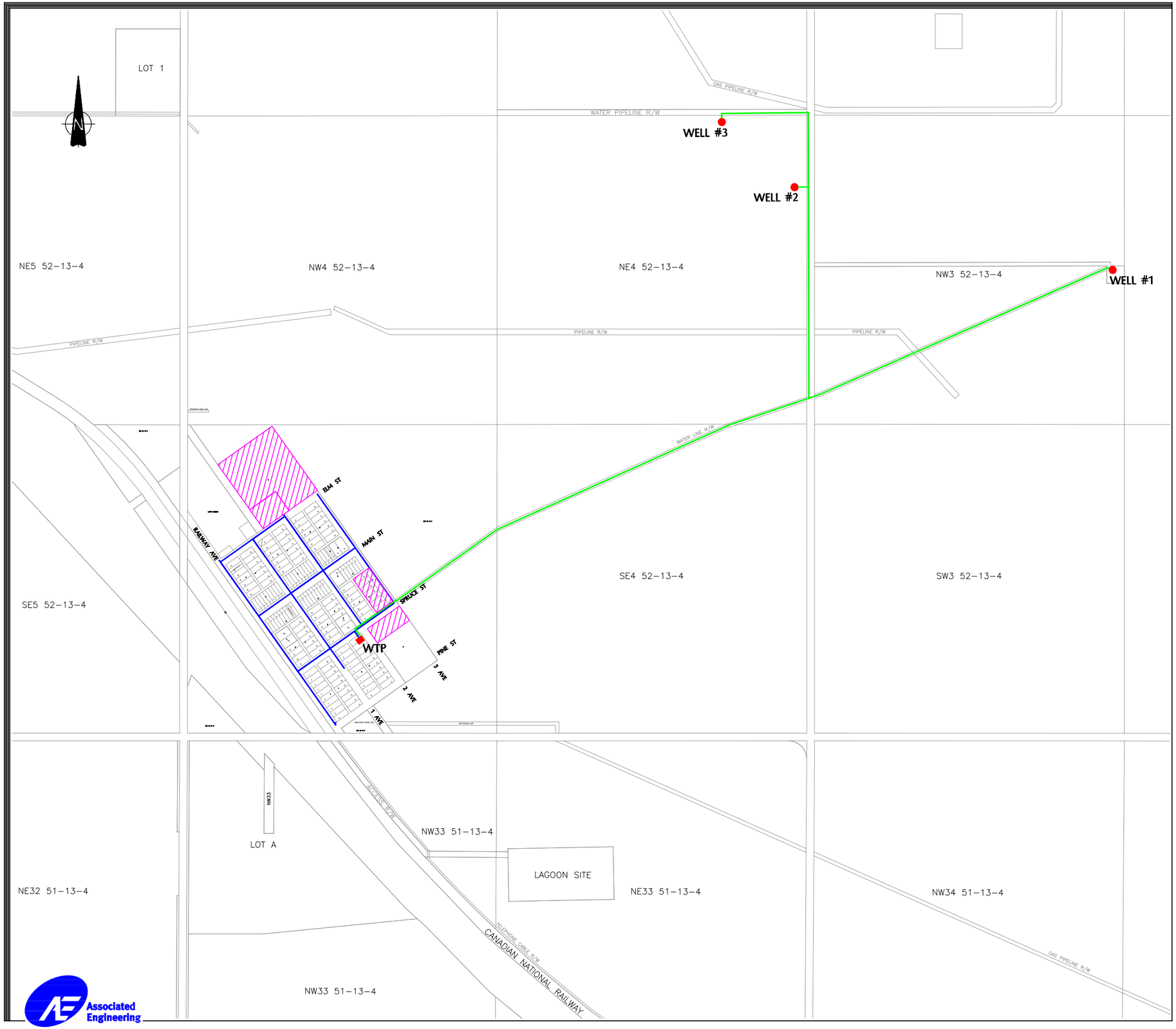
Each well has a submersible pump, which is pumping the raw water through a 75 mm diameter PVC supply water line to the Water Treatment Plant. The wells are controlled remotely by radio from the Water Treatment Plant. The pumps were last upgraded in 2009, with the SCADA radios replaced at the three well sites and a new pump and flow restrictor installed at Well #1.

Each submersible raw water pump has the following characteristics, see Table 2.1.

COUNTY OF MINBURN No. 27
HAMLET OF LAVOY

MASTER SERVICING PLAN

EXISTING WATER SYSTEM



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Xrefs: 3779-RT-01

Associated Engineering

LEGEND

- EXISTING 75mmø WATERMAIN
- EXISTING 150mmø WATERMAIN
- INFILL LOTS

SCALE : 1 : 10,000

DECEMBER, 2010

FIGURE 2.1

Table 2-1
Raw Water Supply – Pumping Capacity

Item No.	Location	Pumping Capacity	
		(L/s)	m^3/d
1	Well No. 1 – Pump 1	0.27	23.7
2	Well No. 2 – Pump 2	0.34	29.2
3	Well No.3 – Pump 3	0.24	20.7
4	Total	0.85	73.6

2.1.2 Water Treatment Plant

The Water Treatment Plant is located in the south-east part of Lavoy. The plant includes the following:

- One (1) package water treatment plant
- Two (2) treated water reservoirs (the main reservoir plus the smaller clearwell which is also the pumpwell)
- Two (2) distribution pumps

The Water Treatment Plant is an in-line package, comprised of the following:

- Chemical feeders
- Mixer
- Iron removal filter
- Backwash system.

There are two (2) treated water reservoirs

- Clearwell Reservoir No. 1
- Reservoir No. 2

The Clearwell Reservoir No. 1 is located below the water treatment plant building and the Reservoir No. 2 is located to the south of the water treatment plant building (Photo 2.2).

Photo 2.2
Reservoir No. 2

The total storage capacity of the two reservoirs is shown on the following table:

Table 2-2
Treated Water Reservoir Capacity

Item No	Description	Volume (m^3)
1	Clearwell No. 1	94.5
2	Reservoir No. 2	338.6
3	Total	433.1

The two distribution pumps are vertical turbines, WilronCrown Model S6-80 ten-stage pumps (Photo 2.3).

Photo 2.3
Existing Distribution Pumps

The pumps have Selector Switches that will allow alternating the Lead pump.

The Lead pumps will run continuously. The Lag pump may be started manually if a high demand situation occurs.

The capacity of each of the pumps is shown in the following table:

Table 2-3
Pumping System Capacity

Item No.	Description	Status	Capacity
1	Lead Pump*	ON	3.8 L/s @ 345 kPa (50 psi)
2	Lag Pump*	OFF	3.8 L/s @ 345 kPa
Combined	Both Pumps Running	ON	7.6 L/s @ 345 kPa

* The two pumps have Selector Switches that will allow the operator to alternate the Lead pump. The alternation is done weekly.

The Pump Curve is shown in Appendix A.

2.1.3 Water Distribution System

The water distribution system is comprised of 150 mm diameter AC (asbestos cement) pipes that convey water from the Water Treatment Plant throughout the Hamlet of Lavoy. The system was installed in 1979 to provide services to what was then the Town of Lavoy. The water distribution system was upgraded in 2003 to replace curb cocks and add a loop on Elm Street.

Figure 2.2 shows the overall water distribution system in the Hamlet.

System pressures are controlled with a pressure-reducing valve (PRV) located at the water treatment plant.

2.2 DESIGN CRITERIA

2.2.1 References

The design criteria have been adopted from:

- Hamlet of Lavoy – record data
- Alberta Environment Standards and Guidelines for “Municipal Waterworks, Wastewater and Storm Drainage Systems”, December 1997.

2.2.2 Population

One of the variables in assessing the water system of a community is the population. The population will:

- Determine the quantity of water consumed;
- Have an impact on the peaking hour;
- Have an impact on the distribution system based on population density;
- Determine the requirement for fire flows.

The projected population is summarised in the following table:

COUNTY OF MINBURN No. 27
HAMLET OF LAVOY

MASTER SERVICING PLAN

EXISTING WATER DISTRIBUTION SYSTEM

LEGEND

- EXISTING 75mmø WATERMAIN
- EXISTING 150mmø WATERMAIN
- EXISTING HYDRANT
- EXISTING VALVE
- PROPOSED 200mmø WATERMAIN
- PROPOSED HYDRANT

SCALE : 1 : 2,500

DECEMBER, 2010

FIGURE 2.2

Associated Engineering

Time: 9:53am
Date: Dec 13, 2010
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Xrefs: 3779-RT-01

Table 2-4
Projected Population

Item No.	Description	Added Land Use	Population Density	Cumulative Population
		Residential (Homes)	Residential	
1	Existing	51	2.2 people per household*	112
2	Future	34	2.2 people per household	75
3	**Total**	**85**		**187**

* The population density was determined based on the existing population divided by the lot numbers.

The data indicates full development would increase the population to about 187 people.

2.2.3 Water Demand

Water demand is critical in determining the distribution network, pumping capability and storage required for water system.

There are three (3) critical rates of demand normally used:

- Average Day
- Peak Day
- Peak Hour

Fire flows in conjunction with the peak day are used to test the water system capability to deliver water and meet the system demand.

2.2.4 Average Day

The Average Day demand is determined by dividing the total annual consumption by 365 days. By dividing this rate by the population served, the “Per Capita Per Day Demand” is derived. This rate is used primarily as a basis for the projection of the total water demand.

An average day demand of 365 L/c/d will be used for the study. Historical water distribution pumping records for 2003 to 2008 were provided by the County of Minburn and have been summarized in Appendix B. The analysis shows that for the period from 2003 to 2009, the average raw water supply to the Hamlet was 375 litres per person per day (L/c/d). It includes the filler backwash at the water treatment plant which accounts for about 10% of the daily total raw water supply.

2.2.5 Peak Day

The Peak Day demand is the single day of maximum consumption observed in the distribution system. In using the single day maximum flow, one must ensure that the record is not distorted by fire fighting demand, equipment malfunction or watermain breaks. To project the future peak demand, a peak day to average day ratio is used. The Peak Day demand is used in determining the delivery capacity required of the raw water supply mains, treatment facilities, storage facilities, transmission main and pumping facilities at the raw water treatment plant. This demand with the fire flow is used to test the water system's capacity.

Based on the historical water records (see Appendix A), the ratio of peak day flow to average day flow is approximately 1.85. This peak flow factor is fairly close to most recommended peak day factor in a water system (2.0) observed in many communities. Therefore, for the purpose of this report, the Peak Day demand of 2 times the Average Day will be used.

ie, P.D. = A.D. x 2.0

2.2.6 Peak Hour

The Peak Hour demand is the expected maximum demand observed during a short period of the day. Usually, most facilities are not equipped to record peak hour demands in such detail. Therefore, the rate is established based on experience and judgement. The Peak Hour rate is used in determining water main sizing and pumping requirements.

For Peak Hour a peaking factor of 2.0 times Peak Day, or 4.0 times Average Day, will be used.

ie, P.H. = A.D. x 4.0

The following table summarizes the water demand for the Hamlet of Lavoy:

Table 2-5
Projected Water Demand

Description	Units	Existing	Future
No. of Lots		51	85
Density	people/lot	2.2	2.2
Population	people	112	187
Consumption	l/c/d	365	365
Avg. Day	l/s	0.47	0.79
	m^3/d	40.9	68.26
PEAK DAY 2 x (AD)	l/s	0.95	1.58
	m^3/d	81.8	136.51
PEAK HOUR 4 x (AD)	l/s	1.89	3.16
	m^3/d	163.5	273.02

2.2.7 Fire Flows

The Table 2.6 gives the flow required in accordance with the suggested values by the Fire Underwriters Survey, a national organization that provides fire risk data to 85% of the insurance companies of Canada:

The suggested flows, based on Fire Underwriter's Guidelines are determined as follows:
$F = 220\ C\sqrt{A}$ where:

F = required fire flow in litres per minute
C = 1.5 for wood frame construction
= 1.0 for ordinary construction
= 0.8 for non-combustible construction
= 0.6 for fire flow resistant construction (fully protected frame, floors, roof)
A = total floor area in square metres (including all storeys)

Other considerations when determining the fire flow requirements are:

- Occupancy hazard
- Automatic sprinkler protection

- Exposure within 45 metres

Based on the largest building in Lavoy, the Health Retreat and Spa, the recommended fire flow is 4,400 L/min or 73.3 L/s.

Table 2-6
Fire Flows

Description	Recommended Fire Flow	
	Litres/Minute	Litres/Second
1. Single Family Residential Wood Frame construction, two stories or less		
100 m^2 to 150 m^2	5,000	83
150 m^2 to 275 m^2	6,000	100
2. Multi Family Residential Wood frame construction c/w fire separator		
Four units up to 100 m^2 each	8,000	133
3. Walk-up Apartments Ordinary construction up to 3,200 m^2 (10-20 m separation)	12,000	200
4. Schools Non-combustible construction (15% exposure)		
Up to 3,300 m^2	10,000	167
Up to 4,000 m^2	11,000	187
Up to 12,000 m^2	19,000	317
5. Institutional, Churches Ordinary construction (15% exposure) up to 850 m^2	6,000	100
6. Commercial Non-combustible construction (5 % exposure)		
Up to 2,900 m^2	11,000	183
Up to 4,200 m^2	14,000	233
7. Light Industry Non-combustible construction		
Up to 2,900 m^2 (25% exposure)	9,000	150
Up to 2,900 m^2 (50% exposure)	11,000	193
8. Low Density Rural Residential 2 stories or less over 30 m separation	2,000	33
9. High Density Rural Residential 2 stories or less 10.1 to 30 m separation	3,000	50

2.2.8 Operating Pressure

The principle requirement to be considered in the water distribution system is the operating pressure.

The recommended normal system operating pressures are:

- Minimum pressure at peak demand 350 kPa
- Maximum system pressure 650 kPa

The minimum system pressures during a fire event are:

- Residential pressure at demand hydrant 140 kpa
- Zone pressure with or without sprinklers 280 kPa

The minimum recommended pipe diameters are:

- Single family residential 200 mm
- Multi family development 250 mm
- Industrial/Commercial 300 mm

As noted previously, the water distribution system in Lavoy is composed of 150 mm pipes which are smaller than the minimum size normally recommended for fire flow requirements.

2.2.9 Hydrant Spacing

Based on the Fire Underwriters Survey the maximum recommended spacing of hydrants is as follows:

- Single Family 180 m (90 m radius)
- Multi Family 90 m (45 m radius)
- Commercial 110 m (55 m radius)

2.2.10 Water Storage

It is good practice to provide adequate storage in a water system for operational needs (peak hour), supply interruption and fire flow demand. Design guidelines vary depending on the size of the community and the capital cost involved. Alberta Environment guidelines require:

- Equalization storage (peak hour demand); 25% of maximum daily flow
- Emergency storage (in event of supply interruption): 15% of average daily flow

- Fire storage: 73.3 L/s for 1.75 hours duration fire flow, or a total volume of 462 m^3

The water storage requirement based on the fire flows and projected population is shown in the following table.

Table 2-7
Minimum Water Storage Requirement (per Alberta Environment)

AEP	Existing (m^3)	Future (m^3)
15 % Average Day	6	10
25 % Peak Day	20	34
Fire Storage	462	462
Total Storage *	488	506

Water storage requirements for systems with long supply lines or distances from the source of water are at a higher risk of supply interruption. In those cases, common practice is to provide one (1) peak day plus fire storage.

As the Hamlet of Lavoy reservoir is filled via a long supply main, it is recommended to adopt the one peak day plus fire storage criteria.

Table 2-8
Recommended Water Storage - One Peak Day Plus Fire Flow

Item	Existing (m^3)	Future (m^3)
Peak Day (m^3)	80	137
Fire (m^3)	462	462
Total (m^3)	542	599

Note that the existing system has 433 m^3 of storage capacity which is less than the recommended minimum of 542 m^3 for existing development based on fire flow plus peak day demand.

2.2.11 Pipe Roughness Coefficient ("C" value)

The following "c" values for various pipes, used in the hydraulic model to assess pipe flow, were adopted:

- PVC 130 (PVC New=140)
- Asbestos Cement (AC) 110

2.2.12 Pipe Velocity

Water velocity is the main criteria in pipeline design. Sudden changes in velocity can create pressure surges and possibly negative pressure, which can raise serious pipe (equipment) damage. Increased velocities require higher pumping heads, hence higher energy costs.

The recommended maximum velocity is 1.5 m/s in polyvinylchloride, asbestos, cement, and polyethylene pipes. Higher velocities can be safely used in steel and ductile iron pipelines, provided proper surge allowance and surge suppression is provided.

2.3 SYSTEM ASSESSMENT

2.3.1 Raw Water System Assessment

The three water wells are the source of raw water supply to the water treatment plant.

The projected raw water demand, based on historic data, is shown in the following table.

Table 2-9
Raw Water Demand Assessment

Item No	Demand Type (m^3/d)	Existing Licensed Withdrawal* (m^3/d)	Estimated Well Capacity (m^3/d)	Peak Day Water Demand (m^3/d)	
				Existing	Future
1	Average Day	87.9	49.0*	40.2	68.3
2	Peak Day	180	80.7**	80.3	136.5
3	Assessment			OK	Upgrade

*Existing Licensed Withdrawal volume and Long-Term Yield are based on Hydrological Consultants Ltd., County of Minburn No. 27 – Hamlet of Lavoy 052-13 W4M, Groundwater Availability Phase 3, September 2002, report.

**Estimated from recent pump and water level data.

Data provided by the County indicates that there may be a leak in the distribution system which has recently increased the water supply rates by about 35%. Figure 2.3 shows a time plot of the actual water supply rates in Lavoy reconstructed from data from the County's SCADA system. The data indicate a historic demand from the hamlet of about 40 m^3/d, which has increased to about 55 m^3/d in recent months. The recent demand is less than the licensed withdrawal (88 m^3/d) but higher than most recent estimate of long term yield (in 2002) of 49 m^3/d.

Review of the water level data indicates that Wells 2 and 3 are operating at capacity. Well 2 is exceeding its licensed rate. Water levels in Well 1 are being drawing down to about 15 m above the pump (50 m below static level) which suggests that pumping rates from Well 1 could potentially be increased.

As shown in Figure 2.3, the metered data (sum of all water meters in Lavoy) indicate an average consumption of about 22 m^3/d which is about 50% of the total raw water usage. This suggests either that significant leakage is occurring or that there is significant un-metered water usage.

The assessment of the existing submersible pumps is shown in the Table 2-10:

Table 2-10
Submersible Pump Capacity Assessment

Item No.	Description	Licensed Maximum Pump Rate (L/s)	Pump Capacity (L/s)	Peak Day Demand (L/s)	
				Existing	Future
1	Pump 1 Well # 1	1.21	0.27		
2	Pump 2 Well # 2	0.61	0.34		
3	Pump 3 Well # 3	0.30	0.24		
4	Total	**2.12**	**0.85**	0.95	1.58
5	Assessment			Upgrade	Upgrade

*Submersible Pump Peak Day Demand = Peak Day + 10 % (AD)

Based on the above table, the submersible pumps do not have capacity to meet the existing peak day demand.

The analysis indicates that the existing raw water supply system does not have capacity to meet peak day demands of the existing population, which will place additional demand on the Hamlet's water storage reservoir. The County anticipates being supplied with a regional line from Vegreville within the next two years, which will resolve its raw water supply issues. Meanwhile, we recommend that the County search for and repair the suspected leak in their water distribution system to reduce the raw water demand.

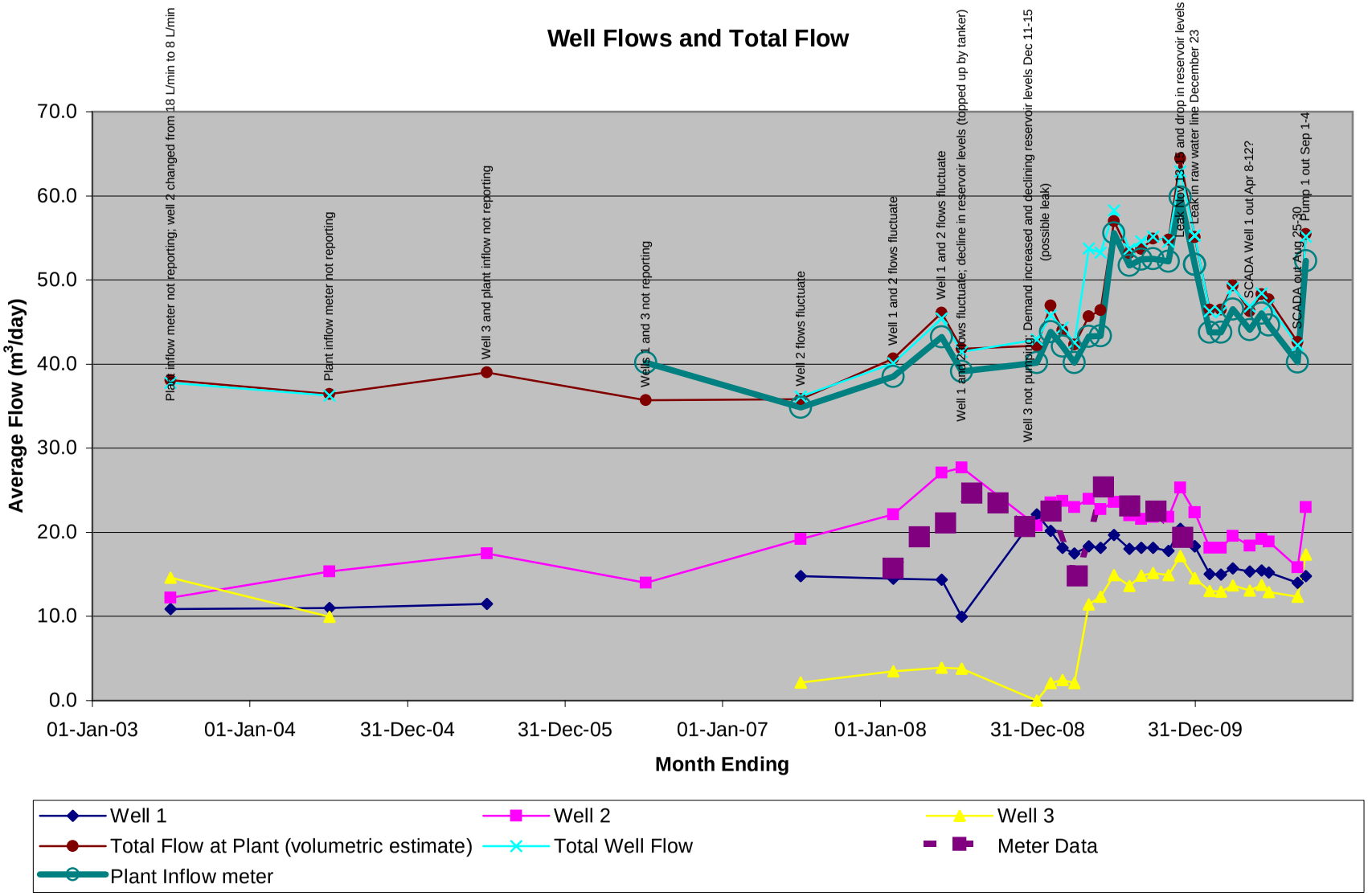


FIGURE 2.3
HISTORIC RAW WATER
SUPPLY TRENDS IN LAVOY

P:\20093779\00_Lavoy_Hamlet_MSP\Engineering\01.00_Background_Data_Collection\water supply\
summary_2009.xlsFlows

2.3.2 Water Storage Reservoir Assessment

The assessment of water storage is shown on the following table:

Table 2-11
Water Storage Reservoir – Assessment

Item No.	Description	Existing Capacity (m^3)	Storage Volume Required	
			Existing (m^3)	Future (m^3)
1	Clearwell No. 1	94.5		
2	Reservoir No.2	338.6		
Total	Clearwell No. 1 + Reservoir No.2	433.0	488 minimum 542 recommended	506 minimum 599 recommended
Assessment			Upgrade	Upgrade

Based on the above table the existing storage reservoir does not have sufficient capacity to meet current design standards for fire storage (Tables 2.7 and 2.8). The existing capacity is about 10% less than the minimum required by Alberta Environment. An additional capacity of at least 166 m^3 would be required to provide the recommended storage capacity for fire flow for a population of 187 people, an increase of about 38% above the present capacity.

As will be demonstrated below, the water distribution system also does not have the capacity to supply fire flows. However, the County has a system in place to provide the initial attack of a fire in the same manner as a fire elsewhere in the County. Initially it would be supported with water supplied from the reservoir. Ultimately, if the reservoir is exhausted or the pipe system fails, water would be supplied with tanker trucks.

Aside from fire storage, the reservoir has adequate capacity for existing and projected populations beyond 187 people.

2.3.3 Water Distribution Pumps Assessment

The water distribution pumps should meet peak hour demand. The assessment of the pumps capacity is shown in the following Table 2.12. Performance curves for these pumps are illustrated in Figure 2.4.

Figure 2.4
WATER TREATMENT PLANT
PUMPS CURVE AND FLOW CAPACITY

Head	Distribution Pumps (l/s)		
TDH(m)	PMP-1	PMP-2	PMP-1 + PMP-2
57.3	0	0	0
50.3	1.58	1.58	3.16
45.7	3.15	3.04	6.19
42.4	3.79	3.79	7.58
32.9	4.73	4.73	9.46
23.6	6.31	6.31	12.62

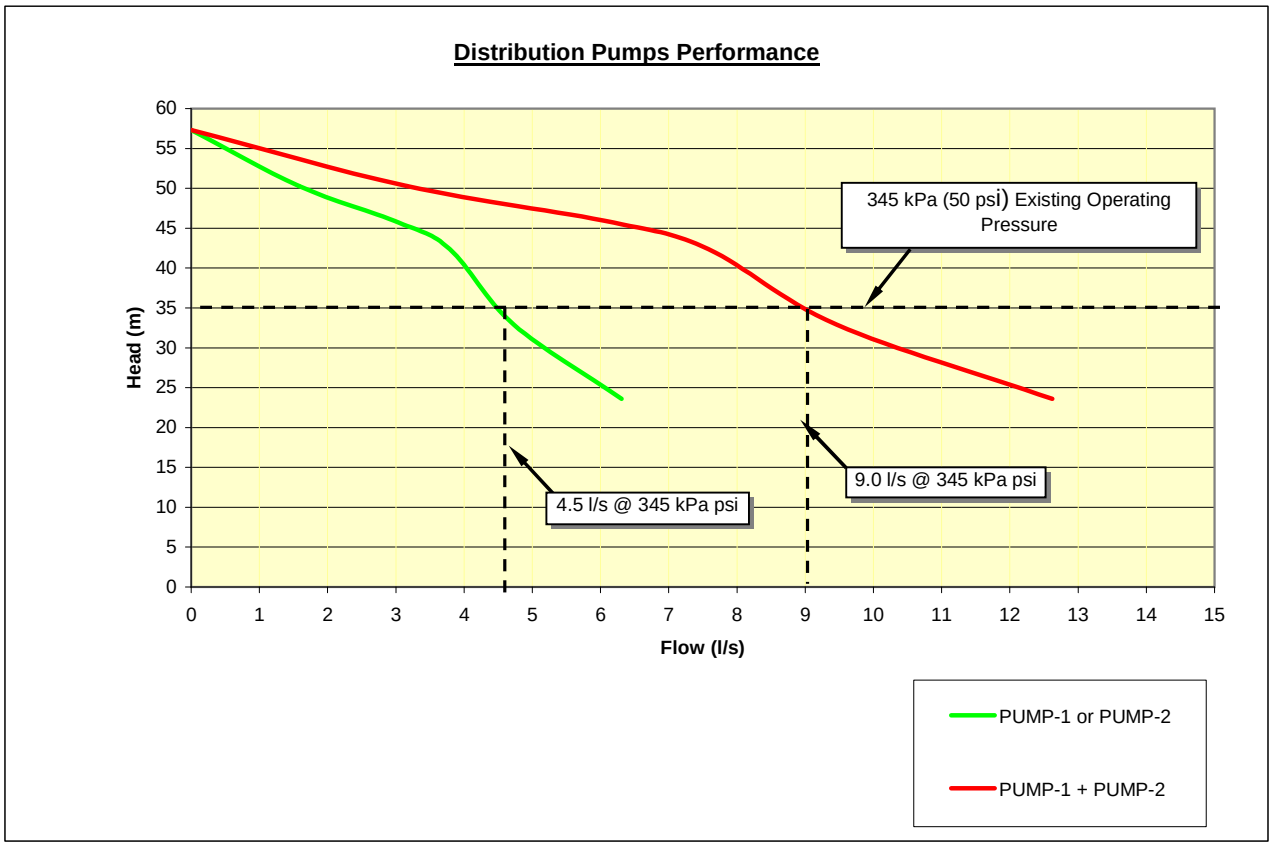


Table 2-12
Pumping System Capacity Assessment

Item No.	Description	Pump Capacity @ 345 kPA (50 psi)	Peak Hour Demand (L/s)	
			Existing	Future
1	Lead Pump	4.5		
2	Lag Pump	4.5		
3	Total Capacity	9.0	1.89	3.16
4	Assessment		OK	OK

The above table shows that the existing pumps can satisfy existing and future peak hour demand. They are not capable of supply fire flow demands of 73 L/s.

A fire pump would be required to provide fire flow demand.

2.3.4 Water Distribution System Assessment

The water distribution system within the study area was assessed using WaterCAD, an AutoCAD based modeling software. All the components of the system required to run the model were entered. These components are:

- Storage reservoir
- Pumps
- Control valves
- Distribution mains

The system was assessed for following scenarios for the existing conditions and future (based on the Area Structural Plan):

- Peak Day
- Peak Hour
- Peak Day plus Fire

2.3.4.1 Normal Operating Conditions

Model results show that the existing water system is adequate to meet the peak day and peak hour demands. However, it can not meet the minimum recommended 50 psi everywhere in the system. To meet this target would require increasing the set point at the plant to 55 psi (380 kPa), which could increase the risk of leaks and increased water usage, and is not recommended until the raw water issues are resolved.

2.3.4.2 Fire Flows

The existing water system does not have the capacity to provide fire flows, mainly due to the absence of a fire pump and the existing 150 mm diameter pipes. The existing pumps have a maximum capacity of approximately 10 L/s with an operating pressure of 140 kPa (20 psi), the minimum recommended in the event of a fire.

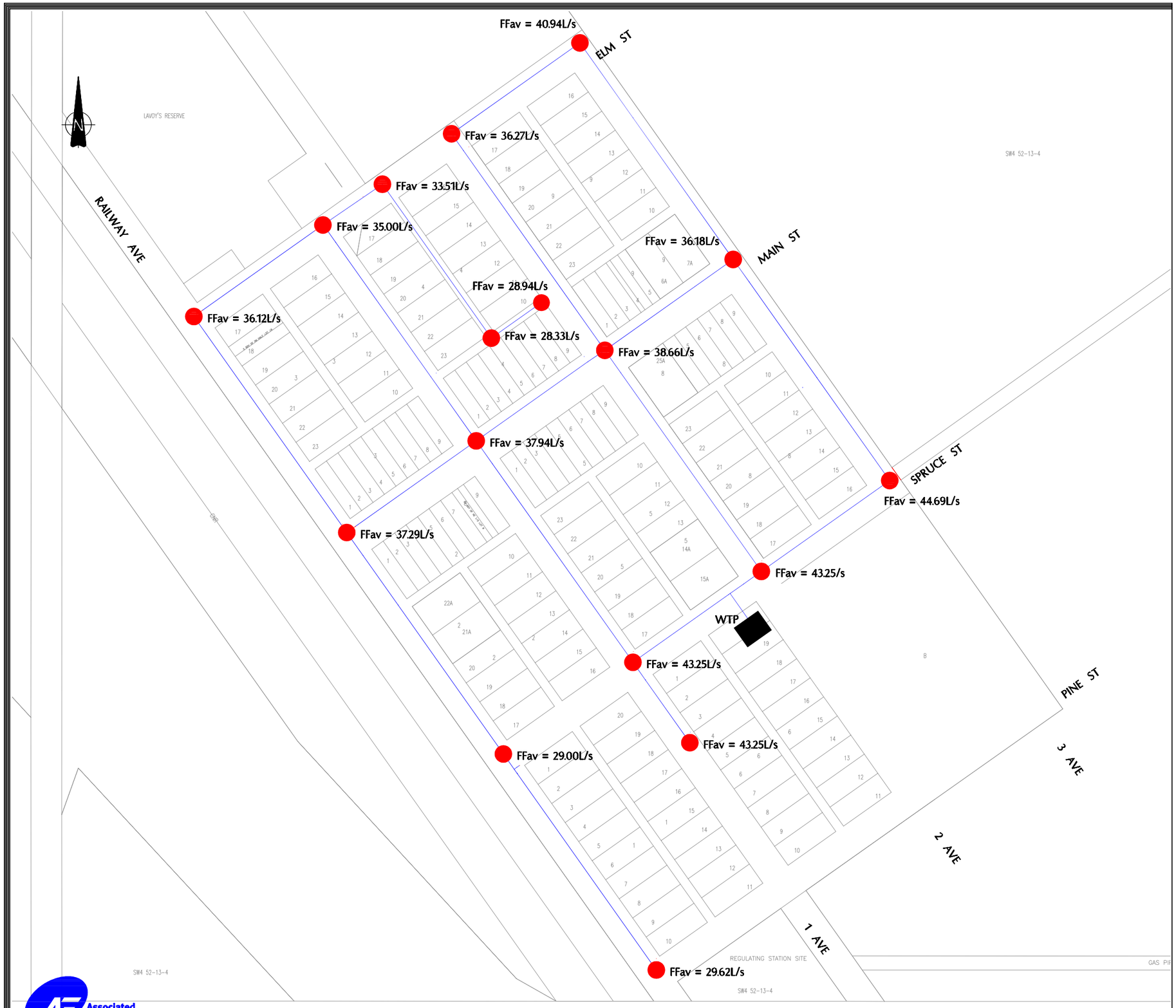
Addition of a fire pump, without upgrading the pipe system, would increase the fire flow capacity to approximately 30 to 50 L/s, depending on location, as shown in Figure 2.5. Operating pressures would need to be limited to a maximum of 55 psi at the plant and a minimum of 20 psi at the hydrant.

Upgrading the pipe system, as shown in Figure 2.6, in addition to installation of a fire pump, would be required to provide the Fire Underwriters' recommended fire flow of 73 L/s. Based on the current design standards, the minimum recommended pipe diameter in a water system is 200 mm.

The analysis demonstrates that extensive upgrading of water mains and addition of a fire pump would be required to provide the fire flow recommended by current standards. The existing system can supply about 20% of the recommended flow, which could be increased to about 50% by addition of a fire pump at the plant.

2.3.5 Hydrant Spacing Assessment

Figure 2.7 show that the existing hydrants are providing sufficient coverage for the existing development. However, their capacity is limited by pump and distribution system capacity as noted above.



COUNTY OF MINBURN No. 27
HAMLET OF LAVOY

MASTER SERVICING PLAN

AVAILABLE FIRE FLOW WITH EXISTING WATER SYSTEM AND PROPOSED FIRE PUMP

LEGEND

———	EXISTING 150mmØ WATERMAIN
○	SATISFY FIRE FLOW DEMAND
●	DOES NOT SATISFY FIRE FLOW DEMAND
FFav	FIRE FLOW AVAILABLE
P	PRESSURE (psi)

NOTE : FOR OPERATING PRESSURE OF
345kPa (50psi) AT THE WTP
AND 138kPa (20psi) AT THE HYDRANT

SCALE : 1 : 2,500

DECEMBER, 2010

Associated Engineering

FIGURE 2.5

Time: 9:54am
Date: Dec 13, 2010
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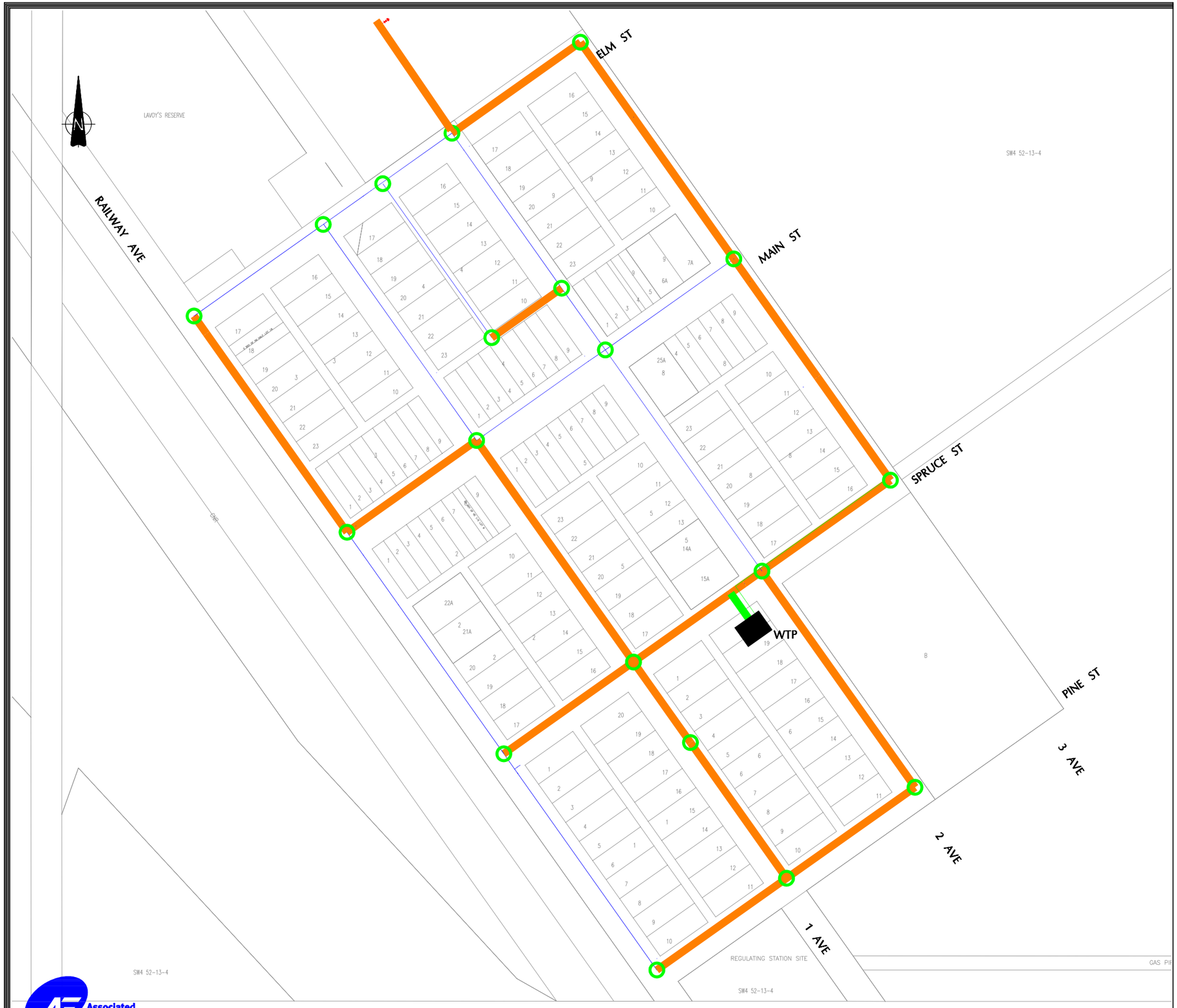
Xrefs: 3779-RT-01



COUNTY OF MINBURN No. 27
HAMLET OF LAVOY

MASTER SERVICING PLAN

EXISTING WATER DISTRIBUTION PEAK DAY PLUS FIRE FLOW SYSTEM UPGRADES

LEGEND

- EXISTING 150mmø WATERMAIN
- PROPOSED 200mmø WATERMAIN
- PROPOSED 250mmø WATERMAIN
- SATISFY FIRE FLOW DEMAND

SCALE : 1 : 2,500

DECEMBER, 2010

FIGURE 2.6

Associated Engineering

Time: 9:54am
Date: Dec 13, 2010
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Xrefs: 3779-RT-01

COUNTY OF MINBURN No. 27
HAMLET OF LAVOY

MASTER SERVICING PLAN

WATER DISTRIBUTION SYSTEM
HYDRANT COVERAGE

LEGEND

- EXISTING 75mmø WATERMAIN
- EXISTING 150mmø WATERMAIN
- EXISTING HYDRANT
- EXISTING VALVE
- EXISTING HYDRANT COVERAGE AREA (R = 90m)
- PROPOSED 200mmø WATERMAIN
- PROPOSED 250mmø WATERMAIN
- PROPOSED HYDRANT
- PROPOSED VALVE

SCALE : 1 : 2,500

DECEMBER, 2010

Associated Engineering

FIGURE 2.7

Time: 9:55am
Date: Dec 13, 2010
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Xrefs: 3779-RT-01

3 Sanitary Sewer System

3.1 SYSTEM OVERVIEW

The Hamlet of Lavoy sanitary sewer system (Figure 3.1) consists of:

- Wastewater gravity collection system
- Stabilization Lagoon Sewage Treatment Facility

3.1.1 Wastewater Gravity Collection System

The wastewater collection system is a network of 200 and 250 mm pipes that is drained by gravity to the existing lagoon located south of the Hamlet of Lavoy, (Figure 3.1). Record drawings show the 250 mm pipes to be PVC, but do not indicate the material used for the smaller line pipes.

3.1.2 Stabilization Lagoon Sewage Treatment Facility

Based on the "Record Drawings" provided by the Hamlet of Lavoy, the existing lagoon was constructed in 1976 and is comprised of a single storage cell. The lagoon has a storage capacity of 21,000 m^3 at an operating depth of 1.53 m.

3.2 DESIGN CRITERIA – SANTITARY SEWER SYSTEM

3.2.1 Population

For total population and population densities see Table 2.4.

3.2.2 Domestic (Dry-Weather) Flow

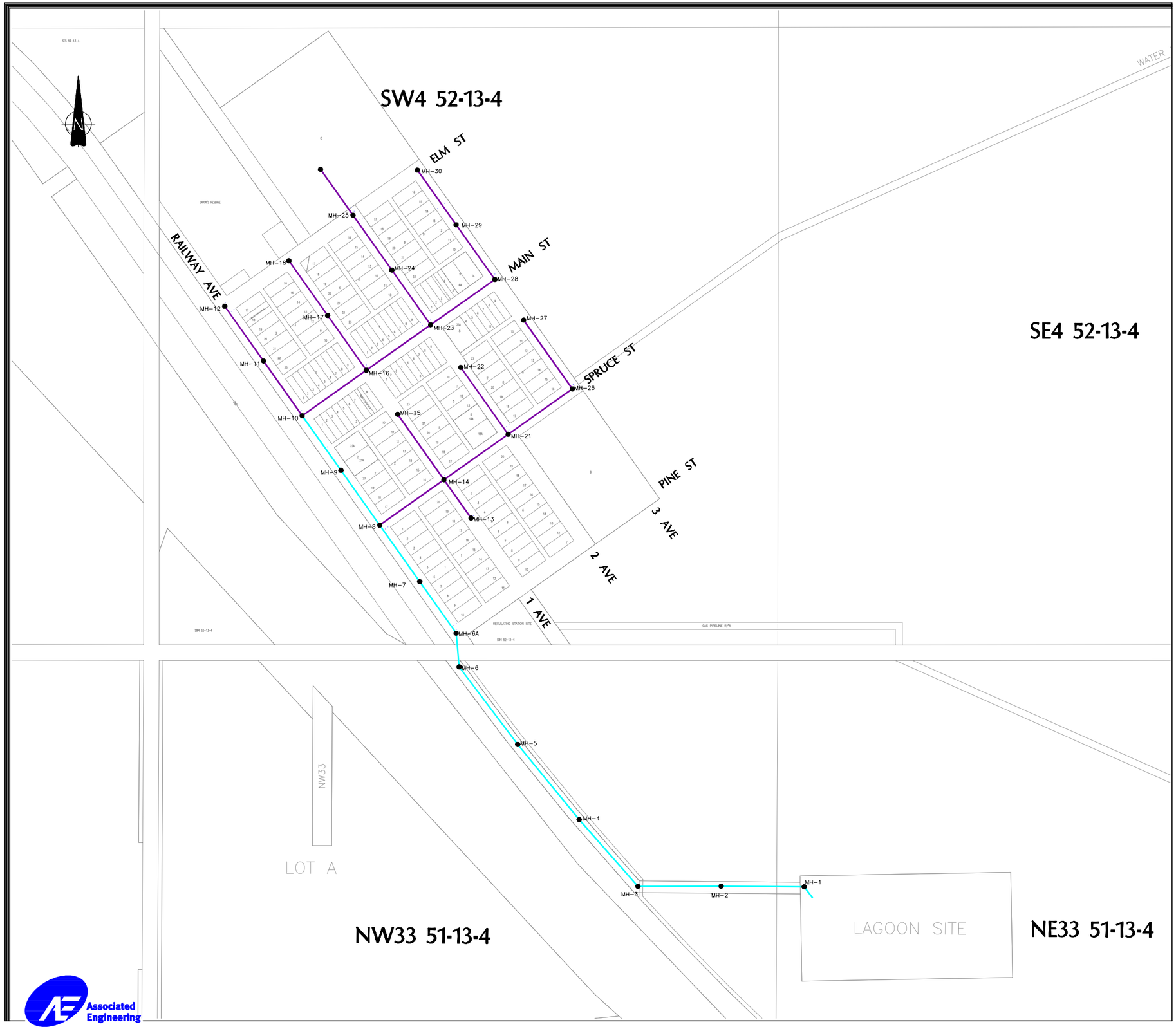
A domestic sanitary sewer contribution of 400 L/c/d will be used. This number includes the population water consumption plus the backwash water from the Water Treatment Plant, which discharges into the sanitary sewer system. Sewage flows for the Health Retreat and Spa were determined from actual water meter records.

3.2.3 Peaking Factor

Harmon's formula will be applied to calculate the Peaking Factor, PF

$$PF = 1 + \frac{14}{4 + \sqrt{p}}$$

Where p = population in thousands



COUNTY OF MINBURN No. 27
HAMLET OF LAVOY

MASTER SERVICING PLAN

EXISTING SANITARY SEWER SYSTEM

LEGEND

EXISTING 200mmØ SANITARY SEWER

EXISTING 250mmØ SANITARY SEWER

SCALE : 1 : 5,000

DECEMBER, 2010

FIGURE 3.1

Associated Engineering

Time: 9:56am
Date: Dec 13, 2010
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Xrefs: 3779-RT-01

The peaking factor is limited to a maximum value of 3.8.

3.2.4 Wet Weather Flows (WWF) Infiltration

Based on Alberta Environment guidelines for wastewater system a general allowance of 0.28L/s/ha should be applied for infiltration flow into pipes and manholes.

In addition, a separate allowance of 0.04 L/s/ha for inflow to manholes located in street sags should be added and 0.60 L/s/ha where weeping tiles are connected to the sanitary sewer.

3.2.5 Sewage Flow Formula

For gravity sewers the Manning's equation formula will be used to calculate pipefull capacity:

$$Q = \frac{AR^{2/3} S^{1/2}}{n}$$

Q = design flow population in m^3/s
A = cross-sectional area in m^2
R = hydraulic radius (area/welted perimeter) in m
S = slope of hydraulic grade line in m/m
N = roughness coefficient

Roughness coefficient will be 0.013 for all smooth walled pipes of approved material.

Ideally, sanitary sewers are designed to flow at a maximum depth of 80% of pipe diameter, which corresponds to a discharge rate of 86% of pipefull capacity, to provide a factor of safety against surcharging.

3.2.6 Velocity

Velocities for the sanitary sewer system should be as follows:

- Minimum = 0.6 m/s
- Maximum = 3.0 m/s

3.2.7 Stabilization Lagoon Sewage Treatment Facility

The minimum design standards for wastewater lagoons are a function of the average daily design flow, and are summarized in Table 3.1.

Table 3-1
Wastewater Lagoon Requirements - AEP

Average Daily Design Flow (m^3/d)	No. of Anaerobic Cells (2 days storage)	Requirements for Facultative Cell(s) (60 days storage)	Requirements for 12 Months Storage Cell(s) (365 days storage)
Less than 250	0 Min. Depth = 3.0 m	Yes Max. Depth = 1.5 m	Yes Max. Depth = 3.0 m
250 – 500	2 Min. Depth = 3.0 m	Yes Max. Depth = 1.5 m	Yes Max. Depth = 3.0 m
Greater than 500	4 Min. Depth = 3.0 m	Yes Max. Depth = 1.5 m	Yes Max. Depth = 3.0 m

3.3 SANITARY SEWER SYSTEM - ASSESSMENT

3.3.1 Wastewater Gravity Collection System - Assessment

Table 3.2 provides the calculated peak flows compared with pipe capacity in the existing sewer system. It shows that the existing sanitary sewer system servicing the Hamlet of Lavoy performs reasonably well compared with the current design standards. Peak flows are less than pipe capacity at all locations, even under peak wet weather flow conditions.

Table 3.3 shows the calculated peak flows compared with pipefull capacity after the future area is fully developed. It shows that the sewer flow is less than pipefull capacity at allocations, but the factor of safety against surcharging is reduced to about 10% in four pipes. Note that the design calculations assumed that the existing and future homes would have weeping tiles draining to the sanitary sewers, which is a conservative assumption.

Therefore, the sanitary sewer collection system has sufficient capacity for both dry weather and wet weather peak flows for a future population of 187 people.

ASSOCIATED ENGINEERING ALBERTA LTD.
SANITARY SEWER DESIGN CHART
RATIONAL METHOD FOR CIRCULAR PIPE

General	Existing Areas
Per Capita Flow Generation	400 L/c/day
Peaking Factor	Harmons
General Infiltration	0.28 L/s/ha
Sag Manhole	0.05 L/s/ha
Foundation Drain	0.60 L/s/ha
Manning's n — Old Pipe	0.015
Manning's n — New Pipe	0.013
commercial/industrial	people/home
Residential Density	p/ha
Residential Density	1.7 people/home

TABLE 3.2

HAMLET OF LAVOY
SANITARY SEWER ANALYSIS - EXISTING DEVELOPMENT
SYSTEM HYDRAULIC ANALYSIS -MAY, 2009

(EXTRANEOUS=GENERAL INFILTRATION+SAG MANHOLE+FOUNDATION DRAIN)

CLIENT: County of Minburn No. 27
PROJECT: Hamlet of Lavoy-Master Servicing Plan
PROJECT No.: 2009-3779
DESIGNED BY:: FZ
REVISED BY: LB

From/To Node	Contributing Area (ha)					Infiltration Area	Total Population	Peaking Factor	Design Flow		Total Design Flows			Manhole				Pipe							Spare Capacity	
	Residential				Ind/Comm				Residential	Ind/Comm	Domestic	Extraneous	Total	MH Numbers		Invert Elevation		Length	Diameter	Type	Slope	Qcap	86% Qcap	V	(L/s)	%
	ha	# of homes			ha				L/s	L/s	L/s	L/s	L/s	Upstream	Downstream	Upstream (m)	Downstream (m)	(m)	(mm)		(%)	(l/s)	(l/s)	(m/s)		
		existing	future	total																						
Mh12-Mh11	0.80	4.00	0.00	4.00	0.00	0.80	7	3.80	0.12	0.000	0.12	0.74	0.86													
Mh11	0.80	4.00	0.00	4.00	0.00	0.80	7	3.80	0.12	0.000	0.12	0.74	**0.86**	Mh 12	Mh11	670.390	669.447	87.32	200.00	PVC	1.08	**35.6**	**30.6**	1.13	**29.7**	**97.2**
Mh11-Mh10	0.45	0.00	0.00	0.00	0.00	0.45	0	3.80	0.00	0.000	0.00	0.42	0.42													
Mh10	1.25	16.00	0.00	16.00	0.00	1.25	27	3.80	0.47	0.000	0.47	1.16	**1.63**	Mh11	Mh10	669.447	669.030	87.32	200.00	PVC	0.48	**23.6**	**20.3**	0.75	**18.7**	**92.0**
Mh10-Mh9	7.63	1.00	0.00	1.00	0.00	7.63	2	3.80	0.03	0.000	0.03	7.10	7.13													
Mh9	15.83	29.00	0.00	29.00	0.00	15.83	48	3.80	0.85	0.000	0.85	14.72	**15.57**	Mh10	Mh9	669.030	668.770	87.32	250.00	PVC	0.30	**33.9**	**29.1**	0.69	**13.5**	**46.5**
Mh9-Mh8	0.68	3.00	0.00	3.00	0.00	0.68	5	3.80	0.09	0.000	0.09	0.63	0.72													
Mh8	16.51	32.00	0.00	32.00	0.00	16.51	53	3.80	0.93	0.000	0.93	15.35	**16.29**	Mh9	Mh8	668.770	668.510	87.32	250.00	PVC	0.30	**33.9**	**29.1**	0.69	**12.8**	**44.1**
Mh8-Mh7	5.31	18.00	0.00	18.00	0.00	5.31	30	3.80	0.53	0.000	0.53	4.94	5.46													
Mh7	26.43	64.00	0.00	64.00	0.00	26.43	106	3.80	1.87	0.000	1.87	24.58	**26.45**	Mh8	Mh7	668.510	668.247	90.22	250.00	PVC	0.29	**33.5**	**28.8**	0.68	**2.4**	**8.2**
Mh7-Mh6A	0.69	2.00	0.00	2.00	0.00	0.69	3	3.80	0.06	0.000	0.06	0.64	0.70													
Mh6A	27.12	66.00	0.00	66.00	0.00	27.12	110	3.80	1.93	0.000	1.93	25.22	**27.15**	Mh7	Mh6A	668.247	668.009	82.10	250.00	PVC	0.29	**33.4**	**28.7**	0.68	**1.6**	**5.5**
Mh6A-Mh6	0.20	0.00	0.00	0.00	0.00	0.20	0	3.80	0.00	0.000	0.00	0.19	0.19													
Mh6	27.32	66.00	0.00	66.00	0.00	27.32	110	3.80	1.93	0.000	1.93	25.41	**27.34**	Mh6A	Mh6	668.009	667.877	44.14	250.00	PVC	0.30	**34.0**	**29.2**	0.69	**1.9**	**6.5**
Mh6-Mh5	0.63	0.00	0.00	0.00	0.00	0.63	0	3.80	0.00	0.000	0.00	0.59	0.59													
Mh5	27.95	66.00	0.00	66.00	0.00	27.95	110	3.80	1.93	0.000	1.93	25.99	**27.92**	Mh6	Mh5	667.877	667.527	126.49	250.00	PVC	0.28	**32.6**	**28.0**	0.66	**0.1**	**0.5**
Mh5-Mh4	0.64	0.00	0.00	0.00	0.00	0.64	0	3.80	0.00	0.000	0.00	0.60	0.60													
Mh4	28.59	66.00	0.00	66.00	0.00	28.59	110	3.80	1.93	0.000	1.93	26.59	**28.52**	Mh5	Mh4	667.527	667.146	126.49	250.00	PVC	0.30	**34.0**	**29.3**	0.69	**0.8**	**2.6**
Mh4-Mh3	0.57	0.00	0.00	0.00	0.00	0.57	0	3.80	0.00	0.000	0.00	0.53	0.53													
Mh3	29.16	66.00	0.00	66.00	0.00	29.16	110	3.80	1.93	0.000	1.93	27.12	**29.05**	Mh4	Mh3	667.146	666.664	115.82	250.00	PVC	0.42	**40.0**	**34.4**	0.82	**5.4**	**15.6**
Mh3-Mh2	0.29	0.00	0.00	0.00	0.00	0.29	0	3.80	0.00	0.000	0.00	0.27	0.27													
Mh2	29.45	66.00	0.00	66.00	0.00	29.45	110	3.80	1.93	0.000	1.93	27.39	**29.32**	Mh3	Mh2	666.664	666.076	108.21	250.00	PVC	0.54	**45.7**	**39.3**	0.93	**10.0**	**25.5**
Mh2-Mh1	0.30	0.00	0.00	0.00	0.00	0.30	0	3.80	0.00	0.000	0.00	0.28	0.28													
Mh1	29.75	66.00	0.00	66.00	0.00	29.75	110	3.80	1.93	0.000	1.93	27.67	**29.59**	Mh2	Mh1	666.076	665.654	108.20	250.00	PVC	0.39	**38.7**	**33.3**	0.79	**3.7**	**11.2**
Mh1-Mh PD-1	0.20	0.00	0.00	0.00	0.00	0.20	0	3.80	0.00	0.000	0.00	0.19	0.19													
MhPD-1	29.95	66.00	0.00	66.00	0.00	29.95	110	3.80	1.93	0.000	1.93	27.85	**29.78**	Mh1	MhPD-1	665.817	665.454	18.13	250.00	PVC	2.00	**87.7**	**75.5**	1.79	**45.7**	**60.5**
Mh30-Mh29	0.77	2.00	0.00	2.00	0.00	0.77	3	3.80	0.06	0.000	0.06	0.72	0.77													
Mh29	0.77	2.00	0.00	2.00	0.00	0.77	3	3.80	0.06	0.000	0.06	0.72	**0.77**	Mh 12	Mh29	670.390	669.447	87.32	200.00	PVC	1.08	**35.6**	**30.6**	1.13	**29.8**	**97.5**
Mh29-Mh28	0.42	1.00	0.00	1.00	0.00	0.42	2	3.80	0.03	0.000	0.03	0.39	0.42													
Mh28	1.19	3.00	0.00	3.00	0.00	1.19	5	3.80	0.09	0.000	0.09	1.11	**1.19**	Mh29	Mh28	669.447	669.030	87.32	200.00	PVC	0.48	**23.6**	**20.3**	0.75	**19.1**	**94.1**
Mh28-Mh23	1.05	3.00	0.00	3.00	0.00	1.05	5	3.80	0.09	0.000	0.09	0.98	1.06													
Mh23	2.24	6.00	0.00	6.00	0.00	2.24	10	3.80	0.18	0.000	0.18	2.08	**2.26**	Mh28	Mh23	669.030	668.770	87.32	250.00	PVC	0.30	**33.9**	**29.1**	0.69	**26.9**	**92.2**
Mh23-Mh16	2.45	4.00	0.00	4.00	0.00	2.45	7	3.80	0.12	0.000	0.12	2.28	2.40													
Mh16	4.69	10.00	0.00	10.00	0.00	4.69	17	3.80	0.29	0.000	0.29	4.36	**4.65**	Mh23	Mh16	668.770	668.510	87.32	250.00	PVC	0.30	**33.9**	**29.1**	0.69	**24.5**	**84.0**
Mh16-Mh10	2.26	2.00	0.00	2.00	0.00	2.26	3	3.80	0.06	0.000	0.06	2.10	2.16													
Mh10	6.95	12.00	0.00	12.00	0.00	6.95	20	3.80	0.35	0.000	0.35	6.46	**6.81**	Mh16	Mh10	668.510	668.247	90.22	250.00	PVC	0.29	**33.5**	**28.8**	0.68	**22.0**	**76.3**
Mh27-Mh26	0.78	0.00	0.00	0.00	0.00	0.78	0	3.80	0.00	0.000	0.00	0.73	0.73													
Mh26	0.78	0.00	0.00	0.00	0.00	0.78	0	3.80	0.00	0.000	0.00	0.73	**0.73**	Mh10	Mh26	668.247	668.009	82.10	250.00	PVC	0.29	**33.4**	**28.7**	0.68	**28.0**	**97.5**
Mh26-Mh21	0.36	0.00	0.00	0.00	0.00	0.36	0	3.80	0.00	0.000	0.00	0.33	0.33													
Mh21	1.14	0.00	0.00	0.00	0.00	1.14	0	3.80	0.00	0.000	0.00	1.06	**1.06**	Mh26	Mh21	668.009	667.905	44.14	250.00	PVC	0.24	**30.1**	**25.9**	0.61	**24.8**	**95.9**
Mh21-Mh14	1.53	4.00	0.00	4.00	0.00	1.53	7	3.80	0.12	0.000	0.12	1.42	1.54													
Mh14	2.67	4.00	0.00	4.00	0.00	2.67	7	3.80	0.12	0.000	0.12	2.48	**2.60**	Mh21	Mh14	667.905	667.527	126.49	250.00	PVC	0.30	**33.9**	**29.2**	0.69	**26.6**	**91.1**
Mh14-Mh8	1.94	10.00	0.00	10.00	0.00	1.94	17	3.80	0.29	0.000	0.29	1.80	2.10													
Mh8	4.61	14.00	0.00	14.00	0.00	4.61	23	3.80	0.41	0.000	0.41	4.29	**4.70**	Mh14	Mh8	667.527	667.146	126.49	250.00	PVC	0.30	**34.0**	**29.3**	0.69	**24.6**	**84.0**

ASSOCIATED ENGINEERING ALBERTA LTD.
SANITARY SEWER DESIGN CHART
RATIONAL METHOD FOR CIRCULAR PIPE

General		Existing Areas
Per Capita Flow Generation		400 L/c/day
Peaking Factor		Harmons
General Infiltration		0.28 L/s/ha
Sag Manhole		0.05 L/s/ha
Foundation Drain		0.60 L/s/ha
Manning's n	Old Pipe	0.015
	New Pipe	0.013
commercial/industrial		6.0 people/home
Residential Density		p/ha
Residential Density		1.5 people/home

TABLE 3.3

HAMLET OF LAVOY
SANITARY SEWER ANALYSIS - FUTURE DEVELOPMENT
SYSTEM HYDRAULIC ANALYSIS -MAY, 2009

(EXTRANEOUS=GENERAL INFILTRATION+SAG MANHOLE+FOUNDATION DRAIN)

CLIENT: County of Minburn No. 27
PROJECT Hamlet of Lavoy-Master Servicing Plan
PROJECT No. 2009-3779
DESIGNED BY:: FZ
REVISED BY: LB

From/To Node	Contributing Area (ha)					Infiltration Area	Total Population	Peaking Factor	Design Flow		Total Design Flows			Manhole				Pipe							Spare Capacity	
	Residential				Ind/Comm				Residential	Ind/Comm	Domestic	Extraneous	Total	MH Numbers		Invert Elevation		Length	Diameter	Type	Slope	Qcap	86% Qcap	V		
	ha	# of homes			ha				L/s	L/s	L/s	L/s	L/s	Upstream	Downstream	Upstream (m)	Downstream (m)	(m)	(mm)		(%)	(l/s)	(l/s)	(m/s)	(L/s)	%
		existing	future	total																						
Mh12-Mh11	0.80	4.00	0.00	4.00	0.20	0.80	7	3.80	0.13	0.000	0.13	0.74	0.87													
Mh11	0.80	4.00	0.00	4.00	0.20	0.80	7	3.80	0.13	0.000	0.13	0.74	**0.87**	Mh 12	Mh11	670.390	669.447	87.32	200.00	PVC	1.08	**35.6**	**30.6**	1.13	**29.7**	**97.1**
Mh11-Mh10	0.45	0.00	0.00	0.00	0.00	0.45	0	3.80	0.00	0.000	0.00	0.42	0.42													
Mh10	1.25	14.00	11.00	25.00	0.20	1.25	40	3.80	0.70	0.000	0.70	1.16	**1.86**	Mh11	Mh10	669.447	669.030	87.32	200.00	PVC	0.48	**23.6**	**20.3**	0.75	**18.5**	**90.9**
Mh10-Mh9	7.63	1.00	0.00	1.00	0.00	7.63	2	3.80	0.03	0.000	0.03	7.10	7.12													
Mh9	15.83	25.00	22.00	47.00	0.20	15.83	106	3.80	1.86	0.000	1.86	14.72	**16.58**	Mh10	Mh9	669.030	668.770	87.32	250.00	PVC	0.30	**33.9**	**29.1**	0.69	**12.5**	**43.0**
Mh9-Mh8	0.68	3.00	0.00	3.00	0.00	0.68	5	3.80	0.08	0.000	0.08	0.63	0.71													
Mh8	16.51	28.00	22.00	50.00	0.20	16.51	110	3.80	1.94	0.000	1.94	15.35	**17.30**	Mh9	Mh8	668.770	668.510	87.32	250.00	PVC	0.30	**33.9**	**29.1**	0.69	**11.8**	**40.6**
Mh8-Mh7	5.31	12.00	0.00	12.00	0.00	5.31	18	3.80	0.32	0.000	0.32	4.94	5.26													
Mh7	26.43	48.00	32.00	80.00	0.20	26.43	184	3.80	3.24	0.000	3.24	24.58	**27.82**	Mh8	Mh7	668.510	668.247	90.22	250.00	PVC	0.29	**33.5**	**28.8**	0.68	**1.0**	**3.4**
Mh7-Mh6A	0.69	2.00	0.00	2.00	0.00	0.69	3	3.80	0.05	0.000	0.05	0.64	0.70													
Mh6A	27.12	50.00	32.00	82.00	0.20	27.12	187	3.80	3.29	0.000	3.29	25.22	**28.51**	Mh7	Mh6A	668.247	668.009	82.10	250.00	PVC	0.29	**33.4**	**28.7**	0.68	**0.2**	**0.7**
Mh6A-Mh6	0.20	0.00	0.00	0.00	0.00	0.20	0	3.80	0.00	0.000	0.00	0.19	0.19													
Mh6	27.32	50.00	32.00	82.00	0.20	27.32	187	3.80	3.29	0.000	3.29	25.41	**28.70**	Mh6A	Mh6	668.009	667.877	44.14	250.00	PVC	0.30	**34.0**	**29.2**	0.69	**0.5**	**1.8**
Mh6-Mh5	0.63	0.00	0.00	0.00	0.00	0.63	0	3.80	0.00	0.000	0.00	0.59	0.59													
Mh5	27.95	50.00	32.00	82.00	0.20	27.95	187	3.80	3.29	0.000	3.29	25.99	**29.29**	Mh6	Mh5	667.877	667.527	126.49	250.00	PVC	0.28	**32.6**	**28.0**	0.66	**-1.2**	**-4.4**
Mh5-Mh4	0.64	0.00	0.00	0.00	0.00	0.64	0	3.80	0.00	0.000	0.00	0.60	0.60													
Mh4	28.59	50.00	32.00	82.00	0.20	28.59	187	3.80	3.29	0.000	3.29	26.59	**29.88**	Mh5	Mh4	667.527	667.146	126.49	250.00	PVC	0.30	**34.0**	**29.3**	0.69	**-0.6**	**-2.0**
Mh4-Mh3	0.57	0.00	0.00	0.00	0.00	0.57	0	3.80	0.00	0.000	0.00	0.53	0.53													
Mh3	29.16	50.00	32.00	82.00	0.20	29.16	187	3.80	3.29	0.000	3.29	27.12	**30.41**	Mh4	Mh3	667.146	666.664	115.82	250.00	PVC	0.42	**40.0**	**34.4**	0.82	**4.0**	**11.6**
Mh3-Mh2	0.29	0.00	0.00	0.00	0.00	0.29	0	3.80	0.00	0.000	0.00	0.27	0.27													
Mh2	29.45	50.00	32.00	82.00	0.20	29.45	187	3.80	3.29	0.000	3.29	27.39	**30.68**	Mh3	Mh2	666.664	666.076	108.21	250.00	PVC	0.54	**45.7**	**39.3**	0.93	**8.6**	**22.0**
Mh2-Mh1	0.30	0.00	0.00	0.00	0.00	0.30	0	3.80	0.00	0.000	0.00	0.28	0.28													
Mh1	29.75	50.00	32.00	82.00	0.20	29.75	187	3.80	3.29	0.000	3.29	27.67	**30.96**	Mh2	Mh1	666.076	665.654	108.20	250.00	PVC	0.39	**38.7**	**33.3**	0.79	**2.4**	**7.1**
Mh1-Mh PD-1	0.20	0.00	0.00	0.00	0.00	0.20	0	3.80	0.00	0.000	0.00	0.19	0.19													
MhPD-1	29.95	50.00	32.00	82.00	0.20	29.95	187	3.80	3.29	0.000	3.29	27.85	**31.15**	Mh1	MhPD-1	665.817	665.454	18.13	250.00	PVC	2.00	**87.7**	**75.5**	1.79	**44.3**	**58.7**
Mh30-Mh29	0.77	2.00	0.00	2.00	0.00	0.77	3	3.80	0.05	0.000	0.05	0.72	0.77													
Mh29	0.77	2.00	0.00	2.00	0.00	0.77	3	3.80	0.05	0.000	0.05	0.72	**0.77**	Mh 12	Mh29	670.390	669.447	87.32	200.00	PVC	1.08	**35.6**	**30.6**	1.13	**29.8**	**97.5**
Mh29-Mh28	0.42	1.00	4.00	5.00	0.00	0.42	8	3.80	0.14	0.000	0.14	0.39	0.53													
Mh28	1.19	3.00	4.00	7.00	0.00	1.19	11	3.80	0.19	0.000	0.19	1.11	**1.30**	Mh29	Mh28	669.447	669.030	87.32	200.00	PVC	0.48	**23.6**	**20.3**	0.75	**19.0**	**93.6**
Mh28-Mh23	1.05	3.00	0.00	3.00	0.00	1.05	5	3.80	0.08	0.000	0.08	0.98	1.06													
Mh23	2.24	6.00	4.00	10.00	0.00	2.24	15	3.80	0.27	0.000	0.27	2.08	**2.35**	Mh28	Mh23	669.030	668.770	87.32	250.00	PVC	0.30	**33.9**	**29.1**	0.69	**26.8**	**91.9**
Mh23-Mh16	2.45	2.00	7.00	9.00	0.00	2.45	14	3.80	0.24	0.000	0.24	2.28	2.52													
Mh16	4.69	8.00	11.00	19.00	0.00	4.69	29	3.80	0.51	0.000	0.51	4.36	**4.88**	Mh23	Mh16	668.770	668.510	87.32	250.00	PVC	0.30	**33.9**	**29.1**	0.69	**24.2**	**83.3**
Mh16-Mh10	2.26	2.00	0.00	2.00	0.00	2.26	3	3.80	0.05	0.000	0.05	2.10	2.16													
Mh10	6.95	10.00	11.00	21.00	0.00	6.95	32	3.80	0.57	0.000	0.57	6.46	**7.03**	Mh16	Mh10	668.510	668.247	90.22	250.00	PVC	0.29	**33.5**	**28.8**	0.68	**21.8**	**75.6**
Mh27-Mh26	0.78	0.00	0.00	0.00	0.00	0.78	0	3.80	0.00	0.000	0.00	0.73	0.73													
Mh26	0.78	0.00	0.00	0.00	0.00	0.78	0	3.80	0.00	0.000	0.00	0.73	**0.73**	Mh10	Mh26	668.247	668.009	82.10	250.00	PVC	0.29	**33.4**	**28.7**	0.68	**28.0**	**97.5**
Mh26-Mh21	0.36	0.00	10.00	10.00	0.00	0.36	15	3.80	0.27	0.000	0.27	0.33	0.61													
Mh21	1.14	0.00	10.00	10.00	0.00	1.14	15	3.80	0.27	0.000	0.27	1.06	**1.33**	Mh26	Mh21	668.009	667.905	44.14	250.00	PVC	0.24	**30.1**	**25.9**	0.61	**24.6**	**94.9**
Mh21-Mh14	1.53	4.00	0.00	4.00	0.00	1.53	6	3.80	0.11	0.000	0.11	1.42	1.53													
Mh14	2.67	4.00	10.00	14.00	0.00	2.67	22	3.80	0.38	0.000	0.38	2.48	**2.86**	Mh21	Mh14	667.905	667.527	126.49	250.00	PVC	0.30	**33.9**	**29.2**	0.69	**26.3**	**90.2**
Mh14-Mh8	1.94	4.00	0.00	4.00	0.00	1.94	6	3.80	0.11	0.000	0.11	1.80	1.91													
Mh8	4.61	8.00	10.00	18.00	0.00	4.61	28	3.80	0.49	0.000	0.49	4.29	**4.77**	Mh14	Mh8	667.527	667.146	126.49	250.00	PVC	0.30	**34.0**	**29.3**	0.69	**24.5**	**83.7**

3.3.2 Stabilization Lagoon Sewage Treatment Facility

The assessment of the existing sewage lagoon is provided in the following table.

Table 3-4
Sewage Lagoon Requirements

	Existing	Future
Population	112	187
Consumption (L/c/d)	400	400
Average Day Flow (m^3)	44.8	74.8
Anaerobic cell	Not required	Not Required
Facultative Cell (m^3) (60 days capacity)	2,688	4,488
Storage Cell (m^3) (365 days capacity)	16,352	27,302

As noted previously, the existing lagoon has one storage cell of 21,000 m^3 capacity, which is sufficient for existing development conditions plus an additional population of 33 people (approximately 15 new homes), according to present standards. The storage cell would then need to be expanded to 28,000 m^3 for the future population.

A new facultative cell is also required to meet current Alberta Environment standards. It is not clear when Alberta Environment will require the facultative cell to be added. Typically, these requirements are assessed on a case by case basis when the municipality's operating licence is due for renewal. This may not occur until the effluent quality exceeds the limits specified in the operating licence.

Current design criteria do not require an anaerobic cell at the moment or with future conditions, until the population exceeds 625 people, which is about six times the current population.

4 Cost Estimate

The cost estimates for the upgrades identified above are based on current (2010) industry prices, plus contingency and engineering.

4.1 WATER DISTRIBUTION SYSTEM

The County is planning to supply water to the Hamlet with a regional line from Vegreville in the near future. Cost of this line is budgeted elsewhere.

Other upgrades would be required to provide fire protection from the water distribution system. The County has a fire response plan that does not require upgrading of the water supply system.

4.2 SANITARY SEWER SYSTEM

To satisfy current design criteria for a future population of 187 people, the following upgrades are required:

Upgrade Existing Sewage Lagoon as follows:

• Build one facultative cell having a total capacity of 4,800 m^3	$100,000
• Expand the existing storage cell by adding an additional 14,000 m^3	$300,000
Total	$400,000
Contingency (25%)	$100,000
Engineering (20%)	$ 80,000
Total	**$580,000**

The existing cell will provide for a population of 145 people which is 33 more than existing.

5 Conclusions

5.1 WATER SYSTEM

- The raw water supply system is currently operating at capacity and should be upgraded or replaced as soon as possible. Lavoy is to be supplied from a regional line in the near future.
- There is evidence of a leak in the water distribution system that has increased the water supplied to the community by about 35% since July 2009.
- The water distribution system has capacity for only 20% of the fire flow recommended by the Fire Underwriters. To provide the recommended fire flow capacity would require replacing most of the existing 150 mm diameter water distribution pipes with 200 mm diameter mains, addition of a fire pump, and expanding the reservoir, which may not be practical. Instead, the County has a contingency plan for fire protection similar to that used throughout the County.
- If fire flows are ignored, the existing reservoir and distribution system have capacity to serve the future population of 187 people.

5.2 SANITARY SEWER SYSTEM

- The existing gravity collection system has adequate capacity for the existing and future development scenarios.

5.3 STABILIZATION LAGOON SEWAGE TREATMENT FACILITY

- The existing lagoon has sufficient capacity for a population of approximately 145 people, which allows for an increase of 33 people or 15 homes. Alberta Environment may require addition of a facultative cell if the effluent quality exceeds the limits specified in the operating licence.
- To meet Alberta Environment's current standards, and serve a population of 187 people, the existing lagoon would need to be upgraded by adding one facultative cell having a capacity of 4,888 m^3 and expanding the storage cell to 28,000 m^3.
- An anaerobic cell is not required by Alberta Environment until the population reaches 625 people.

6 Recommendations

Following are the principal recommendations of the Master Services Plans:

6.1 WATER SUPPLY SYSTEM

- Search for and repair the suspected leak in the water distribution system to reduce the water supply to the community by about 30%.
- Supply water from a regional line as soon as possible.
- Consider increasing the system operating pressure to 55 psi at the water treatment plan once the regional line is in service.

6.2 SANITARY SEWER SYSTEM

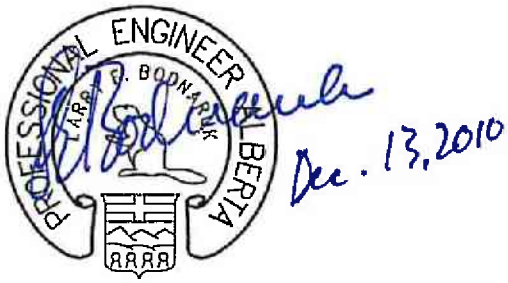
- Upgrade the sewage lagoon when and as required by Alberta Environment.

7 Closure

This report was prepared for the County of Minburn No. 27 to provide a Master Services Plan for the Hamlet of Lavoy.

The services provided by Associated Engineering Alberta Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,
Associated Engineering Alberta Ltd.



Dec. 13, 2010

Larry Bodnaruk, P. Eng.
Senior Water Resources Engineer
Project Manager

Floarea Zerfass, P. Eng.
Project Engineer

ASSOCIATED ENGINEERING
QUALITY MANAGEMENT SIGN-OFF
Signature:
Date: Dec. 14, 2010

APEGGA Permit to Practice P 3979

A Appendix A – Water Distribution Pumps Curve

CROWN

3/96

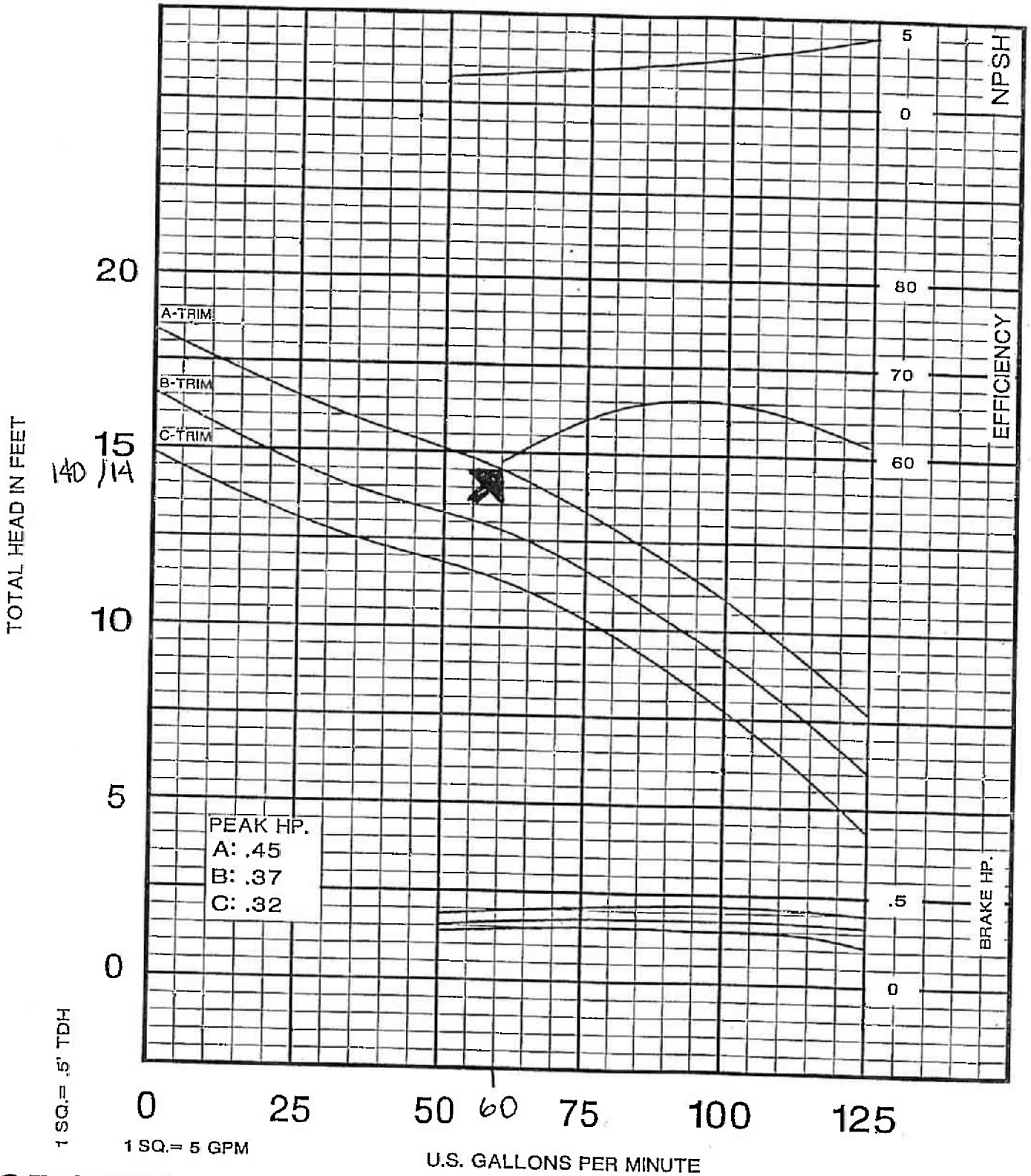
S6-80

(1800 RPM)

MODEL S6-80

PERFORMANCE CHARACTERISTICS

MINIMUM WELL SIZE 7"



CROWN PUMP CORPORATION , HIGHWAY 16 & BIVAR , DE LEON , TEXAS

B Appendix B – Historical Water Record Data

DAILY FLOW CONSUMPTION (m3/day)						
2009	**2008**	**2007**	**2006**	**2005**	**2004**	**2003**
		4	49.55	34.55	10.91	15.91
45	47	2	46.36	36.82	36.37	60.45
67	32	27	35.45	32.73	31.82	15.00
65	38	41	41.36	28.64	50.00	46.82
36	36	36	44.55	34.55	38.18	55.00
45	29	38	41.36	37.73	25.00	24.09
45	48	36	34.09	26.36	44.55	41.82
48	33	48	18.18	50.00	32.27	47.27
40	33	21	41.36	28.64	54.09	40.45
49	45	35	50	29.10	3.64	45.91
45	37	44	35	25.00	34.09	36.82
27	31	26	33.64	48.64	49.55	37.27
45	36	33	39.55	50.45	61.36	55.91
43	42	30	54.09	0.00	0.00	28.18
36	37	29	29.55	29.55	39.09	30.45
36	40	40	32.27	48.18	44.55	50.91
42	40	49	38.64	**70.45**	40.91	43.18
66	32	48	27.27	36.82	20.91	15.00
39	40	49	50.91	2.27	32.73	36.36
45		36	40.45	57.73	43.18	61.82
40	37	44	30.91	48.64	53.18	30.00
30	47	32	36.81	41.36	0.00	31.36
37	39	28	42.73	45.45	47.27	58.64
37	38	44	39.09	27.27	47.73	0.00
40	25	43	49.09	30.91	0.00	54.09
40	39	53	40	51.82	40.45	19.55
35	43	48	33.18	27.73	28.64	50.91
35	38	48	40.45	37.27	36.82	54.09
35		29	42.27	43.64	23.18	15.45
50	47	43	33.63	50.91	44.09	34.09
46	51	50	47.73	0.00	28.18	42.73
50	44	44	42.73	30.00	53.18	59.09
36	52	49	4.09	36.36	7.73	12.73
58	53	50	39.55	29.09	35.45	57.27
45	53	56	47.27	41.82	53.18	31.82
41	41	48	35.45	32.73	46.82	45.45
40	45	4	36.36	39.09	31.36	0.00
35	31	41		30.45	51.82	51.36
42	47	31	37.73	46.82	55.00	30.00
41	42	23	29.09	44.55	49.55	48.18
27	52	53	54.09	34.55	59.55	13.63
40	49	32	40	38.64	0.00	60.45
45	35	40	28.18	46.36	46.36	46.82
44	35	35	27.73	45.00	35.45	51.36
38	43	32	32.27	47.27	40.45	12.27
40	41	24	52.73	41.36	21.36	61.36
47	47	37	32.27	35.45	52.27	35.91
34	35	25	41.82	43.64	33.64	54.09
44	40	38	44.55	35.45	42.73	36.36
41	36	38	40	45.00	18.18	34.09
38	36	27	50	42.27	38.18	40.91
38	31	34	35.91	34.09	21.36	30.00
	32	38	34.55	43.64	56.36	45.91
	42	30	33.18	22.73	19.55	42.73
		21	31.64	56.82	53.64	37.73
	49	33	39.09	45.91	31.36	58.18
	52	37	35.91	34.09	53.64	55.45
	41	29	18.64	54.55	20.45	58.64
	43	39	38.64	50.00	53.64	40.00
	44	34	33.18	33.64	36.36	45.91
	38	39	31.82	46.36	45.91	26.82
	44	35	40.45	31.36	54.55	56.36
	45	33	29.55	47.73	49.09	18.64
	36	40	43.18	41.36	37.27	31.82
	43	24	47.73	38.64	39.09	46.82

	41	35	32.73	46.82	54.55	27.73
	44	35	40.45	44.09	54.09	54.55
	43	44	40.45	49.55	32.73	24.09
	41	30	45.00	54.09	50.00	38.18
	43	24	40.45	49.09	47.73	46.82
	42	37	41.36	46.82	49.09	55.00
	46	39	25.45	53.18	44.09	60.91
	41	38	30.91	44.55	51.36	25.91
	41	43	25.91	33.64	49.55	30.45
	35	30	50	47.73	49.09	57.73
	43	30	35.91	45.00	55.00	45.00
	46	35	34.09	44.09	53.64	27.73
	50	37	35.45	39.55	25.00	35.91
	51	37	46.36	42.27	35.00	28.64
	37	38	35	42.27	31.82	45.91
	45	34	30	44.09	40.91	37.27
	49	32	34.09	27.73	40.45	25.00
	38	21	44.09	62.73	46.36	38.18
	55	35	30.91	40.91	52.27	39.09
	36	34	32.73	51.82	45.45	43.64
	46	37	24.55	0.00	26.36	35.91
	39	38	36.82	26.81	34.55	42.73
	46	35	42.73	51.82	43.64	41.36
	44	34	20.91	51.36	49.55	45.45
	43	33	36.36	42.73	32.73	42.73
	36	38	39.55	8.18	38.18	41.81
	37	31	27.73	47.27	22.73	40.00
	35	44	46.36	45.45	51.36	30.00
	40	38	36.36	58.18	35.00	42.73
	33	38	38.18	4.55	37.73	17.73
	46	21	33.18	48.18	48.64	51.82
		37	32.72	40.91	54.55	64.09
	34	25	27.27	57.27	30.91	3.18
	45	36	36.82	0.91	34.55	35.91
	47	27	33.18	50.45	34.55	55.91
	48	32	32.27	39.09	40.00	28.18
	46	44	29.55	31.82	40.45	57.27
	48	38	43.64	36.81	48.18	58.18
	35	41	19.09	41.82	49.55	52.73
	49	30	43.18	46.36	44.09	45.91
	23	46	39.09	44.09	38.64	40.00
	45	40	42.27	35.91	40.91	28.18
	35	50	32.27	40.45	50.00	40.00
	29	34	37.73	42.73	32.27	39.55
	32	40	32.73	44.55	36.36	17.73
	40	47	32.27	37.73	44.09	59.09
	35	35	36.82	36.36	38.64	53.18
	37	30	43.64	44.09	37.27	43.18
	32	37	50.45	26.36	37.27	28.18
	36	42	25	50.45	34.55	40.45
	32	33	41.82	53.64	43.18	28.18
	42	30	41.81	55	49.09	39.10
	29	33	33.18	0.9	50.00	41.36
	41	34	33.18	46.82	40.91	25.91
	41	35	32.73	25.91	41.36	30.45
	33	54	38.64	56.82	1.00	52.27
	33	23	32.27	32.73		51.82
	49	55	44.10	36.36	32.73	33.64
	49	25	40.45	37.27	36.82	31.36
	1	51	41	45.45	53.64	50.45
	6	25	26	38.18	50.00	52.73
	40	37	36	32.73	44.55	31.82
	36	43	19.45	41.82	45.91	32.73
	40	34	42.73	49.09	48.18	30.00
	38	36	19.55	37.73	50.91	54.54
		31	36.36	37.73	38.64	4.55
	40	29	32.73	50.91	48.64	53.18
	40	42	35.45	46.82	49.55	53.18
	39	33	32.73	35.91	47.27	39.55
	37	46	39.1	49.55	31.82	51.82
	35	32	34.09	58.64	30.00	21.36
	36	33	34.55	50.91	30.00	43.18

	37	38	37.73	22.18	51.82	30.91
	32	26	39.09	53.18	24.09	51.36
	43	32	26.82	22.27	37.27	50.00
	30	21	36.36	58.64	44.55	3.18
	42	37	30.45	25.45	48.64	45.91
	37	45	27	38.18	31.82	34.55
	36	37	31	45.45	30.45	27.27
	39	36	29	56.36	39.55	33.64
	43	50	38	44.55	47.73	41.82
	37	33	30	23.64	37.27	40.45
	36	43	30	43.64	41.82	8.64
	38	39	29	44.09	48.64	49.55
	38	33	44	40.91	47.27	48.63
	37	37	30	37.27	43.64	40.45
	32	43	30	51.36	46.82	27.73
	47	43	34	32.27	36.82	26.82
	49	52	35	35	21.36	28.18
	49	34	39	59.72	39.09	44.55
	49	29	34	0.45	54.55	32.27
	49	43	39	50.9	35.45	34.09
	28	28	41	35.82	33.18	48.18
	37	49	38	38.18	35.00	62.27
	39	35	32	42.73	52.27	37.27
	39	34	29	47.27	31.36	41.36
	33	48	36	34.55	31.82	26.36
	34	44	38	33.64	40.45	39.55
	40	37	33	40.05	45.45	51.36
	39	43	32	51.36	19.09	52.27
	29	31	29	28.64	36.36	45.00
	40	45	44	50.91	33.18	50.00
	39	26	50	42.73	47.27	34.09
	42	45	29	25.91	49.55	31.82
	44	31	36	32.73	59.55	9.55
	43	43	30	45.45	56.82	39.55
	32	37	50	55	2.27	49.09
	41	40	45	59.55	21.36	49.09
	37	31	49	37.73	50.00	49.55
	38	43	41	36.82	34.55	50.00
	29	39	32	30	17.27	48.64
	42	38	40	45.45	31.82	48.18
	34	45	36	52.27	49.55	38.18
	40	45	23	35.91	17.72	11.36
	42	47	36	25	37.73	0.45
	37	47	35	47.73	47.27	29.55
	39	39	28	42.72	24.55	34.55
	33	44	26	34.55	35.00	51.36
	36	53	27	49.09	21.36	35.45
	68	44	32	40.91	43.18	50.91
	40	56	41	47.27	43.18	45.95
	38	34	36	31.81	37.73	36.82
	33	40	37		45.91	51.36
	37	37	38		37.27	46.82
	41		42		52.27	41.82
	39		38		32.73	9.55
	41				27.27	52.73
	43				40.91	53.64
	43				48.64	0.00
	45				46.36	39.09
	41				26.82	50.91
	36				30.90	54.55
	35				35.91	47.28
	44				53.64	0.00
	43				53.64	51.82
	44				53.18	
	49				0.00	
	38				52.27	
	37				30.45	
	43				17.27	
67	**68**	**56**	**54.09**	**70.45**	**61.36**	**64.09**

PD = 70.45/37.49 = 1.88

C Appendix C - Model Results

Lavoy Water system.wtg
Active Scenario: PH-2009
Current Time: 0.000 hours

Label	Elevation (m)	Zone	Demand (L/s)	Pressure (psi)	Hydraulic Grade (m)
J-20	675.30	707.5m	0.00	45.8	707.54
J-22	674.75	707.5m	0.17	46.5	707.54
J-17	674.55	707.5m	0.00	46.8	707.54
J-16	674.41	707.5m	0.00	47.0	707.54
J-9	673.61	707.5m	0.00	48.2	707.54
J-10	673.39	707.5m	0.35	48.5	707.54
J-15	673.35	707.5m	0.00	48.5	707.54
J-14	673.31	707.5m	0.00	48.6	707.54
J-11	673.11	707.5m	0.35	48.9	707.54
J-18	673.00	707.5m	0.00	49.0	707.54
J-19	673.00	707.5m	0.00	49.0	707.54
J-21	672.80	707.5m	0.35	49.3	707.54
J-23	672.50	707.5m	0.17	49.7	707.54
J-12	672.40	707.5m	0.00	49.9	707.54
J-6	672.40	707.5m	0.27	49.9	707.54
J-5	672.35	707.5m	0.00	50.0	707.55
J-13	672.17	707.5m	0.17	50.2	707.54
J-7	672.00	707.5m	0.00	50.5	707.54
J-8	671.74	707.5m	0.00	50.8	707.54
J-24	671.62	707.5m	0.00	51.0	707.54
J-26	671.35	707.5m	0.00	51.4	707.54
J-25	670.99	707.5m	0.00	51.9	707.54

Lavoy Water system.wtg

Active Scenario: PH 2009-Upgrades

Current Time: 0.000 hours

Label	Elevation (m)	Zone	Demand (L/s)	Pressure (psi)	Hydraulic Grade (m)
J-20	675.30	707.5m	0.00	50.7	710.99
J-22	674.75	707.5m	0.17	51.4	710.98
J-17	674.55	707.5m	0.00	51.7	710.99
J-16	674.41	707.5m	0.00	51.9	710.99
J-9	673.61	707.5m	0.00	53.1	710.99
J-10	673.39	707.5m	0.35	53.4	710.99
J-14	673.31	707.5m	0.00	53.5	710.98
J-11	673.11	707.5m	0.35	53.8	710.99
J-18	673.00	707.5m	0.00	53.9	710.99
J-19	673.00	707.5m	0.00	53.9	710.99
J-21	672.80	707.5m	0.35	54.2	710.98
J-23	672.50	707.5m	0.17	54.6	710.99
J-12	672.40	707.5m	0.00	54.8	710.99
J-6	672.40	707.5m	0.27	54.8	710.99
J-5	672.35	707.5m	0.00	54.9	710.99
J-13	672.17	707.5m	0.17	55.1	710.98
J-7	672.00	707.5m	0.00	55.3	710.99
J-8	671.74	707.5m	0.00	55.7	710.99
J-24	671.62	707.5m	0.00	55.9	710.99
J-26	671.35	707.5m	0.00	56.3	710.98
J-25	670.99	707.5m	0.00	56.8	710.98

Lavoy Water system.wtg
Active Scenario: PD+Fire-2009
Current Time: 0.000 hours

Label	Zone	Satisfies Fire Flow Constraints?	Flow (Total Available) (L/s)	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Demand (L/s)	Pressure (psi)	Fire Flow (Upper Limit) (L/s)	Velocity of Maximum Pipe (m/s)	Pipe w/ Maximum Velocity
J-20	707.5m	False	36.68	73.30	36.68	0.00	45.8	75.00	2.13	P-35
J-22	707.5m	False	43.13	73.30	43.04	0.09	46.6	75.00	2.49	P-35
J-17	707.5m	False	33.32	73.30	33.32	0.00	46.8	75.00	1.94	P-35
J-16	707.5m	False	35.16	73.30	35.16	0.00	47.0	75.00	2.04	P-35
J-9	707.5m	False	41.64	73.30	41.64	0.00	48.2	75.00	2.41	P-35
J-10	707.5m	False	39.11	73.30	38.94	0.18	48.5	75.00	2.26	P-35
J-14	707.5m	False	36.57	73.30	36.57	0.00	48.6	75.00	2.12	P-35
J-11	707.5m	False	40.08	73.30	39.90	0.18	48.9	75.00	2.31	P-35
J-21	707.5m	False	36.77	73.30	36.59	0.18	49.3	75.00	2.12	P-35
J-12	707.5m	False	49.84	73.30	49.84	0.00	49.9	75.00	2.87	P-35
J-6	707.5m	False	55.06	73.30	54.92	0.14	49.9	75.00	3.16	P-35
J-5	707.5m	True	75.00	73.30	75.00	0.00	50.0	75.00	4.30	P-35
J-13	707.5m	False	38.17	73.30	38.08	0.09	50.2	75.00	2.21	P-35
J-7	707.5m	False	50.41	73.30	50.41	0.00	50.5	75.00	2.90	P-35
J-8	707.5m	False	47.38	73.30	47.38	0.00	50.8	75.00	2.73	P-35
J-24	707.5m	False	47.38	73.30	47.38	0.00	51.0	75.00	2.73	P-35
J-26	707.5m	False	29.20	73.30	29.20	0.00	51.4	75.00	1.70	P-35
J-25	707.5m	False	28.52	73.30	28.52	0.00	51.9	75.00	1.67	P-35

Lavoy Water system.wtg

Active Scenario: 2009 PD+FF Upgrades v=1.5m/s

Current Time: 0.000 hours

Label	Zone	Satisfies Fire Flow Constraints?	Flow (Total Available) (L/s)	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Demand (L/s)	Pressure (psi)	Fire Flow (Upper Limit) (L/s)	Velocity of Maximum Pipe (m/s)	Pipe w/ Maximum Velocity
J-20	707.5m	True	75.00	73.30	75.00	0.00	50.7	75.00	1.55	P-35
J-22	707.5m	True	75.09	73.30	75.00	0.09	51.5	75.00	1.55	P-35
J-17	707.5m	True	75.00	73.30	75.00	0.00	51.7	75.00	1.57	P-23
J-16	707.5m	True	75.00	73.30	75.00	0.00	51.9	75.00	1.83	P-23
J-9	707.5m	True	75.00	73.30	75.00	0.00	53.1	75.00	1.55	P-35
J-10	707.5m	True	75.18	73.30	75.00	0.18	53.4	75.00	1.55	P-35
J-14	707.5m	True	75.00	73.30	75.00	0.00	53.5	75.00	1.55	P-35
J-11	707.5m	True	75.18	73.30	75.00	0.18	53.8	75.00	1.55	P-35
J-21	707.5m	True	75.18	73.30	75.00	0.18	54.2	75.00	1.55	P-35
J-12	707.5m	True	75.00	73.30	75.00	0.00	54.8	75.00	1.55	P-35
J-6	707.5m	True	75.14	73.30	75.00	0.14	54.8	75.00	1.55	P-35
J-5	707.5m	True	75.00	73.30	75.00	0.00	54.9	75.00	1.55	P-35
J-13	707.5m	True	75.09	73.30	75.00	0.09	55.1	75.00	1.55	P-35
J-7	707.5m	True	75.00	73.30	75.00	0.00	55.4	75.00	1.55	P-35
J-8	707.5m	True	75.00	73.30	75.00	0.00	55.7	75.00	1.55	P-35
J-24	707.5m	True	75.00	73.30	75.00	0.00	55.9	75.00	1.55	P-35
J-26	707.5m	True	75.00	73.30	75.00	0.00	56.3	75.00	1.78	P-47
J-25	707.5m	True	75.00	73.30	75.00	0.00	56.8	75.00	1.55	P-35

Lavoy Water system.wtg

Active Scenario: PD+Fire-Ultimate

Current Time: 0.000 hours

Label	Zone	Satisfies Fire Flow Constraints?	Flow (Total Available) (L/s)	Fire Flow (Needed) (L/s)	Fire Flow (Available) (L/s)	Demand (L/s)	Pressure (psi)	Fire Flow (Upper Limit) (L/s)	Velocity of Maximum Pipe (m/s)	Pipe w/ Maximum Velocity
J-20	707.5m	True	75.00	73.30	75.00	0.00	50.7	75.00	1.56	P-35
J-22	707.5m	True	75.02	73.30	75.00	0.02	51.5	75.00	1.56	P-35
J-17	707.5m	True	75.00	73.30	75.00	0.00	51.7	75.00	1.57	P-26
J-16	707.5m	True	75.00	73.30	75.00	0.00	51.9	75.00	1.84	P-23
J-9	707.5m	True	75.08	73.30	75.00	0.08	53.1	75.00	1.56	P-35
J-10	707.5m	True	75.05	73.30	75.00	0.05	53.4	75.00	1.56	P-35
J-14	707.5m	True	75.00	73.30	75.00	0.00	53.5	75.00	1.56	P-35
J-11	707.5m	True	75.05	73.30	75.00	0.05	53.8	75.00	1.56	P-35
J-21	707.5m	True	75.05	73.30	75.00	0.05	54.2	75.00	1.56	P-35
J-12	707.5m	True	75.00	73.30	75.00	0.00	54.8	75.00	1.85	P-17
J-6	707.5m	True	75.04	73.30	75.00	0.04	54.8	75.00	1.56	P-35
J-5	707.5m	True	75.00	73.30	75.00	0.00	54.9	75.00	1.56	P-35
J-13	707.5m	True	75.02	73.30	75.00	0.02	55.1	75.00	1.56	P-35
J-7	707.5m	True	75.00	73.30	75.00	0.00	55.4	75.00	1.57	P-11
J-8	707.5m	True	75.00	73.30	75.00	0.00	55.7	75.00	1.56	P-35
J-24	707.5m	True	75.00	73.30	75.00	0.00	55.9	75.00	1.56	P-35
J-26	707.5m	True	75.05	73.30	75.00	0.05	56.3	75.00	1.81	P-47
J-25	707.5m	True	75.03	73.30	75.00	0.03	56.8	75.00	1.56	P-35

Report

Associated Engineering
GLOBAL PERSPECTIVE. LOCAL FOCUS.

County of Minburn No. 27

Hamlet of Lavoy
Stormwater Management Plan

November 2008

Associated Engineering | GLOBAL PERSPECTIVE. LOCAL FOCUS.

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November 21, 2008
File: 2007-3472.E.03.02

Mr. Ryan Hall
Director - Development Services
County of Minburn No. 27
4909 - 50 Street
Vegreville, AB T9C 1R6

Re: HAMLET OF LAVOY
STORMWATER MANAGEMENT PLAN

Dear Sir:

Enclosed please find three (3) copies of our Final Report for the above mentioned project.

Please do not hesitate to contact the undersigned should you have any questions

Yours truly,

Larry E. Bodnaruk, P. Eng.
Senior Water Resource Engineer
Project Manager

LEB/ja

Enclosures

Table of Contents

1 Introduction

Associated Engineering was retained by the County of Minburn No. 27 to complete a stormwater management plan for the Hamlet of Lavoy, which occupies approximately 27 ha in SW4-52-13-W4. **Figure 1.1** shows the location of the project and the regional drainage pattern which will be discussed below.

Lavoy is currently experiencing some growth with a number of lots in various stages of planning and development. The proposed developments are located along Railway Avenue and 3 Avenue. A recent topographic survey, completed in November 2007, shows that the existing ground elevations of the lots along Railway Avenue are low and the County is concerned that they may be at risk of flooding. The County is also planning to sell a number of new lots in the vicinity of Spruce Street and 3 Avenue and would like the lot grades to be established. In addition, the County requires a stormwater management plan to identify areas of concern and required upgrades to help guide development within the Hamlet.

1.1 Project Issues

The County has identified the following concerns that they would like addressed in the stormwater management plan:

- Several low-lying lots are about to be developed, on Railway Avenue and 3 Avenue, that could be at risk of flooding.
- The low area along the highway that collects runoff from the Hamlet could flood the low-lying areas along Railway Avenue.
- Stormwater runoff needs to be managed so as to prevent flooding within the Hamlet and downstream.

1.2 Objectives

Project objectives are as follows:

1. To develop an overall drainage plan for the Hamlet of Lavoy showing existing deficiencies, constraints, and required upgrading.
2. To develop the design of lot grades in Block "8", adjacent to 3 Avenue from Spruce Street to the lane north[1] of Spruce Street, and the preliminary grading design of the bounding streets (Spruce Street and 3 Avenue).
3. To define the stormwater management requirements for the existing and future development within the Hamlet.

[1] For this report, streets are taken to run north-south and Avenues are taken to run east-west, even though they run somewhat diagonally.

2 Existing Drainage

2.1 Survey Information

In November 2007, Associated Engineering carried out a drainage survey in Lavoy. The survey included:

- property line elevations along with the swale/gutter and road centerline elevations for all streets, avenues and intersections
- property line and centerline elevations in the back lanes
- culvert inverts and diameters
- catchbasin inverts
- detailed topography of the low area in the southeast, near Spruce Street and 3 Avenue for the lot grading plan
- invert elevations of the low area along the highway

Appendix A provides the plan and profile of each Street and Avenue in Lavoy, showing the principal drainage features and direction of drainage.

2.2 Regional Drainage

The regional drainage for Lavoy is shown in **Figure 1.1.** Based on available contour and survey information, the area is divided into five catchments. With the exception of the area north of Elm Street which drains to the north, the general direction of drainage is to the southwest. Approximately half of Lavoy (catchments 1 and 2) drains to the low area located along the highway. The remaining area (catchment 3) drains to a low area located on the southeast edge of the Hamlet. An 80 ha off-site area (catchment 4) located to the east also drains to this low area; the off-site area is currently used for agriculture.

The low area in the southeast drains to the west towards the highway drainage system. These areas eventually drain to the south to an existing drainage course that continues to Akasu Lake and eventually to the Vermillion River.

2.3 Drainage Assessment

The existing drainage conditions in Lavoy are shown in **Figure 2.1**. Drainage in Lavoy is primarily accommodated with a series of ditches and swales. Generally, these are located on each side of the street, in gravelled areas, adjacent to the sidewalk. Two blocks on Main Street, from Railway Avenue to 2 Avenue, and the connecting streets for one block, north and south, have curb-and-gutter drainage. There are also several shallow culverts and catchbasins that convey flow across intersections.

In general, the existing system provides an adequate level of service; however, some upgrades may be required to improve the drainage system and reduce the risk of flooding of private property.

A site inspection conducted on September 28, 2007 revealed the following:

- A low area in the southeast collects runoff from agricultural land and from part of the Hamlet; this could flood some of the new lots that are proposed along 3 Avenue.
- There are several locations where street runoff could spill over to private property and one location where the basement flooding has occurred in the past.
- There are locations where the pavement is failing due to cross-drainage, in particular at the intersection of Railway Avenue and Main Street.
- There are three locations where light-weight catchbasin grates have been used; these create potential safety hazards as they could easily be displaced.
- Back lanes are poorly graded and at certain locations, they drain onto private property.
- "Sidewalk" swales have limited capacity but appear adequate for short runs on-street.
- The ditch/swale in the lane north of Main Street, from 2 Avenue to 3 Avenue, is within private property.

Further assessment of the survey data revealed the following:

- Approximately half of the Hamlet drains to the low area in the southeast. A small area along Elm Street drains to the northwest. The remaining area drains to the low area along the highway.
- The existing ground elevations of the proposed development along 3 Avenue are lower than the road centerline elevations on 2 Avenue and 3 Avenue and are at risk of flooding.
- The existing ground elevations along the east side of Railway Avenue are lower than Railway Avenue and may be at risk of flooding.
- Existing culverts are shallow and have limited capacities. Consequently, they may overflow to the streets in a major storm event
- There are several locations where the swales have minimal grades and where lanes are poorly graded. While these conditions do not provide optimal drainage, improving these grades would require large scale regrading that is probably not warranted since they have not resulted in major problems. There may be a risk of flooding in a major storm event.

3 Proposed Drainage Improvements

Based on our assessment of existing drainage, a number of upgrades are proposed to improve the drainage conditions and the level of service in Lavoy. The proposed drainage improvements are shown in **Figure 3.1**, and generally include:

- Re-grading at key locations:
  - the back lane north of Main Street, between 2 Avenue and 3 Avenue
  - the back lane and Lots 18, 19, 20, east of Railway Avenue and north of Spruce Street as part of the development along Railway Avenue
  - 3 Avenue and Spruce Street as part of the proposed development
  - the future development area south of Spruce Street between 1 Avenue and 2 Avenue
- Construction of concrete swales to carry flow across Main Street at Railway Avenue, and 2 Avenue north of Main Street
- Catchbasin improvements to improve safety as the existing catchbasin grates are not anchored down
- Construction of a shallow storm sewer or culvert in the lane to the north of Main Street, for one block west from 1 Avenue, to carry the storm drainage from 1 Avenue
- The construction of a stormwater management pond to store flows from the east side of Lavoy in the low area on the southeast side of Lavoy
- Construction of a ditch to convey the off-site drainage around the proposed park and pond, to the proposed outlet ditch on Pine Street
- Improved lot grades adjacent to the low areas in the southeast and along Railway Avenue as shown in the hatched areas in **Figure 3.1**

4 Lot Grading

4.1 Constraints

There are a number of constraints that will affect the lot grading of the proposed development along 3 Avenue, and the design of the stormwater management facility including:

- The existing road and ditch grades on 3 Avenue, 2 Avenue, Main Street, and Spruce Street.
- The existing grades on the developed lots on the east side of 2 Avenue, south of Main Street.
- The existing ground elevations in and around the proposed pond location.
- The existing grades of the downstream system, in particular the elevations of the ditches and culverts along Highway 16 that receive the run-off from the entire Hamlet and the 80 hectares to the east.

4.2 Design Criteria

The following design criteria were used to set the proposed road centerline, ditch and lot grades on Spruce Street and 3 Avenue:

- Maintain existing elevations where possible.
- Minimum swale slope of 0.5%, or as required to fit existing right-of-way.
- Minimum back lane slope of 0.5%.
- Minimum lot slope of 2% from the lot corners to the center.
- Lots will have split drainage.
- Minimum ditch slope of 0.1%.

4.3 Preliminary Grades

The culvert invert in the downstream drainage system (668.98 m at the railway) is the critical elevation in setting pond elevations. The outlet of the stormwater management facility is approximately 420 m upstream, using a slope of 0.15% results in a Normal Water Level (NWL) of 669.6 m. A High Water Level (HWL) of 670.7 m has been selected based on the surrounding ground elevations and provides 1.1 m of storage depth. The average existing ground elevation in this area is approximately 671.0 m.

The minimum elevation of the surrounding park has been set at 671.2 m to provide at least 0.5 m of freeboard. The lots along 3 Avenue will be slightly higher with a minimum property line elevation of 671.8 m.

The preliminary grades for the seven lots along 3 Avenue are shown in **Figure 4.1.** The existing and proposed swale and road centerline elevations for Spruce Street and 3 Avenue are shown in **Figures 4.2** and **4.3**.

5 Stormwater Management Facility

5.1 Allowable Release Rate

A regional analysis using Water Survey of Canada data for 17 gauges located in the area around Lavoy shows that the 1:100 year predevelopment flow rate would range from approximately 3.0 L/s/ha for a 100 ha drainage area to 6 L/s/ha for a 10 ha drainage area.

An allowable release rate of 3 L/s/ha is recommended for this project. This value is comparable to values being used by other municipalities around Edmonton and Vegreville and will minimize downstream impacts.

5.2 Design Objectives

The Lavoy stormwater management facility will be designed as a constructed wetland in order to provide the required storage while incorporating wetland features to provide additional treatment benefits. The design objectives for the facility are as follows:

- Provide adequate storage capacity to control flows from the drainage area to the design outflow rate of 3 L/s/ha (1:100 year pre-development rate) to minimize the impact on the downstream drainage system.
- Provide adequate freeboard and an emergency overflow to protect against storm events more severe than the design event.
- Provide water quality improvements through extended detention in order to promote particle settling and biological processes.

5.3 Design Criteria

Based on the Alberta Environment Stormwater Management Guidelines, the design criteria for this project are as follows:

- Provide adequate storage capacity to control flows from the 100 year 24 hour event to the predevelopment flow rate of 3.0 L/s/ha.
- Provide adequate freeboard to protect against flooding of private property.
- Provide an emergency overflow to protect against flooding from storm events more severe than the design event.
- Maximum side slopes shall be:
    - 7:1 within the active storage zone,
    - 1% slope across the high/low marsh area,
    - 3:1 within the deep pools.

Wetlands provide water quality improvements by storing runoff and promoting particle settling and biological processes. There are several factors that affect the degree of water quality improvements including: storage volume, detention time, pool shape, wetlands biota and seasonal variation.

Alberta Environment's Stormwater Management Guidelines aim to promote particle settling and the removal of at least 85% of suspended solids 75 µm or larger. Design guidelines to achieve this objective are as follows:

- Minimum deep pool volume equal to or greater than the runoff from a 25 mm storm (1:2 year 4 hour) over the catchment area.
- Minimum detention time of 24 hours.

- Wetland size should be approximately 5% of the catchment area draining to it, which for the catchment area of 10 ha, represents a wetland area of 0.5 ha.
- The recommended average permanent wetland water depth is 0.3 m with approximately 2 m deep pools.

5.4 Storage Volume Requirements

The stormwater management facility will be sized to store runoff from the 1:100 year design storm event. The required storage volume was calculated using the Modified Rational Method, based on the allowable release rate of 3.0 L/s/ha. Details of the calculations are included in **Table 5.1**.

The modified rational method is based on the following two equations:

$$VR = CAIt$$

$$VS = VR - \frac{Qt}{2}$$

where:

VR = volume of runoff
C = coefficient of runoff
A = tributary area
I = average rainfall intensity for the duration of the storm, t, as given in the Intensity – Duration – Frequency (IDF) curve for the city of Edmonton, for a return period of 1:100 years
VS = required storage volume, and
Q = peak outflow rate
t = duration of rainfall

The outflow is assumed to peak at the end of the storm, and therefore the time averaged outflow rate during the storm is one half of the peak rate.

The following catchments and runoff coefficients (C) were used in the storage calculations, for the 1:100 year storm:

- Residential Area = 8.2 ha C = 0.60
- Park Area = 1.0 ha C = 0.30
- Pond Area = 0.8 ha C = 1.00

The modified rational method calculations were carried out for the 1:100 year storm with durations varying from 1 hour to 24 hours using Intensity-Duration-Frequency (IDF) curves for the City of Edmonton. In this case the 24 hour storm duration, which yields 127 mm of rainfall, is the critical event resulting in the greatest storage volume; it was therefore used in the design of the stormwater management facility. The storage volume required in the proposed stormwater management

wetland to control flows to 3.0 L/s/ha is 6,400 m^3. This is additional to the storage in the existing low area between Railway Avenue and the railway.

Note, the 80 ha offsite area was not included in the storage calculation. Drainage from this area will be directed via a ditch to the south and west around Lavoy to the highway drainage system, at a design rate of 3.0 L/s/ha, in order to reduce the pond outlet size and maintain better control over pond levels.

5.5 Design Concept

The pond concept including a cross section through the pond is shown in **Figure 5.1**. **Figure 5.2** shows the profile through the outlet ditch from the pond outlet to the culvert across Highway 16. **Figure 5.3** shows the stage-storage and stage-discharge curves for the proposed stormwater management facility.

The proposed Normal Water Level (NWL) is 669.6 m and the proposed High Water Level (HWL) is 670.7 m providing 1.1 m of storage depth. An emergency overflow to the downstream outlet ditch will be provided at an elevation of 671.0. The minimum property line elevation for the surrounding lots has been set at 671.2 m, which provides a minimum freeboard of 0.5 m above the HWL.

The main design features of the pond are as follows:

- The proposed pond will provide the required storage for the 1:100 year 24 hour storm.
- The pond will have a storage capacity of 6,400 m^3 at the design high water level of 670.7 m.
- The pond will have a surface area of 0.5 ha at the normal water level, 0.75 ha at the high water level and 0.8 ha at the top of the pond.
- Water level fluctuations will be 1.1 m (above the normal water level) in the 1:100 year storm.
- A 200 mm outlet pipe will control flows to the proposed discharge of 30 L/s corresponding to a release rate of 3 L/s/ha.

The average ground elevation around the stormwater management facility is approximately 671.0 m. In order to provide the required volume at a storage depth of 1.1 m, the top area of the pond must be 0.80 ha. The proposed ditch elevation at the corner of Spruce Street and 3 Avenue has been set at 670.8 m, approximately 0.1 m above the HWL to prevent the pond from backing up into the ditches during a severe event.

The proposed location of the pond is within a 1.8 ha area located in the southeast corner of the Hamlet. The County also plans to construct a park in this area and would like to integrate the pond with the park.

5.6 Hydraulic Modeling

The proposed stormwater management facility and the outlet channel through to the highway drainage system have been modeled using the urban drainage model MOUSE, to confirm the operation of the stormwater management system, including the ponding area along Railway Avenue, and to confirm the capacity of the highway culvert.

The model setup is shown in **Figure 5.4**, and includes:

- two existing 900 mm CMP culverts across the railway and Highway 16
- two proposed 900 mm CMP culverts along Pine Street
- the proposed stormwater management facility and 200 mm CMP outlet pipe
- the proposed outlet ditch connecting the stormwater management facility to the downstream highway drainage system

The proposed dimensions of the outlet ditch are:

- 1 m bottom, 3:1 side slopes
- minimum depth of 1 m
- approximate longitudinal slope of 0.15%

The low areas along the railway and highway have been modeled as detention areas to account for the storage and attenuation of flows. Using available survey and contour information, the estimated storage capacity in each of these low areas is approximately 2300 m^3.

The model also includes the proposed diversion ditch which will carry the offsite flows around the stormwater management facility to the outlet ditch. This ditch will simplify the pond design and operation and limit the potential for flooding.

The total area draining to the railway and highway culverts is approximately 108 ha. The modeled catchments are as follows:

- 81.8 ha of offsite agricultural area draining to the diversion ditch
- 10 ha existing and proposed residential, on the east side of Lavoy, draining to the proposed stormwater management facility
- 6.4 ha in the southwest part of Lavoy and the undeveloped area along the railway draining to the detention area upstream of the railway
- 7.3 ha in the northwest part of Lavoy and part of the highway drainage system draining to the detention area upstream of the highway
- 2.5 ha of Highway 16 draining to the catchbasin located in the median ditch

The 1:100 year 4 hour and 24 hour events were simulated in order to assess the system performance. The model results show that the stormwater management facility will operate as intended and that the existing culverts have capacity for the 1:100 year flows. **Figure 5.5** shows the 1:100 year 24 hour hydraulic grade line profile from the pond to the Highway 16 culvert.

Table 5.2 provides a summary of the model results:

Table 5.2
Summary of Model Results

Parameter	1:100 Year 4 Hour Duration Storm	1:100 Year 24 hour Duration Storm
Pond HWL	670.3 m	670.6 m
Peak Pond Outflow	24 L/s	30 L/s
Offsite Flow	540 L/s	600 L/s
HWL at Railway Avenue	669.8 m	669.9 m
Freeboard at low point in Railway Avenue (El 670.5)	0.7 m	0.6 m
Peak Flow through Railway Culvert	630 L/s	700 L/s
Peak Flow through Highway Culvert	720 L/s	800 L/s

Results show that the offsite area generates a significant amount of flow compared to the regulated flow from the Hamlet. The outlet ditch and culverts have been sized to pass the flow from this area. The proposed culvers, except for the pond outlet pipe (200 mm) will be 900 mm in diameter, which is the same diameter as the railway and highway culverts. If the offsite area were to be diverted entirely to another drainage system, the outlet channel and culverts could be made smaller.

Diverting the offsite area around the stormwater management facility simplifies the pond operation and control structure. In addition, routing the offsite area around reduces the risk of the developed area being flooded.

6 Water Quality Improvements

Stormwater management facilities improve water quality by controlling flows and providing sufficient detention time for the removal of pollutants and sediments that are transported by the runoff from urban areas. Stormwater management facilities are also an important aesthetic, recreational and environmental resource to a community.

Constructed wetlands offer enhanced nutrient removal and other benefits including aquatic habitat. Removal rates of TSS for wet ponds of 50- 90% have typically been achieved. This removal rate is dependant on detention time which is related to the pond volume and shape.

Alberta Environment's guidelines recommend a minimum detention time of 24 hours in order to provide water quality improvements. This minimum detention time is based on the settling velocity of particles entering the wet pond. The pond should be designed so that the minimum detention time is achieved for a range of storm events, particularly the more frequent, smaller storms which "wash off" a majority of the pollutants. The Lavoy stormwater management facility will have a detention time of 30 hours for the 1:2 year storm and 117 hours for the 1:100 year 24 hour design storm (based on flood storage), which exceed Alberta Environment's guidelines.

Another guideline is to size the permanent pool to store the volume of runoff from a 25 mm storm (1:2 year 4 hour) over the catchment area. This corresponds to a volume of 1,500 m^3 for the area of Lavoy draining to the pond (10 ha). The permanent pools of the proposed pond will be 2.0 m deep and have a volume of approximately 2,000 m^3, which exceeds the minimum guideline.

Since these design parameters exceed the minimum requirements it is reasonable to expect that, as designed, the pond will achieve the desired target of 85% removal of suspended solids 75 µm or larger, based on experience elsewhere.

7 Conclusions

- The drainage system in the Hamlet of Lavoy generally provides an adequate level of service; however, some upgrades are proposed to improve drainage conditions and reduce the risk of flooding to private property.

- The upgrades to the existing drainage system include re-grading at key locations, the construction of concrete swales, catchbasin improvements, and the addition of a stormwater management facility.

- The proposed stormwater management facility will be constructed as a wetland and will improve the quality of the runoff from the catchment area. It is expected to achieve the removal of at least 85% of suspended solids 75 µm or larger.

- The stormwater management facility will have a normal water level of 669.6 m, a high water level of 670.7 m, a storage capacity of 6,400 m^3, and a peak outflow rate of 30 L/s.

- The stormwater management facility will occupy a 0.8 ha area and will provide storage for a 10 ha area of Lavoy. Additional storage, of as much as 4,500 m^3 , is also provided in the low areas adjacent to the railway.

- The outflow from the pond will be controlled to the recommended rate of 3 L/s/ha by a 200 mm culvert.

- The minimum lot elevation has been set at 671.2 m to provide at least 0.5 m of freeboard in the design event. The minimum lot grade for the lots on 3 Avenue has been set at 671.8 m.

- An emergency overflow is provided at 0.3 m above the high water level in order to accommodate events larger than the design storm event.

- The proposed stormwater management facility, outlet ditch and highway drainage system have been modeled to confirm the design and operation.

- The model results show that the proposed drainage system will provide at least 0.6 m of freeboard at Railway Avenue.

8 Recommendations

- Upgrade the storm drainage system in Lavoy in accordance with **Figure 3.1**.
- Construct the stormwater management facility with a normal water level of 669.60 m and high water level of 670.7 m to control and treat runoff from the Hamlet, to prevent flooding in the area, and to limit the amount of water ponding in the ditches along Spruce Street and 3 Avenue.
- Construct the diversion ditch around the Hamlet to divert the offsite flows to the highway drainage system.
- The catchbasins and culverts should be inspected and cleaned as necessary.
- Construct lot grades in accordance with **Figure 4.1,** and complete the road grading design in accordance with the Preliminary Designs in **Figures 4.2, and 4.3.**
- Regrade lanes and swales over the longer term to improve drainage within the Hamlet.
- In the development of lots abutting Railway Avenue, the finished lot grades should be above the elevation of Railway Avenue and no lower than an elevation of 670.5 m, in order to protect them against flooding from the low area along Railway Avenue.

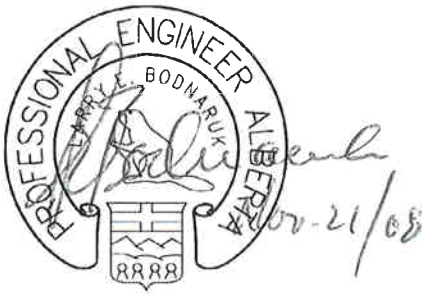
9 Closure

This report was prepared for the County of Minburn No. 27 to complete a stormwater management plan for the Hamlet of Lavoy.

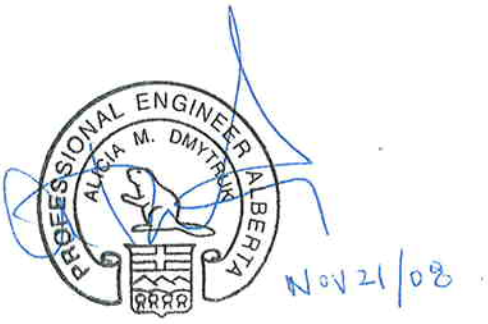
The services provided by Associated Engineering Alberta Ltd. in the preparation of this report were conducted in a manner consistent with the level of skill ordinarily exercised by members of the profession currently practicing under similar conditions. No other warranty expressed or implied is made.

Respectfully submitted,

Associated Engineering Alberta Ltd.



Larry Bodnaruk, P. Eng.
Project Manager



Alicia Dmytruk, M. Eng., P. Eng.
Project Engineer

PERMIT TO PRACTICE
ASSOCIATED ENGINEERING ALBERTA LTD.
Signature _____
Date May 21, 2008
PERMIT NUMBER: P 3979
The Association of Professional Engineers, Geologists and Geophysicists of Alberta

PERMIT STAMP

Table 5.1
Storage Requirements for the Hamlet of Lavoy

Location:
Project #: 20073472 Date: 08/04/08 Computed by: AD

NOTE: USE YELLOW AREAS ONLY FOR DATA INPUT

IDF Curve Edmonton

	Area (ha)	Cv
Residential	8.2	0.6
Rural		0.3
Park	1	0.3
Pond	0.8	1
Total area =	10 ha	
Cv =	0.60	
Return period	100 years	
Peak outflow rate	3 l/s/ha	
Tc	15 minutes	

Storage Parameters		
Peak inflow	1.70	m^3/s
Peak outflow	30	l/s
Storage volume	6380	m^3
Critical storm event	24	hours
Time to drain	118	hours
	5	days

Rainfall parameters		
Return period	100	years
IDF Curve	Edmonton	
IDF Curve Number	4	
a	43.22826	(t in hours)
b	-0.661	
c	0.0253333	hours

Storage volume for Edmonton 1:100 year storm Cv = 0.60

Duration (hours)	Rainfall (mm)	Runoff (m^3/ha)	Storage per ha for various peak flow rates (l/s) 0.5	1.2	2.5	5	10	Design value 3	Duration hours
1	43	257	256	255	253	248	239	252	1
2	54	328	326	324	319	310	292	317	2
4	69	417	413	408	399	381	345	395	4
6	79	479	473	466	452	425	371	446	6
12	100	606	596	580	552	498	390	542	12
24	127	767	746	716	659	551	335	638	24

Maximum storage req'd (m^3/ha)		746	716	659	551	390	638	
	mm	74.6	71.6	65.9	55.1	39.0	63.8	
Critical storm duration (hours)		24	24	24	24	12	24	
Time to drain	hours	828.7	331.3	146.5	61.3	21.7	118.1	
	days	34.5	13.8	6.1	2.6	0.9	4.9	

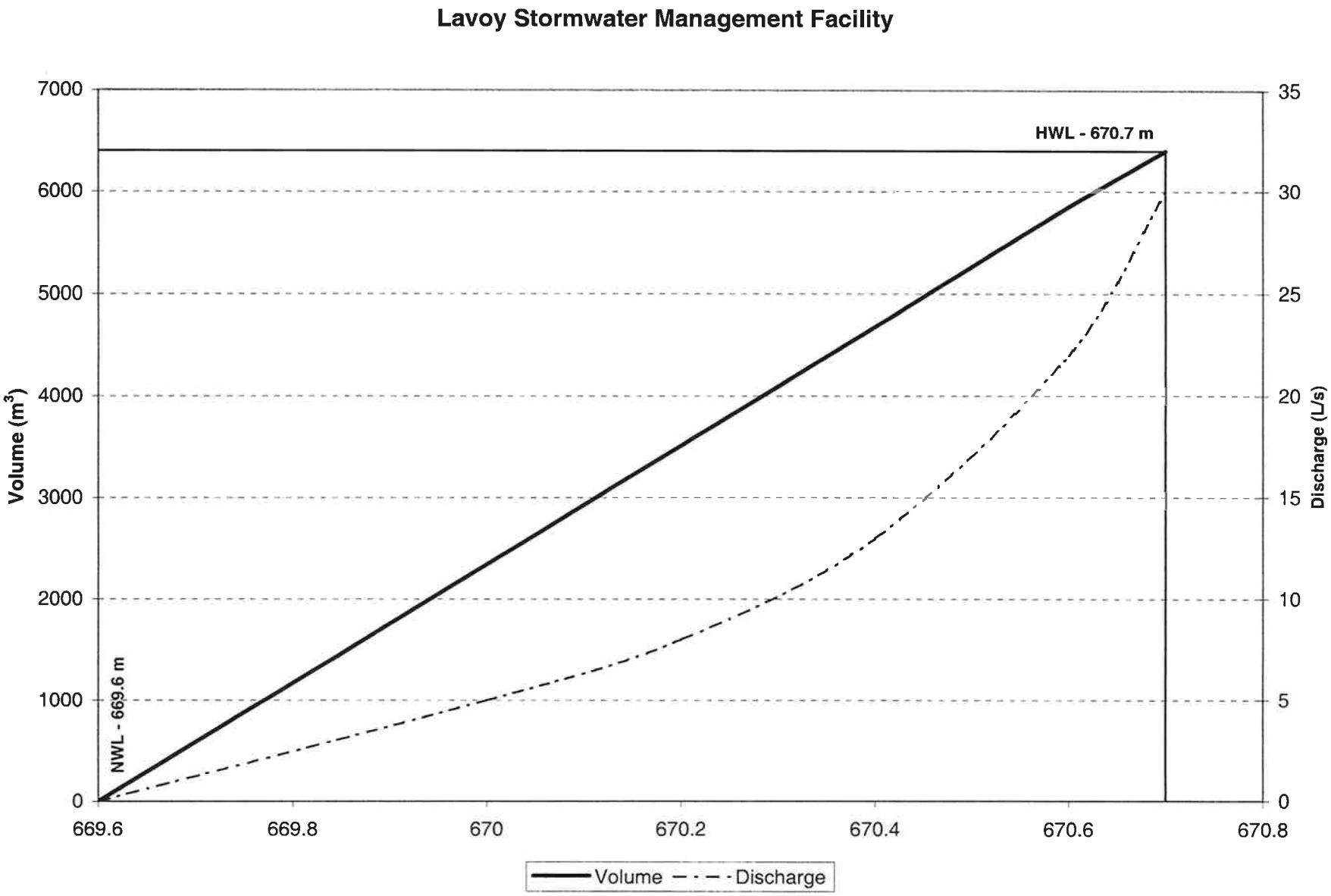


FIGURE 5.3
STAGE-STORAGE AND STAGE-DISCHARGE CURVES

FIGURE 5.4
MODEL SETUP

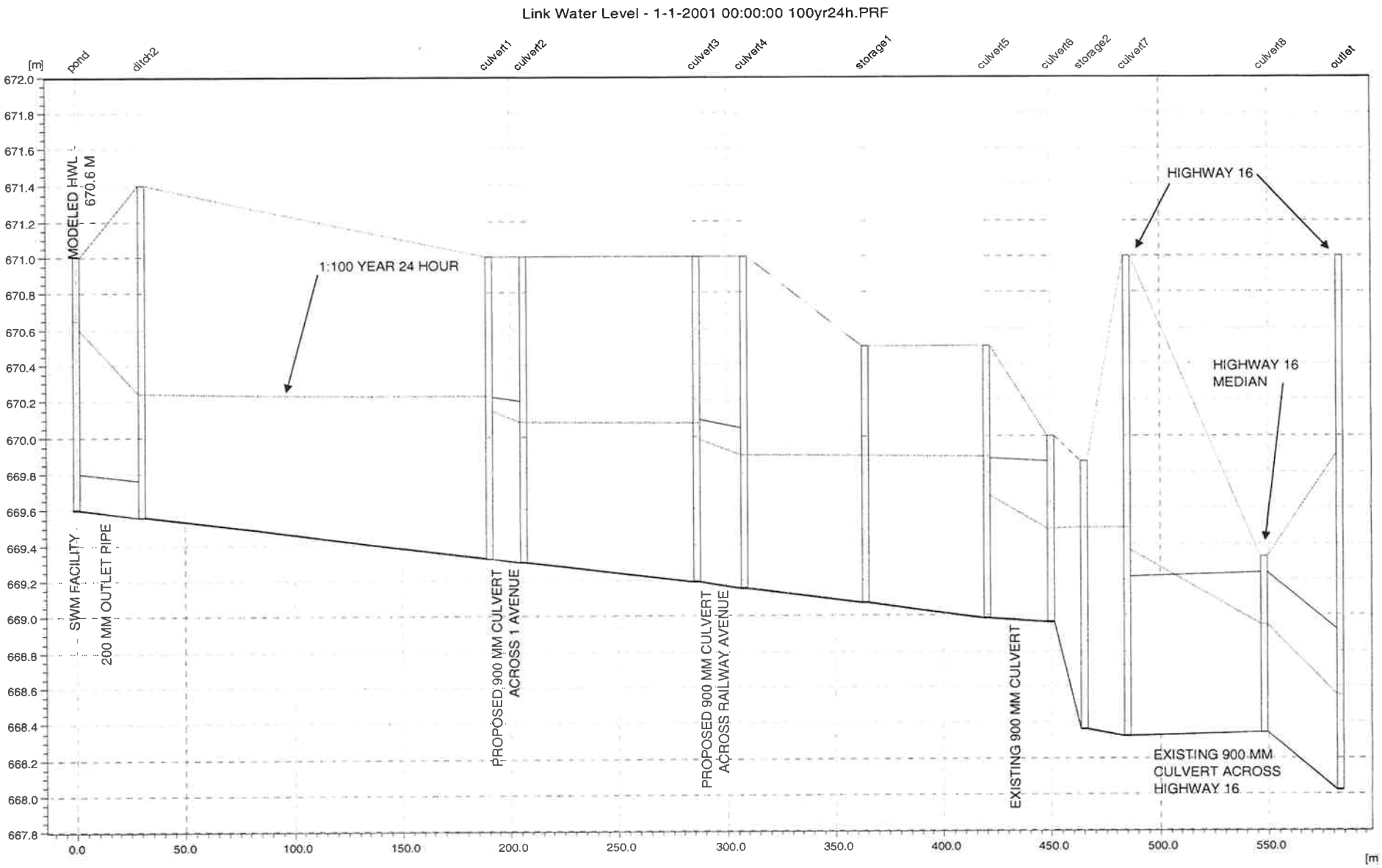
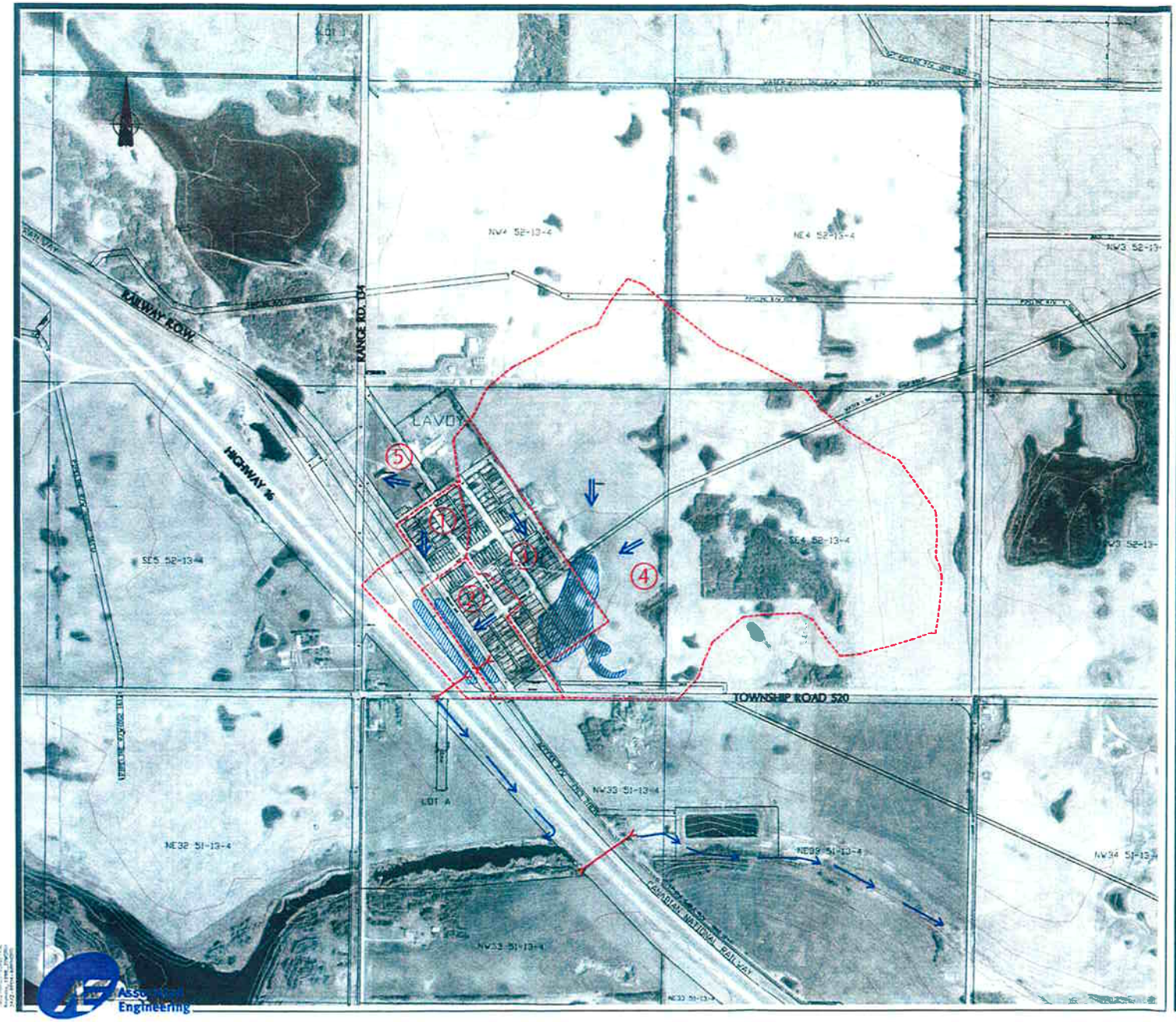


FIGURE 5.5
HYDRAULIC GRADE LINE PROFILE FOR THE 100 YEAR 24 HOUR STORM

APPENDIX A - STREET PLANS/PROFILES (EXISTING CONDITIONS)



COUNTY OF MINBURN

LAVOY STORMWATER MANAGEMENT PLAN

REGIONAL DRAINAGE

LEGEND:

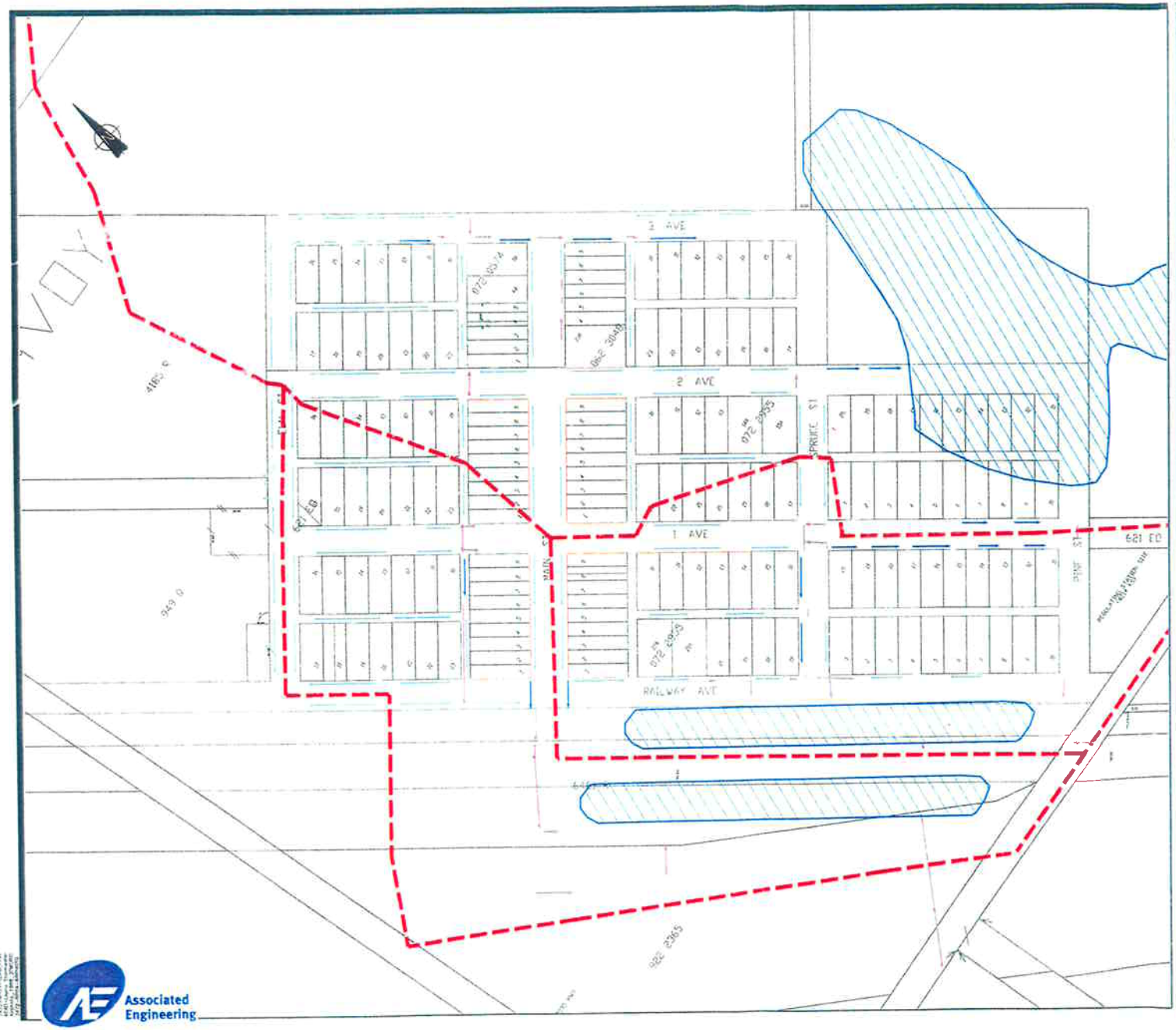
- GROUND ELEVATION CONTOURS (APPROXIMATE)
- LOW AREA, POORLY DRAINED
- DITCH
- DIRECTION OF DRAINAGE
- CATCHMENT BOUNDARY
- CULVERT
- ① CATCHMENT NUMBER

SCALE : 1 : 10,000

AUGUST, 2008

Associated Engineering

FIGURE 1.1



COUNTY OF MINBURN

LAVOY STORMWATER MANAGEMENT PLAN

EXISTING DRAINAGE

LEGEND:

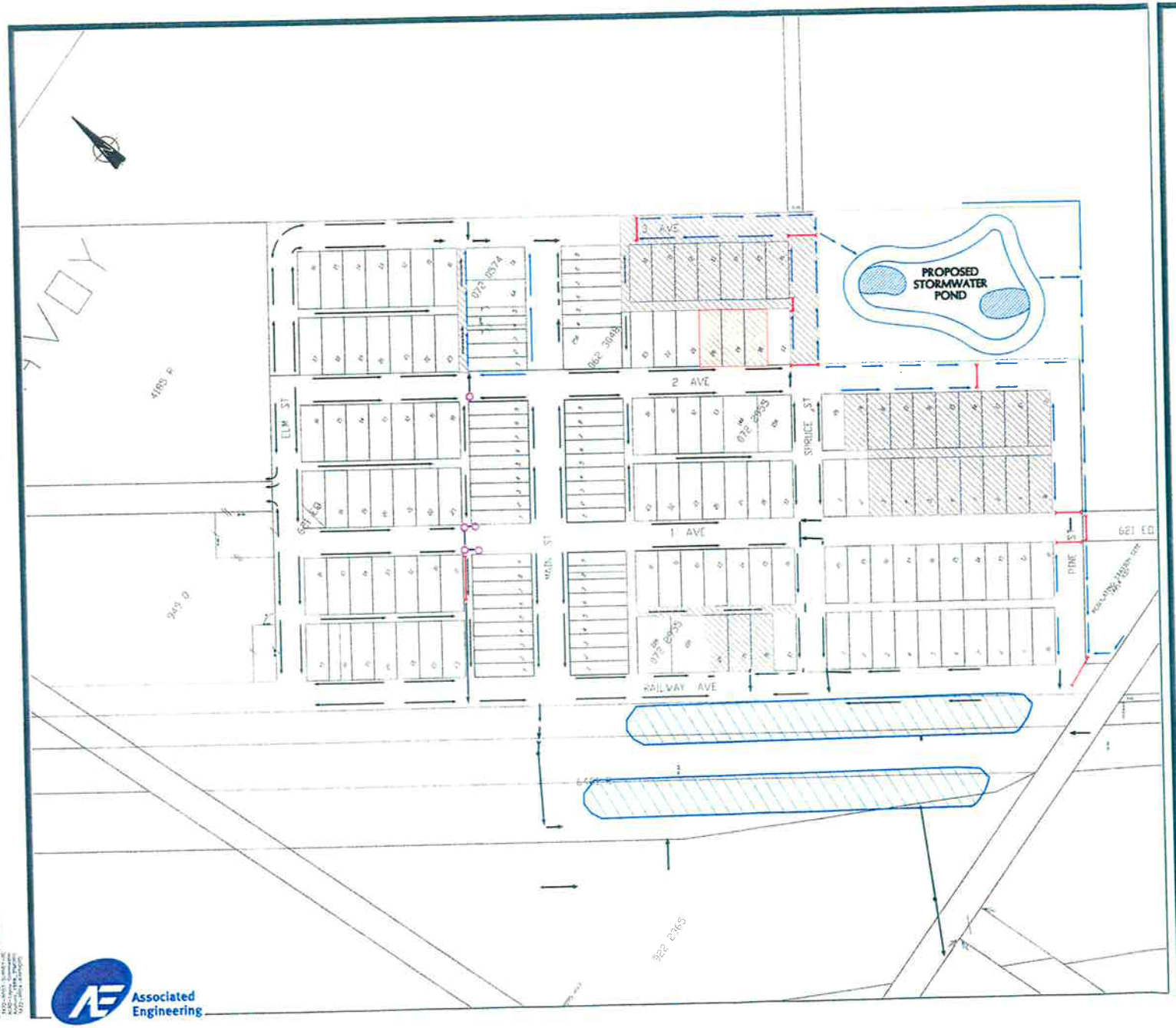
- GROUND ELEVATION CONTOURS (APPROXIMATE)
- DRAINAGE DIRECTION
- DITCH OR SWALE
- CURB/GUTTER
- CULVERT, LOCATION, SIZE AND DIRECTION OF FLOW
- CATCHMENT BOUNDARY
- LOW AREAS, SAGS AND POORLY DRAINED AREAS
- CATCHBASIN GRATE

SCALE : 1 : 2500

AUGUST, 2008

Associated Engineering

FIGURE 21



COUNTY OF MINBURN

LAVOY STORMWATER MANAGEMENT PLAN

PROPOSED DRAINAGE IMPROVEMENTS

LEGEND:

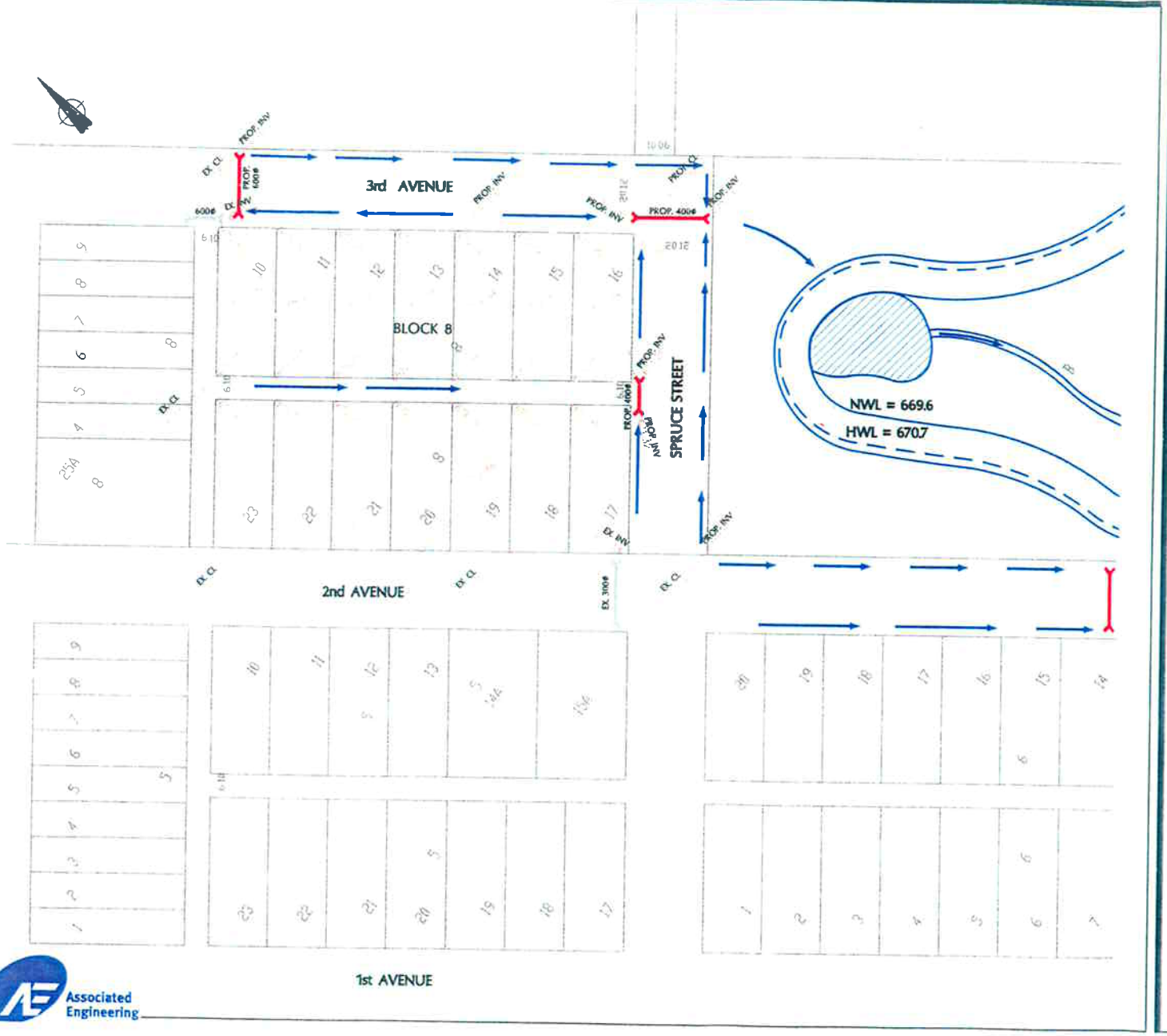
- DRAINAGE DIRECTION
- STORMWATER PONDING AREA
- PROPOSED CATCHBASIN
- PROPOSED CULVERT
- PROPOSED DITCH OR SWALE
- PROPOSED CONCRETE SWALE
- PROPOSED RE-GRADING

SCALE : 1 : 2500

AUGUST, 2008

Associated Engineering

FIGURE 3.1



COUNTY OF MINBURN

LAVOY STORMWATER MANAGEMENT PLAN

PRELIMINARY LOT GRADING PLAN

LEGEND:

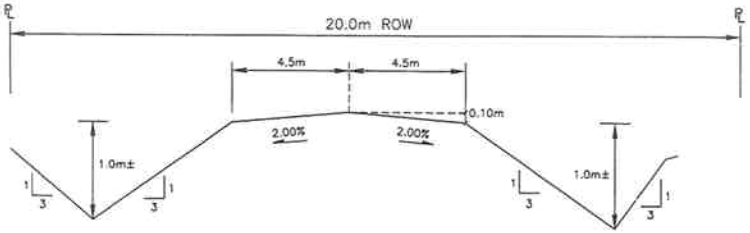
- EXISING CULVERT
- PROPOSED CULVERT
- DIRECTION OF FLOW
- PROPOSED FINISHED LOT GRADES
- EXISTING GROUND ELEVATION

SCALE : 1 : 1000

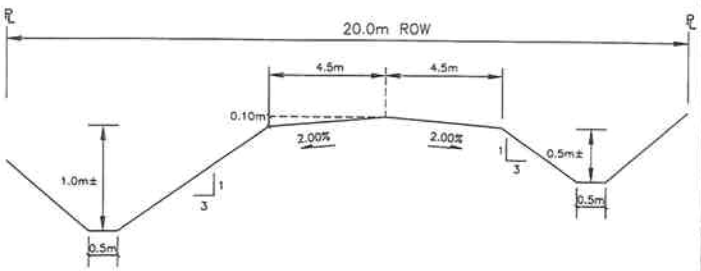
AUGUST, 2008

Associated Engineering

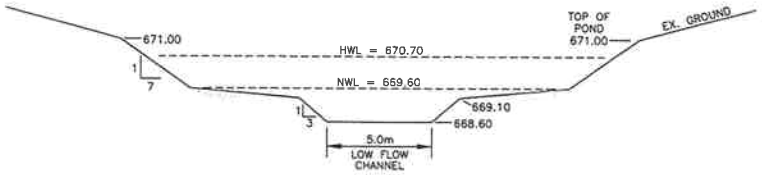
FIGURE 4.1



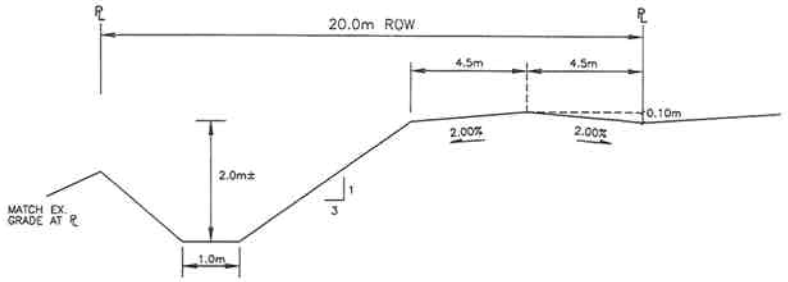
TYPICAL ROAD SECTION A-A 4.2



TYPICAL ROAD SECTION B-B 4.3



TYPICAL POND SECTION C-C 5.1



TYPICAL DITCH SECTION D-D 5.2

Associated Engineering

COUNTY OF MINBURN

LAVOY STORMWATER MANAGEMENT PLAN

TYPICAL CROSS SECTIONS PRELIMINARY DESIGN

SCALE : NOT TO SCALE

AUGUST, 2008

FIGURE 4.4