SECTION 8.1

LA SALLE REDBOINE CONSERVATION DISTRICT: LA SALLE RIVER WATERSHED ASSESSMENT SURVEY – WITH EMPHASIS ON LA SALLE RIVER, ELM RIVER, ELM CREEK CHANNEL, AND THE KING DRAIN - 2005

A Report Prepared
for

La Salle Redboine
CONSERVATION DISTRICT

by

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EXECUTIVE SUMMARY

This study was conducted to provide baseline information on the aquatic habitat and riparian areas throughout the La Salle River watershed (i.e., La Salle River, Elm River, Elm Creek Channel, and King Drain) that could be used to develop a watershed management plan and to facilitate selection of locations for rehabilitation efforts.

Existing physical, hydrological, water quality, and fisheries information was compiled and summarized for the La Salle River watershed. The main field component of this project was the collection of aerial video along the watershed for subsequent land use/land cover classification and to assist in the development of rehabilitation efforts. Additional field work involved: spring and summer fish utilization surveys; collection of hydrology and basic water quality parameters; and groundtruthing aerial video interpretations.

A succession of dams along the La Salle River has resulted in a series of impoundments, which can fill with sediment and potentially block fish movements. A relatively homogeneous habitat based on velocities, depths, substrate composition, and shoreline conditions is found throughout the La Salle River, also as a result of these impoundments.

A review of historical water quality studies indicates a system that is stressed by point/non-point anthropogenic inputs, increasing substantially over the last 25 to 30 years.

As a tributary to the Red River, the La Salle River could provide habitat for at least 53 species of fish. Fisheries investigations within the La Salle River have identified 13 species. A series of dams along the river (St. Norbert Dam 8.8 km upstream from the Red River), serve as significant impediments to fish passage. The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) lists three of the fish species potentially inhabiting the La Salle River watershed as 'special concern': the bigmouth buffalo; silver chub; and chestnut lamprey.

Approximately 262 km of the La Salle River watershed was classified for land use/land cover. Nearly 184 km of this classification was focused on the mainstem of the La Salle River. Cropland comprised the greatest land use along the La Salle River (46%), followed by other agricultural land (20%), and deciduous forest (10%). Pasture/grazing (6%), mixed urban or built-up land (5%), other urban or built-up land (5%), confined feeding operations

(4%), residential (3%), and transportation (1%) comprised the remainder of land use along the La Salle River.

Qualitative classifications of channel morphology, bank stability, and riparian zone function were rated along approximately 262 km of the La Salle River watershed. Based on these ratings, one of four aquatic habitat quality ratings (Class A – minimally impacted; Class B – moderately impacted; Class C – highly impacted; Class D – severely impacted) was assigned to each stream reach where attributes were similar. Over one-third (36%) of the La Salle River watershed was categorized as Class C. Class B (35%) and Class D (25%) habitat were the next most abundant. Only 3% of the watershed was comprised of Class A habitat.

Overall, an assessment of the La Salle River watershed illustrates an area that is highly to severely impacted by anthropogenic influences. A total of 119 prioritized sites have been identified within the study area that may warrant potential rehabilitation.

ACKNOWLEDGMENTS

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1.0 INTRODUCTION

Originating near Portage la Prairie and terminating in the Red River south of Winnipeg, the LaSalle River flows, predominantly, through agricultural land. Through much of its course, it is a turbid, slow moving, meandering prairie river with erodable, undercut banks, and variable water depths. Riparian areas typically consist of oak, poplar, dogwood, and willow species, with an understory of grasses and shrubs.

A number of user-groups rely on the La Salle River to fulfill needs ranging from recreational fishing to domestic/agricultural water demands. Quite often, these needs act as stressors on aquatic systems. As such, the La Salle Redboine Conservation District (LSRBCD) is in the process of developing a watershed management plan (WMP) for the La Salle River watershed. The WMP process begins with developing an understanding of watershed function and how human activities affect watershed health.

The LSRBCD invited North/South Consultants Inc. to conduct the *La Salle River Watershed Assessment Survey*. The primary objective of this survey was to provide the LSRBCD board with a comprehensive overview of riparian and land use conditions affecting the La Salle River watershed. Specific objectives of the assessment included:

- Compiling and summarizing historical information on hydrology, water quality, and fisheries resources;
- Determining fish use of the La Salle River watershed by conducting spring and summer surveys;
- Determining land use practices along stream corridors;
- Documenting riparian conditions; and
- Identifying and prioritizing sites in the watershed that are contributing to degradation of water quality and aquatic habitat.

This report provides baseline aquatic habitat and riparian conditions pertaining to the La Salle River watershed, as well as areas that may be stressors on this watershed. It can act as a resource tool for continued watershed management and water quality improvements.

2.0 METHODS

2.1 HISTORICAL REVIEW

2.1.1 Physical and Hydrological Information

Historical hydrological data along the La Salle River watershed was obtained from the Environment Canada web page at www.msc.ec.gc.ca/wsc.

Using a USGS digital elevation model (DEM), longitudinal streambed profiles were generated along the La Salle River, Elm River, Elm Creek Channel, and King Drain. The profiles were generated by intersecting points along the La Salle River watershed polylines with 90 metre Shuttle Radar Topography Mission (SRTM) USGS DEM, using Spatial Analyst extension in ESRI ArcGIS® v.9.

2.1.2 Water Quality

Historical water quality information (1973 – 2005) was obtained from the Water Quality Management Section, Manitoba Water Stewardship (WQMS 2005). The data were sorted and tabularized to assist in the recognition of water quality trends

2.1.3 Fish Species Utilization

The Manitoba Water Stewardship Fisheries Branch (MWSFB) office in Winnipeg was queried with regard to historical fish utilization in the La Salle River watershed. The MWSFB Fisheries Inventory Habitat Classification System (FIHCS) was also searched. Where possible, interviews were conducted with local landowners and tenants who live within the watershed.

2.2 FIELD SURVEYS

2.2.1 Aerial Videography

Taiga Air Services (Winnipeg) was chartered to collect aerial video from a helicopter using a digital nose mounted camera and Red Hen System Media-Mapper software. This application produced real-time geo-referenced video and digital still images which were then integrated into a Geographic Information System (GIS). In-flight real-time Geographic Positioning System (GPS) coordinates, altitude, speed and track information were encoded into the digital video and images captured from the onboard nose mounted camera. Specific points of interest (e.g., dams, fords, etc.) along the video flight route were marked as integrated video waypoints.

The aerial videography flight was conducted on October 28, 2005.

2.2.2 Groundtruthing

Classification of physical characteristics via aerial video is often difficult due to a number of factors including, but not limited to, elevation, atmospheric conditions, and ground cover. Therefore, wherever possible, areas of the La Salle River watershed were groundtruthed to ensure classification accuracy. Groundtruthing also allowed for collection of ground-based photographs. Groundtruthing sites were selected during analysis of the aerial video and visited during the fisheries surveys

2.2.3 Physical and Hydrological Information

To provide a general understanding of stream morphology and substrates in the various branches of the watershed, a number of locations were selected during the field investigations for measurement of cross-sectional profiles and water velocities, and characterization of substrates. Substrate types were assessed based on a modified Wentworth classification, as outlined in Bain and Stevenson (1999). Water velocity was measured with a Model 1210, Price Type “AA” current meter.

Three type Z, *i*B Tags™, programmed to collect water temperatures (^{o}C) every four hours, were installed at three locations along the La Salle River.

2.2.4 Water Quality

In conjunction with groundtruthing and fish utilization surveys, some basic water quality parameters were measured *in situ* (i.e., in the field) with a Horiba U-10 water quality meter. The parameters measured included: dissolved oxygen; conductivity (measured as specific conductance); temperature; pH; and turbidity. In some locations, water temperature was measured with a hand held alcohol filled pocket thermometer.

Water samples were collected from three locations during the spring, summer, and fall. The samples were submitted to Enviro-Test Laboratories in Winnipeg for analysis of the following parameters: dissolved ammonia; dissolved nitrate-nitrite; total dissolved phosphorus; total phosphorous; chlorophyll-*a*; fecal coliform; total dissolved solids; total kjeldahl nitrogen; and total suspended solids.

2.2.5 Fish Species Utilization

2.2.5.1 Spring

Spring fish utilization of the La Salle River watershed was assessed during a three day hoop net survey. The survey was timed to coincide with anticipated peak upstream movements of northern pike (*Esox lucius*), walleye (*Sander vitreus*), and white sucker (*Catostomus commersoni*), as determined by water temperature. Each hoop net was 1.2 m in diameter, constructed of 6.45 cm^2 nylon mesh, and had 10.0 m long wings which were extended to each shore where possible. All fish captured were identified to species, measured for fork length (± 1 mm) and weight (± 25 g), classified by sex and state of maturity, and released.

Where possible, visual inspections for fish presence were conducted along stream reaches.

2.2.5.2 Summer

Fish use within the La Salle River watershed was assessed during summer/fall over a two day survey period. Methods included back-pack electrofishing (Smith-Root Model 15-C), beach seining, dip netting, and visual surveys. Sampling was conducted at sites throughout the watershed, where access was available, and where spring hoop nets were deployed. All fish collected were identified to species and released. Some of the larger bodied fish were measured for fork length (± 1 mm). A number of the small-bodied fish were preserved in the field (10% formaldehyde solution) for subsequent identification.

2.2.6 Benthic Invertebrate Collection

Because macroinvertebrates respond to a range of stream disturbances (e.g., sedimentation, heat pollution, nutrient loading, chemicals, etc.) they can be used to determine aquatic ecosystem health and integrity (Gibbons et al 1993; Milner and Roberts 1997). However, successful assessments require knowledge of the life cycles of aquatic insects, specific tolerance levels of individual species, and well established sampling protocols (e.g., number of stations, time of sampling, habitat stratification, etc.) (Milner and Roberts 1997; USDA 1998). The tolerance levels presented within this document were adopted from a stream monitoring manual compiled by the West Virginia Department of Environmental Protection (2004).

Benthic invertebrates were collected with the use of either a 'tall' Ekman or a D-Frame kick net. The Ekman dredge had a 0.023 m^2 opening and attached lead weights to assist in substrate penetration, when lowered from a bridge or other structure. The kick net had a 500 µm nitex mesh bag (D-shaped) attached to a single wooden pole; which was held on the river bottom to catch invertebrates, while the substrate was being agitated.

Invertebrate samples were preserved in the field (10% formaldehyde solution) for subsequent identification (i.e., to Order and Family where possible) and enumeration.

2.3 WATERSHED CLASSIFICATION

To assist in watershed classification and under the direction of the LSRBCD, the La Salle River was divided into three reaches. These reaches were delineated as follows: Reach 1 – headwaters of the La Salle River to the mouth of the Elm Creek Channel; Reach 2 – mouth of the Elm Creek Channel to the Sanford Spillway; and Reach 3 – Sanford Spillway to the mouth of the La Salle River.

The aerial video and groundtruthing data were used to classify predominant land use practices and aquatic habitat quality along reaches of the La Salle River watershed. In each case, reaches were bounded by obvious changes in classification attributes and extended at least two active channel widths on each side. Potential barriers to fish movement were identified and classified. The following provides a description of the classification processes and methods

2.3.1 Land Use

Land use in the watershed was classified based on visual interpretation of the aerial videography. Interpretations were based on the identification of patterns, textures, colours and contrasts visible on the landscape being viewed. Where possible, groundtruthing was used to assist in the interpretation of land use.

Land use along the La Salle River, Elm River, Elm Creek Channel, King Drain, and Domain Drain was delineated into 12 general categories as outlined below. The categories were developed by North/South Consultants Inc. based on the predominant land use practices found in southern Manitoba and by implementing classifications described by Anderson et al. (1976). The categories focus on reaches of the watercourses and the predominant land use adjacent to them. Although reaches classified often incorporated more than one land use type, classification of the reach was based on the most intensive land use within the area.

Residential: Anderson et al. (1976) define residential as the multiple unit structures of urban cores to houses on lots of more than one acre. Generally, residential strips have uniform size and spacing of structures, linear driveways, and lawn areas. Examples of residential areas are towns or the recently developed 'suburbs' of these small towns.

Transportation: This category is applied where a major transportation route (i.e., Trans-Canada Hwy.) crosses or influences other land uses with boundaries being outlined by them.

Mixed Urban or Built-up Land: This category is applied when separate land uses cannot be mapped individually and may include residential, commercial, or industrial practices (Anderson et al. 1976). Farmsteads intermixed with a cluster of structures (residential or storage) would fall under this category.

Other Urban or Built-up Land: Land use within this category is defined as golf courses, parks, cemeteries, and undeveloped land within an urban setting (Anderson et al. 1976).

Crop Land: This category may be defined as land used for the production of food (e.g. cattle, wheat crop, legumes, etc.) or for the production of forage crops (e.g. alfalfa, timothy, etc.). These areas were generally characterized by coarser textures, linear crop/cultivation features, and (often) yellow to gold colour tones. Land under cultivation or without vegetative cover (e.g., tilled) also fell under this category.

Pasture/Grazing: Areas of land used for livestock operations were classified as pasture/grazing. This land use was generally characterized by a smooth texture resulting from grazed herbaceous cover. Pasture/grazing are often associated with heavily defined linear tracks and, where applicable, fence lines. Pastures in forested areas were identified by a decreased density of trees within the forest stand.

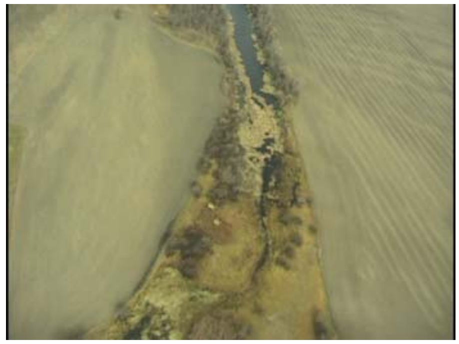
Confined Feeding Operations: Anderson et al. (1976) defines this category as a livestock production enterprise (e.g., cattle, hog, poultry, etc) with a large animal population restricted to a small area. These areas have a built-up appearance, fencing, paddocks, access paths, and (typically) a large concentration of waste material.

Other Agricultural Land: This category includes farmsteads, holding areas for livestock (i.e. corrals), and structures associated with agricultural practices (e.g. barns, storage silos, etc). Typically, practices under this category are on a smaller scale than confined feeding operations or mixed urban/built-up land uses (for example).

Canals: Defined as an artificial waterway used for irrigation, drainage, etc. These areas are typically linear and often associated with cement fords and a marginal/non-existent riparian area.

Deciduous Forest Land : Areas dominated by forest land (e.g., mixed deciduous) tend to be more 'natural' and have few linear or man-made patterns. Forest land was characterized by a smooth texture and a randomly undulating 'cellular' pattern, resulting from the tree crowns.

Non-Forested Wetland: An area dominated by natural herbaceous vegetation. These areas tended to be more 'natural', had few linear patterns, and were characterized by smooth, undulating textures and random patterns.



Forested Wetland: A wetland (water table at/near the land surface) dominated by woody vegetation (Anderson et al 1976).

Residential, transportation, mixed urban or built-up land, other urban or built-up land, crop land, pasture/grazing, confined feeding operations, other agricultural land, and canals are considered to be anthropogenic in origin. Deciduous forest land, non-forested wetland, and forested wetland are assumed to be in a natural state or areas not necessarily altered by anthropogenic means.

Categories were delineated as accurately as possible. However, there are basic limitations given the temporal scale and resolution of the aerial video. Therefore, where possible, groundtruthing was utilized to confirm the initial classification based on aerial footage.

2.3.2 Aquatic Habitat Conditions

The aerial video and information collected by groundtruthing were used to classify aquatic habitat conditions within the La Salle River watershed. Stream reaches were classified based on a visual qualitative assessment of conditions in and adjacent to the stream. Stream condition assessments were based on the United States Department of Agriculture (USDA 1998) Stream Visual Assessment Protocol.

The classification system was based on identifying potential impacts as a True or False attribute (i.e., 1 or 0 within the geodatabase) within four criteria for each reach. For example: if a reach of stream exhibited a denuded riparian zone on one or both banks, it would receive an attribute value of 1(true) for the riparian zone criteria. If the stream banks showed excessive erosion or slumping, this reach would receive an additional value of 1 (true), and so on. The three criteria selected were: channel morphology (hydrologic alterations and channelization), bank stability, and intactness of the riparian zone. These criteria were chosen based on their relative importance to stream health described within the USDA Stream Visual Assessment Protocol (1998) and the ability to interpret these criteria using the quality of the videography.

The following sections describe the stream conditions assessed in determining aquatic habitat quality and the classification methods used.

2.3.2.1 Channel Morphology

Bankfull flows and flooding are important in maintaining both the shape of a channel and its function (USDA 1998). High flows can redistribute larger sediments and debris to form pool/riffle habitats and increase the habitat diversity of a watershed. Altered channel morphology can limit the scouring effect of high flows, allowing siltation of important spawning areas and habitat zones (USDA 1998; Bain and Stevenson 1999).

Channel morphology was rated with a true or false value based on the following criteria (USDA 1998):

True Condition(s):

- Dykes or other man-made structures prevent natural flooding of the adjacent floodplain;
- Channel is altered, braided, or with man-made structures restricting floodplain width. Channel may be incised; or
- Evidence of past channel alteration, but with significant recovery of channel and banks.

False condition(s):

- Channel appears to be 'natural' with no structures or dykes. No dams, water withdrawal, dykes or other structures limiting streams access to floodplain.

2.3.2.2 Bank Stability

Stream banks are important transition zones between aquatic and terrestrial systems (Bain and Stevenson (1999). Eroding banks can reduce instream fish cover, reduce water transparency, smother fish eggs and benthic invertebrates with silt, and infill shallow water habitats (Bain and Stevenson 1999). Although some bank erosion is normal in a healthy watershed system, excessive erosion can occur when riparian areas are degraded, hydrology is altered, or when sediment load is increased (USDA 1998).

Assessments of bank stability were based on the potential for detachment of soil from the upper and lower stream banks and the subsequent deposition to the stream channel. Both the left bank (LB) and right bank (RB), when looking upstream, were classified and rated. Due to the scale and resolution of the aerial video, bank stability was at times difficult to visually assess. Ratings were based on the application of groundtruthing data to the aerial video and an overall visual assessment of the stream reach being classified.

Bank stability was rated with a true or false value based on the following criteria (USDA 1998).

True Condition(s):

- Bank(s) unstable and typically high. There may be overhanging vegetation at top of a bare bank, trees falling into stream, or a number of slope failures apparent.
- Bank(s) moderately unstable and typically high. Some trees may be falling into the stream and there may be some slope failures apparent.
- Bank(s) moderately stable and low. A lower amount of eroding surface on outside bends is protected by roots that extend to the base-flow elevation.

False condition(s):

- Bank(s) are stable and low. A large amount of eroding surface area on outside bends is protected by roots that extend to the base-flow elevation.

2.3.2.3 Riparian Zone Function

The riparian zone is defined as an area adjacent to a body of water or as the transition zone between aquatic and upland areas; it can also be referred to as riparian buffer zone, buffer strip, or vegetation retention zone (Kipp and Callaway 2003; Williams et al. 1997; Bain and Stevenson 1999). The health of the riparian zone is fundamental to the well being of an entire stream ecosystem (USDA 1998). A healthy riparian zone can: buffer the introduction of pollutants and/or organic matter to a stream; regulate instream algal production via shading; decrease erosion by stabilizing stream banks and dissipating energy during flood events; provide a source of cover, food, and microclimate control for fish and invertebrates; and act as a travel corridor for terrestrial animals/birds (Williams et al. 1997; USDA 1998; Bain and Stevenson 1999; Koning 1999; AAFC-PFRA 2004).

From an agricultural standpoint, riparian vegetative cover helps regulate soil climate, stimulate soil activity (via biomass production) and acts as a buffer between water courses and fertilizer and pesticide applications (Donat 1995). It has been found that dew formation, precipitation, and soil moisture increases in the vicinity of a well-established riparian zone (Donat 1995). The quality of the riparian zone increases as both the width and complexity of woody vegetation within it increases (USDA 1998).

Riparian zone function was rated with a true or false value based on the following criteria (USDA 1998).

True Condition(s):

- Natural vegetation/regeneration of vegetation is lacking and the ‘filtering’ function of the riparian zone is severely or moderately compromised.

False condition(s):

- Natural vegetation extends at least two active channel widths on each side and the ‘filtering’ function of the riparian zone does not appear to be compromised.

2.3.3 Aquatic Habitat Quality Rating

To assist in the identification of sites for rehabilitation, a qualitative rating of aquatic habitat quality was assigned to stream reaches based on an overall assessment of the stream conditions assessed above. The rating system incorporated four classes as outlined below.

- Class D: Stream reaches within this category are severely impacted and generally characterized by altered channels and a heavily altered hydrologic regime. There is a lack of vegetation regeneration within the riparian zone. Because of this, the filtering function of the riparian zone is severely compromised. Bank stability is generally unstable within this class.
- Class C: Stream reaches within this category are highly impacted and generally have altered hydraulic regimes (e.g., channelization, barriers). Bank stability in this class tends to be moderately stable. Reaches with marginal riparian vegetation may have a moderate filtering capacity.
- Class B: Stream reaches in this category are moderately impacted, and typically have a more natural channel morphology and hydrologic regime than Class C reaches. Bank stability in this class tends to be moderately stable. Commonly, a margin of natural vegetation may remain increasing bank stability and buffering capacity. Some stream reaches in this category have more ‘natural’ conditions on one bank and a greater amount of impact on the opposite bank.
- Class A: Stream reaches within this category are minimally impacted and tend to have natural channel morphology. The riparian vegetation, which is typically present on both stream banks, provides a high level of buffering capacity, fish habitat and bank stability.

2.3.4 Potential Barriers

Barriers to fish movement can be defined as any structure or habitat conditions that create a potential obstacle to fish movements (Bain and Stevenson 1999). These barriers can be anthropogenic in origin (e.g., concrete structure, earthen dam, dike, perched culvert) or natural (e.g., beaver dam, debris dam, rapids). Besides limiting/stopping the movement of fishes, barriers can affect the health of a stream via disruption of stream flow, sediment transport, and thermal regimes (Bain and Stevenson 1999).

Potential barriers to fish movement were identified from the aerial video and where possible groundtruthed to verify the nature and extent of the blockage. Barriers were classified as follows:

1) Beaver dams
2) Debris – Accumulations of natural or man-made debris.
3) Anthropogenic – dams, fords, or culverts.

Under the classification of anthropogenic barriers, dams may also be referred to as 'low-head dams'. A low head dam is defined as a constructed barrier in a river, spanning the entire width, with a hydraulic height not exceeding eight meters (ICF 2005). Dam composition may include concrete, rubble, boulder, or a similar aggregate.

Each barrier was assessed as to the severity of blockage including the potential to limit fish access to important areas for feeding, reproduction, and/or rearing. Potential barriers were also digitized as point features within the geodatabase.

Given limitations of aerial videography and logistics involved with groundtruthing, it is expected that some barriers were not identified.

3.0 RESULTS AND DISCUSSION

3.1 HISTORICAL REVIEW

3.1.1 Physical and Hydrological Information

Originating near Portage la Prairie and terminating in the Red River south of Winnipeg, the LaSalle River has a drainage area of 2,407 km^2, with an approximate channel course of 180 km (Figure 1). The LaSalle River flows, predominantly, through agricultural land consisting of soils and fine sediments (e.g., calcareous shale, fossiliferous limestone, argillaceous dolomite). It is typically a turbid, slow moving, meandering prairie river with erodable, undercut banks, and variable water depths (greater than 1.0 m at center channel). Riparian areas may typically consist of oak, poplar, dogwood, and willow species, with an under story of grasses and shrubs.

Streambed identification points and longitudinal streambed profiles for the La Salle and Elm rivers are presented in figures 2 to 4. Average elevations of the La Salle and Elm rivers are 240 and 250 masl, respectively. The La Salle River drops approximately 36 m over a 180 km run of river, while the Elm River drops 16 m over 50 km. The greatest elevation within the La Salle River watershed occurs in the south western portion, after which it slopes gently eastward towards its confluence with the Red River (AAFC-PFRA 2004).

Commencing in the 1940's a series of eight provincially owned dams were constructed along the La Salle River by PFRA (J. Smithson, MWS-Water Science and Management Branch, pers. comm. 2006) (Figure 5). Three of these dams (located at St. Norbert, Elie, and Sanford) are classified as 'stop-log' dams. The remaining five are defined as fixed crest weirs, constructed with sheet piling and rock (Manitoba Water Stewardship – Fisheries Branch, La Salle River file, circa 1996). This succession of dams has changed the riverine habitat of the La Salle River to a series of impoundments, which have filled with sediment and block fish movements (Anonymous, circa 1994). A relatively homogeneous habitat based on velocities, depths, substrate composition, and shoreline conditions is found throughout the La Salle River, also as a result of these impoundments.

Low head dams, flow augmentation, and irrigation play a significant part in the flow regime of the La Salle River. To provide adequate flow for domestic consumption, livestock watering, and irrigation, flows in the La Salle River were augmented (0.70 m^3/sec) with water drawn from the Assiniboine River by a pumping station located just east of Portage la

Prairie (Therrien-Richards and Williamson 1987; Gurney 1991 in Baker 1993) (Figure 5). There are currently three active pumping sites within the La Salle River watershed: Pumpsite-W, Elm River; Pumpsite-Y, La Salle River; and Pumpsite-Z, Mill Creek (S. Jackson, MWS-Grosse Isle, pers. comm. 2006) (Figure 5). Pumping records for these sites, from 1985 to 2005, are presented in Appendix 1.

Pumpsite-W typically runs from late April/May until the end of October, pumping 5 to 15 cfs. In 2005, this Pumpsite was in operation from August 2 until October 28. Pumpsite Y typically runs year round, pumping between 5 and 25 cfs. In 2005 this Pumpsite nearly ran continuously, with intermittent stops due to heavy rains. Pumpsite-Y did not run at all in 2005 due to heavy rains.

Wardrop/TetrES (1991 in Baker 1993) indicated that significant irrigation withdrawals from the La Salle River occur upstream of the City of Winnipeg, although the actual amount is difficult to determine (Anonymous 1994). Water withdrawal for domestic consumption occurs from the R. M. of MacDonald plant located in Sanford. This is a regional water system, servicing the communities and rural areas of Sanford, Starbuck, Oakbluff, La Salle, Domain, and Brunkild (Gurney 1991 in Baker 1993: B. Bolduc, R.M. of MacDonald, pers. comm. 2006).

There are 12 hydrometric stations along the La Salle River, three along the Elm Creek Channel, and one on the Domain Drain (ECWSC 2005) (Table 1). No stations were located along the Elm River or King Drain. Eight of the 12 stations on the La Salle River record water levels, while the remaining four stations record flow and/or levels.

Monthly mean flows for April and August, and the median, upper and lower quartiles for Station # 05OG008 (La Salle River near Elie) are presented on figures 6 and 7. From 1979 to 2004, mean discharge in the La Salle River for the month of April, near Elie, was 1.52 m^3/s, ranging from 0.04 to 4.63 m^3/s (ECWSC 2005). In August, mean discharge was 0.25m^3/s, ranging from 0.0 to 1.12 m^3/s. Peaking in April and tapering off in early May, discharge on the La Salle River, from 1979 to 2004, was relatively stable. This is likely attributable to the gradual sloping topography, low head dams, flow augmentation, and water withdrawals (i.e., irrigation, domestic consumption).

3.1.2 Water Quality

Historical water quality information for the La Salle River watershed was obtained from the Water Quality Management Section (WQMS), Manitoba Water Stewardship (2005), who collected water quality information from a number of sites throughout the watershed from 1973 to 2006. This information is provided in its entirety on Disc 1 and is summarized for water quality sites WQ0068, WQ0069, WQ0070, WQ0071, WQ0072, WQ0073, and MBO5OGS039 (Table 2, Figure 5).

Water from the La Salle River is used for a number of purposes including recreation, municipal water supply, livestock watering, and irrigation. As such, the river has received attention and study regarding the quality of water within its banks. Therrien-Richards and Williamson (1987) studied pesticide contamination on the La Salle River; Currie and Williamson (1995) assessed levels of pesticide residues; Jones (1999) monitored microcystin-LR in municipal surface water supplies; Hughes (2001) reviewed and summarized water and biological quality; Jones and Armstrong (2001) summarized trends in total nitrogen (TN) and total phosphorus (TP); and Bourne et al. (2002) estimated TN and TP loading to streams in Manitoba.

A review of historical water quality studies indicates a system that is stressed, primarily due to point/non-point anthropogenic inputs (e.g., cultivation, livestock operations, wastewater lagoon discharges, recreational sites, urban storm water drains, landscape and soils, etc.) (EMD 1980 in Jones 1999; Bourne et al. 2002; Manitoba Phosphorus Expert Committee [MPEC] 2006). Although it is possible to identify sources of point/non-point nutrient loading, quantifying the amount of nitrogen and phosphorus from these sources is often problematic. For example, many provincial wastewater treatment lagoons are not required to monitor effluent for nitrogen (N) and phosphorus (P), discharges are often done on an irregular basis, or domestic and industrial wastewater are treated at the same facility (Bourne et al. 2002; B. Bolduc, R. M. of MacDonald, pers. comm. 2006).

Based on results from WQ0068, Jones and Armstrong (2001) suggested that anthropogenic loading to the La Salle River has ‘increased substantially’ over the last 25 years (TN increased 145.5% from 1974 to 1999, while the median trend in TP rose 193.8%). However, the authors also stipulated that a more detailed assessment regarding nutrient loading was warranted given the large gap in the database and the distance between the flow station and water quality sampling station. In 2001, the La Salle River accounted for 1.5% of the TN and 1.3% of the TP in the Red River (Bourne et al. 2002).

Because water flows within the La Salle River are augmented with water diverted from the Assiniboine River, water quality in the latter is a concern. Concentrations of TN and TP in the Assiniboine River (at water quality sampling station WQ0018, near Headingly) have also 'increased substantially' over the last three decades (Jones and Armstrong 2001). However, the increasing trends of TN (median trend increased 54%) and TP (median trend increased 62%) in the Assiniboine are not as great as those reported in the La Salle over a similar time frame.

Jones (1999) reported that water quality data collected at sampling stations along the La Salle River over the past 30 years is indicative of a eutrophic system. At the water quality sampling station downstream of the water intake in Sanford (WQ0070), TP concentrations over the last 30 years ranged from 0.08 mg/l to 1.96 mg/L (Jones 1999). Based on the classification system developed by Dodds et al. (1998), this range in TP places the La Salle River in a eutrophic state (TP value for Mesotrophic/Eutrophic boundary is 0.075 mg/L).

Eutrophication is defined as the nutrient enrichment of a water body (e.g., surplus inputs of phosphorus and/or nitrogen), which can lead to excess growth of rooted aquatic plants and/or algae (Thomann and Mueller 1987; MPEC 2006). Eutrophication of a water course can lead to low levels of dissolved oxygen resulting in fish kills; algal growth clogging water intake devices; excessive growth of rooted vegetation resulting in reduced channel carrying capacity; and/or loss of aesthetic values via discoloration and emission of odours (Thomann and Mueller 1987; Armstrong 2002). A study conducted by Youth Corps Canada (1995) recorded excessive growth of both rooted aquatic vegetation and mats of duck weed (see photos) along the La Salle River. As a guideline to help prevent the growth of nuisance aquatic plants and algae, Williamson (2002) indicated the total phosphorus concentration entering a lake, pond, reservoir, or tributary should not exceed 0.025 mg/L (0.05 mg/L in streams).



Photos of excessive rooted aquatic vegetation and duckweed/algal growth along the La Salle River (Youth Corps Canada 1995)

Water quality in the La Salle River has affected its suitability as a raw water source for domestic consumption. The historical quality of water was taken into consideration prior to, and during, the construction phase of the water treatment plant located in Sanford, Manitoba. Initially going ‘on-line’ in 1989 and servicing the communities of Sanford and La Salle, the water treatment facility was upgraded in 1996 to service additional communities (B. Bolduc, R. M. of MacDonald, pers. comm. 2006). External storage reservoirs (65-75 million gallon capacity) are filled three to four times per year (late fall or early spring), depending on existing water conditions/quality within the La Salle River. Problems often associated with water withdrawal at this location are increased turbidity, poor flow or stagnation, and algae blooms (B. Bolduc, R. M. of MacDonald, pers. comm. 2006).

Although the data were limited, Therrien-Richards and Williamson (1987) determined that concentrations of acid herbicides detected in the water column of the La Salle River did not pose a significant threat to humans. However, the authors did raise concerns over the presence of trifluralin and triallate in the sediment and fish samples collected.

3.1.3 Fish Species Utilization

As a tributary to the Red River, there is potential for the 53 species of fish occurring in the Red River to occur within the La Salle River (Table 3). The provincial FIHCS system lists thirteen species of fish as having been identified in the La Salle River (Table 3, Appendix 2). The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) lists three of the fish species potentially inhabiting the La Salle River watershed as ‘special concern’, the bigmouth buffalo, silver chub, and chestnut lamprey (Table 3). The Species At Risk Act (SARA) defines special concern as ‘a wildlife species that may become a threatened or an endangered species because of a combination of biological characteristics and identified threats’.

The bigmouth buffalo is primarily found in the Assiniboine (downstream of Portage La Prairie) and Red rivers, and within the lowermost reaches of tributaries entering the Red River (Stewart and Watkinson 2004). Preferred habitat is the shallow depths of slow or still waters of larger rivers, oxbows, or reservoirs with a tolerance for turbid water (Scott and Crossman 1979).

The silver chub prefers large sandy or silty rivers and, in Manitoba, restricts itself to the lowermost reaches of tributaries to the Red and lower Assiniboine Rivers (Scott and Crossman 1979; Stewart and Watkinson 2004). Although it is one of the three most abundant fish species in the Red River above St. Andrews Dam, the silver chub population of the Red River is one of the few apparently healthy and abundant populations for this species (Keleher and Kooyman 1957 in Scott and Crossman 1979; Stewart and Watkinson 2004).

In Canada, the chestnut lamprey is only known to be found in southern Manitoba, occurring in most streams and lakes (Scott and Crossman 1979; Stewart and Watkinson 2004). Although they are the most commonly collected of the three lamprey species in Manitoba, sampling gear is ineffective at catching them and the species is most likely more common and widespread than data suggest (Stewart and Watkinson 2004).

Actual fish utilization of the La Salle River is probably restricted by habitat suitability, water quantity, and by a series of low head dams that limit access from the Red River (Anonymous, circa 1994) (Figure 5). The first of these dams is the St. Norbert Dam, at La Barriere Park, located approximately 8.8 km upstream from the mouth.

Almost all of the fish that could potentially be found in the La Salle River are spring (i.e., northern pike, white sucker) and early summer spawners (i.e., carp, black crappie). Spring spawners generally initiate spawning activity during the spring freshet and increasing water temperatures. Species such as northern pike, quillback, shorthead redhorse, and white sucker may ascend the La Salle River (from the Red River) in the spring for the purpose of spawning. In years of low runoff upstream migrations may be blocked by the St. Norbert Dam and numerous other dams located further upstream. However, during years of high run off events, migration past these barriers may be possible for short periods of time.

Other species found in the La Salle River could be classified as late spring-summer spawners. These species may not show specific migratory patterns, but rather be of resident populations within the La Salle River (upper reaches or headwaters). Examples of these species would belong to the families Cyprinidae, Percidae, or Ictaluridae (Table 3).

In the fall of 2004 and 2005, North/South Consultants Inc. (unpublished data) conducted a number of studies within the lower reach of the La Salle River (i.e., 200 m upstream from the mouth). Fish catches included adult bigmouth buffalo, sauger, black crappie, walleye, white bass, quillback, channel catfish, and northern pike. One hoop net set within the mouth of the La Salle River captured over 65 channel catfish. Several of the walleye, channel catfish, and northern pike had acoustic tags surgically implanted within them. Preliminary results indicate that these species could possibly be using the lower reach of the La Salle River as an over wintering area or for feeding. One northern pike, initially tagged in the Red River (downstream of the south inlet floodway control structure) in September 2005, was located approximately one km upstream on the La Salle River in October of 2005.

The Department of Fisheries and Oceans (DFO) conducted fisheries investigations throughout the La Salle River watershed during the open water season of 2005 (D. Milani, DFO, pers. comm. 2006). Data analysis and report preparation for this work was ongoing as this report was published.

3.1.4 Benthic Invertebrates

In 1995 Manitoba Water Stewardship – Water Quality Management Section initiated a program to assess assemblages of macroinvertebrates using rapid bioassessment techniques (Hughes 2001). Macroinvertebrates collected at WQ0068 (PTH 75 at St. Norbert) from 1995 to 1998 are presented on Table 4. Based on 'biological condition', Hughes (2001) indicated the La Salle River was moderately impaired between 1995 and 1997. However, in 1998 it was classified as moderately to severely impaired. The moderately impaired classification is indicative of a reduced species assemblage due to an absence of intolerant species. The severely impaired classification is indicative of a benthic population composed of only a few species of which only one or two species occurs in larger numbers.

3.2 FIELD SURVEYS

3.2.1 Physical and Hydrological Information

Still photographs taken during the groundtruthing component of this study are presented in digital format on Disc 1. This disc contains the following: a photographic index; folders of photographs taken during the early spring, spring, summer, and fall groundtruthing periods; and a site map showing photograph locations.

Ground surveys and classification of physical attributes (e.g., substrate compaction and composition) in the La Salle River watershed were limited due to the high water events of 2005. Work conducted on the ground primarily consisted of fisheries surveys, verifying aerial classifications, collecting still photographs of physical conditions, collecting water quality samples, and visiting potential rehabilitation sites.

Physical and hydrological data collected along the La Salle River watershed is presented in Appendix 3. Sample locations are presented on Figure 8. Discharge measurements collected throughout the watershed are presented on Table 5. On April 20, ECWSC (2005) measured a mean daily discharge of 7.78 m^3/s at Station # 050G001, near Sanford. The La Salle River (1.181 m^3/s, 15.2%), Elm Creek Channel (1.353 m^3/s, 17.4%), and Elm River (0.735 m^3/s, 9.4%) contributed a combined total of 42% towards the total daily discharge recorded near Sanford on April 20.

On August 31, the La Salle River (LRVEL, 0.229 m^3/s, 23.3%), Elm Creek Channel (0.298 m^3/s, 30.3%), and Elm River (0.207 m^3/s, 21.1%) contributed a combined total of nearly 75% towards the total daily discharge recorded near Sanford (0.982 m^3/s) (ECWSC Station # 050G001, 2005).

The locations where *i*B Tags were installed in the river are presented on Figure 8. Because of high water events during early summer 2005, only one (i.e., TEMP 3) of the three *i*B Tags deployed were recovered at the end of the open-water season. From April 20 to November 1, water temperatures at TEMP 3 ranged from 4.6 to 26.2 ^oC. Mean daily temperature during this period was 16.2 ^oC (Figure 9). Located under a bridge, TEMP 3 was shaded and in approximately 1.0 to 1.5 m of water. However, water temperatures either mirrored or were greater than mean daily ambient air temperatures recorded near Winnipeg by Environment Canada – Climate Weather Office (ECCWO 2006) (-3.7 to 26.5 ^oC, 13.5 ^oC mean).

Riparian vegetation often regulates stream temperature by providing shade, thus reducing instream water temperatures (Bain and Stevenson 1999; Koning 1999). Cooler water may hold more oxygen and assist in reducing the effects of pollution which is often magnified by warmer water (www.agr.gc.ca/pfra/land/shorelds). The similarity between water and ambient air temperature suggests that riparian coverage upstream of the TEMP 3 site provides little assistance in regulating increases in water temperature.

3.2.2 Water Quality

Water quality parameters measured *in situ* throughout the La Salle River watershed during the current study are presented in Table 6. Dissolved oxygen measurements, recorded during daylight hours, met or exceeded the Manitoba Water Quality Standards, Objectives, and Guidelines (MWQSOGs) for the protection of cool-water aquatic life in the open-water season (instantaneous minimum – 5 mg/L) (Williamson 2002). However, given the large amount of vegetation present at some sites, oxygen levels may decline below the MWQSOGs during the night; oxygen was not measured at night during this study. In addition, oxygen may decline under ice cover and, in fact, dissolved oxygen levels of 0.4 to 2.2 ppm have been recorded in the La Salle River during February and March (Manitoba Water Stewardship – Fisheries Branch, La Salle River file, circa 1996).

Results from the laboratory analysis of water samples collected during this study are provided in Table 7, with sampling locations being illustrated on Figure 8. At all three sites and during all sampling periods, dissolved ammonia was within the calculated site-specific Manitoba water quality objectives for the protection of aquatic life (0.694 to 1.945 mg/L depending on exposure duration) (Williamson 2002). Analysis for fecal coliform bacteria also revealed levels within the MWQSOG for primary recreation (200 CFU/100 ml) at all sites.

On the basis of the trophic classification for streams presented in Dodds et al. (1998), chlorophyll *a*, TP, and TN at SANWQ indicate the La Salle River (at this site) is in a eutrophic state. Based on TP and TN, the river is also eutrophic at LSRWQ and WQOGS039. However, with the exception of the spring sample (81 µg/L), chlorophyll *a* readings at LSRWQ were below the mesotrophic-eutrophic boundary established by Dodds et al. (1998).

As discussed in Section 3.1.2, eutrophication can lead to the excessive growth of aquatic plants and algae. A number of duckweed/algal mats were identified via aerial footage taken in late October, 2005. Groundtruthing at two sites on November 1 revealed that these mats consisted primarily of duckweed, though algae may also have been present.

Duckweed/algal growth at '1919B (headwaters) and at 'FORT' (near Fortier Gospel Chapel)

Although TP and TN values recorded at ECCWQ were lower than those from SANWQ and LSRWQ, they were either above or just below the eutrophication values established by Dodds et al. (1998). Chlorophyll *a* values recorded at ECCWQ were well below the other two sites during all three sample periods.

3.2.3 Fish Species Utilization

3.2.3.1 Spring

Hoop nets were set in the La Salle River and King Drain to capture fish moving in an upstream direction. One hoop net was set in the Elm Creek Channel to capture fish moving in a downstream direction. A total of 123 fish, representing nine species were captured in five hoop nets set throughout the La Salle River watershed from April 19 to 21 (Table 8, Figure 8). The majority of these fish (n = 118) were captured in the La Salle River. Five fish were captured in the King Drain, while no fish were found to be moving downstream on the Elm Creek Channel.

Twenty-four fish, representing eight species, were captured at LRH1 (~ 13 km upstream from the mouth) (Table 8, Figure 8). These were: black crappie (n = 7); carp (n = 4); northern pike (n = 4); shorthead redhorse (n = 3); quillback (n = 2); and white sucker (n = 2). One each of bigmouth buffalo and freshwater drum were also captured. Six female and one male black crappie were preparing to spawn in the current year; two male carp were preparing to spawn in the current year; and one female northern pike was preparing to spawn while one had already spawned in the current year (Appendix 4). Three of the suckers captured (i.e., shorthead redhorse and white sucker) were spent males, while one was a ripe female. The big mouth buffalo, measuring 511 mm, did not show any sign of current year reproductive activity.

Two northern pike (one a spent male) and one black crappie (preparing to spawn) were captured at LRH2 (~ 34 km upstream from the mouth) (Table 8, Figure 8, and Appendix 4).

Ninety-one fish, representing five species, were captured at LRH3 (~ 102 km upstream from the mouth) (Table 8, Figure 8). The majority of these were black bullheads (n = 74) followed by white sucker (n = 11). The remainder of the catch was comprised of three northern pike, two black crappie, and one carp. Five male and four female white suckers captured were preparing to spawn in the current year. Sex and state of maturity were not obtainable from either the northern pike or black crappie (Appendix 4).

Three northern pike, one white sucker, and one quillback were captured at KDH1 (Table 8, Figure 8). Sex and state of maturity could only be classified for the white sucker (i.e., female preparing to spawn) (Appendix 4).

3.2.3.2 Summer

A total of 148 fish, representing 10 species were captured throughout the La Salle River watershed from August 30-31 (Table 9). The majority of the fish captured were carp (n = 66), brook stickleback (n = 28), fathead minnow (n = 25), and central mudminnow (n = 11).

The carp, which were young-of-the-year and had a mean length of 69 mm (n = 18), were all captured in the King Drain. These fish were captured upstream of a small wooden weir which effectively blocked their downstream migration. Although not represented in the catch, it is possible that additional fish species (e.g. northern pike, white sucker, and quillback) used this drain for spawning, with potential 'stranding' of their young-of-the-year.

3.2.4 Benthic Invertebrates

Based on input from LSRBCD, three invertebrate collection sites were established along the La Salle River (Figure 8). At each site, one sample was taken from near each side of the bank for a combined total of six samples. Total count and identification of invertebrates, by site, are presented in Appendix 5.

Samples from Reach 1 were comprised of 11 major taxa, including: Coleoptera; Diptera; Odonata; Hemiptera; Trichoptera; Ephemeroptera; Hirudinea; Ostracoda; Amphipoda; Bivalvia; and Gastropoda (Appendix 5). Of the ten families identified from these taxa, five are considered 'somewhat tolerant' to levels of pollution, two are 'tolerant', while one family is considered 'less sensitive' (Appendix 5).

Samples from Reach 2 were comprised of 12 major taxa, including: Oligochaeta; Hirudinea; Nemata; Amphipoda; Diplostraca; Acarina; Bivalvia; Hemiptera; Diptera; Coleoptera; Ephemeroptera; and Trichoptera (Appendix 5). Of the ten families identified from these taxa, three are considered 'less sensitive' to levels of pollution, two are 'somewhat tolerant', two (F. Ameletidae and Phryganeidae) are ‘sensitive’, and one (F. Chironomidae) is ‘tolerant, (Appendix 5).

Samples from Reach 3 were comprised of four major taxa, including: Oligochaeta; Bivalvia; Coleoptera; and Diptera (Appendix 5). The majority of invertebrates at this reach (n=14) belong to the Family Chironomidae, which is considered ‘tolerant’ to levels of pollution (Appendix 5).

3.3 WATERSHED CLASSIFICATION

3.3.1 Land Use

Approximately 262 km of the La Salle River watershed were classified according to land use (Table 10, figures 10-12). Nearly 184 km of this classification was conducted along the mainstem of the La Salle River. Representative flights, and subsequent land use classifications, were completed along the Elm River (48 km), Domain Drain (13 km), Elm Creek Drain (7 km), King Drain (5 km), and Maness Drain (5 km) (Table 10).

Cropland comprised the greatest land use along the La Salle River (46%), followed by other agricultural land (20%), and deciduous forest land (10%) (Table 10; figures 10-12). Pasture/grazing (6%), mixed urban or built-up land (5%), other urban or built-up land (5%), confined feeding operations (4%), residential (3%), and transportation (1%) comprised the remainder of land use along the La Salle River.

Land use adjacent to the La Salle River watershed is primarily comprised of cropland (41%), canals (16%), and other agricultural land (16%). The remaining 27% is comprised of deciduous forest land (8%), pasture/grazing (5%), mixed urban or built-up land (4%), confined feeding operations (3%), other urban or built-up land (3%), residential (2%), transportation (<1%), and non-forested wetland (<1%).

Confined feeding operations represented 3% of the total land use throughout the La Salle River watershed. Even though the total length of river that feedlots are adjacent to is relatively short (~ 8 km), this land use can pose a significant threat to the health of an aquatic system. Feedlot runoff may contain elevated levels of phosphorus, nitrogen, organic material, and bacteria which can hasten the eutrophication of a stream as well as contaminate groundwater sources (Pries 2002; Miller et al. 2004; Davis et al. 2005).

3.3.2 Aquatic Habitat Conditions

Qualitative classifications for channel morphology, bank stability, and intactness of the riparian zone (as per Section 2.3.2) are provided for each point on the watercourse within the geodatabase that accompanies this report (Disc 1). Because each of these stream attributes are interrelated in terms of the overall health of the watershed, the classifications were considered collectively to develop a qualitative aquatic habitat rating for each reach in the La Salle River watershed. These ratings are presented and discussed in the following section.

3.3.3 Aquatic Habitat Quality Ratings

Approximately 262 km of the La Salle River watershed were rated according to habitat quality (Table 11, figures 13-15). Highly impacted areas (Class C) comprised the largest segment (36%), followed by: moderately impacted (Class B, 35%); severely impacted (Class D, 25%); and minimally impacted areas (Class A, 3%).

Approximately 184 km of the La Salle River were rated according to habitat quality. Highly impacted areas (Class C) comprised the largest segment (44%), followed by: moderately impacted (Class B, 43%); severely impacted (Class D, 10%); and minimally impacted areas (Class A, 4%).

Thirty-eight percent of the 49 km of Elm River were rated as Class D or severely impacted. This was followed by: highly impacted areas (Class C, 35%); moderately impacted (Class B, 24%); and minimally impacted areas (Class A, 2%).

Nearly all of the 29 km of habitat rated in the Domain, Elm Creek, King, and Maness drains was classified as Class D, or severely impacted. Throughout the La Salle River watershed, a complex network of drains has been established. Typically, drains are constructed to either remove excess water from fields or to supply irrigation water to areas which require water (Evanitski, no date; AAFC-PFRA 2004). Although drains can offer certain agricultural advantages (e.g., earlier planting times) there are environmental concerns associated with them. An accelerated removal of water from fields can place rivers into a flood or near flood stage, increasing the risk of water erosion and bank failure (AAFC-PFRA 2004). Man-made drains are often also associated with marginal riparian zones, which are unable to act as effective buffers resulting in increased introduction of substances deleterious to the aquatic habitat (DFO 1995; AAFC-PFRA 2004).

Within this document, the aquatic habitat quality rating is intended to provide a general overview of the condition of stream reaches within the La Salle River watershed and could be used to focus rehabilitation efforts. However, it should be noted that the rating is qualitative and may be used in a variety of ways to focus efforts.

3.3.4 Potential Barriers

A total of 75 potential barriers to fish movement were identified throughout the La Salle River watershed (Figure 16, Appendix 6). Sixty-one percent of these (n = 46) were considered to be anthropogenic in origin, while the remaining 39% were associated with naturally occurring debris (n = 29). Although beaver dams were not identified within the watershed, it is likely that some were present. Difficulties in classification (beaver dam versus debris dam) can be encountered with aerial videography.

The majority of the anthropogenic barriers identified were ford crossings (n = 29, 64%), followed by culverts (n = 8, 18%), and low head dams (n = 8, 18%). A low head dam can be defined as a constructed barrier in a river with a hydraulic height, head water to tail water, not exceeding 8.0 m (ICF 2005). Low head dams may cause a number of biological impacts to rivers, the most obvious being a barrier to fish passage. In spring, these can be complete barriers at low water levels or act as velocity barriers at higher flows. Conversely, downstream migrations can also be impaired at some flows or as a result of plugged outlets (e.g., young of year carp captured on King Drain). Less obvious impacts that can be caused by dams include: changes in aquatic and terrestrial habitat; changes in hydraulic regimes upstream; reducing the flow of water required by wetlands or riparian areas downstream; and changes to water quality of the stream (Anonymous, circa 1994; www.axelfish.uoguelph.ca/research/BILD: www.epa.gov/owow/nps/MMGI/Chapter6).

The La Salle River is characteristically a slow moving river, affected by irrigation withdrawal, low sloped topography, and low head dams. Combined, the effect may be a longer hydraulic residence time and subsequent accelerated eutrophication of the water body via reduced nutrient cycling and increased primary productivity (Cumming 2004; www.epa.gov/owow/nps/MMGI/Chapter6).

4.0 POTENTIAL REHABILITATION SITES

Rehabilitation, within this document, can be used to refer to local or site specific planning (Williams et al. 1997). The rehabilitation of site specific areas can be used as a tool towards watershed restoration. Williams et al. (1997) viewed watershed restoration as the process of reversing the decline of ecosystem health, thus returning a degraded ecosystem toward its historic function. The development of a watershed restoration program is a difficult process to initiate and should begin with an understanding of watershed structure and function and how human activities affect watershed health (Williams et al. 1997).

A total of 119 sites have been identified throughout the La Salle River watershed that may warrant potential rehabilitation activities (Appendix 7, figures 13-15). Potential impacts to the watershed at each site are varied; ranging in complexity from field erosion to large confined feeding operations.

Based on review of the aerial video, historical information, and groundtruthing, the 119 potential rehabilitation sites identified were prioritized from 1 to 3. Sites given a priority 1 were often 'large' in scale, exhibiting multiple environmental issues (e.g., water quality degradation, shoreline erosion, denuded riparian) that may warrant more immediate attention (i.e., rehabilitation efforts). These sites typically had more direct negative impacts to the health of the watershed and fell within Class D and C reaches. Conversely, sites labelled as priority 3 were often 'smaller' in scale, exhibiting only one environmental concern. Sites identified as priority 3 are also areas in which long-term planning could be required. These sites could be located in Class D reaches, but were typically found in Class C and B reaches.

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TABLES, FIGURES AND APPENDICES

Table 1. Locations, data years, and measurement types of Environment Canada hydrometric stations on the La Salle River, Elm Creek Channel, and Domain Drain (Source: Environment Canada, Water Survey – 2005).

DATA YEARS	MEASUREMENT TYPE	STATION ID	STATION NAME
1915 - 2004	Flow and Level	050G001	La Salle River near Sanford
1935 -1936	Flow	050G002	La Salle River at La Salle
1958 - 1966	Flow	050G003	La Salle River near Sanford
1979 - 2004	Flow and Level	050G008	La Salle River near Elie
1983 - 2004	Level	050G801	La Salle River above Hampson Dam
1983 - 2002	Level	050G802	La Salle River above Houge Dam
1983 - 1995	Level	050G803	La Salle River above Lewko Dam
1983 - 2004	Level	050G804	La Salle River above St. Norbert Dam
1983 - 2004	Level	050G805	La Salle River above Starbuck Dam
1983 - 2004	Level	050G806	La Salle River above Sanford Dam
1983 - 2004	Level	050G807	La Salle at Elie
1983 - 2004	Level	050G808	La Salle River above La Salle Dam
1960 - 1977	Flow	050G004	Elm Creek Channel near Fannystelle
1960 - 2005	Flow and Level	050G005	Elm Creek Channel near Elm Creek
1960 - 1994	Flow	050G006	Elm Creek Channel No. 3 near Elm Creek
1981- 1987	Flow	050G009	Domain Drain near Domain

Table 2. Summary of selected water quality parameters collected by Water Quality Management Section – Manitoba Water Stewardship (WQMS 2005).

Sampling Location	Station No	Period of Record	Statistics	Ammonia (mg/L)	Nitrate-Nitrite (mg/L)	TKN	Total Phosphorus (mg/L)	Dissoved Phosphorus (mg/L)	Total Dissolved Solids (mg/L)	Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Dissolved Oxygen (mg/L)	pH (pH units)
			median	**0.100**	**0.035**	**1.365**	**0.393**	**0.335**	**449**	**807**	**26**	**7.5**	**8.09**
LA SALLE RIVER AT PTH 75 IN ST. NORBERT	WQ0068.00	1973-1999	min	<0.02	0.01	15.43	0.090	0.025	130	161	<5	1.2	7.41
			max	0.99	3.78	7.50	0.897	0.672	990	1780	370	15.3	9.45
			SE	0.02	0.11	62.50	0.02	0.02	29.0	39.6	5.64	0.27	0.05
			n	62	64	7.43	79	64	52	80	79	80	78
			median	**0.043**	**0.050**	**1.300**	**0.482**	**0.381**	**-**	**973**	**7**	**6.6**	**8.22**
LA SALLE RIVER AT PR #330 AT LA SALLE	WQ0069.00	1973-1997	min	<0.02	<0.010	0.100	0.304	0.200	-	172	3	0.7	7.32
			max	0.636	2.670	2.600	0.826	0.680	-	2750	450	15.7	8.97
			SE	0.032	0.084	0.082	0.025	0.022	-	102	13.1	0.60	0.08
			n	32	33	28	28	28	-	28	36	28	28
			median	**0.030**	**0.010**	**1.10**	**0.281**	**0.470**	**260**	**410**	**5**	**9.0**	**8.21**
LA SALLE RIVER AT PR 247 AT SANFORD	WQ0070.00	1973-1997	min	<0.02	<0.010	0.100	0.080	0.160	130	167	3	0.8	7.30
			max	0.403	2.810	4.440	1.340	1.160	565	1120	870	14.6	9.45
			SE	0.012	0.051	0.055	0.024	0.048	23.9	20.62	12.1	0.252	0.05
			n	43	92	90	93	24	19	93	91	92	70
			median	**0.024**	**<0.01**	**1.300**	**0.510**	**0.476**	**-**	**791**	**<5**	**6.5**	**8.23**
LA SALLE RIVER AT PR #332 AT STARBUCK	WQ0071.00	1973-1997	min	<0.02	<0.010	0.100	0.134	0.100	-	179	<5	0.1	7.27
			max	0.912	2.580	2.600	1.350	0.720	-	2790	690	10.7	8.84
			SE	0.046	0.070	0.082	0.050	0.032	-	82.03	19.2	0.46	0.08
			n	33	39	28	30	30	-	30	36	27	30

Table 2. Continued.

Sampling Location	Station No	Period of Record	Statistics	Ammonia (mg/L)	Nitrate-Nitrite (mg/L)	TKN	Total Phosphorus (mg/L)	Dissoved Phosphorus (mg/L)	Total Dissolved Solids (mg/L)	Conductivity (µS/cm)	Total Suspended Solids (mg/L)	Dissolved Oxygen (mg/L)	pH (pH units)
LA SALLE RIVER AT CH, NW OF ELIE	WQ0072.00	1973-1997	median	**0.058**	**0.020**	**1.110**	**0.422**	**0.371**	**-**	**856**	**<5**	**4.4**	**7.89**
			min	<0.02	<0.010	0.100	0.140	0.110	-	208	<5	0.3	7.32
			max	2.88	2.310	3.900	1.670	1.620	-	1340	71	10.7	8.49
			SE	0.106	0.076	0.120	0.067	0.055	-	44.44	2.5	0.60	0.06
			n	30	30	29	29	29	-	29	30	24	29
LA SALLE RIVER AT TCH, NW OF OAKVILLE	WQ0073.00	1973-1997	median	**0.021**	**0.020**	**1.050**	**0.232**	**0.181**	**-**	**875**	**<5**	**6.4**	**7.97**
			min	<0.02	<0.010	0.100	0.100	0.029	-	289	<5	0.5	7.37
			max	1.94	0.880	7.190	1.890	1.290	-	2230	120	16.2	8.72
			SE	0.072	0.037	0.235	0.065	0.049	-	61.52	3.34	0.70	0.06
			n	29	28	27	27	26	-	27	36	27	27
LA SALLE RIVER AT LA BARRIER PARK DAM	MB05OGS 039	2001-2006	median	**0.165**	**0.600**	**1.950**	**0.507**	**0.328**	**366**	**541**	**35.5**	**8.2**	**7.71**
			min	< 0.01	< 0.01	< 0.2	0.255	0.173	130	183	4	3.5	7.07
			max	0.64	5.65	3.9	0.896	0.67	1290	1850	168	10.3	8.43
			SE	0.042	0.399	0.210	0.048	0.033	77.21	117.08	11.30	0.48	0.11
			n	16	16	16	16	16	16	16	16	16	16

Table 3. Fish species potentially utilizing the La Salle River watershed. Based on Manitoba Water Stewardship – Fisheries Branch FIHCS search and information provided in Stewart and Watkinson (2004).

FAMILY	COMMON NAME	GENUS	SPECIES	OCCURRENCE[1]	COSEWIC LISTING
Acipenseridae	Lake sturgeon	*Acipenser*	*fulvescens*	N Rare	Not at risk
Catostomidae	Bigmouth buffalo	*Ictiobus*	*cyprinellus*	N	Special concern
Catostomidae	Golden redhorse	*Moxostoma*	*erythrurum*	N	Not at risk
Catostomidae	Quillback	*Carpiodes*	*cyprinus*	N	Not listed
Catostomidae	Shorthead redhorse	*Moxostoma*	*macrolepidotum*	N	Not listed
Catostomidae	Silver redhorse[2]	*Moxostoma*	*anisurum*	N	Not listed
Catostomidae	White sucker[2]	*Catostomus*	*commersoni*	N	Not listed
Centrarchidae	Black crappie[2]	*Pomoxis*	*nigromaculatus*	N	Not listed
Centrarchidae	Bluegill	*Lepomis*	*macrochirus*	N Tribs.	Not listed
Centrarchidae	Largemouth bass	*Micropterus*	*salmoides*	I	Not listed
Centrarchidae	Rock bass[2]	*Ambloplites*	*rupestris*	N	Not listed
Centrarchidae	Smallmouth bass	*Micropterus*	*dolomieu*	I Recent	Not listed
Centrarchidae	White crappie	*Pomoxis*	*annularis*	N Rare	Not listed
Cyprinidae	Carp[2]	*Cyprinus*	*carpio*	I	Not listed
Cyprinidae	Common shiner	*Luxilus*	*cornutus*	N Tribs.	Not listed
Cyprinidae	Creek chub	*Semotilus*	*atromaculatus*	N	Not listed
Cyprinidae	Emerald shiner[2]	*Notropis*	*atherinoides*	N	Not listed
Cyprinidae	Fathead minnow	*Pimephales*	*promelas*	N	Not listed
Cyprinidae	Golden shiner	*Notemigonus*	*crysoleucas*	N Rare	Not listed
Cyprinidae	Goldfish	*Carassius*	*auratus*	I	Not listed
Cyprinidae	Longnose dace	*Rhinichthys*	*cataractae*	N	Not listed
Cyprinidae	River shiner[2]	*Notropis*	*blennius*	N	Not listed
Cyprinidae	Sand shiner	*Notropis*	*stramineus*	N Tribs.	Not listed
Cyprinidae	Silver chub	*Macrhybopsis*	*storeriana*	N	Special concern
Cyprinidae	Spotfin shiner[2]	*Cyprinella*	*spiloptera*	N	Not listed
Cyprinidae	Spottail shiner	*Notropis*	*hudsonius*	N	Not listed
Cyprinidae	Western blacknose dace	*Rhinichthys*	*obtusus*	N	Not listed
Esocidae	Northern pike[2]	*Esox*	*lucius*	N	Not listed
Gadidae	Burbot	*Lota*	*lota*	N	Not listed
Gasterosteidae	Brook stickleback	*Culaea*	*inconstans*	N	Not listed
Hiodontidae	Goldeye	*Hiodon*	*alosoides*	N	Not listed
Hiodontidae	Mooneye	*Hiodon*	*tergisus*	N	Not listed
Ictaluridae	Black bullhead	*Ameiurus*	*melas*	N	Not listed
Ictaluridae	Brown bullhead	*Ameiurus*	*nebulosus*	N	Not listed
Ictaluridae	Channel catfish	*Ictalurus*	*punctatus*	N	Not listed
Ictaluridae	Stonecat	*Noturus*	*flavus*	N	Not listed
Ictaluridae	Tadpole madtom[2]	*Noturus*	*gyrinus*	N	Not listed
Moronidae	White bass[2]	*Morone*	*chrysops*	I	Not listed

Table 3. Continued.

FAMILY	**COMMON NAME**	**GENUS**	**SPECIES**	**OCCURRENCE[1]**	**COSEWIC LISTING**
Percidae	Blackside darter	*Percina*	*maculata*	N	Not listed
Percidae	Iowa darter	*Etheostoma*	*exile*	N Tribs.	Not listed
Percidae	Johnny darter	*Etheostoma*	*nigrum*	N	Not listed
Percidae	Log perch	*Percina*	*caprodes*	N	Not listed
Percidae	River darter	*Percina*	*shumardi*	N	Not listed
Percidae	Sauger	*Sander*	*canadensis*	N	Not listed
Percidae	Walleye[2]	*Sander*	*vitreus*	N	Not listed
Percidae	Yellow perch	*Perca*	*flavescens*	N	Not listed
Percopsidae	Trout perch	*Percopsis*	*omiscomaycus*	N	Not listed
Petromyzontidae	Chestnut lamprey	*Ichthyomyzon*	*castaneus*	N	Special concern
Petromyzontidae	Silver lamprey	*Ichthyomyzon*	*unicuspis*	N	Not listed
Salmonidae	Cisco	*Coregonus*	*artedi*	N Lower	Not listed
Salmonidae	Lake whitefish	*Coregonus*	*clupeaformis*	N Recent	Not listed
Sciaenidae	Freshwater drum	*Aplodinotus*	*grunniens*	N	Not listed
Umbridae	Central mudminnow[2]	*Umbra*	*limi*	N	Not listed

[1] N = Native; I = Introduced; Tribs. = Tributaries
[2] Occurrence based on results of FIHCS search (Manitoba Water Stewardship - Fisheries Branch)

Table 4. Preliminary results of invertebrate sampling conducted by Manitoba Conservation – Water Quality Management Section (Hughes 2001), on the La Salle River from 1995 to 1998.

PHYLUM	ORDER/SUBCLASS	GENUS	SPECIES	NUMBER OF ORGANISMS			
				1995	1996	1997	1998
Arachnoidae	Hydracarina	Hydracarina unidentified		-	3	2	-
Arachnoidae	Hydracarina	*Limnesia*	*sp.*			2	
Crustacea	Amphipoda	*Hyalella*	*azteca*	3	29	3	
Insecta	Coleoptera	*Bledius*	*sp.*				1
Insecta	Coleoptera	*Dubiraphia*	*sp.*	3	1	7	1
Insecta	Coleoptera	*Haliplus*	*borealis*		1		
Insecta	Coleoptera	*Peltodytes*	*sp.*	1			
Insecta	Diptera Chironomidae	*Chironomus*	*plumosus*	2			
Insecta	Diptera Chironomidae	*Chironomus*	*sp.*		1	59	26
Insecta	Diptera Chironomidae	*Cryptochironomous*	*sp.*	16	1		
Insecta	Diptera Chironomidae	*Glyptotendipes*	*sp.*			2	1
Insecta	Diptera Chironomidae	*Parachironomous*	*sp.*			2	
Insecta	Diptera Chironomidae	*Polypedilum*	*sp.*	1	1		
Insecta	Diptera Chironomidae	*Procladius*	*sp.*	2		99	
Insecta	Diptera Chironomidae	*Tanypus*	*sp.*	2			
Insecta	Diptera Miscelaneous	*Chaoborus*	*sp.*			2	
Insecta	Diptera Miscelaneous	*Palpomyia*	*sp.*	1		1	
Insecta	Diptera Miscelaneous	*Tipula*	*sp.*			1	
Insecta	Ephemeroptera	Ephemeroptera unidentified				1	
Insecta	Ephemeroptera	*Caenis*	*sp.*	6	7	5	1
Insecta	Hemiptera	Corixidae unidentified		1	23		
Insecta	Hemiptera	*Palmacorixa*	*buenoi*			4	1
Insecta	Hemiptera	*Palmacorixa*	*sp.*				5
Insecta	Hemiptera	*Trichocorixa*	*borealis*		1		
Insecta	Hemiptera	*Trichocorixa*	*naias*		1		
Insecta	Megaloptera	*Chauliodes*	*sp.*			1	
Insecta	Megaloptera	*Sialis*	*sp.*			31	
Insecta	Trichoptera	*Oecetis*	*sp.*		1		
Insecta	Trichoptera	*Phryganea*	*sp.*	1			
Insecta	Odonata	*Enallagma*	*sp.*	3	1		
Annelidae	Hirudinea	*Placobdella*	*sp.*			1	
Annelidae	Oligochaeta	Tubificidae unidentified				1	
Annelidae	Oligochaeta	*Limnodrilus*	*udekemianus*	2			
Annelidae	Oligochaeta	*Limnodrilus*	*sp.*				6
Gastropoda	Ctenobranchiata	*Marstonia*	*decepta*	1			
Gastropoda	Pulmonata	*Armiger*	*crista*	1			
Gastropoda	Pulmonata	*Ferrissia*	*rivularis*	1	2		
Gastropoda	Pulmonata	*Gyraulus*	*sp.*		5		
Gastropoda	Pulmonata	*Lymnaea*	*sp.*	1			
Gastropoda	Pulmonata	*Physa*	*sp.*		1		1
Pelecypoda	Sphaeriidae	*Sphaerium*	*sp.*				1
Pelecypoda	Unionidae	Unionidae unidentified				1	
TOTAL				48	79	225	44

Table 5. Discharges recorded by North/South Consultants on the La Salle River, King Drain, Elm Creek Channel, and the Elm River, spring and summer, 2005.

DATE	LOCATION	CODE	DISCHARGE (m3/sec)
20-Apr-05	King Drain	KDVEL	0.140
31-Aug-05	King Drain	KDVEL	-
20-Apr-05	Elm Creek Channel	ECVEL	1.353
31-Aug-05	Elm Creek Channel	ECVEL	0.298
20-Apr-05	La Salle River	LRVEL	1.181
31-Aug-05	La Salle River	LRVEL	0.229
20-Apr-05	Elm River	ERVEL	0.735
31-Aug-05	Elm River	ERVEL	0.207

Table 6. Water quality data collected *in situ* (i.e., in the field) from the La Salle River watershed study area, 2005.

DATE	LOCATION	SITE	PARAMETER				
			DO	Temp.	pH	Turb	Cond.
1-Nov-05	La Salle River	1919B	8.61	5.8	8.36	10	1.130
1-Nov-05	La Salle River	BEAV1	7.5	6	8.10	n/a	n/a
1-Nov-05	La Salle River	DSDIV	13.69	6.2	9.42	1.11	246.000
19-Apr-05	Elm Creek Channel	ECCH1	9.48	14.2	8.63	34	0.513
30-Aug-05	Elm Creek Channel	ECCH1	n/a	20.9	9.45	48	0.722
1-Nov-05	Elm Creek Channel	ECCH1	13.59	6.9	9.38	32	1.380
1-Nov-05	Elm River	ERNEW	12.41	5.6	8.82	14	1.150
20-Apr-05	Elm River	ERVEL	8.91	14.0	8.13	26	0.486
1-Nov-05	La Salle River	FORT	8.3	7.0	8.10	20	1.100
21-Apr-05	La Salle River	GTA	10.00	10.0	8.32	15	0.462
1-Nov-05	King Drain	KDGT2	13.89	6.5	8.82	20	2.280
19-Apr-05	King Drain	KDH1	9.81	11.5	8.55	104	0.667
30-Aug-05	King Drain	KDH1	n/a	22.3	9.20	80	1.200
19-Apr-05	La Salle River	LRH1	8.52	12.7	8.19	130	0.404
30-Aug-05	La Salle River	LRH1	n/a	19.1	9.11	53	0.765
3-Nov-05	La Salle River	LRH1	15.3	6.8	10.65	37	1.280
19-Apr-05	La Salle River	LRH2	9.31	12.8	8.52	120	0.422
30-Aug-05	La Salle River	LRH2	n/a	19.3	9.09	63	0.698
19-Apr-05	La Salle River	LRH3	12.98	13.8	9.01	49	0.436
1-Nov-05	La Salle River	LRH3	11.85	6.5	8.81	19	0.958
21-Apr-05	La Salle River	LSRWQ	13.01	12.4	9.12	56	0.493
30-Aug-05	La Salle River	LSRWQ	n/a	20.0	9.13	65	0.768
1-Nov-05	La Salle River	LSRWQ	12.4	5.7	8.76	26	0.993
30-Aug-05	La Salle River	R2IN	n/a	19.0	9.13	63	0.746
30-Aug-05	La Salle River	R3IN	n/a	19.7	9.09	63	0.736
21-Apr-05	La Salle River	SANWQ	11.03	12.9	8.21	70	0.463
30-Aug-05	La Salle River	SANWQ	n/a	19.2	9.30	45	0.707
1-Nov-05	La Salle River	SANWQ	11.5	7.1	9.06	23	0.930
30-Aug-05	La Salle River	SUMH1	n/a	19.0	9.08	47	0.686

Table 7. Results of analytical analyses conducted on water samples collected in the La Salle River watershed study area by North/South Consultants and Water Quality Management Section (WQMS) - Manitoba Water Stewardship, 2005.

WATER QUALITY PARAMETER	UNITS	ECCWQ			LSRWQ			SANWQ			WQ OGS039[1]			Trophic Classification[2]
		21-Apr	31-Aug	02-Nov	21-Apr	31-Aug	02-Nov	21-Apr	31-Aug	02-Nov	06-Apr	06-Aug	29-Sep	
Ammonia (NH_3) - Dissolved	mg/L	<0.003	0.005	0.014	<0.003	0.032	0.008	<0.003	0.003	0.008	0.64	0.018	0.07	
Chlorophyll a	mg/L	3	13	11	81	26	23	63	32	31	-	-	-	30
Fecal Coliform	CFU/100 ml	<10	6	10	<10	57	<10	<10	29	<10	<10	10	30	
Nitrate+Nitrite-N	mg/L	0.010	<0.005	0.010	0.011	0.381	0.028	0.017	0.008	0.012	1.01	0.56	<0.01	
Total Kjeldahl Nitrogen (TKN)	mg/L	1.4	2.9	1.6	1.9	1.7	1.4	1.9	2.5	1.6	2.6	2.1	1.4	
Total Nitrogen[2]	mg/L	1.410	2.900	1.610	1.911	2.081	1.428	1.917	2.508	1.612	3.610	2.660	1.400	1.500
Total Phosphorous	mg/L	0.145	0.301	0.060	0.788	0.838	0.429	0.587	0.821	0.693	0.805	0.703	0.532	0.075
Total Dissolved Phosphorous	mg/L	0.124	0.244	0.031	0.641	0.761	0.365	0.477	0.742	0.633	0.447	0.203	0.388	
Total Dissolved Solids	mg/L	400	540	820	370	550	710	340	500	540	130	229	524	
Total Suspended Solids	mg/L	5	7	8	14	8	8	17	7	9	100	45	30	

[1] Data provided by Water Quality Management Section (WQMS) - Manitoba Water Stewardship, 2005
[2]Suggested trophic classification scheme for streams (Dodds et al. 1998): Mesotrophic-Eutrophic boundary
[3] Calculated as the sum of TKN and nitrate/nitrite

Table 8. Spring fish utilization results, by location and date, from the La Salle River watershed study area, 2005.

HOOP SET	**LOCATION**	**CATCH**									**TOTAL CATCH**
		BGBF	**BLBL**	**BLCR**	**CARP**	**FRDR**	**NRPK**	**QUIL**	**SHRD**	**WHSC**	
KDH1	King Drain	-	-	-	-	-	3	1	-	1	5
LRH1	La Salle River	1	-	7	4	1	4	2	3	2	24
LRH2	La Salle River	-	-	1	-	-	2	-	-	-	3
LRH3	La Salle River	-	74	2	1	-	3	-	-	11	91
ECCH1	Elm Creek Channel	-	-	-	-	-	-	-	-	-	0
TOTALS		1	74	10	5	1	12	3	3	14	123

Table 9. Summer fish utilization results, by location and date, from the La Salle River watershed study area, 2005.

DATE	LOCATION	TECHNIQUE	CODE	SPECIES										TOTALS
				BLBL	BLCR	BLGL	BRST	CARP[1]	CNMD	FRDR	FTMN	NRPK	SLCH[2]	
30-Aug-05	King Drain	Dip net	DN1	1	-	-	-	-	-	-	-	-	-	1
31-Aug-05	La Salle River	Dip net	DN2	-	-	-	-	-	-	-	-	-	-	0
31-Aug-05	La Salle River	Electrofishing	E1	-	-	-	2	-	9	-	-	-	-	11
31-Aug-05	King Drain	Electrofishing	E2	2	-	-	26	66	1	-	25	-	-	120
31-Aug-05	King Drain	Electrofishing	E3	-	-	-	-	-	1	-	-	-	-	1
31-Aug-05	King Drain	Electrofishing	E4	-	-	-	-	-	-	-	-	-	-	0
31-Aug-05	La Salle River	Electrofishing	E5	-	-	-	-	-	-	-	-	-	-	0
31-Aug-05	La Salle River	Seine net	SN1	-	1	-	-	-	-	-	-	1	1	3
31-Aug-05	La Salle River	Seine net	SN2	-	-	4	-	-	-	1	-	1	-	6
31-Aug-05	La Salle River	Hoop net	SUMH1	-	2	-	-	-	-	1	-	2	-	5
31-Aug-05	La Salle River	Hoop net	SUMH2	-	1	-	-	-	-	-	-	-	-	1
TOTALS				3	4	4	28	66	11	2	25	4	1	148

[1] Mean length of 18 fish = 69 mm
[2] Fork length = 47 mm

Table 10. Total number of reaches (by land use), length of water course classified, and percentage of reach by land use cover in the La Salle River study area, 2005.

LAND USE	# OF REACHES	TOTAL LENGTH OF REACHES (km)	% OF REACHES
La Salle River			
Canals	-	-	0
Confined Feeding Operations	8	7	4
Cropland	43	85	46
Mixed Urban or Built-up Land	9	10	5
Other Agricultural Land	31	36	20
Other Urban or Built-up Land	6	9	5
Pasture/Grazing	7	12	6
Residential	4	5	3
Transportation	5	2	1
Deciduous Forest Land	17	19	10
Non-forested wetland	-	-	0
Total Along La Salle River	130	184	100
Elm River			
Canals	1	18	37
Confined Feeding Operations	1	1	1
Cropland	11	21	43
Mixed Urban or Built-up Land	1	<1	1
Other Agricultural Land	7	6	12
Deciduous Forest Land	4	3	5
Non-forested wetland	1	<1	1
Total along Elm River	26	48	100
Domain Drain			
Canals	2	11	88
Confined Feeding Operations	1	1	4
Pasture/Grazing	1	1	8
Total along Domain Drain	4	13	100
Elm Creek Drain			
Canals	1	7	100
Total along Elm Creek Drain	1	7	100
King Drain			
Canals	1	5	100
Total along King Drain	1	5	100

Table 10. Continued.

LAND USE	# OF REACHES	TOTAL LENGTH OF REACHES (km)	% OF REACHES
Maness Drain			
Canals	1	2	38
Cropland	1	2	49
Other Agricultural Land	2	1	14
Total along Maness Drain	4	5	100
Combined			
Canals	6	43	16
Confined Feeding Operations	10	8	3
Cropland	55	108	41
Mixed Urban or Built-up Land	10	10	4
Other Agricultural Land	40	42	16
Other Urban or Built-up Land	6	9	3
Pasture/Grazing	8	13	5
Residential	4	5	2
Transportation	5	2	<1
Deciduous Forest Land	21	21	8
Non-forested wetland	1	<1	<1
Total Combined	166	262	100

Table 11. Total number of reaches (by habitat quality rating), length of water course classified, and percentage of reach by rating in the La Salle River study area, 2005.

HABITAT QUALITY RATING	# OF REACHES/ RATING	TOTAL LENGTH OF REACHES (km)	PERCENT OF RATING
La Salle River			
Class A	8	7	4
Class B	54	81	44
Class C	55	78	43
Class D	13	18	10
Total Along La Salle River	130	184	100
Elm River			
Class A	2	1	2
Class B	13	12	24
Class C	9	17	35
Class D	2	19	38
Total Along Elm River	26	49	99
Domain Drain			
Class A	-	-	-
Class B	-	-	-
Class C	-	-	-
Class D	4	13	100
Total Along Domain Drain	4	13	100
Elm Creek Drain			
Class A	-	-	-
Class B	-	-	-
Class C	-	-	-
Class D	1	7	100
Total Along Elm Creek Drain	1	7	100
King Drain			
Class A	-	-	-
Class B	-	-	-
Class C	-	-	-
Class D	1	5	100
Total Along King Drain		5	100

Table 11. Continued.

HABITAT QUALITY RATING	# OF REACHES/ RATING	TOTAL LENGTH OF REACHES (km)	PERCENT OF RATING
Maness Drain			
Class A	-	-	-
Class B	-	-	-
Class C	1	<1	7
Class D	3	4	93
Total Along Maness Drain	4	4	100
Combined			
Class A	10	8	3
Class B	67	92	35
Class C	65	96	36
Class D	24	65	25
Total Combined	166	262	100

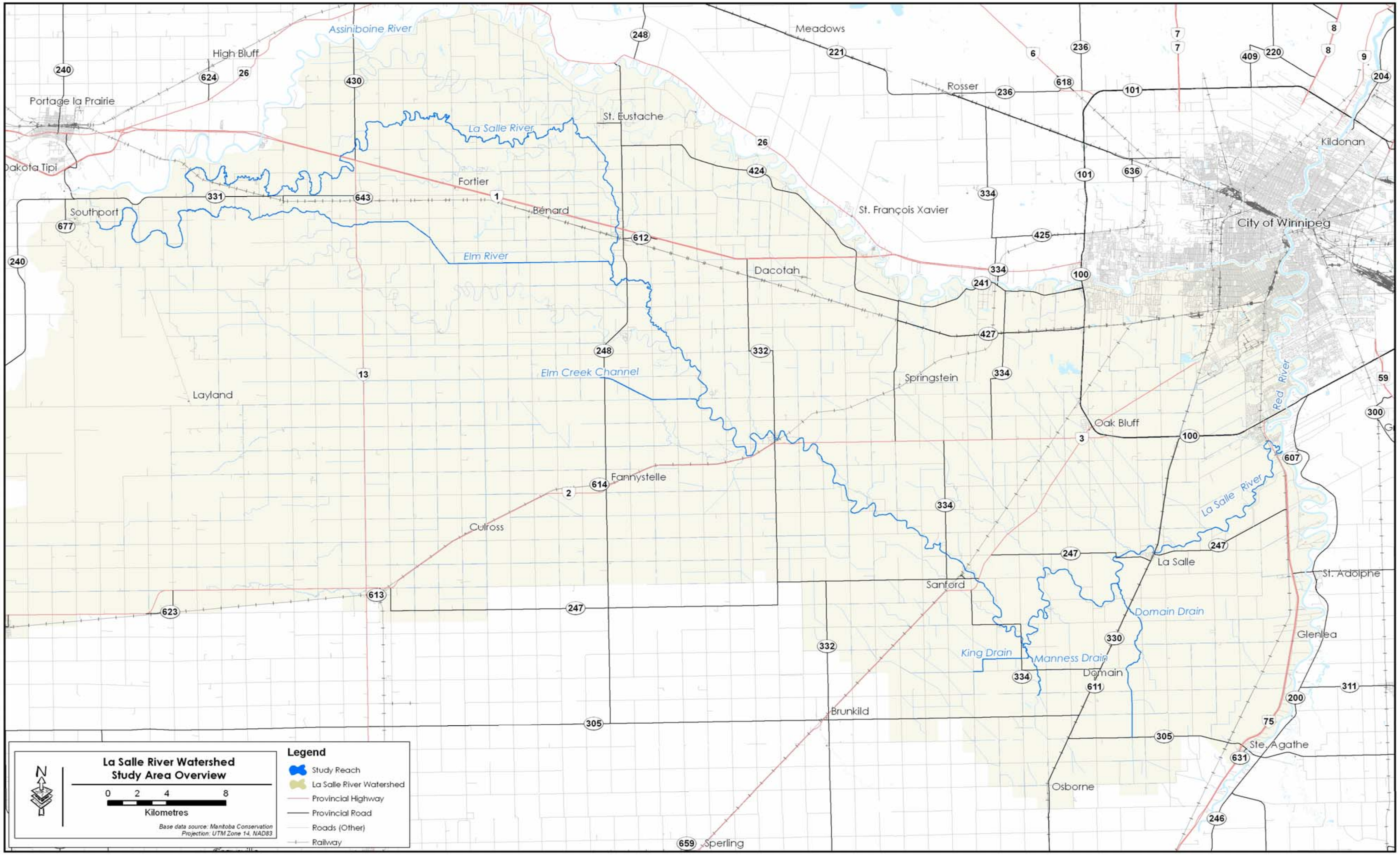

Figure 1. La Salle River watershed study area, 2005.

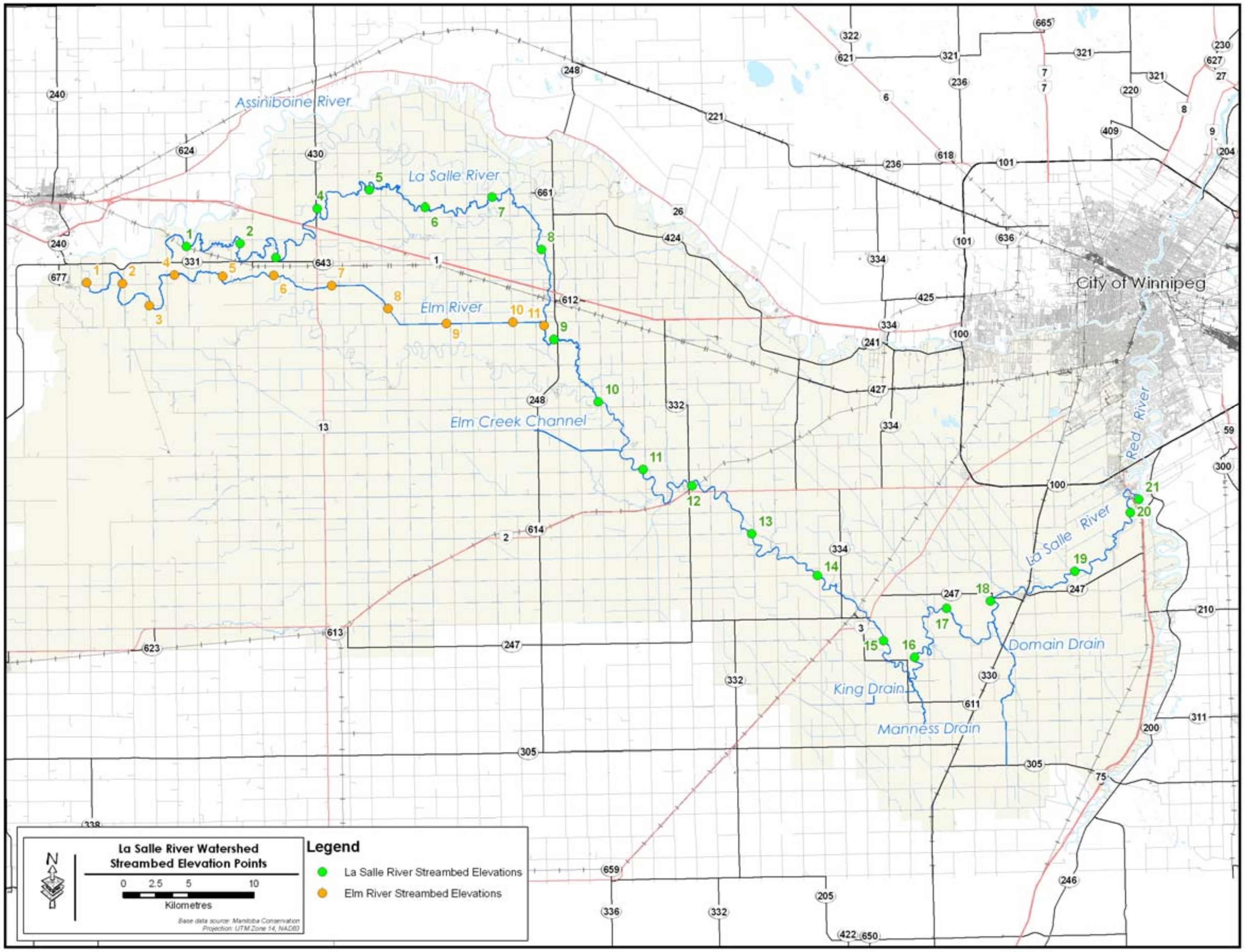

Figure 2. Identification points used to generate longitudinal stream bed profiles along the La Salle and Elm rivers, 2005.

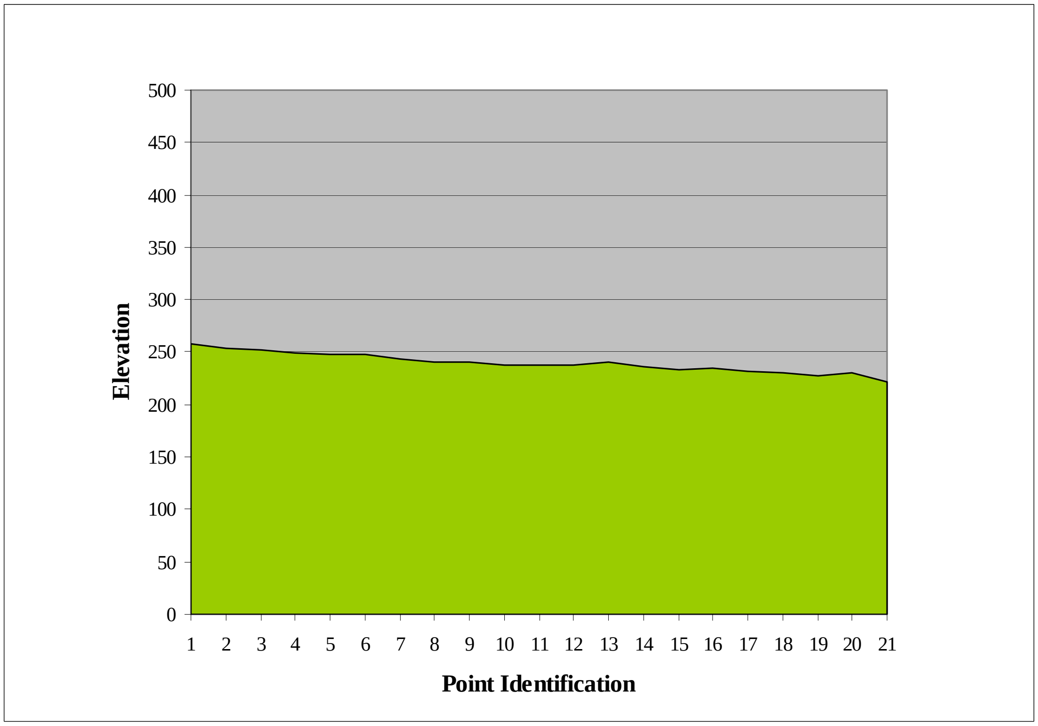

Figure 3. Longitudinal streambed profile of the La Salle River (elevation in masl).

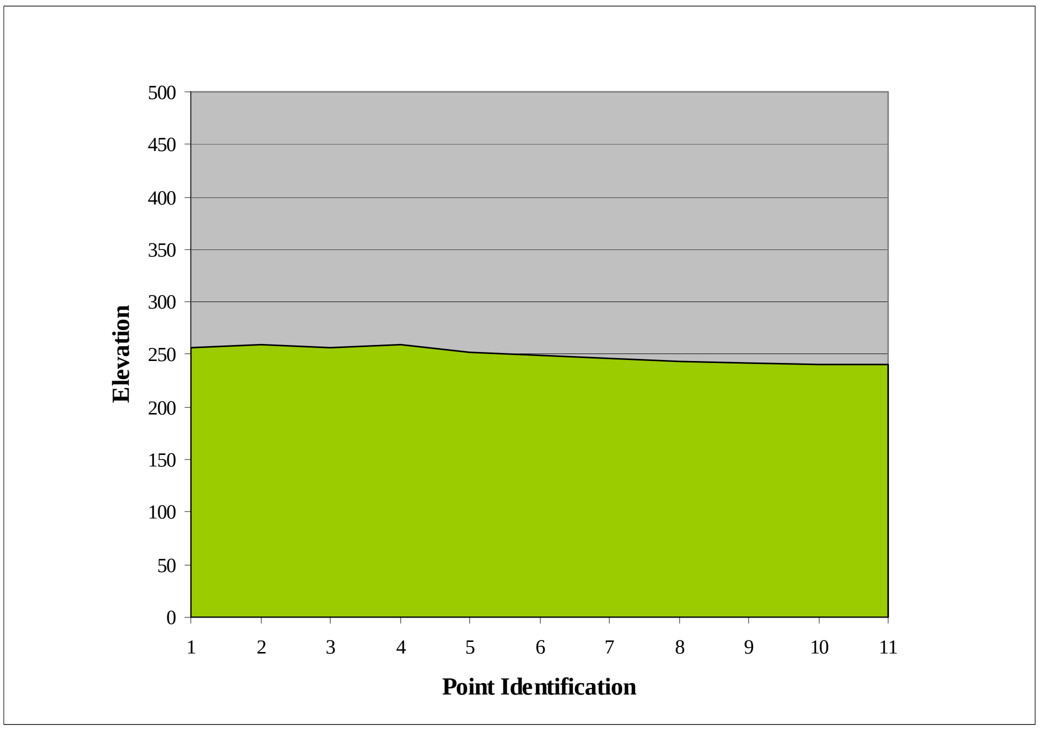

Figure 4. Longitudinal streambed profile of the Elm River (elevation in masl).

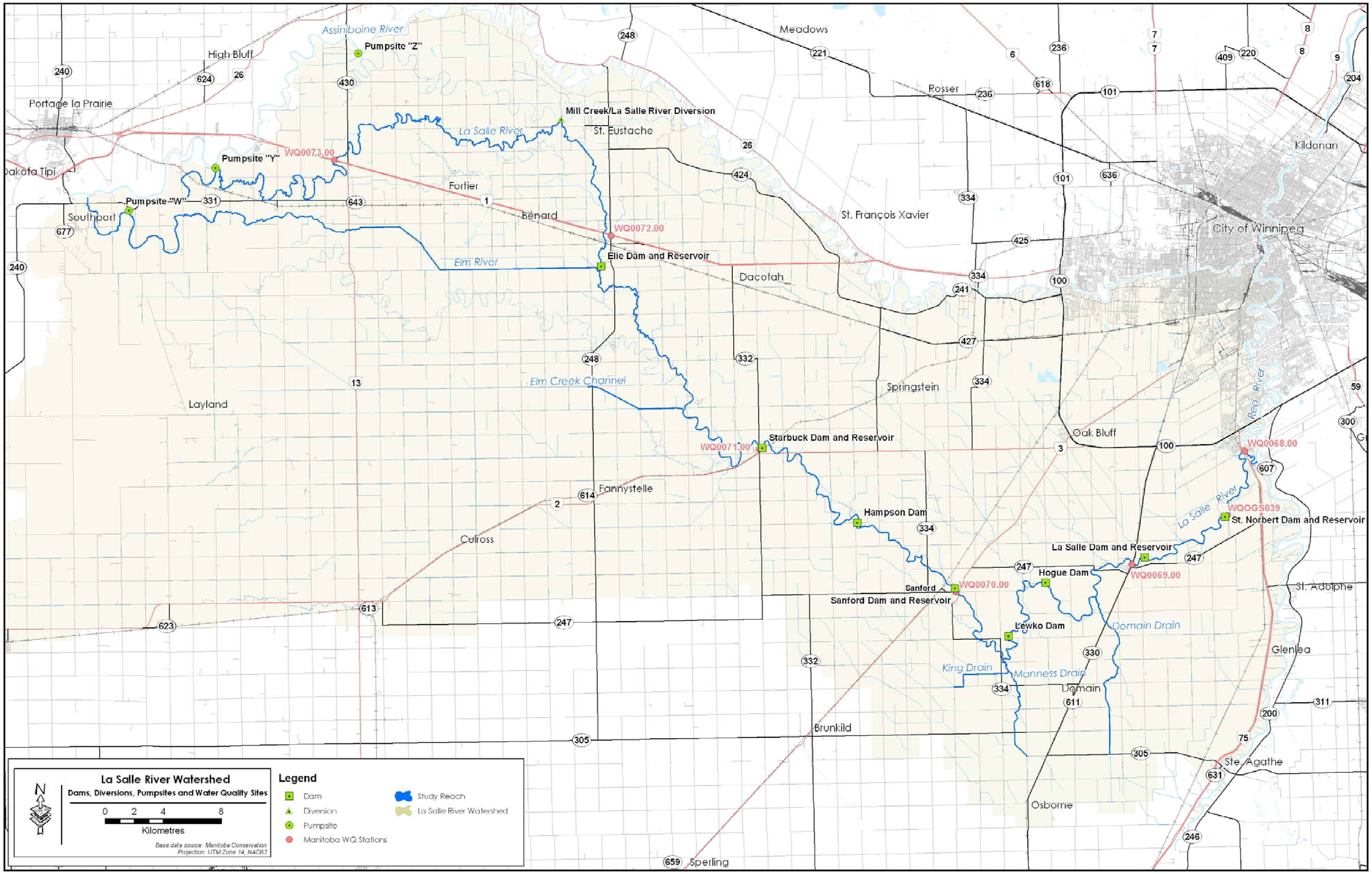

Figure 5. Location of provincial pump sites, low head dams, and Manitoba Water Stewardship – Water Quality Management sampling sites.

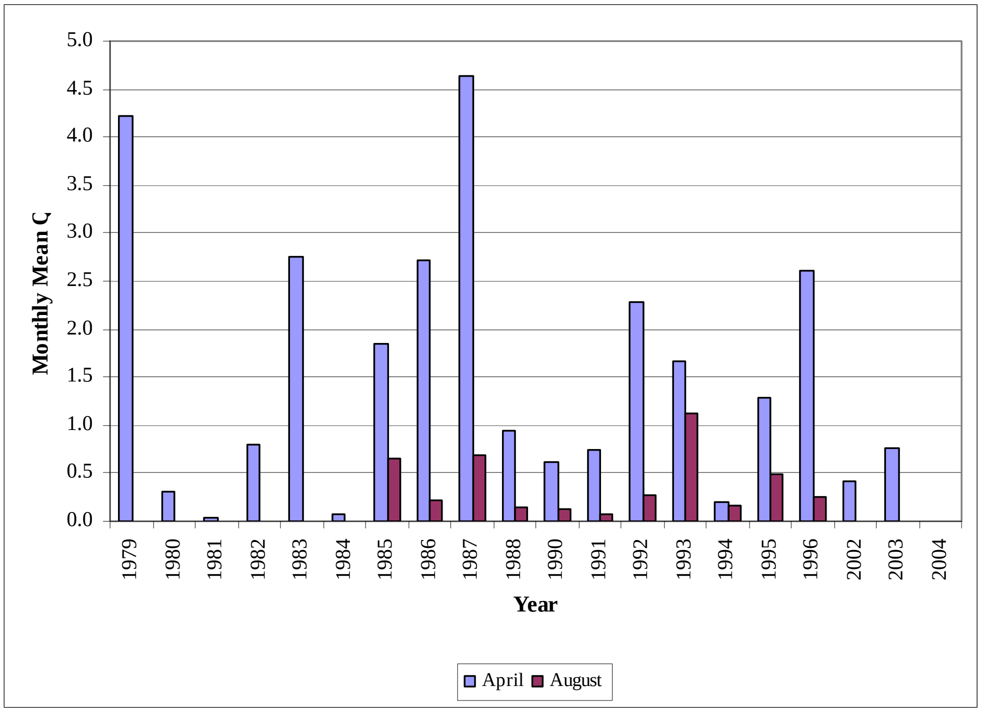

Figure 6. Mean monthly discharges in the La Salle River (Station # 050G008 near Elie) for the months of April and August, 1979 to 2004 (Source: Environment Canada, Water Survey of Canada).

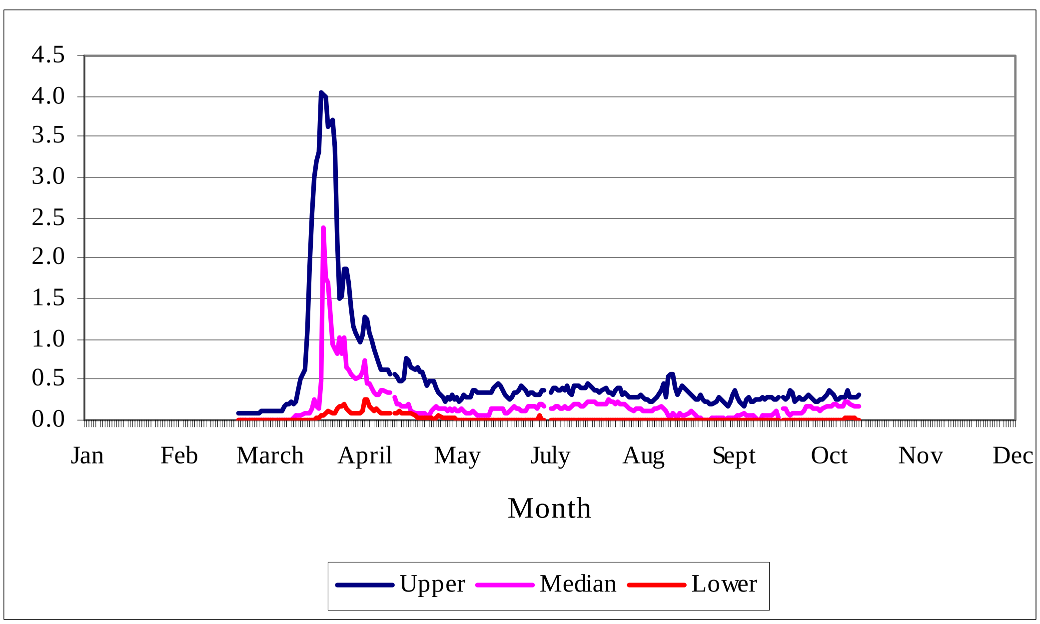

Figure 7. Median, upper and lower daily quartile flows for the La Salle River (Station # 050G008 near Elie) from 1979 to 2004 (Source: Environment Canada, Water Survey of Canada).

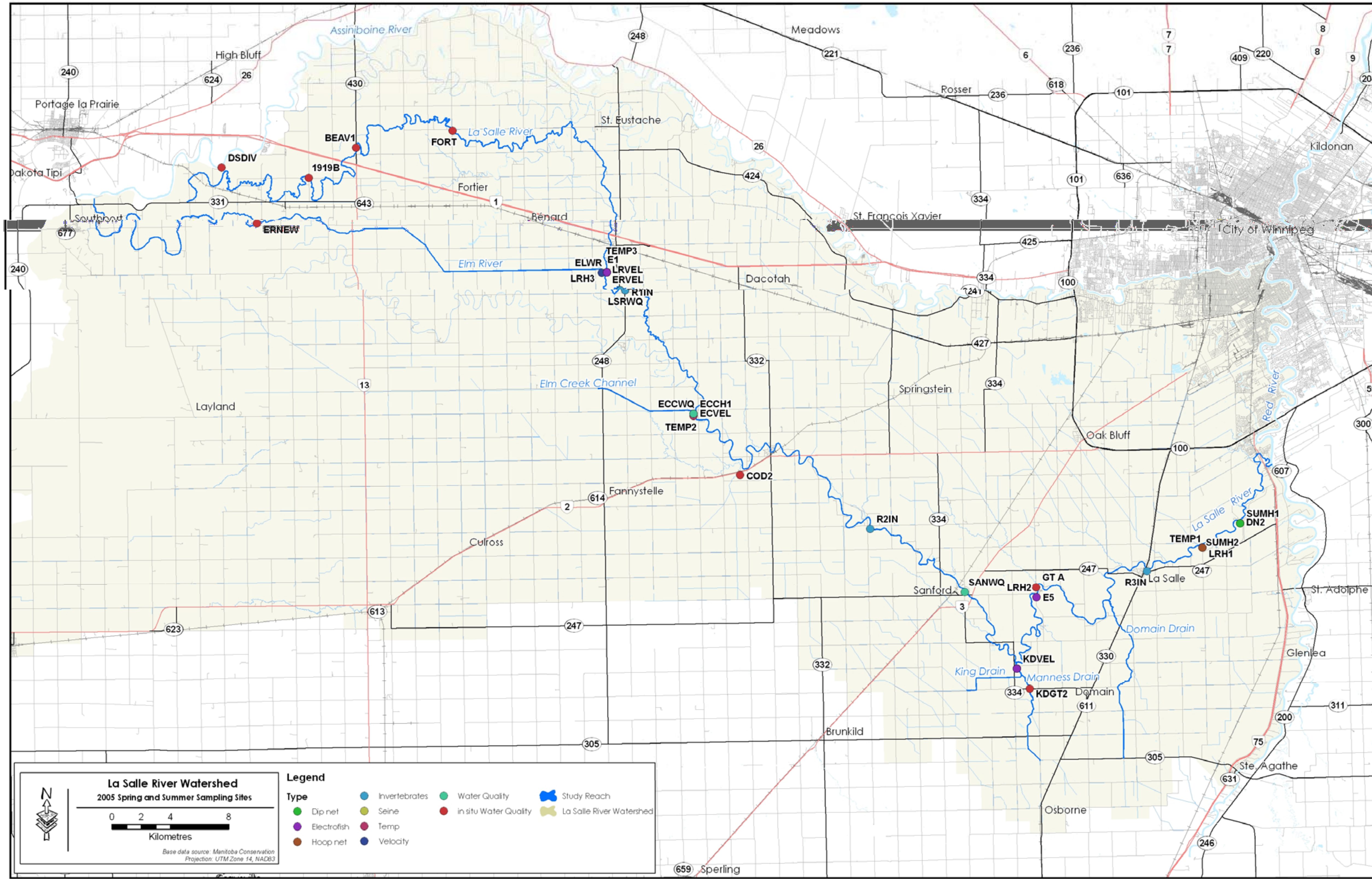

Figure 8. Hydrologic, hoopnetting, water quality, and invertebrate sampling locations throughout the La Salle River watershed, 2005.

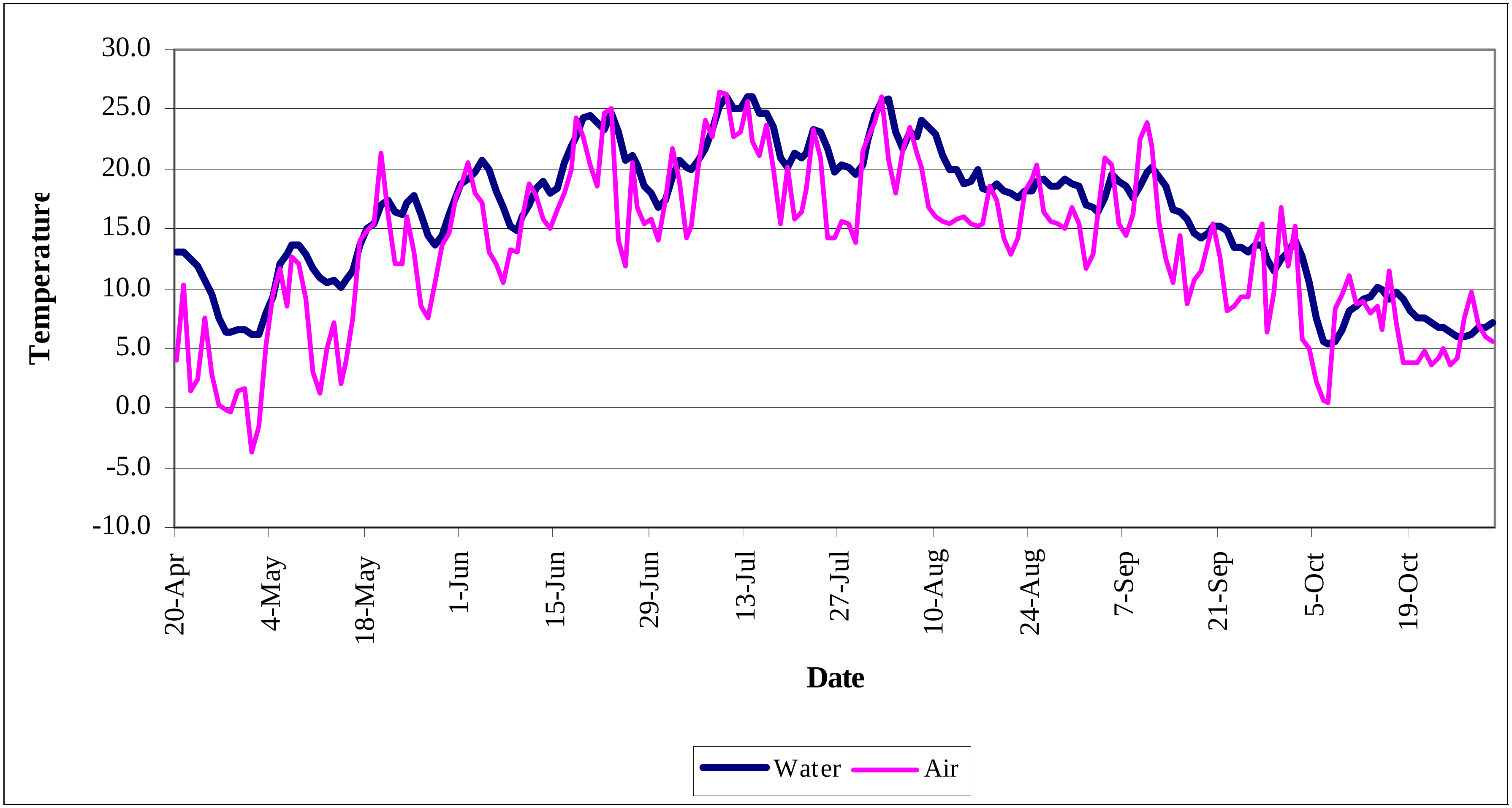

Figure 9. Mean daily water (TEMP3 at the La Salle River) and air temperature (°C) data recorded from April 20 to November 1, 2005. Mean daily air temperatures recorded at Winnipeg by Environment Canada (ECCWO 2006).

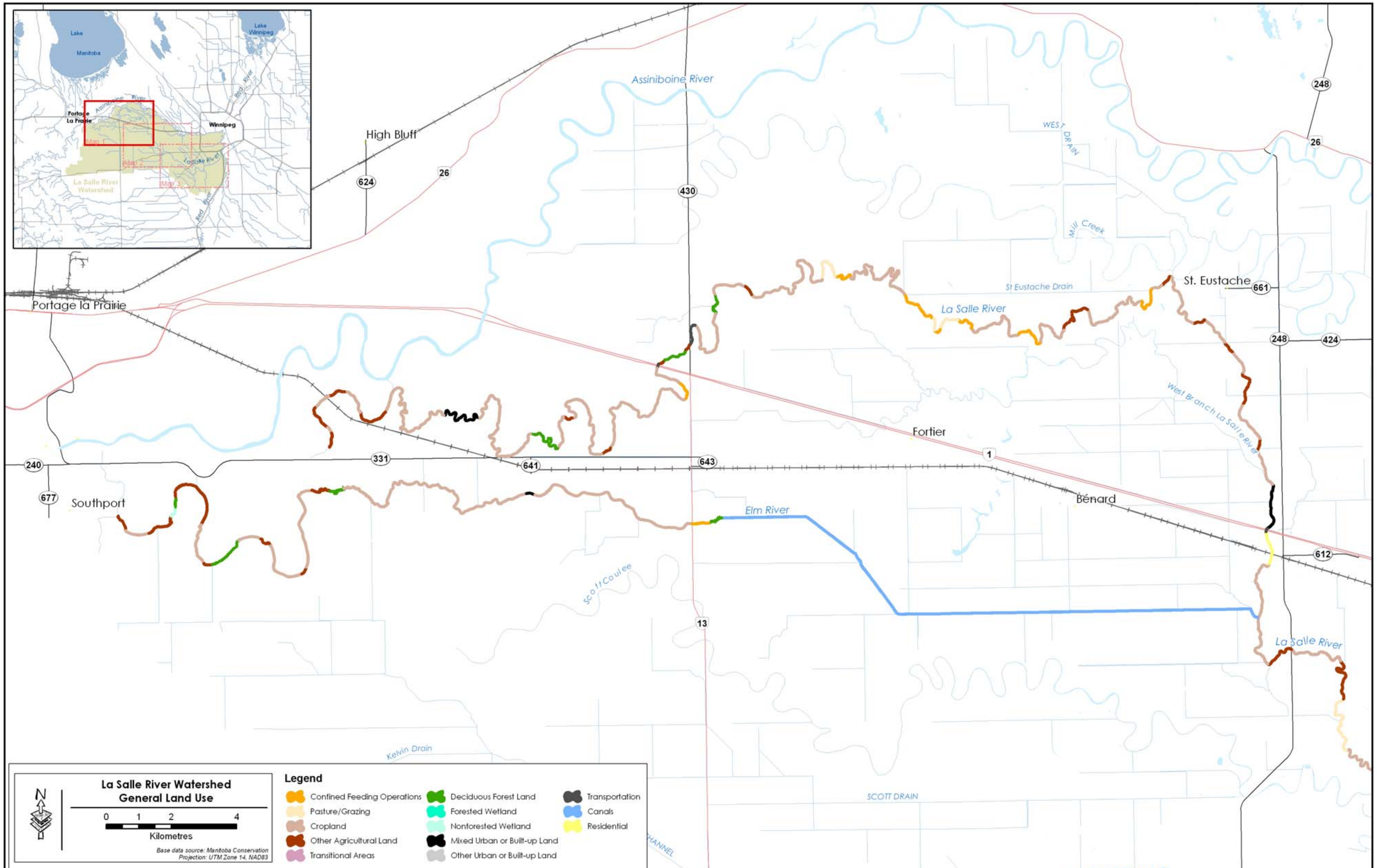

Figure 10. General land use in Reach 1 of the La Salle River watershed, 2005.

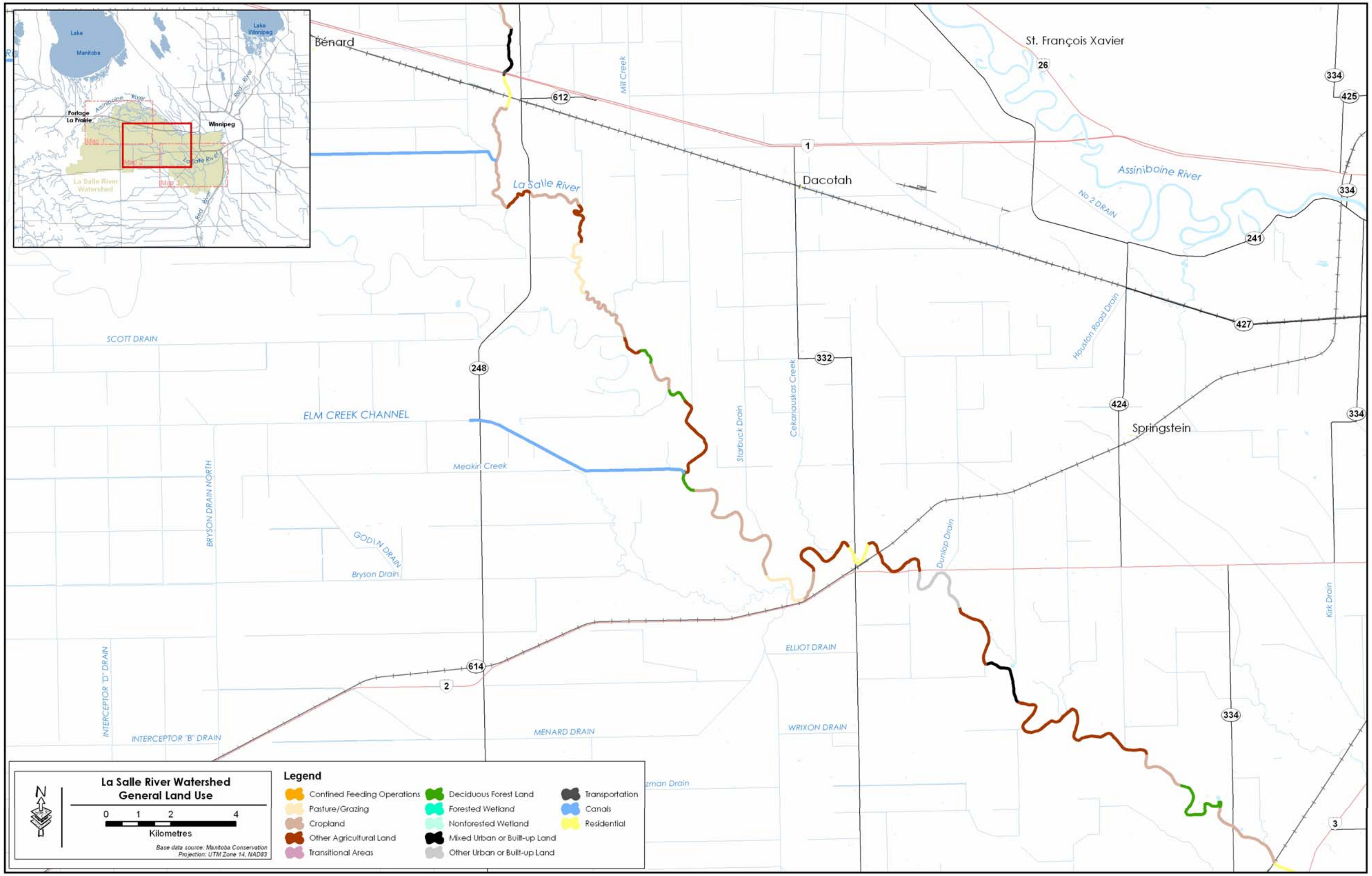

Figure 11. General land use in Reach 2 of the La Salle River watershed, 2005.

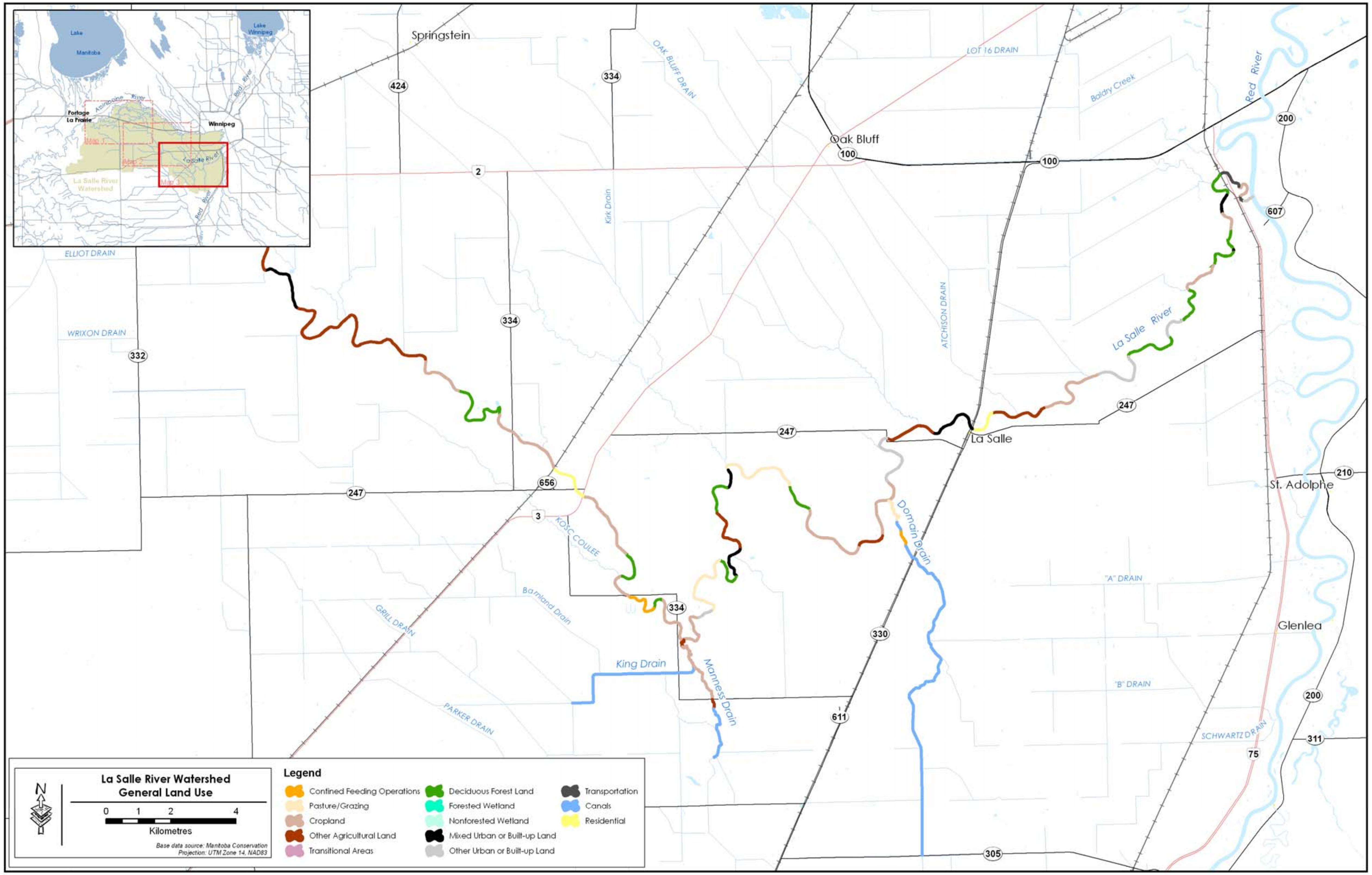

Figure 12. General land use in Reach 3 of the La Salle River watershed, 2005.

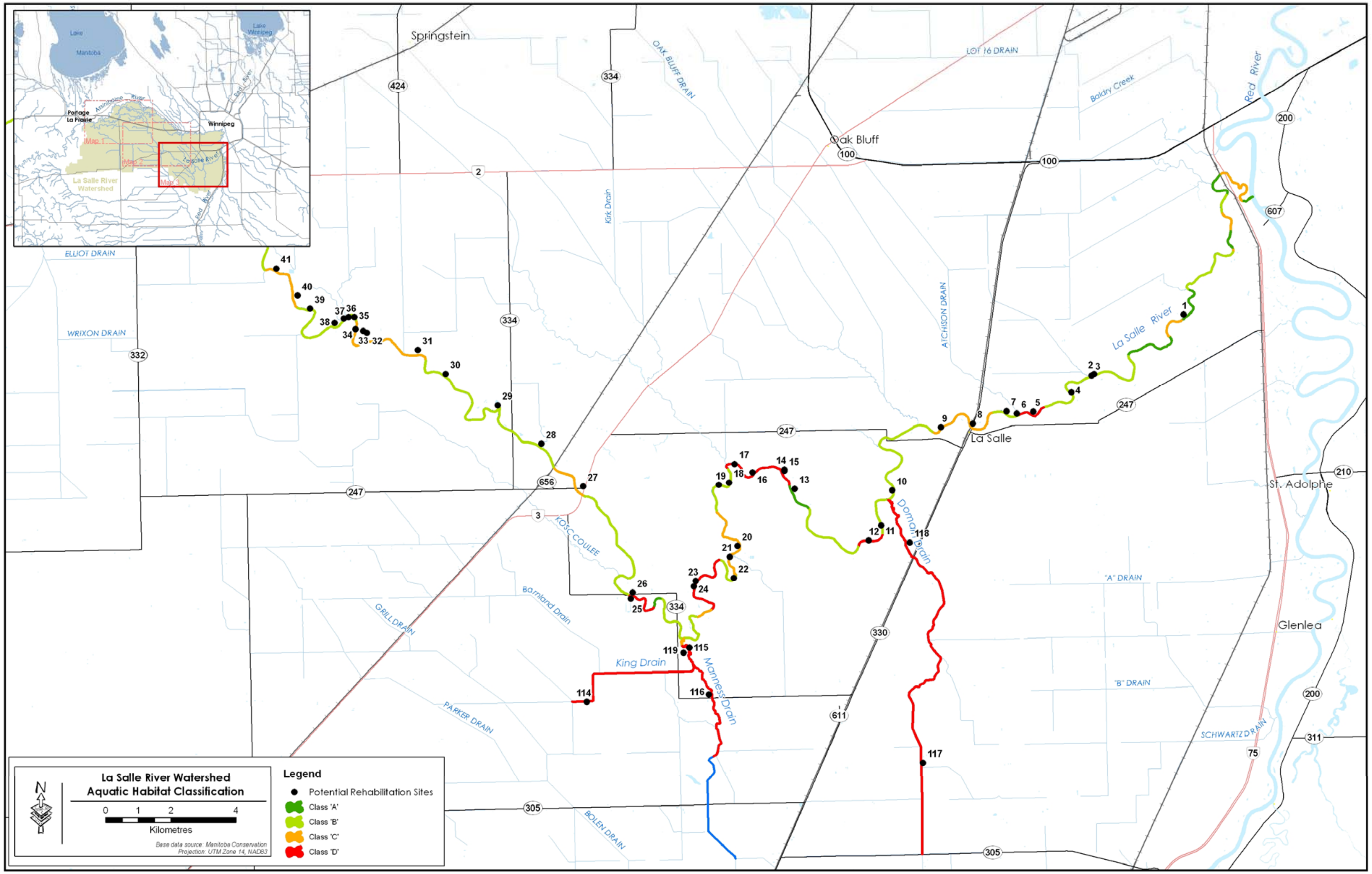

Figure 13. Aquatic habitat quality ratings and potential rehabilitation sites identified in Reach 1 of the La Salle River watershed, 2005.

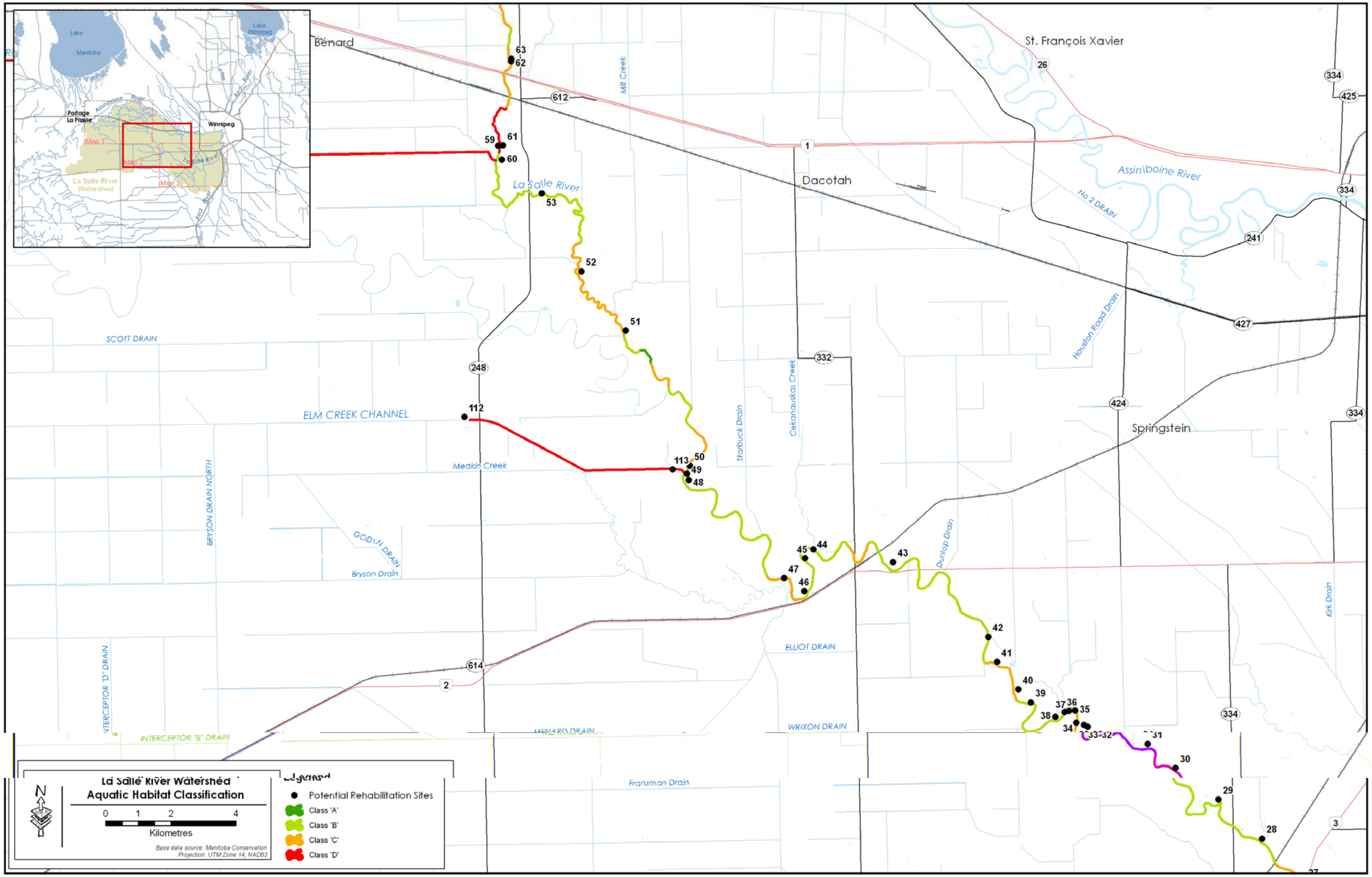

Figure 14. Aquatic habitat quality ratings and potential rehabilitation sites identified in Reach 2 of the La Salle River watershed, 2005.

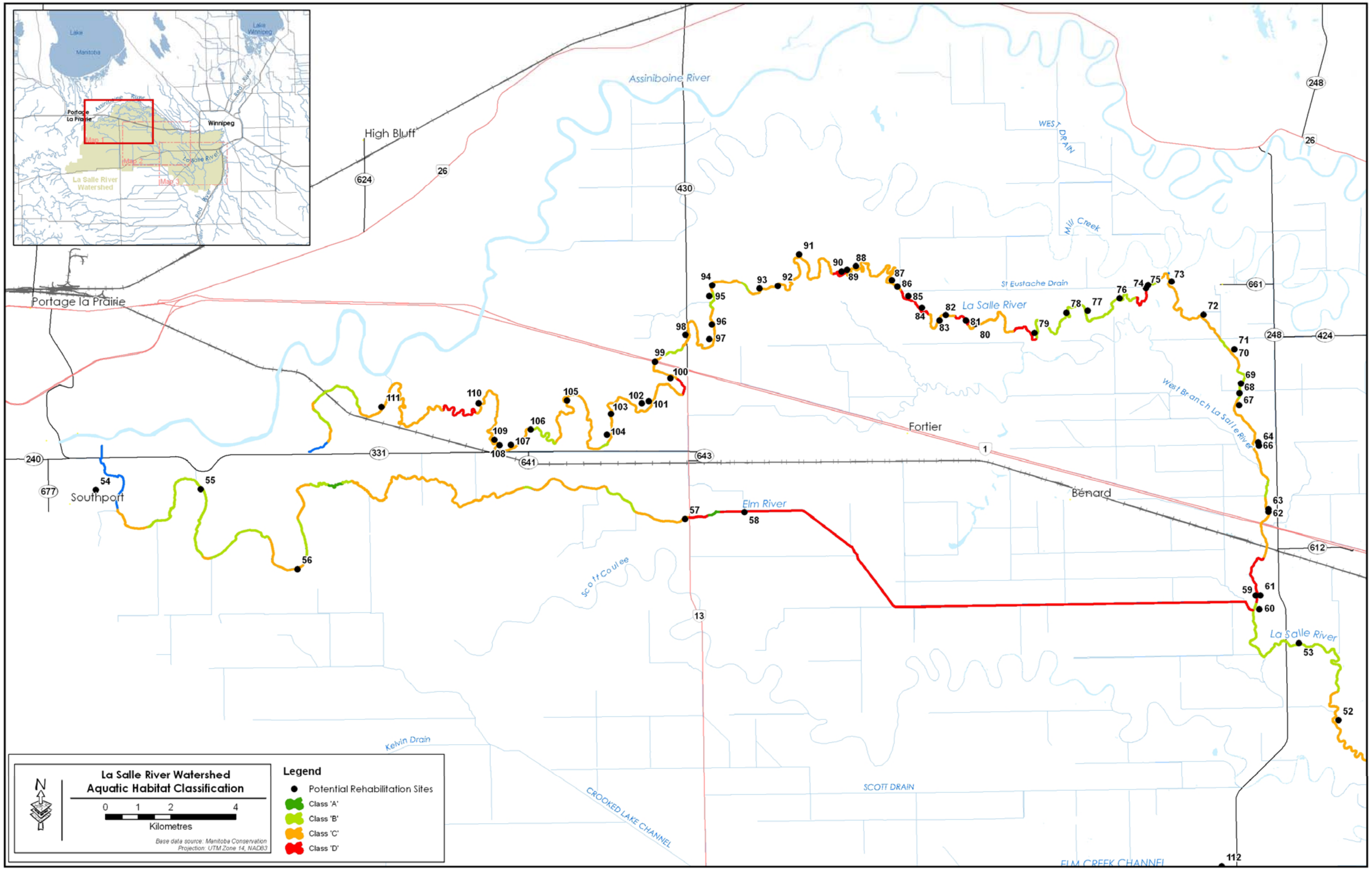

Figure 15. Aquatic habitat quality ratings and potential rehabilitation sites identified in Reach 3 of the La Salle River watershed, 2005.

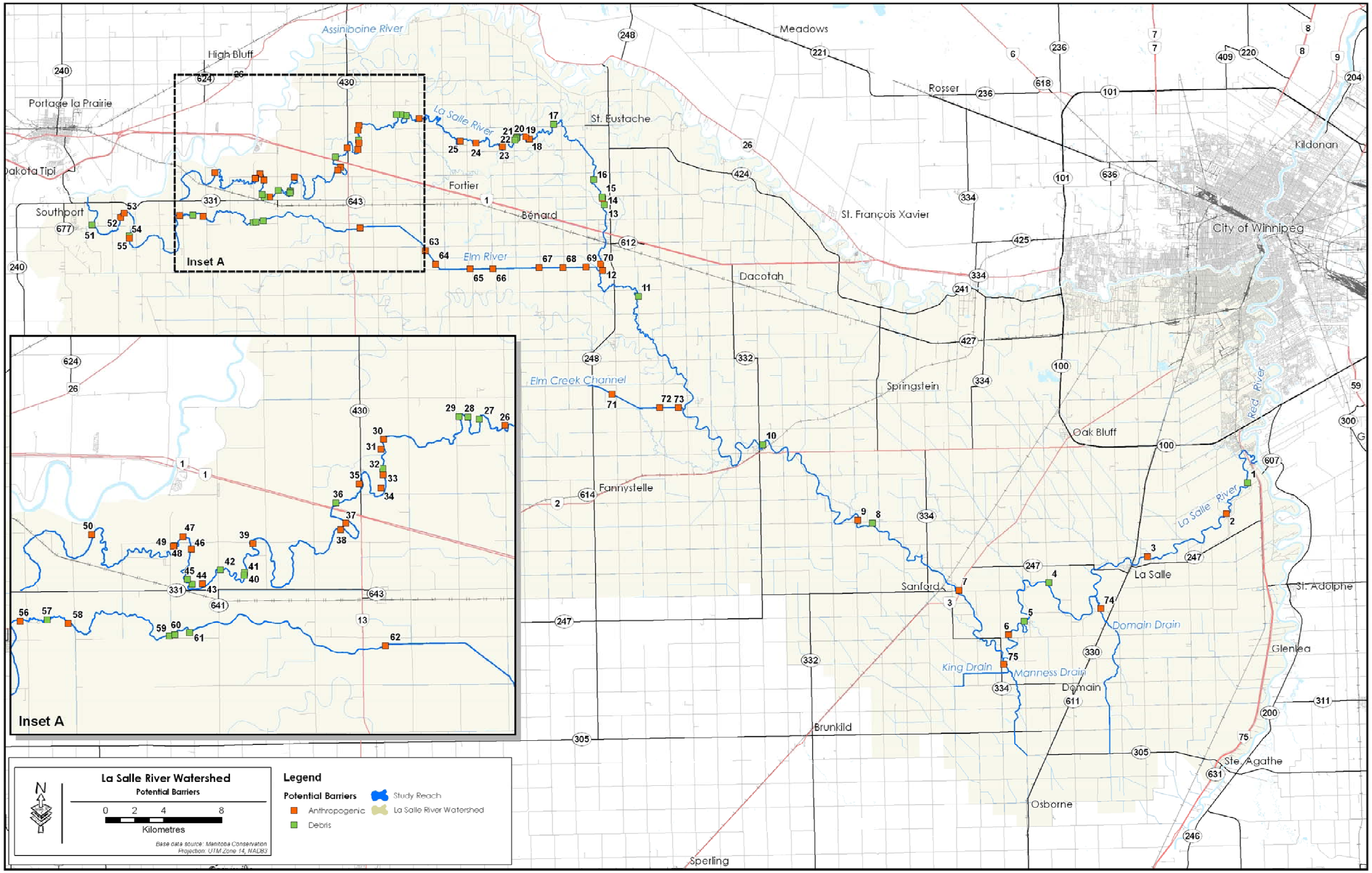

Figure 16. Potential barriers identified in the La Salle River watershed, 2005.

Appendix 1.1. Provincial pumping records (1985 – 2005) for Pumpsite "Y", located on the La Salle River (Source: Manitoba Water

DATE	BEFORE CHANGE (CFS)	AFTER CHANGE (CFS)	COMMENTS
1985			
17-Jun-85	0	5	Start up
10-Jul-85	5	25	Discharge increased to 25 cfs
17-Jul-85	25	0	Pumps off due to heavy rain
28-Oct-85	0	25	Pumps turned on
1-Nov-85	25	10	Discharge reduced to 10 cfs
30-Dec-85	10	0	Pumps turned off
1986			
18-Jun-86	0	10	Turned on 10 cfs, 1:30 p.m.
30-Jul-86	10	0	Turned off @ 1:00 p.m., Mr. Mudry's Request
3-Sep-86	0	5	Turned on @ 3:15
19-Dec-86	5	0	Turned off 5 cfs pump @ 1:15 p.m.
1987			
7-May-87	0	10	Turned on 2-5 cfs pumps on @ 9:30 a.m.
15-May-87	10	15	Added 5 cfs @ 2:30 p.m. Attempt to discourage beaver activity
14-Aug-87	15	0	Turned pumps off @ 9:35 p.m. due to rainfall.
24-Aug-87	0	15	Turned on pumps @ 1:15 p.m.
1988			
19-Feb-88	15	0	Turned off pumps due to flooding caused by snow blocks
24-May-88	0	10	Requested by M.E. Moffat
14-Jun-88	10	15	Pumping as per M.E. Moffat request
27-Jun-88	15	25	Increased pumping to flushout intake
25-Jul-88	25	15	Reduced pumping intake has flushed out, seems to be clear of sand
7-Sep-88	15	20	Requested by M.E. Moffat
25-Oct-88	20	10	Set up for winter pumping
1989			
27-Jan-89	10	0	Turned off pumps due to ice build up in channel
8-May-89	0	10	Requested by M.E. Moffat, Water Resources
10-May-89	10	15	Increased pumping @ 10:00 a.m.

Appendix 1.1. Continued.

DATE	BEFORE CHANGE (CFS)	AFTER CHANGE (CFS)	COMMENTS
16-Jun-89	15	0	Turned off pump requested by R.M. of P. la P. - repairing Municipal crossings.
21-Jun-89	0	15	Turned on 15 cfs pump on @ 4:00 p.m, R.M. of P. la P. has completed crossing repairs.
31-Oct-89	15	10	Reduced discharge for winter pumping
1990			
16-Feb-90	10	0	Turned pumps off @ 9:30 a.m. due to ice & snow blockages in channel
8-May-90	0	15	Turned on pump for summer pumping
1-Nov-90	15	10	Reduced pumping rate for winter season
1991			
RECORDS NOT AVAILABLE			
1992			
27-Feb-92	10	5	Turned off pump @ 9:30 a.m.
29-Mar-92	5	0	Turned off pump @ 8:00 p.m.- water elevation rising in Mr. Strank's
19-May-92	0	15	Start pump #1 (15 cfs) @ 12:05 p.m.
2-Sep-92	15	20	
2-Nov-92	20	10	Reduce flow for winter pumping
1993			
5-Mar-93	10	0	Shut off pump #2 & #3 (5 cfs), pumping not needed during spring runoff, water table @ Stranks basement is rising
18-May-93	0	15	Start pump #1 (15 cfs) @ 9:00 a.m.
16-Aug-93	15	10	High flow not needed b/c of La Salle river is full d/s of Elie, due to heavy rains south of Elie all the way to St. Norbert
	10	0	Pumps shut off - date unknown
1994			
9-May-94	0	10	At 10:30 a.m. Mon. May 9, 1994 started 2 - 5 cfs pumps on the La Salle R. for a total of 10 cfs
9-May-94	10	0	Shut pumps off to May 16, 1994, reason - Elm R. Colony were clearing river by their place.
16-May-94	0	10	Turned on 2-5 cfs pumps
1995			
RECORDS NOT AVAILABLE			
1996			
22-May-96		5	11:00 a.m.

Appendix 1.1. Continued.

DATE	BEFORE CHANGE (CFS)	AFTER CHANGE (CFS)	COMMENTS
14-Jun-96	5	10	3:3 p.m. Dave Buhler's orders
21-Oct-96	10	0	Turned off to build up level in pump pit
22-Oct-96	0	10	Turned back on
5-Nov-96	10	5	
6-Nov-96	5	10	
9-Nov-96	10	5	No water in wet well, little water flowing from outlet, lots of ice on river
1997			
13-Jan-97	5	0	Pump off for the winter
5-Jun-97	0	10	
29-Jul-97	10	5	Shut 5 cfs off
19-Aug-97	5	10	Started #3 @ 4:00 p.m. - low water -
3-Nov-97	10	5	Slush coming down river
16-Nov-97	5	10	
1998			
1-Jan-98	10	10	Pumps running (2 - 5 cfs pumps)
21-Jan-98	10	10	Pumps off for approx. 21 hours re: line maintenance by hydro
12-Mar-98	10	5	Turned off 1 pump
26-Mar-98	5	0	Pumps turned off
8-May-98	0	15	Pump turned on
24-Jun-98	15	10	Turned off 15 cfs pump and turned on 2 - 5 cfs pumps
12-Aug-98	10	15	Turned off 2 - 5 cfs pumps and turned on 15 cfs pump
17-Aug-98	15	10	Turned off 15 cfs pump and turned on 2 - 5 cfs pumps
11-Sep-98	10	5	Turned off one 5 cfs pump, not working well
17-Sep-98	5	15	Turned off 5 cfs pump and strated 15 cfs pump
29-Sep-98	15	5	Turned off 15 cfs pump and started one 5 cfs pump
30-Oct-98	5	15	Turned off 5 cfs pump and strated 15 cfs pump
5-Nov-98	15	5	Turned off 15 cfs pump and started one 5 cfs pump
26-Nov-98	5	15	
30-Nov-98	15	5	
2-Dec-98	5	15	
4-Dec-98	15	5	

Appendix 1.1. Continued.

DATE	BEFORE CHANGE (CFS)	AFTER CHANGE (CFS)	COMMENTS
1999			
1-Jan-99	5	5	Pump running
6-Feb-99	5	0	Pump shut off due to low water
7-Feb-99	0	5	Pump restarted (pump off for approx. 21.5 hours)
24-Mar-99	5	0	Pump shut off for spring runoff
4-May-99	0	5	Turned 5 cfs pump on
26-May-99	5	0	Turned pump off - flowing by gravity
6-Jul-99	0	5	Turned 5 cfs pump on
6-Aug-99	5	15	Turned off 5 cfs pump and turned on 15 cfs pump
7-Sep-99	15	5	Turned off 15 cfs pump and turned on 5 cfs pump
2000			
1-Jan-00	5	5	Pump running
1-Jun-00	5	10	Started second 5 cfs pump
5-Jul-00	10	5	Shut off pump #2 due to heavy rains
7-Jul-00	5	0	Transformer damaged due to lightening, all pumps off
13-Jul-00	0	5	Turned on #3 pump
18-Jul-00	5	10	Turned on #2 pump
24-Jul-00	10	5	Shut off #2 pump
11-Sep-00	5	0	Shut off pump to install culvert at Strank's
12-Sep-00	0	5	Turned pump back on
2001			
1-Jan-01	5	5	Pump running
12-Mar-01	0	0	Turn on for 5 hrs. (Running during day only)
13-Mar-01	0	0	Turned on for 8 hrs.
14-Mar-01	0	0	Turned on for 8 hrs.
15-Mar-01	0	0	Turned on for 4 hrs.
16-Mar-01	0	0	Turned on for 7 hrs.
19-Mar-01	5	0	Shut off 1-5 cfs pump for spring runoff
4-Jun-01	0	5	Started 5 cfs today
14-Sep-01	0	5	

Appendix 1.1. Continued.

DATE	BEFORE CHANGE (CFS)	AFTER CHANGE (CFS)	COMMENTS
2002			
1-Jan-02	5	5	1-5 cfs pump running
2003			
1-Jan-03	5	5	1-5 cfs pump running
21-Jul-03	5	10	Started second 5 cfs (two running)
26-Sep-03	10	5	Shut off second 5 cfs pump
2004			
1-Jan-04	5	5	#2 pump running
21-Feb-04	5	5	#2 pump off - burnt out, started #3-5 cfs pump
10-Mar-04	5	0	Shut down pumps for spring runoff
3-May-04	0	5	Started #3 pump
12-May-04	5	0	Shut down pump due to heavy snow
27-May-04	0	5	Started #3 pump
31-May-04	5	0	Shut down pump due to heavy rain
8-Jun-04	0	5	Started #3 pump
6-Oct-04	5	5	Shut down # 3 pump at 9:30 AM; removed #2 pump (burnt out) installed 5 cfs pump from Mill Creek site; restarted #3 pump at 3:15 PM
31-Dec-04	5	5	#3 pump running
2005			
1-Jan-05	5	5	5 cfs pump running
18-Mar-05	5	0	Shut down pumping for spring runoff
17-May-05	0	5	Started #2 - 5 cfs pump
8-Jun-05	5	0	Shut down pumping due to heavy rains - Assiniboine over 9,000 cfs
21-Jun-05	0	5	Started #2 - 5 cfs pump
27-Jun-05	5	0	Shut down pumping due to heavy rains
8-Aug-05	0	5	Started #2 - 5 cfs pump
31-Dec-05	5	5	#2 - 5 cfs pump running

Appendix 1.2. Provincial pumping records (1985 – 2005) for Pumpsite “W”, located on the Elm River (Source: Manitoba Water Stewardship, Grosse Isle.).

DATE	BEFORE CHANGE (CFS)	AFTER CHANGE (CFS)	COMMENTS
1986			
27-May-86	0	5	Turned on 5 cfs pump @ 1:30 p.m.
30-Jul-86	5	0	Turned off pump @ 12:45 p.m., Mr. Mudry's request
18-Aug-86	0	5	Turned on 5 cfs pump @ 4:00 p.m.
22-Oct-86	5	0	Turned off 5 cfs pump @ 11:30 a.m.
1987			
30-Apr-87	0	5	Turned on 1-5 cfs pump @ 8:00 a.m.
10-Jun-87	5	0	Request by R.M. of P. la P. due to bridge replacement E16-11-5W
18-Jun-87	0	5	Turned on 5 cfs pump @ 4:00 p.m. R.M. has completed the culvert installation E 16-11-5W
14-Aug-87	5	0	Turned off pump @ 9:20 p.m. due to rainfall
24-Aug-87	0	5	Turned on 5 cfs pump @ 1:00 p.m.
7-Oct-87	5	0	Turned off 5 cfs pump @ 8:30 a.m.
1988			
3-May-88	0	5	Turned on 5 cfs pump on @ 9:00 a.m.
8-Sep-88	5	15	Requested by M.E. Moffat
26-Oct-88	15	5	
31-Oct-88	5	0	Pump turned off for winter season.
1989			
1-May-89	0	5	Requested by M.E. Moffat Water Resources
31-Oct-89	5	0	Turned off pumping for winter season
1990			
8-May-90	0	5	Turned on pump for summer pumping.
1-Nov-90	5	0	Turned off pump for winter season
1991			
21-May-91	0	10	Started pump for summer season
28-May-91	10	5	

Appendix 1.2. Continued.

DATE	BEFORE CHANGE (CFS)	AFTER CHANGE (CFS)	COMMENTS
16-Aug-91	5	10	Irrigators needed more water
23-Aug-91	10	5	High flow not needed
17-Sep-91	5	10	More flow was needed to fill reservoirs
29-Oct-91	10	0	Shut off pump for winter season
1992			
20-May-92	0	10	Start pump #1 (10 cfs) for summer season @ 9:35 a.m.
29-May-92	10	5	High flow not needed
31-Aug-92	5	0	Shut off pump to install C.M.P. on Elm River Ch. NE 34-10-3W
24-Sep-92	0	5	C.M.P.'s have been installed. Turned on 5 cfs
5-Oct-92	5	0	Shut off pump for winter season
1993			
23-Apr-93	0	10	Started 10 cfs's pump for summer season
30-Apr-93	10	5	High flow not needed @ this time all reservoirs full
21-Jun-93	5	10	Started 10 cfs pump to fill reservoirs on Elm River for irrigators
25-Jun-93	10	5	High flow not needed, reservoirs are all full
28-Jul-93	5	0	Shut off pump #2 (5 cfs) due to high flow levels caused by rains over the last week
1994			
29-Apr-94	0	10	Pump was started at 3 p.m. on Fri. April 29, 1994 at the request of John Arthur
3-May-94	10	5	Pump #1 was shut off & 5 cfs was switched on
1995			
RECORDS NOT AVAILABLE			
1996			
22-May-96	0	5	9:00 a.m.
14-Jun-96	5	10	Turned 5 cfs off & put 10 cfs on, Dave Buhler's orders
15-Aug-96	10	15	Orders from Dave Buhler - Lorne Henry complaining
13-Sep-96	15	10	
3-Oct-96	10	5	Marge Panko says too much water
11-Oct-96	5	0	Shut pump off for the winter
1997			
15-May-97	0	5	Started pump for 1997

Appendix 1.2. Continued.

DATE	BEFORE CHANGE (CFS)	AFTER CHANGE (CFS)	COMMENTS
13-Jun-97	5	10	Shut 5 cfs off and turned 10 cfs on, farmers are low on water
6-Aug-97	10	15	
19-Aug-97	15	5	Open 6" valve, fill connery's reservoir 9:30 a.m.
15-Sep-97	5	15	Started 10 cfs - Hutterites filling dugouts
18-Sep-97	15	5	Shut off 10 cfs
24-Sep-97	5	15	Hutterites needed more water for their pump
30-Sep-97	15	5	
?	5	0	Pump shut off for winter - date unknown
1998			
23-Apr-98	0	5	Turned pump on - demand from irrigators
19-Aug-98	5	10	Turned off 5 cfs pump and turned on 10 cfs pump
9-Sep-98	10	5	Turned off 10 cfs pump and started 5 cfs pump
11-Sep-98	5	0	Turned off pump for culvert work downstream
17-Sep-98	0	10	Turned 10 cfs pump on
21-Sep-98	10	5	
16-Oct-98	5	0	Shut pump off for the winter
1999			
26-Apr-99	0	5	Pump turned on for season
4-Aug-99	5	10	Shut off 5 cfs and started 10 cfs - farmers need more water
5-Aug-98	10	15	Turned on 5 cfs pump
11-Aug-98	15	10	Turned off 5 cfs pump
19-Aug-99	10	5	Turned off 10 cfs pump and started 5 cfs pump
20-Sep-99	5	0	Turned pump off for bridge work downstream
8-Oct-99	0	5	Started 5 cfs pump again
22-Oct-99	5	0	Shut off for season
2000			
1-Jun-00	0	5	Started pumping for season
13-Jun-00	5	0	Pump off due to heavy rains
15-Jun-00	0	5	Pump turned back on
7-Jul-00	5	0	Pump off due to heavy rains

Appendix 1.2. Continued.

DATE	BEFORE CHANGE (CFS)	AFTER CHANGE (CFS)	COMMENTS
17-Jul-00	0	5	Pump turned back on
7-Sep-00	5	0	Pump off due to heavy rains and for season
2001			
7-Jun-01	0	5	Turned on pump for season
27-Jun-01	5	0	Shut off due to heavy rain
3-Jul-01	0	5	Turned on pump
5-Jul-01	5	0	
9-Jul-01	0	5	
25-Oct-01	5	0	Shut off for winter
2002			
3-May-02	0	5	Started #2-5 cfs pump
10-Jun-02	5	0	Shut off pump due to heavy rains
17-Jun-02	0	5	Started #2-5 cfs pump
27-Jul-02	5	10	Switched to #1-10 cfs pump
21-Aug-02	10	5	Switched to #2-5 cfs pump
21-Oct-02	5	0	Pump turned off for winter
2003			
16-Apr-03	0	5	Started 1-5 cfs pump
17-Apr-03	5	0	Pump turned off due to heavy snow
22-Apr-03	0	10	Started 1-10 cfs pump, 5 cfs not working properly
18-May-03	10	0	Shut off pump due to heavy rain
20-May-03	0	10	Turned on 10 cfs pump
24-Jun-03	10	5	Shut off 10 cfs and turned on 5 cfs
25-Jun-03	5	0	Shut off due to heavy rains
27-Jun-03	0	5	Started 5 cfs pump
22-Jul-03	5	10	Shut off 5 cfs and started pumping with 10 cfs pump
6-Sep-03	10	0	Pump turned off due to low water level in river
17-Sep-03	0	5	Pump turned off and on due to low water at intake up until Sept. 29 (1-5 cfs pump, 133 hours, September 17-29)
29-Sep-03	5	0	Pump turned off- low water level in river

Appendix 1.2. Continued.

DATE	BEFORE CHANGE (CFS)	AFTER CHANGE (CFS)	COMMENTS
2004			
28-Apr-04	0	5	Started #2-5 cfs pump on request of Connery Farms to fill reservoirs
30-Apr-04	5	0	Shut down #2-5 cfs pump
3-May-04	0	5	Started #2-5 cfs pump
11-May-04	5	0	Shut down #2 pump due to heavy snowfall
28-Jun-04	0	5	Started #2-5 cfs pump
26-Aug-04	5	0	Shut down #2 pump due to heavy rain
30-Aug-04	0	5	Started #2-5 cfs pump
20-Sep-04	5	0	Shut down #2 pump due to heavy rain
24-Sep-04	0	5	Started #2-5 cfs pump on request from Mill Town Colony to fill reservoir
9-Oct-04	5	0	Pump off at 1:00 PM, cause unknown
12-Oct-04	0	5	Reset power and started #2 pump at 9:30 AM
15-Oct-04	5	0	Pump off at 10:30 PM due to ice and leaf blockage of intake
18-Oct-04	0	5	Flushed out blockage and restarted #2 pump at 9:15 AM
22-Oct-04	5	0	Shut down pumpsite for winter
2005			
2-Aug-05	0	5	Started #2-5 cfs pump
17-Sep-05	5	0	#2 pump off due to power failure
19-Sep-05	0	5	Restarted pump # 2
21-Oct-05	5	0	#2 pump off due to motor overheating
24-Oct-05	0	5	Restarted pump # 2
28-Oct-05	5	0	Shut down #2 pump for inspection and for season. Pump sent to Flygt. to rebuild

Appendix 1.3. Provincial pumping records (1985 – 2005) for Pumpsite “Z”, located on Mill Creek (Source: Manitoba Water Stewardship, Grosse Isle.).

DATE	BEFORE CHANGE (CSF)	AFTER CHANGE (CSF)	COMMENTS
1986			
June 30, 1986	0	10	Turned on 10 cfs as requested by R.M. Cartier
July 11, 1986	10	0	Turned off pumps @ 1:30 p.m., requested by R.M. of Cartier
1987			
July 20, 1987	0	5	Turned on 5 cfs pump @ 9:30 a.m., requested by R.M. of Cartier
August 14, 1987	5	0	Turned off pump @ 9:00 p.m. due to rainfall
1988			
June 16, 1988	0	5	Turned on 5 cfs @ 9:30 a.m. M.E.Moffat request
September 13, 1988	5	10	Requested by M.E. Moffat Water Resources
October 7, 1988	10	0	Turned off pumps @ 3:30 p.m.
1989			
May 30, 1989	0	5	Commenced pumping @ 11:00 a.m.
June 14, 1989	5	0	Turned pump off due to rainfall
June 19, 1989	0	5	Turned on 5 cfs pump requested by M.E. Moffat
October 13, 1989	5	0	Turned off pumping operation for winter season
1990			
July 3, 1990	0	5	Commenced pumping @ 2:00 p.m.
October 9, 1990	5	0	Turned pump off for winter season
1991			
June 25, 1991	0	5	Started pump for summer season @ 2:10p.m.
October 10, 1991	5	0	Shut off pump for the winter season
1992			
August 6, 1992	0	5	Start pump #2 (5 cfs) for summer season @ 8:30 a.m.
September 1, 1992	5	0	Pump shut down for winter

Appendix 1.3. Continued.

DATE	BEFORE CHANGE (CSF)	AFTER CHANGE (CSF)	COMMENTS
1993			
RECORDS NOT AVAILABLE			
1994			
RECORDS NOT AVAILABLE			
1995			
RECORDS NOT AVAILABLE			
1996			
August 12, 1996	0	5	Turned pump on for 1996
	5	0	Turned off for season - date unknown
1997			
June 9, 1997	0	5	Started pump, gravity too low.
September 22, 1997	0	5	Turned on #1
	5	0	Turned off for season - date unknown
1998			
May 4, 1998	0	5	Turned pumps on for the season
May 15, 1998	5	0	Pump turned off - farmer seeding downstream
May 19, 1998	0	5	Pump turned back on
June 24, 1998	5	0	Pump shut off due to heavy rain
June 25, 1998	0	5	Pump turned back on
July 31, 1998	5	0	Pump turned off for weekend
August 4, 1998	0	5	Pump turned back on
August 6, 1998	5	0	
August 10, 1998	0	5	
August 14, 1998	5	0	
August 17, 1998	0	5	
August 27, 1998	5	0	
August 31, 1998	0	5	pumps turned on & off for selected weekends
September 4, 1998	5	0	

Appendix 1.3. Continued.

DATE	**BEFORE CHANGE (CSF)**	**AFTER CHANGE (CSF)**	**COMMENTS**
September 8, 1998	0	5	
September 18, 1998	5	0	
September 21, 1998	0	5	
November 2, 1998	5	0	Shut off pump for the winter season
1999			
May 4, 1999			Flowing by gravity
July 6, 1999	0	5	Turned pump on for 1996
September 21, 1999	5	0	Turned pump off
September 23, 1999	0	5	Turned pump on for 1996
	5	0	Turned off for season - date unknown
2000			
June 1, 2000	0	5	Started pumping for the season
June 13, 2000	5	0	Turned off due to heavy rains
June 15, 2000	0	5	Pump turned back on
July 7, 2000	5	0	Turned off due to heavy rains
July 13, 2000	0	5	Pump turned back on
September 7, 2000	5	0	Turned off due to heavy rains
September 11, 2000	0	5	Pump turned back on
September 15, 2000	5	0	Pump turned off for season
2001			
June 12, 2001	0	5	Started for season
June 15, 2001	5	0	Turned off due to heavy rain
June 18, 2001	0	5	Turned on after heavy rain
June 27, 2001	5	0	Shut off due to heavy rain
July 3, 2001	0	5	Turned back on
July 5, 2001	5	0	Shut off due to high river levels
July 9, 2001	0	5	Turned on

Appendix 1.3. Continued.

DATE	BEFORE CHANGE (CSF)	AFTER CHANGE (CSF)	COMMENTS
September 14, 2001	5	0	Tripped off on 14 th, possible power failure
September 17, 2001	0	5	Turned back on
September 22, 2001	5	0	Tripped off on 22 ond, ?? (off for approx. 47 hours)
September 24, 2001	0	5	Turned back on
October 5, 2001	5	0	Pump shut off for winter
2002			
May 13, 2002	0	5	Started 1-5 cfs pump
June 10, 2002	5	0	Pump shut off due to heavy rain
June 17, 2002	0	5	Started 1-5 cfs pump
October 21, 2002	5	0	Pump turned off for winter
2003			
May 5, 2003	0	5	Started 1-5 cfs pump
May 18, 2003	5	0	Pump shut off due to heavy rain. Kept off during construction thru Kuzyks
June 13, 2003	0	5	Started 1-5 cfs pump. Construction completed
October 20, 2003	5	0	Pump turned off for winter
2004			
May 10, 2004	0	5	Started #2-5 cfs pump
May 11, 2004	5	0	Shut down pump due to heavy snow
June 28, 2004	0	5	Started #2-5 cfs pump
July 10, 2004	5	0	#2 pump off due to lightening at 4:00 AM
July 12, 2004	0	5	reset power and restarted #2 pump at 12:18 PM
July 15, 2004	5	0	#2 pump off due to lightening at 3:00 PM
July 16, 2004	0	5	reset power and restarted #2 pump at 3:00 PM
August 26, 2004	5	0	#2 pump off due to lightening at 12:30 PM
August 27, 2004	0	0	reset power, left pumps off due to heavy rain, pumps off for winter
2005			
No pumping at Mill Creek this year due to heavy rainfall throughout the spring and summer			

Appendix 2.1. Results of the Manitoba Water Stewardship – Fisheries Branch FIHCS search on the La Salle River, 2005.

FIHCS - Header

Date Created: 1992-03-31
Date Modified: 2002-04-10
Contact:

Manitoba Conservation Fisheries Branch

Waterbody: La Salle River

Number	Watershed	Region	District	Map Sheet	Latitude / Longitude
2715	5OGA	Winnipeg	Winnipeg	62H14	49° 45' 22" 97° 8' 29"

Habitat Suitability

Seasonal Habitat Suitability*

All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	None
Y	N	N	N	N	N	N	N	N	N	N	N	N	N

*The month(s) the waterbody is useable for fish Habitat (without human intervention)

Resource Access

Resource	Distance (km)
Aircraft on Floats	0
Aircraft on Wheels	16
All Season Road	0
Boat	0
Electrical Power	0
Walking	0

General Uses

General Use	Estimated Harvest (kg)
Recreational Angling	

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Appendix 2.1. Continued.

Waterbody: La Salle River

Number	Watershed	Region	District	Map Sheet	Latitude / Longitude
2715	5OGA	Winnipeg	Winnipeg	62H14	49° 45' 22" 97° 8' 29"

Habitat Classifications

Classification based on habitat rating	Class 3 - Waterbodies that have moderate limitations to production of fish
Condition of the waterbody 5 years ago	Class 2 - Waterbodies that have slight limitations to production of fish
Intuitive classification of the waterbody	Class 2 - Waterbodies that have slight limitations to production of fish
Predicted classification in 5 years if controlled	Class 2 - Waterbodies that have slight limitations to production of fish

Needed Improvments / Modifications

More flow is necessary.

Historic Improvements

Year	Improvements	Comments
2001	Eight dams have been built along the river for water storage. Each providing overwintering habitat however they block fish migration.	

2005-05-09

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Manitoba Conservation

Appendix 2.1. Continued.

FIHCS - Biology

Date Created: 1992-03-31
Date Modified: 2002-04-10
Contact:

Manitoba Conservation Fisheries Branch

Waterbody: La Salle River

Waterbody Number	Watershed Unit	Region	District	Map Sheet	Latitude / Longitude
2715	5OG	Winnipeg	Winnipeg	62H14	49° 45' 22" 97° 8' 29"

Species	Presence	Class	Use
BLACK CRAPPIE	Unknown		
CARP	Unknown		
CENTRAL MUDMINNOW	Unknown		
EMERALD SHINER	Common		
NORTHERN PIKE	Common	Sport	Year Round Resident Overwinter
RIVER SHINER	Common		
ROCK BASS	Common	Non-Sport	Year Round Resident Overwinter
SILVER REDHORSE	Rare		
SPOTFIN SHINER	Unknown		
TADPOLE MADTOM	Common	Non-Sport	Year Round Resident Overwinter
WALLEYE	Common	Sport	Year Round Resident Overwinter
WHITE BASS	Unknown		
WHITE SUCKER	Common	Non-Sport	Year Round Resident Overwinter

Print Date: May 09, 2005 1 of 1 Manitoba Conservation

Appendix 2.1. Continued.

FIHCS - Inventory Report

Date Created: 1992-03-31
Date Modified: 2002-04-10
Contact:

Manitoba Conservation Fisheries Branch

Waterbody La Salle River

Number	Watershed	Region	District	Map Sheet	Latitude / Longitude
2715	5 0 G A	Winnipeg	Winnipeg	62H14	49° 45' 22" 97° 8' 29"

Creel

Year	Species	Catch/Unit Effort*

*Catch/Unit Effort = Catch/Hour

Lodges

Lodges	Beds	Estimated Harvest (kgs)

*Estimated Harvest is approximately 375 kg/bed/season

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Appendix 2.1. Continued.

Waterbody La Salle River

Number	Watershed	Region	District	Map Sheet	Latitude / Longitude
2715	5 0 G A	Winnipeg	Winnipeg	62H14	49° 45' 22" 97° 8' 29"

FIHCS - Water Chemistry

La Salle River

Sample Dates: 2001-04-09

Code	Samples	Low	High	Average	MSWQO LO	MSWQO HI	CWQG LO
Inorganic							
Arsenic	11.0000	0.0050	0.0400	0.0305		190.0 ug/L	.0500 mg/L
Boron	14.0000	0.0900	0.2200	0.1590			.2000 ug/L
Cadmium	29.0000	0.0010	0.0500	0.0060	.6600 ug/L	2.000 ug/L	.2000 ug/L
Calcium	26.0000	18.4000	168.0000	59.4800			
Carbon (Total Inorganic)	27.0000	15.0000	91.5000	41.3600			
Carbon (Total Organic)	29.0000	7.5000	62.5000	17.6700			
Chromium	14.0000	0.0200	0.0200	0.0200		11.00 ug/L	.0020 mg/L
Copper (Ext.)	30.0000	0.0050	0.0250	0.0100			
Dissolved Oxygen	31.0000	0.1000	11.5300	7.3000			5.000 mg/L
Iron Ext.	27.0000	0.1500	13.2000	1.0200			
Lead	30.0000	0.0020	0.0200	0.0080	1.300 ug/L	7.700 ug/L	1.000 ug/L
Magnesium	29.0000	8.2600	68.0000	29.4200			
Manganese(Ext.)	26.0000	0.0200	13.0000	0.6800			
Nickel	14.0000	0.0050	0.0050	0.0050	56.00 ug/L	160.0 ug/L	25.00 ug/L
Nitrogen (Ammonia Tota	28.0000	0.0200	3.3000	0.3030	.0160 mg/L	.0500 mg/L	1.370 mg/L
Nitrogen (TKN)	28.0000	0.5000	3.9000	1.3400			
NO3-NO2 Diss	30.0000	0.0100	2.7000	0.3530			
Ph (Ph Units)	29.0000	7.4000	9.4500	7.7700	6.500 unit	9.000 unit	6.500 unit
Phosphorous Total	30.0000	0.0500	0.8500	0.2637			
Potassium	31.0000	5.0000	25.0000	10.4500			
Sodium	31.0000	8.5900	340.0000	75.5300			
Sulphate	31.0000	12.5000	230.0000	89.3000			
Zinc (Ext.)	19.0000	0.0100	0.2800	0.0240			
Organic							
Coliforms (Fecal)	14.0000	10.0000	100.0000	16.0000			
Physical							
Alkalinity (Total)	31.0000	64.0000	352.0000	179.0000			
Colour	31.0000	5.0000	70.0000	32.0000			
Conductivity (mho/cm)	31.0000	195.0000	2800.0000	836.2000			
Hardness (Total)	31.0000	79.9000	682.0000	262.7000			
Tempurature (C)	30.0000	0.0000	25.0000	10.0000			
Turbidity (NTU Or JTU)	28.0000	1.0000	160.0000	21.0800			

MSWQO = Manitoba Surface Water Quality Objectives
CWQG = Canadian Water Quality Guidelines

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Manitoba Conservation

Appendix 2.1. Continued.

Waterbody La Salle River

Number	Watershed	Region	District	Map Sheet	Latitude / Longitude
2715	50GA	Winnipeg	Winnipeg	62H14	49° 45' 22" 97° 8' 29"

Summer Temperature

Date	Max Temp (°C)	Thermocline Present	Thermocline Depth (m)	Max Temp Below Thermocline (°C)

Dissolved Oxygen

Date	# Stations	HI (ppm)	Low (ppm)	Average (ppm)	Conductivity (uhmos)	Temp (°C)	Ph Level
1992-02-23	8	1.35	0.30				

Lake Morphology

Survey Date: Lake Elevation ASL (m):

Lake Area (ha):
Maximum Depth (m):
Mean Depth (m):
Volume (cu.m. X 10E6):
Shoreline Length (km):
Island Shore Length (km):
Total Shoreline Length (km):
Shoreline Development Index:

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Appendix 2.1. Continued.

Waterbody La Salle River

Number	Watershed	Region	District	Map Sheet	Latitude / Longitude
2715	50 G A	Winnipeg	Winnipeg	62H14	49 ° 45' 22" 97 ° 8' 29"

Stream Morphology

Date:

Drainage Area (km2): **Stream Length (km):**

Highest Stream Order:

Average Bankfull Width (m):

Average Bankfull Depth (m): **Gauge Station:**

QBF (m3/sec): **TBF:**

Present n: **Estimated n:**

Average Slope (%): **Riffle Slope:**

Pool Slope (%):

Mean Substrate Diameter (m):

Present Discharge (m3/sec):

Average Width (m):

Average Depth (m):

Average Velocity (m/sec):

Land Use

Broad Class	Sub Class	Class Number*
Agriculture	- Farming (general)	1
Agriculture	- Feedlots	1
Transportation and Transmission	- All Season Roads	1
Transportation and Transmission	- Seasonal Roads	1
Water Development and Control	- Water Supply Impoundments	3
Waste Treatment/Disposal	- Wastewater Treatment Lagoons	2

* Class number is based on the Classes of Development Regulation, under Chapter 26 (Bill 26) of the Manitoba Environment Act. Class numbers increase in order of magnitude from 1 to 3 based on the environmental effects of the development.

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Appendix 2.1. Continued.

Waterbody La Salle River

Number	Watershed	Region	District	Map Sheet	Latitude / Longitude
2715	5OGA	Winnipeg	Winnipeg	62H14	49° 45' 22" 97° 8' 29"

Habitat Conditions

Habitat Parameter	Limiting Factor	Weight*	Probable Source	Weight*
USABLE HABITAT	Adult/Juvenile Habitat	2	Migration blockage	2
WATER QUANTITY	Flow Levels - Below Optimum	1	Natural	1

*Weight

1 = Minor Concern
2 = Major Concern

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Appendix 2.1. Continued.

Waterbody La Salle River

Number	Watershed	Region	District	Map Sheet	Latitude / Longitude
2715	50 G A	Winnipeg	Winnipeg	62H14	49° 45' 22" 97° 6' 29"

Literature

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Stewart, K.W. 1990. Reports on fish collecting activities under Scientific Collection Permit #89-1. Letter to J. O'Connor, Fisheries Branch, Man. Dept. of Natural Resources, Mar. 28, 1990. University of Manitoba, Dept. of Zoology, Winnipeg, Manitoba.	BIOLOGY

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Appendix 2.1. Continued.

Waterbody La Salle River

Number	Watershed	Region	District	Map Sheet	Latitude / Longitude
2715	5OGA	Winnipeg	Winnipeg	62H14	49° 45' 22" 97° 8' 29"

Yake, B. 1992. Pers. Comm. Manitoba Department of Natural Resources Fisheries Branch, Brandon, Manitoba.

BIOLOGY
CHEMISTRY
FISHING-SPORT
HABITAT
LAND USE
MORPHOLOGY
RESOURCE USE
WATER QUALITY

2005-05-09

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Manitoba Conservation

Appendix 3.1. Physical information collected in the La Salle River watershed study area, 2005.

DATE	LOCATION	SIDE	DISTANCE FR. SHORE (m)	DEPTH (m)	SUBSTRATE			OTHER
					Composition	Compaction	Shape	
30-Aug-05	SUMH1	LB		0.45	silt/mud	soft		undercut banks, overhanging roots
30-Aug-05	SUMH1	LB		0.50	silt/mud	soft		undercut banks, overhanging roots
30-Aug-05	SUMH1	LB		0.56	silt/mud	soft		undercut banks, overhanging roots
30-Aug-05	SUMH1	LB		0.75	silt/mud	soft		undercut banks, overhanging roots
30-Aug-05	SUMH1	LB		0.77	silt/mud	soft		undercut banks, overhanging roots
30-Aug-05	SUMH2	LB	b/w pillar and shore	0.45	silt/mud	soft		overlain with woody debris
30-Aug-05	SUMH2	LB	b/w pillar and shore	0.77	silt/mud	soft		overlain with woody debris
30-Aug-05	SUMH2	LB	b/w pillar and shore	0.78	silt/mud	soft		overlain with woody debris
30-Aug-05	SUMH2	LB	b/w pillar and shore	0.80	silt/mud	soft		overlain with woody debris
30-Aug-05	SUMH2	LB	b/w pillar and shore	0.92	silt/mud	soft		overlain with woody debris
30-Aug-05	SUMH2	LB	shore		cobble/boulder	hard		due to bridge (?)
30-Aug-05	R3IN	LB			silt/mud	soft		overlain with woody debris
30-Aug-05	R3IN	RB			silt/mud	soft		overlain with woody debris
30-Aug-05	R1IN	LB	shore	0.45	silt/mud	soft		foul smelling water and oily substance from substrate
31-Aug-05	SN2	LB	1.0	0.36	cobble	hard		cobble/gravel shore
31-Aug-05	SN2		2.0	0.49	cobble	hard		
31-Aug-05	SN2		3.0	0.57	cobble	hard		
31-Aug-05	SN2		4.0	0.54	cobble	hard		
31-Aug-05	SN2		5.0	0.60	gravel	hard		
31-Aug-05	SN2		6.0	0.65	gravel	hard		
31-Aug-05	SN2		7.0	0.67	gravel	medium		

Appendix 3.1. Continued.

DATE	LOCATION	SIDE	DISTANCE FR. SHORE (m)	DEPTH (m)	SUBSTRATE Composition	Compaction	Shape	OTHER
31-Aug-05	SN2		8.0	0.72	silt/mud	soft		
31-Aug-05	SN2		9.0	0.78	silt/mud	soft		
31-Aug-05	SN2		10.0	0.82	silt/mud	soft		
31-Aug-05	SN2		11.0	0.87	silt/mud	soft		
31-Aug-05	SN2		12.0	0.71	silt/mud	soft		
31-Aug-05	SN2		13.0	0.94	silt/mud	soft		
31-Aug-05	SN2		14.0	1.04	silt/mud	medium		
31-Aug-05	SN2		15.0	0.95	gravel	hard		
31-Aug-05	SN2		16.0	0.89	gravel	hard		
31-Aug-05	SN2		17.0	0.80	gravel	hard		
31-Aug-05	SN2		18.0	0.56	cobble	hard		
31-Aug-05	SN2		19.0	0.27	cobble/silt	medium		
31-Aug-05	SN2	RB	21.1			hard		cobble/gravel shore
31-Aug-05	E1		under bridge		silt/mud	very soft		
31-Aug-05	ERVEL	LB	0.5	0.28	silt/mud	soft	uniform	
31-Aug-05	ERVEL		1.0	0.28	silt/mud	soft	uniform	
31-Aug-05	ERVEL		1.5	0.3	silt/mud	soft	uniform	
31-Aug-05	ERVEL		2.0	0.32	silt/mud	soft	uniform	
31-Aug-05	ERVEL		2.5	0.32	silt/mud	soft	uniform	
31-Aug-05	ERVEL		3.0	0.24	silt/mud	soft	uniform	
31-Aug-05	ERVEL		3.5	0.26	silt/mud	soft	uniform	
31-Aug-05	ERVEL	RB	3.7					
31-Aug-05	ECVEL	LB	1.0	0.60	silt/mud	soft		reeds
31-Aug-05	ECVEL	LB	2.0	0.72	silt/mud	soft		reeds
31-Aug-05	ECVEL	LB	3.0	1.00	silt/mud	soft		

Appendix 3.1. Continued.

DATE	LOCATION	SIDE	DISTANCE FR. SHORE (m)	DEPTH (m)	SUBSTRATE			OTHER
					Composition	Compaction	Shape	
31-Aug-05	E2 (King Drain)			0.45	cobble/gravel	hard		upstream of wood weir under bridge
31-Aug-05	E3 (King Drain)			0.8	silt/mud	soft		downstream of wood weir under bridge
31-Aug-05	E4 (King Drain)			0.8	silt/mud	soft		approximately 20 m upstream of bridge
31-Aug-05	E5 (LRH2)	RB	under bridge		silt/mud	soft		interspersed with gravel/cobble and woody debris
1-Nov-05	FORT	LB	near shore		silt/mud	very soft		no flow, duck weed, woody debris. smell of rotting vegetation

Appendix 3.2. Hydrological information collected in the La Salle River watershed study area, 2005.

DATE	LOCATION	SIDE	DISTANCE	WIDTH	DEPTH	AREA	REV.	SEC.	VELOCITY	DISCHARGE (m^3/sec)
20-Apr-05	KDVEL	LB	0.0	0.25						
20-Apr-05	KDVEL		0.5	0.50	0.10	0.05	12	42.0	0.175	0.009
20-Apr-05	KDVEL		1.0	0.50	0.17	0.09	10	44.0	0.141	0.012
20-Apr-05	KDVEL		1.5	0.50	0.12	0.06	12	41.1	0.179	0.011
20-Apr-05	KDVEL		2.0	0.50	0.18	0.09	12	41.4	0.178	0.016
20-Apr-05	KDVEL		2.5	0.50	0.13	0.07	11	43.1	0.157	0.010
20-Apr-05	KDVEL		3.0	0.50	0.12	0.06	10	44.8	0.138	0.008
20-Apr-05	KDVEL		3.5	0.50	0.14	0.07	8	43.0	0.117	0.008
20-Apr-05	KDVEL		4.0	0.50	0.20	0.10	7	42.9	0.103	0.010
20-Apr-05	KDVEL		4.5	0.50	0.20	0.10	6	45.2	0.085	0.009
20-Apr-05	KDVEL		5.0	0.50	0.20	0.10	10	43.7	0.142	0.014
20-Apr-05	KDVEL		5.5	0.50	0.27	0.14	10	43.9	0.141	0.019
20-Apr-05	KDVEL		6.0	0.50	0.19	0.10	8	46.4	0.109	0.010
20-Apr-05	KDVEL		6.5	0.50	0.14	0.07	3	50.5	0.042	0.003
20-Apr-05	KDVEL		7.0	0.40	still water					
20-Apr-05	KDVEL	RB	7.3	0.15						**0.140**
20-Apr-05	ECVEL	LB	0.0	0.5						
20-Apr-05	ECVEL		1.0	1.0						
20-Apr-05	ECVEL		2.0	1.0	0.72	0.72	7	41.4	0.121	0.087
20-Apr-05	ECVEL		3.0	1.0						
20-Apr-05	ECVEL		4.0	1.0	1.60	1.60	10	48.3	0.147	0.234
20-Apr-05	ECVEL		5.0	1.0						
20-Apr-05	ECVEL		6.0	1.0	1.80	1.80	14	45.8	0.212	0.382
20-Apr-05	ECVEL		7.0	1.0						
20-Apr-05	ECVEL		8.0	1.0	0.82	0.82	15	37.0	0.279	0.229
20-Apr-05	ECVEL		9.0	1.0						
20-Apr-05	ECVEL		10.0	1.0	0.64	0.64	12	45.3	0.185	0.118
20-Apr-05	ECVEL		11.0	1.0						

Appendix 3.2. Continued.

DATE	LOCATION	SIDE	DISTANCE	WIDTH	DEPTH	AREA	REV.	SEC.	VELOCITY	DISCHARGE (m^3/sec)
20-Apr-05	ECVEL		12.0	1.0	0.90	0.90	14	46.7	0.208	0.188
20-Apr-05	ECVEL		13.0	1.0	0.70	0.70	11	47.4	0.163	0.114
20-Apr-05	ECVEL		14.0	1.0						
20-Apr-05	ECVEL		15.0	1.0						
20-Apr-05	ECVEL		16.0	1.0						
20-Apr-05	ECVEL		17.0	0.6						
20-Apr-05	ECVEL	RB	17.2	0.1						**1.353**
20-Apr-05	LRVEL	LB	0.0	0.25		0.00				
20-Apr-05	LRVEL		0.5	0.50	0.52	0.26	16	42.4	0.260	0.068
20-Apr-05	LRVEL		1.0	0.50	0.70	0.35	30	47.7	0.428	0.150
20-Apr-05	LRVEL		1.5	0.50	0.80	0.40	30	46.9	0.435	0.174
20-Apr-05	LRVEL		2.0	0.50	0.80	0.40	31	45.5	0.463	0.185
20-Apr-05	LRVEL		2.5	0.50	0.80	0.40	30	48.0	0.425	0.170
20-Apr-05	LRVEL		3.0	0.50	0.78	0.39	30	51.4	0.397	0.155
20-Apr-05	LRVEL		3.5	0.50	0.68	0.34	30	45.1	0.452	0.154
20-Apr-05	LRVEL		4.0	0.50	0.66	0.33	26	46.4	0.382	0.126
20-Apr-05	LRVEL		4.5	0.50		0.00				
20-Apr-05	LRVEL	RB	5.0	0.25		0.00				**1.181**
20-Apr-05	ERVEL	LB	0.0	0.25		0.00				
20-Apr-05	ERVEL		0.5	0.5	0.44	0.22	6	46.1	0.095	0.021
20-Apr-05	ERVEL		1.0	0.5	0.52	0.26	21	43.3	0.332	0.086
20-Apr-05	ERVEL		1.5	0.5	0.6	0.30	32	45.6	0.476	0.143
20-Apr-05	ERVEL		2.0	0.5	0.68	0.34	27	42.6	0.431	0.147
20-Apr-05	ERVEL		2.5	0.5	0.6	0.30	28	45.8	0.416	0.125
20-Apr-05	ERVEL		3.0	0.5	0.58	0.29	23	45.7	0.344	0.100
20-Apr-05	ERVEL		3.5	0.5	0.5	0.25	21	42.6	0.337	0.084
20-Apr-05	ERVEL		4.0	0.5	0.34	0.17	11	44.2	0.174	0.030
20-Apr-05	ERVEL		4.5	0.5	0.24	0.12				

Appendix 3.2. Continued.

DATE	LOCATION	SIDE	DISTANCE	WIDTH	DEPTH	AREA	REV.	SEC.	VELOCITY	DISCHARGE (m^3/sec)
20-Apr-05	ERVEL		5.0	0.5		0.00				
20-Apr-05	ERVEL	RB	5.5	0.25		0.00				**0.735**
31-Aug-05	LRVEL	LB	0.0	0.25						
31-Aug-05	LRVEL		0.5	0.5	0.34	0.17	4	43.1	0.064	0.011
31-Aug-05	LRVEL		1.0	0.5	0.44	0.22	5	45.7	0.075	0.017
31-Aug-05	LRVEL		1.5	0.5	0.58	0.29	7	47.1	0.102	0.030
31-Aug-05	LRVEL		2.0	0.5	0.58	0.29	6	46.5	0.089	0.026
31-Aug-05	LRVEL		2.5	0.5	0.58	0.29	8	45.8	0.120	0.035
31-Aug-05	LRVEL		3.0	0.5	0.58	0.29	8	42.6	0.129	0.037
31-Aug-05	LRVEL		3.5	0.5	0.56	0.28	6	47.1	0.087	0.024
31-Aug-05	LRVEL		4.0	0.5	0.58	0.29	7	45.1	0.106	0.031
31-Aug-05	LRVEL		4.5	0.5	0.48	0.24	6	51.7	0.080	0.019
31-Aug-05	LRVEL		5.0	0.5	0.32	0.16				
31-Aug-05	LRVEL	RB	5.5	0.25						**0.229**
31-Aug-05	ERVEL	LB	0.0	0.25		0.00				
31-Aug-05	ERVEL		0.5	0.5	0.28	0.14	8	44.9	0.122	0.017
31-Aug-05	ERVEL		1.0	0.5	0.28	0.14	11	43.3	0.174	0.024
31-Aug-05	ERVEL		1.5	0.5	0.3	0.15	15	42.4	0.241	0.036
31-Aug-05	ERVEL		2.0	0.5	0.32	0.16	19	43.9	0.295	0.047
31-Aug-05	ERVEL		2.5	0.5	0.32	0.16	18	43.0	0.285	0.046
31-Aug-05	ERVEL		3.0	0.5	0.24	0.12	11	43.9	0.171	0.021
31-Aug-05	ERVEL		3.5	0.35	0.26	0.09	12	46.3	0.177	0.016
31-Aug-05	ERVEL	RB	3.7	0.1		0.00				**0.207**
31-Aug-05	ECVEL	LB	0.0	1.25						
31-Aug-05	ECVEL		2.5	2.75	0.42	1.16	4	49.3	0.056	0.065
31-Aug-05	ECVEL		5.5	3.5	0.52	1.82	4	48.0	0.057	0.105
31-Aug-05	ECVEL		9.5	2.75	0.56	1.54	6	49.3	0.084	0.129
31-Aug-05	ECVEL	RB	11.0	0.75						**0.298**

Appendix 4.1. Biological information for fish captured during the spring fish utilization component of the La Salle River watershed assessment survey, 2005.

LOCATION	DATE	TIME	FISH #	COUNT	SPECIES	LENGTH (mm)	WEIGHT (g)	SEX	MATURITY
LRH1	20-Apr-05	8:30	1	1	QUIL	460	2000		
LRH1	20-Apr-05	8:30	2	1	QUIL	451	2500		
LRH1	20-Apr-05	8:30	3	1	NRPK	590	1500	F	4
LRH1	20-Apr-05	8:30	4	1	NRPK	453	600		
LRH1	20-Apr-05	8:30	5	1	WHSC	426	1100	M	9
LRH1	20-Apr-05	8:30	6	1	SHRD	380	750	M	9
LRH1	20-Apr-05	8:30	7	1	SHRD	404	1000	F	
LRH1	20-Apr-05	8:30	8	1	WHSC	442	1400	F	3
LRH1	20-Apr-05	8:30	9	1	BLCR	245	250	F	2
LRH1	20-Apr-05	8:30	10	1	BLCR	231	225		
LRH1	20-Apr-05	8:30	11	1	BLCR	227	200	F	2
LRH1	20-Apr-05	8:30	12	1	BLCR	241	225	F	2
LRH1	20-Apr-05	8:30	13	1	BLCR	226	200	F	2
LRH1	20-Apr-05	8:30	14	1	BGBF	511	2900		
LRH2	20-Apr-05	10:00	15	1	NRPK	403	405		
LRH2	20-Apr-05	10:00	16	1	NRPK	611	1650	M	9
LRH2	20-Apr-05	10:00	17	1	BLCR	249	200	F	2
KDH1	20-Apr-05	10:35	18	1	WHSC	352	700	F	2
KDH1	20-Apr-05	10:35	19	1	QUIL	384	1200	M	
KDH1	20-Apr-05	10:35	20	1	NRPK	582	1200		
KDH1	20-Apr-05	10:35	21	1	NRPK	251	100		
KDH1	20-Apr-05	10:35	22	1	NRPK	234	100		
LSRH3	20-Apr-05	14:35	23	1	WHSC	431	1250	F	2

Appendix 4.1. Continued.

LOCATION	DATE	TIME	FISH #	COUNT	SPECIES	LENGTH (mm)	WEIGHT (g)	SEX	MATURITY
LSRH3	20-Apr-05	14:35	24	1	WHSC	387	850	M	7
LSRH3	20-Apr-05	14:35	25	1	WHSC	451	1500	F	2
LSRH3	20-Apr-05	14:35	26	1	WHSC	406	1000	M	7
LSRH3	20-Apr-05	14:35	27	1	WHSC	418	1050	F	
LSRH3	20-Apr-05	14:35	28	1	WHSC	363	700	M	7
LSRH3	20-Apr-05	14:35	29	1	WHSC	385	950	F	
LSRH3	20-Apr-05	14:35	30	1	WHSC	461	1400	F	2
LSRH3	20-Apr-05	14:35	31	1	WHSC	417	1000	M	7
LSRH3	20-Apr-05	14:35	32	1	BLCR	195	100		
LSRH3	20-Apr-05	14:35	33	1	BLCR	195	100		
LRH1	21-Apr-05	9:00	34	1	CMCR	392	1100	M	7
LRH1	21-Apr-05	9:00	35	1	CMCR	347	850		
LRH1	21-Apr-05	9:00	36	1	SHRD	385	825	M	9
LRH1	21-Apr-05	9:00	37	1	FRDR	399	800		
LRH1	21-Apr-05	9:00	38	1	BLCR	227	225	F	2
LRH1	21-Apr-05	9:00	39	1	BLCR	242	225	F	2
LRH1	21-Apr-05	9:00	40	1	NRPK	565	1100		
LRH1	21-Apr-05	9:00	41	1	NRPK	795	3600	F	5
LRH1	21-Apr-05	9:00	42	1	CMCR	525	2200	M	7
LRH1	21-Apr-05	9:00	43	1	CMCR	439	1400	M	7
LSRH3	21-Apr-05	13:50	44	1	NRPK	397	550		
LSRH3	21-Apr-05	13:50	45	1	NRPK	480	800		
LSRH3	21-Apr-05	13:50	46	1	WHSC	414	1100	M	7

Appendix 4.1. Continued.

LOCATION	DATE	TIME	FISH #	COUNT	SPECIES	LENGTH (mm)	WEIGHT (g)	SEX	MATURITY
LSRH3	21-Apr-05	13:50	47	1	WHSC	418	1000	F	2
LSRH3	21-Apr-05	13:50	48	1	CMCR	324	650	M	7
LSRH3	21-Apr-05	13:50	49	1	NRPK	322	300		
LSRH3	21-Apr-05	13:50		74	BLBL				

F2 = Female maturing to spawn in the current year

F3 = Female ripe/running; ready to spawn

F4 = Spent female

M7 = Male maturing to spawn in the current year

M9 = Spent male

Appendix 5.1. Number of invertebrates collected, by major taxon, at three sites along the La Salle River. Tolerance levels adopted from West Virginia Department of Environmental Protection (2004).

Major Taxon	Family	Life Stage	Number Invertebrates Identified	Number Invertebrates in Sample	Tolerance Level*				
					1	2	3	4	Comments
REACH 1 - EKMAN GRAB SAMPLER									
Insecta									
Coleoptera	Elmidae	larva	10	10		X			
Diptera	Ceratopogonidae	larva	6	6			X		
Diptera	Chironomidae	larva	2	2				X	
		REACH 1 EKMAN TOTAL	18	18					
REACH 1 - KICKNET SAMPLER									
Annelida									
Hirudinea	unidentified		45	45				X	
Crustacea	unidentified		3	3					n/a
Ostracoda									n/a
Amphipoda	unidentified		80	>1000		X			
Mollusca									
Bivalvia	Pisidiidae	larva	12	12		X			Generally
Gastropoda	unidentified		8	8					n/a
Insecta									
Odonata	Coenagrionidae		1	1				X	
Hemiptera	Corixidae	adult	44	44					n/a
Coleoptera	Elmidae	larva	87	87		X			
Coleoptera	Elmidae	adult	7	7		X			
Coleoptera	Halipidae	adult	1	1			X		
Coleoptera	Dytiscidae	adult	11	11			X		
Trichoptera	Polycentropodidae	larva	23	23			X		
Ephemeroptera	Caenidae	larva	39	39			X		
Diptera	Ceratopogonidae	larva	61	61			X		
Diptera	Chironomidae	larva	39	39				X	
		REACH 1 KICKNET TOTAL	461	>1381					
		REACH 1 TOTAL	479	>1399					

Appendix 5.1. Continued.

Major Taxon	Family	Life Stage	Number Invertebrates Identified	Number Invertebrates in Sample	Tolerance Level* 1	2	3	4	Comments
REACH 2 - EKMAN GRAB SAMPLER									
Annelida									
Oligochaeta	unidentified		4	4				X	
Nemata	unidentified		2	2					n/a
Crustacea									
Amphipoda	unidentified		1	1		X			
Crustacea									
Diplostraca	unidentified		6	6					n/a
Arachnida									
Acarina	unidentified		3	3					n/a
Mollusca									
Bivalvia	Pisidiidae		3	3		X			Generally
Insecta									
Hemiptera	Corixidae	larva	1	1					n/a
Diptera	unidentified	pupa	1	1					
Diptera	Chironomidae	larva	7	7				X	
		REACH 2 EKMAN TOTAL	28	28					
REACH 2 - KICKNET SAMPLER									
Annelida									
Oligochaeta	unidentified		40	>75				X	
Hirudinea	unidentified		1	1				X	
Nemata			10	>10					n/a
Crustacea									
Amphipoda	unidentified		125	125		X			
Diplostraca	unidentified		2	2					n/a
Mollusca									
Bivalvia	Pisidiidae		23	23		X			Generally

Appendix 5.1. Continued.

Major Taxon	**Family**	**Life Stage**	**Number Invertebrates Identified**	**Number Invertebrates in Sample**	**Tolerance Level***				
					1	**2**	**3**	**4**	**Comments**
Insecta									
Coleoptera	Elmidae	adult	9	9		X			
Coleoptera	Dytiscidae	adult	3	3			X		
Hemiptera	Corixidae	larva and adult	32	32					n/a
Ephemeroptera	Baetidae	larva	3	3		X			
Ephemeroptera	Caenidae	larva	6	6			X		
Ephemeroptera	Heptageniidae	larva	3	3		X			
Ephemeroptera	Ameletidae	larva	1	1	X				
Trichoptera	Phryganeidae	larva	1	1	X				
Diptera	Chironomidae	larva	105	105				X	
		REACH 2 KICKNET TOTAL	364	>399					
		REACH 2 TOTAL	392	>427					
REACH 3 - EKMAN GRAB SAMPLER									
Annelida									
Oligochaeta	unidentified		1	1				X	
Mollusca									
Bivalvia	Pisidiidae		1	1		X			Generally
Insecta									
Coleoptera	unidentified	adult	1	1		X			Generally
Diptera	Chironomidae		11	11				X	
Diptera	Chironomidae	adult	3	3				X	
		REACH 3 TOTAL	17	17					
		OVERALL TOTAL	**888**	**1843>**					

* Adopted from West Virginia Department of Environmental Protection (2004)
1 = Sensitive organisms
2 = Less-sensitive organisms
3 = Somewhat sensitive organisms
4 = Pollution tolerant organisms
n/a = Data unavailable

Appendix 6.1. Potential barriers identified in the La Salle River watershed study area, 2005.

SITE ID	UID	DISC	VTR TIME	COMMENT	BARRIER	BARRIER TYPE Beaver	Debris	Anthro.	UTM Easting	Northing
1	7	1	00:03:19	riffle or obstruction ? (access site from road)	?		1		633281	5511757
2	13	1	00:05:53	St. Norbert Dam	Yes			1	631806	5509606
3	26	1	00:11:20	Start of LaSalle subdivision? Instream barrier; denuded riparian	Yes			1	626356	5506620
4	47	1	00:18:34	instream barrier; obvious retention of water; composition unknown	Yes		1		619519	5504810
5	62	1	00:22:11	debris dam in river ?	?		1		617834	5502114
6	68	1	00:25:05	Closer look at debris dam; crossing over possible with grazing at base?	Yes			1	616727	5501194
7	83	1	00:02:09	Sanford water control structure (i.e., Sanford Reservoir)	Yes			1	613311	5504288
8	98	1	00:06:34	Possible debris dam in river	?		1		607308	5508954
9	103	1	00:07:59	Possible low head dam in river channel	Yes ?			1	606302	5509160
10	128	1	00:14:27	Debris dam in river, possible barrier	Yes ?		1		599713	5514411
11	158	1	00:10:22	Debris dam and potential barrier	Yes ?		1		591111	5524687
12	244	2	00:01:07	Low head dam	Yes			1	588615	5526506
13	259	2	00:03:08	Debris dam (?)	?		1		588759	5531061
14	260	2	00:03:21	Road crossing (single culvert); possible impoundment of water	?			1	588631	5531490
15	261	2	00:03:24	Possible debris/ford in river (again at 0:4:19)	?		1		588609	5531596
16	266	2	00:05:01	Debris/natural barrier instream	?		1		588007	5532813
17	288	2	00:07:55	debris in river; potential barrier?	?		1		585245	5536655
18	294	2	00:09:21	Possible ford crossing ?	?			1	583578	5535627
19	297	2	00:09:30	Ford/machine crossing from same operation as 0:9:30	?			1	583332	5535778
20	298	2	00:10:02	Debris dam in river with duckweed/algae/algae	?		1		582705	5535752
21	300	2	00:10:05	Debris dam at same operation as 0:10:04	?		1		582662	5535695
22	302	2	00:10:12	Debris dam (?)	?		1		582551	5535550
23	305	2	00:11:18	Large operation: Mutiple impacts (access, grazing, feedlot, ford crossing, etc)	?			1	581701	5535093
24	309	2	00:13:03	Large operation: Mutiple impacts (access, grazing, ford, feedlots/paddocks, riparian,etc)	?			1	579873	5535359

Appendix 6.1. Continued..

SITE ID	UID	DISC	VTR TIME	COMMENT	BARRIER	BARRIER TYPE Beaver	Debris	Anthro.	UTM Easting	Northing
25	313	2	00:13:55	Operation: paddocks, denuded riparian, ford with culvert (to access 0:13:40 site?)	?			1	578768	5535480
26	321	2	00:16:35	Operation: Multiple issues (ford, denuded, grazing, access, feedlot	Yes			1	575928	5537056
27	323	2	00:17:18	Debris dam, duckweed/algae	?		1		575054	5537265
28	327	2	00:18:02	Debris dam with duckweed/algae	?		1		574666	5537333
29	329	2	00:18:33	Debris dam with duckweed/algae	?		1		574355	5537342
30	339	2	00:21:02	Machine/ford crossing (culverts?): does not appear to impound	?			1	571778	5536570
31	341	2	00:21:47	earthen ford crossing grown over, but in use: culverts?: does not appear to impound	?			1	571681	5536234
32	342	2	00:22:13	debris dam with duckweed/algae	?		1		571746	5535558
33	343	2	00:22:20	Machine ford with culverts (?): impounded water (note low flow downstream)	Yes			1	571757	5535349
34	344	2	00:22:36	Machine ford with culverts (?): impounded water upstream (and from downstream ford)	Yes			1	571685	5534896
35	349	2	00:23:25	Small operation: denuded riparan, slumping, machine ford crossing impounding flow	Yes			1	570946	5535033
36	352	2	00:24:02	Possible beaver dam activity and/or debris dam	Yes ?		1		570139	5534386
37	355	2	00:24:35	Operation: Multiple issues (ford, denuded, grazing, access, feedlot, no flow)	Yes			1	570486	5533691
38	358	2	00:25:14	Possible earthen ford crossing causing slight impoundment	?			1	570305	5533464
39	374	2	00:28:29	Small operation: ford crossing impounding, denuded riparian, grazing, etc	Yes			1	567302	5532986
40	376	2	00:29:18	Debris barrier with extensive duckweed/algae upstream	?		1		567012	5532003
41	377	2	00:29:23	Debris barrier with extensive duckweed/algae upstream	?		1		567002	5531899
42	380	2	00:30:09	Homestead with denuded riparian area, woody debris and duckweed/algae in river	?		1		566189	5532083
43	381	2	00:30:34	Earthen ford crossing with culverts (?), extensive duckweed/algae downstream	?			1	565574	5531611
44	382	2	00:30:45	Debris dam (grown over) with extensive duckweed/algae upstream; minimal flow	Yes		1		565223	5531603
45	383	2	00:30:52	Debris dam (grown over) with extensive duckweed/algae upstream; minimal/no flow ?	Yes		1		565065	5531766

Appendix 6.1. Continued..

SITE ID	UID	DISC	VTR TIME	COMMENT	BARRIER	BARRIER TYPE			UTM	
						Beaver	Debris	Anthro.	Easting	Northing
46	384	2	00:31:28	Road crossing (culverts?) appears to be impounding of water if any flow	Yes			1	565193	5532799
47	385	2	00:32:02	Road crossing (culverts?) appears to be impounding of water if any flow	Yes			1	564904	5533226
48	386	2	00:32:22	Road crossing (culverts?) appears to be impounding of water if any flow	Yes			1	564605	5532917
49	387	2	00:32:23	Start of Colony: Numerous fords, totally denuded riaparian, grazing?, feedlots?, refuse dump?	Yes			1	564585	5532901
50	392	2	00:35:08	Earthen frod crossing (culverts?)	Yes			1	561780	5533296
51	169	2	00:00:45	debris dam	Yes		1		553293	5529657
52	175	2	00:01:59	Road crossing (?) with no visible passage of water	Yes			1	555261	5530168
53	176	2	00:02:12	Road crossing (?) with no visible passage of water	Yes			1	555521	5530478
54	180	2	00:03:21	Apparent barrier of debris and/or mud (antropogenic in origin)	Yes		1		555869	5528894
55	181	2	00:03:26	Possible crossing with culverts	Yes ?			1	555871	5528747
56	190	2	00:06:47	Road crossing with culvert (possible perched ?)	Yes ?			1	559342	5530321
57	192	2	00:07:16	Debris dam ?	?		1		560270	5530366
58	194	2	00:07:37	Culvert possibly blocked/perched; water impounded	Yes?			1	560976	5530242
59	201	2	00:09:39	Possible debris dam, water does does appear to be impounded	?		1		564447	5529813
60	202	2	00:09:43	Possible debris dam, water does does appear to be impounded	?		1		564635	5529861
61	204	2	00:09:56	Possible debris dam, water does does appear to be impounded	?		1		565135	5529936
62	216	2	00:13:21	Cement ford crossing and beginning of channelization?	Yes ?			1	571842	5529473
63	224	2	00:15:36	Cement ford	Yes			1	576373	5527888
64	225	2	00:16:10	Cement ford	Yes			1	577068	5526922
65	228	2	00:17:16	Cement ford	Yes			1	579455	5526614
66	229	2	00:17:58	Cement ford	Yes			1	581035	5526623
67	231	2	00:19:13	Cement ford	Yes			1	584232	5526696
68	232	2	00:19:51	Cement ford	Yes			1	585880	5526709
69	234	2	00:20:29	Cement ford	Yes			1	587471	5526746

Appendix 6.1. Continued..

SITE ID	UID	DISC	VTR TIME	COMMENT	BARRIER	BARRIER TYPE Beaver	Debris	Anthro.	UTM Easting	Northing
70	237	2	00:21:36	Low head dam	Yes			1	588501	5526940
71	402	3	00:01:11	Cement ford	Yes			1	589282	5517912
72	407	3	00:02:38	cememt ford: field drains upstream and downstream	Yes			1	592595	5516974
73	410	3	00:03:22	Low head dam near mouth and La Salle River	Yes			1	593876	5516961
74	447	3	00:04:23	Cement ford crossing	Yes			1	623129	5502998
75		3	0:03:14	Wooden weir under bridge	Yes			1	616410	5499137
TOTALS						0	29	46		

Appendix 7.1. Index of potential rehabilitation sites, including descriptions, and aerial video chronology for the La Salle River watershed study area, 2005.

SITE	DISC	Chapter	VTR Time	COMMENT	PRIORITY	BANK	UTM Easting	UTM Northing
1	1	1	00:05:53	St. Norbert Dam	2		631806	5509606
2	1	1	00:08:54	Operation of some kind, zero riparian	3	RB	629059	5507769
3	1	1	00:08:58	Same operation as 8:54 but a creek (?) with some erosion	3	RB	628981	5507725
4	1	1	00:09:50	Feedlot area; denuded riparian; manure dump ?	3	LB	628351	5507205
5	1	1	00:10:48	Very large operation: multiple issues (slumping, feedlots, no riparian, pasture, etc.)	1	LB	627184	5506601
6	1	1	00:11:07	Bank failure with no riparian vegetation; at residential home?	3	LB	626671	5506542
7	1	1	00:11:20	Start of LaSalle subdivision? Instream barrier; denuded riparian	3	RB	626356	5506620
8	1	1	00:12:12	Highly erosive banks with zero riparian vegetation	3	RB	625323	5506233
9	1	1	00:13:00	Slumping bank with small drain?; zero riparian	3	LB	624336	5506113
10	1	1	00:15:36	Bank slumping and drain off cropland with denuded riparian area	3	LB	622830	5504163
11	1	1	00:16:26	Operation of some kind; grazing, nil-riparian, slumping	1	LB	622495	5503083
12	1	1	00:16:50	Large operation; multiple impacts (nil-riparian, feedlot, grazing, etc)	1	LB	622116	5502618
13	1	1	00:18:18	Bank slumping at small operation; effect of grazing and minimal riparian	3	RB	619833	5504214
14	1	1	00:18:34	Instream barrier; obvious retention of water; composition unknown	3	RB	619519	5504810
15	1	1	00:18:35	Operation: denuded riparian, grazing ?, auto wrecking?	3	RB	619518	5504766
16	1	1	00:19:14	Operation (?) with grazing (?) and denuded riparian area	3	RB	618531	5504719
17	1	1	00:19:33	Twin culvert draining into LaSalle, zero riparian, grazing	3	RB	617975	5504982
18	1	1	00:20:08	Bridge and roadside drain with erosion (LSRH2 site)	3	LB	617805	5504405
19	1	1	00:20:22	Field drain erosion, no delta	3	RB	617491	5504335
20	1	1	00:21:53	Colony situation?: slumping, nil riparian	3	LB	618069	5502447
21	1	1	00:22:11	Debris dam in river ?	3		617834	5502114
22	1	1	00:22:41	Possible grazing/watering area into river from large home with grain bins	2	LB	617955	5501449
23	1	1	00:24:04	Debris dam (?) with passage over ? Operation and impacts on RB	3		616780	5501362
24	1	1	00:25:05	Closer look at debris dam; crossing over possible with grazing at base?	2		616727	5501194
25	1	1	00:29:08	Very large operation next to river (settling ponds? Treatment?, manure?)	1	LB	614778	5500815
26	1	1	00:29:49	Grazing possible adjacent to bridge	2	LB	614838	5501002
27	1	2	00:02:09	Sanford water control structure (i.e., Sanford Reservoir)	3		613311	5504288
28	1	2	00:02:56	Large operation; hog plant?	3	RB	612023	5505611
29	1	2	00:03:52	Cattle grazing at old farmstead??	3	RB	610680	5506797

Appendix 7.1. Continued.

SITE	DISC	Chapter	VTR Time	COMMENT	PRIORITY	BANK	UTM Easting	UTM Northing
30	1	2	00:05:25	Smaller operation, possible impacts (riparian, feedlot, grazing)	3	RB	609078	5507769
31	1	2	00:05:59	Smaller operation (Possible impacts: extensive grazing, river access, nil-riparian, etc)	2	RB	608224	5508511
32	1	2	00:06:57	Small operation top screen, river access, etc?	3	LB	606652	5509040
33	1	2	00:07:01	Larger operation (extensive grazing, denuded riparian, river access) Again at 0:7:40	3	RB	606545	5509099
34	1	2	00:07:59	Possible low head dam in river channel	3		606302	5509160
35	1	2	00:08:38	Possible dugout/pond settling and draining into LaSalle River	3	RB	606268	5509530
36	1	2	00:08:45	Possible larger operation just beyond camera site	3	RB	606083	5509529
37	1	2	00:08:50	Residential home (?) with denuded riparian	3	LB	605944	5509488
38	1	2	00:09:00	Large operation; manure piles, grazing, access, denuded riparian, more?	3	LB	605657	5509347
39	1	2	00:09:44	Possible extensive grazing	3	RB	604901	5509788
40	1	2	00:10:07	Feedlot adjacent to watercourse (Colony ?)	3	LB	604520	5510191
41	1	2	00:10:39	Manure piles ?, old hay bales ?, close to river	3	LB	603864	5511035
42	1	2	00:11:06	Small operation potential impacts; grazing, access, feedlot?	3	RB	603598	5511807
43	1	2	00:13:33	Operation with potential impacts (grazing, access, manure piles?, feedlot)?	3	RB	600665	5514111
44	1	3	00:01:34	Potential small operation at top of river	3	RB	598206	5514499
45	1	3	00:01:59	Hog operation in close proximity to river?	3	LB	597952	5514236
46	1	3	00:02:42	Small operation close to river (potential for impacts)	3	LB	597923	5513216
47	1	3	00:03:08	Operation with potential impacts (grazing, access, denuded riparian, etc)	3	RB	597305	5513617
48	1	3	00:05:43	Operation on bank (potential impacts: grazing, manure piles, denuded riparian, etc)	3	RB	594366	5516640
49	1	3	00:05:49	Operation: potential impacts feedlot, grazing, denuded riparian, access, etc.	2	RB	594313	5516826
50	1	3	00:05:57	Small operation within riparian zone (potential feedlot impact?)	3	RB	594405	5517077
51	1	3	00:08:36	Larger operation with settling pond (?), minimal riparian, and additional impacts	2	RB	592429	5521240
52	1	3	00:09:43	Feedlot/staging area adjacent to watercourse ?	3	RB	591059	5523067
53	1	3	00:11:34	Small operation (impacts: denuded riparian, grazing, ?)	3	LB	589838	5525465
54	2	2	00:00:28	Large operation at headwaters with potential for runoff to enter (feedlot area)	2		552797	5530212
55	2	2	00:02:33	Operation with potential impacts (feedlot, access, denuded riparian, grazing)	3	RB	556028	5530232
56	2	2	00:05:35	Small operation (impacts beyond denuded riparian?)	3	LB	559001	5527757
57	2	2	00:12:52	Large Operation: multiple potential impacts	1	RB	570938	5529311
58	2	2	00:13:48	Smaller operation (potential impacts: feedlot, grazing, etc)	2	LB	572767	5529524
59	2	2	00:21:36	Low head dam	3		588501	5526940

Appendix 7.1. Continued.

SITE	DISC	Chapter	VTR Time	COMMENT	PRIORITY	BANK	UTM Easting	UTM Northing
60	2	1	00:01:07	Low head dam	3		588615	5526506
61	2	1	00:01:17	Operation with potential impacts (denuded riparian, etc.?)	3	RB	588647	5526944
62	2	1	00:02:26	Small corral with potential for runoff via denuded riparian area	3	LB	588896	5529533
63	2	1	00:02:28	Homestead with potential for runoff/erosion via denuded riparian and barren field	3	LB	588900	5529610
64	2	1	00:03:24	Operation with potential impacts (denuded riparian, etc.?) (again at 0:4:19)	3	RB	588609	5531596
65	2	1	00:03:24	Operation with potential impacts (denuded riparian, etc.?) (again at 0:4:19)	3	LB	588609	5531596
66	2	1	00:03:27	Grazed area (?) with denuded riparian area (again at 0:4:24)	3	RB	588589	5531694
67	2	1	00:05:03	Homestead with denuded riparian area, possible grazing area	3	RB	587999	5532848
68	2	1	00:05:12	Small operation; denuded riparian, slumping bank, possible grazing	3	RB	588013	5533222
69	2	1	00:05:19	Larger operation: machine (?) ford, possible barrier, denuded riparian, slumping?	2	LB	588055	5533521
70	2	1	00:05:46	Homestead with potential multiple impacts (denuded riparian, erosion, grazing?)	2	LB	587844	5534586
71	2	1	00:05:46	Homestead with potential multiple impacts (denuded riparian, erosion, grazing?)	2	RB	587844	5534586
72	2	1	00:06:26	Larger operation: machine (?) ford, possible barrier, denuded riparian, slumping?	2		586901	5535653
73	2	1	00:07:14	Start of large operation: potential for multiple impacts (hog plant?, slumping, etc)	1	RB	585915	5536682
74	2	1	00:08:02	Small homestead: grazing?, denuded riparian, access?	3	LB	585195	5536581
75	2	1	00:08:04	Extensive grazing, larger feedlot area, denuded riparian, access MULTIPLE IMPACTS	1	RB	585132	5536477
76	2	1	00:08:46	Small homestead: grazing?, denuded riparian, access?	3	RB	584312	5536162
77	2	1	00:09:30	Small operation with potential impacts (bank failure, riparian, access.)?	3	RB	583332	5535778
78	2	1	00:10:04	Small operation with potential impacts (bank failure, riparian, access.)?	3	LB	582677	5535715
79	2	1	00:11:18	Large operation: Multiple impacts (access, grazing, feedlot, ford crossing, etc)	1	LB	581701	5535093
80	2	1	00:13:03	Large operation: Multiple impacts (access, grazing, ford, feedlots/paddocks, riparian,etc)	3	LB	579873	5535359
81	2	1	00:13:16	Small homestead: possible grazing/livestock area	3	RB	579584	5535479
82	2	1	00:13:40	Possible large grazing section (thinned riparian area)	3	RB	578967	5535644
83	2	1	00:13:55	Operation: paddocks, denuded riparian, ford with culvert (to access 0:13:40 site?)	2	LB	578768	5535480
84	2	1	00:14:31	Large operation: Multiples; paddocks, direct runoff, grazing, ford ?access, etc)	1	LB	578226	5535869
85	2	1	00:14:51	Road Crossing: Fortier Gospel Chapel (ground truth photos), duck weed	3		577811	5536235
86	2	1	00:15:05	Shallow water crossing ?	3		577470	5536530
87	2	1	00:15:14	Grazing on this point of river ?	3	LB	577309	5536730
88	2	1	00:16:22	Homestead: possible grazing, ford crossing ?, slumping banks, etc	3	LB	576195	5537173

Appendix 7.1. Continued.

SITE	DISC	Chapter	VTR Time	COMMENT	PRIORITY	BANK	UTM Easting	UTM Northing
89	2	1	00:16:35	Operation: Multiple issues (ford, denuded, grazing, access, feedlot	1	Both	575928	5537056
90	2	1	00:16:42	Extensive grazing (from operation at 0:16:35 ?)	2	Both	575762	5537004
91	2	1	00:18:18	Roadside drain and field access point (machinery)	3		574447	5537529
92	2	1	00:19:48	Field/roadside drain with possible erosion/bank failure and silt plume (?)	3	LB	573794	5536549
93	2	1	00:19:49	Homestead operation with denuded riparian	3	RB	573229	5536464
94	2	1	00:21:02	Machine/ford crossing (culverts?): does not appear to impound	3		571778	5536570
95	2	1	00:21:47	Earthen ford crossing grown over, but in use: culverts?: does not appear to impound	3		571681	5536234
96	2	1	00:22:20	Machine ford with culverts (?): impounded water (note low flow downstream)	3		571757	5535349
97	2	1	00:22:36	Machine ford with culverts (?): impounded water upstream (and from downstream ford)	3		571685	5534896
98	2	1	00:23:25	Small operation: denuded riparian, slumping, machine ford crossing impounding flow	2	LB	570946	5535033
99	2	1	00:24:10	Extensive duck weed mats and possible machinery ford crossing	3		570008	5534195
100	2	1	00:24:35	Operation: Multiple issues (ford, denuded, grazing, access, feedlot, no flow	1	LB	570486	5533691
101	2	1	00:25:42	Small operation with slightly denuded riparian	3	LB	569817	5532965
102	2	1	00:25:50	Smaller operation with grazing, denuded riparian, extensive duck weed in river	3	RB	569610	5532896
103	2	1	00:26:34	Earthen ford crossing with culverts (?), extensive duckweed upstream	3		568656	5532573
104	2	1	00:26:59	Private road crossing (culverts?) joining properties?: water impoundment possible	3		568538	5531925
105	2	1	00:28:29	Small operation: ford crossing impounding, denuded riparian, grazing, etc	2	Both	567302	5532986
106	2	1	00:30:09	Homestead with denuded riparian area, woody debris and duck weed in river	3		566189	5532083
107	2	1	00:30:34	Earthen ford crossing with culverts (?), extensive duckweed downstream	3		565574	5531611
108	2	1	00:30:45	Debris dam (grown over) with extensive duckweed upstream; minimal flow	3		565223	5531603
109	2	1	00:30:52	Debris dam (grown over) with extensive duckweed upstream; minimal/no flow ?	3		565065	5531766
110	2	1	00:32:23	Start of Colony: Numerous fords, totally denuded riparian, grazing?, feedlots?	1	Both	564585	5532901
111	2	1	00:35:28	Farmstead with potential grazing	3	RB	561589	5532792
112	3	1	00:00:17	Stone weir, bank slumping	3		587457	5518575
113	3	1	00:03:22	Low head dam near mouth and La Salle River	3		593876	5516961
114	3	2	00:00:36	Heavy bank erosion/slumping: field drain eroding	3	RB	613427	5497614
115	3	2	00:03:11	Small homestead: potential grazing, denuded riparian	3	LB	616589	5499293
116	3	2	00:05:03	Larger operation: no riparian, slumping banks, etc.	2	LB	617188	5497841
117	3	3	00:01:11	Operation (?)	3	LB	623785	5495733
118	3	3	00:04:11	Operation: Multiple impacts - grazing, paddocks, nutrient loading	1	LB	623381	5502552
119	3	1	00:03:14	Wooden weir under bridge, fish blockage (King Drain)	2		616410	5499137