DOG LAKE WATERSHED RIPARIAN AND AQUATIC ASSESSMENT

WIWCD

A Report Prepared by
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AAE

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March 26th, 2012

Mrs. Linda Miller
Manager
West Interlake Watershed Conservation District
Box 732
13 Main Street
Lundar, MB R0C 1Y0

Dear Mrs. Linda Miller:

RE: Dog Lake Watershed Riparian and Aquatic Assessment

As requested, AAE Tech Services Inc. has conducted an aquatic and riparian assessment on the Dog Lake Watershed to document the watershed health. Included within this report is a detailed description of the methods used and results obtained to better understand the current conditions and state of the Dog Lake Watershed. The assessment began on April 14th and was completed November 5th, 2011.

If you require any additional information or have any questions regarding the attached report please feel free to contact myself at 204-997-3483 or via email at mlowdon@aaetechservices.ca

Sincerely,

Mark Lowdon
Fisheries Biologist
AAE Tech Services Inc.

DOG LAKE WATERSHED
RIPARIAN AND AQUATIC ASSESSMENT

April – November 2011

PREPARED FOR

WEST INTERLAKE WATERSHED CONSERVATION DISTRICT (WIWCD)

Prepared by

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1.0 INTRODUCTION

The West Interlake Watershed Conservation District (WIWCD) has been actively involved in improving the health of the watersheds within the Interlake Region of Manitoba (Figure 1). In 2009 and 2010, the WIWCD completed watershed assessments on the Swan Creek and the Lake Francis Watersheds, respectively (Lowdon 2009 & 2010). Riparian, instream fish habitat, and water quality conditions were the primary parameters examined along with better understanding fish utilization of the tributaries within the watersheds. Utilizing the information collected, the WIWCD has started to tackle the high priority projects identified within the two surveys to help restore healthy riparian zones and improve the water quality conditions currently found with the Conservation District.

The WIWCD, with the assistance from the Manitoba Fisheries Enhancement Fund (FEF), initiated this assessment to gain a better understanding of those issues potentially affecting water quality, in-stream habitat, and the riparian health of the tributaries and drains found within the Dog Lake Watershed. The overall goal of the WIWCD is to design an integrated watershed management plan, in cooperation with all municipalities and area residents, to improve the function of each watershed within the conservation district (Figure 1 & 2). The WIWCD encourages sustainable development practices to assist in creating a healthy watershed, ultimately benefitting all user-groups.

The primary objective of this project was to provide a comprehensive overview of the riparian zones and aquatic habitat conditions found within the Dog Lake Watershed. The assessment was to identify areas within the watershed in need of habitat protection, rehabilitation and/or enhancement. Furthermore, the project will enhance measures in developing a watershed management plan to improve water quality and provide a foundation for understanding the state of the fishery and riparian conditions within the Dog Lake Watershed.

Specific objectives of the project include:

- Compile relevant historical data pertaining to water quality trends, in-stream flow requirements, hydrological data, and fish utilization of the Dog Lake Watershed;

- Describe riparian conditions and adjacent land use practices that may be negatively effecting water quality and valuable fish and wildlife habitat along the relevant drains within the Dog Lake Watershed;

- Describe the physical characteristics and hydrology of the watershed;

- Identify potential migration blockages or barriers to fish

- Gain a better understanding of fish species utilization of the watershed including, life stages, egg deposition sites, successful larval emergence, and upstream adult migration;

- Produce a list prioritizing sites potential rehabilitation efforts can be undertaken to help improve water quality and in-stream habitat conditions within the watershed;

- Hold information meetings with the WIWCD Board; and

- Prepare a technical report to the WIWCD Board summarizing information gathered during field surveys.

This project will provide baseline data that the WIWCD can utilize to move forward and improve the riparian and aquatic habitat conditions that currently exist within the Dog Lake Watershed. This report also provides supporting documentation for future funding applications to carry out the enhancement initiatives. Manitoba Water Stewardship, Fisheries Branch authorized the scientific collection permit # 09-11 for the collection of biological specimens for this assessment.

1.1 STUDY AREA

The Dog Lake Watershed (illustrated as the Dog Lake Sub-District in Figure 2) is located within the Interlake Region of Manitoba along the eastern shores of Lake Manitoba. The watershed is of significant importance to a number of user groups including; areas residents, recreational and commercial fishermen, and those involved in domestic and agricultural practices. Located within the rural municipalities of Coldwell, Eriksdale and Siglunes, the watershed is comprised of a network of drains, wetland habitats, and lakes of which Dog Lake and Lake Manitoba are the largest. Although, only four of the tributaries situated within the Dog Lake Sub-District flow directly into Dog Lake all tributaries identified here in will be indentified as part of the Dog Lake Watershed (Figure 2). This includes those tributaries flowing directly into Lake Manitoba (Dog Lake, Pine Lake, Chippewa Creek, and Ashern drains and Moosehorn Creek). Refer to Figure 3 for a schematic drawing illustrating the flow of water within the drains and tributaries of the Dog Lake Watershed.

Figure 1. Map of the Manitoba Conservation District boundaries. WIWCD is located on the east shore of Lake Manitoba.

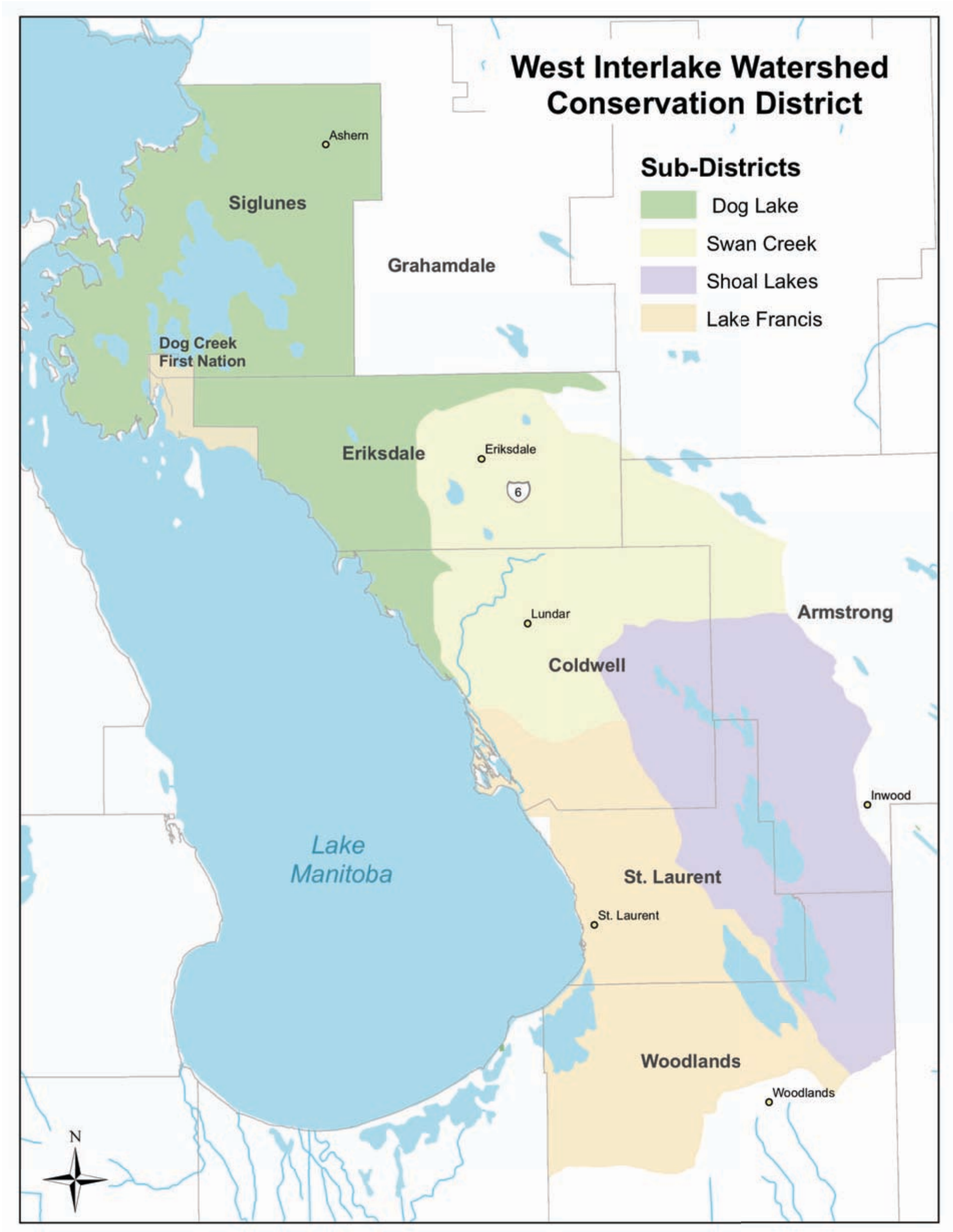


Figure 2. Sub-district watershed boundaries of the West Interlake Watershed Conservation District.

Similar to the previous watershed assessments, the drains located within the Dog Lake Watershed have been channelized to help increase drainage within the area to improve agricultural development. These changes, although important for the agricultural community, have likely had significant impacts on health of the watershed.

The drains or tributaries assessed within the Dog Lake Watershed include:

- Pine Lake Drain,
- Chippewa Creek Drain,
- Dog Lake Drain,
- Ashern Drain,
- Moosehorn Creek
- Little Dog Lake Drain,
- Camper Drain,
- Pioneer Drain.
- Marne Drain

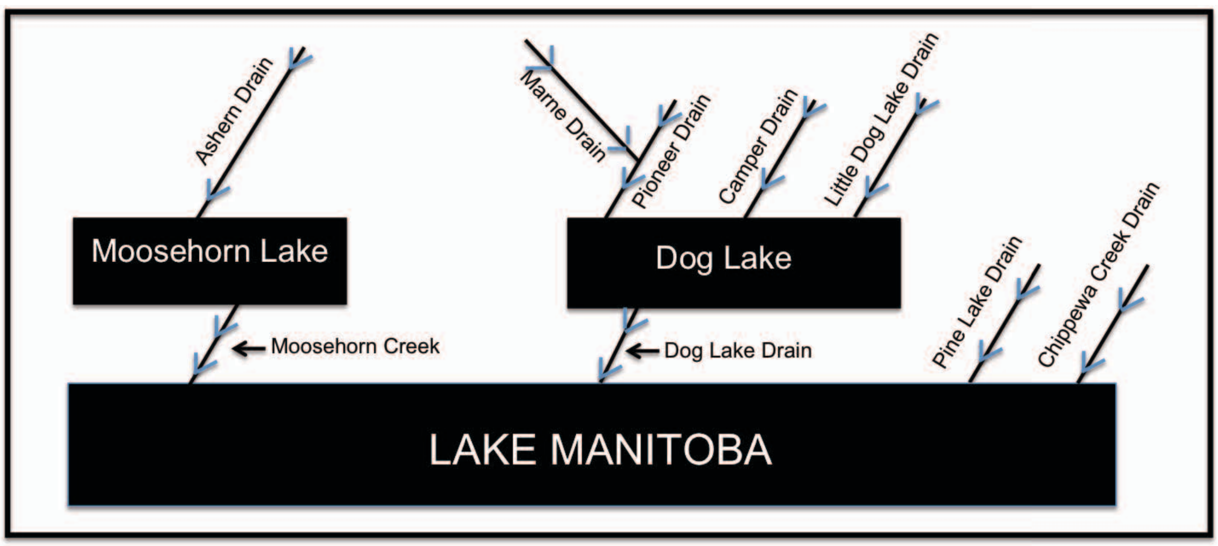


Figure 3. Flow chart illustrating water movement through out the Dog Lake Watershed.

The climate within the area is typical of the northern temperate zone, characterized by short, warm summers and cold winters. The mean annual temperature is 1.2^{o}C, the average growing season is 175 days, and growing degree-days number about 1500. The mean annual precipitation is approximately 510 mm, of which nearly one-quarter falls as snow. Precipitation varies greatly from year to year and is highest from spring through early summer.

Figure 4. Overview map of the Dog Lake Watershed illustrating the network of drains found within.

2.0 APPROACH AND METHODOLOGY

In order to document the riparian and aquatic habitat conditions within the Dog Lake Watershed, various sampling methodologies were utilized, including aerial surveys, ground truthing surveys, physical characteristics and hydrology assessments, water quality sampling, and fish utilization surveys. Refer to section 2.1 to 2.7 for detailed descriptions of the methodologies used to assess the individual sections of the riparian and aquatic survey.

2.1 RIPARIAN SURVEY

The riparian zone is defined as the transition zone between the terrestrial and aquatic environment. Found along lakes, rivers, streams, drains, and wetlands, a well-established riparian zone plays an important role for establishing a healthy ecosystem. Diverse vegetation within a riparian zone including plants, shrubs, trees, and/or grasses is essential for protecting the integrity of the aquatic environment. Healthy riparian zones provide:

- A natural filtration system preventing pollutants from entering the waterway (i.e., chemicals, pesticides, animal waste, high nutrient inputs, etc.),
- A natural means for protecting water quality within the aquatic environment,
- A means to control or alleviate erosion by stabilizing banks, and
- A means to reduce downstream flooding by slowing water movement along the boundaries of a waterway

Aerial and ground surveys were the primary methods used to document the state of the riparian zones along the tributaries of the Dog Lake Watershed. Specific characteristics examined during this assessment included documenting the width of the riparian zone, the type of vegetation within the riparian zone, and land use practices along the riparian corridors.

2.1.1 AERIAL SURVEYS

Aerial surveys were conducted along each tributary and the shoreline of Lake Manitoba within the Dog Lake Watershed to achieve three goals;

1) Provide digital still images of the riparian zone along each corridor to aid in riparian zone classification;
2) Identify and document potential rehabilitation project sites; and
3) Identify land use practices that may be negatively affecting water quality along the tributaries of the Dog Lake Watershed.

AAE Tech Services chartered a slow flying fixed-wing aircraft (Cessna 180) from the St Andrews Airport to conduct the aerial survey. Two flights were conducted during the spring, one on May 14th and one on June 12th, 2011. The fall flight was conducted on October 22nd of 2011. A digital SLR 30-D Canon camera, with image stabilization, was used to take still images during flights. A Garmin 60CSx GPS unit was used to log and track the flight paths by recording waypoints (latitude and longitude coordinates) at one-second intervals. Photographs were then post-processed using a software program (GPS Photolink - standard edition) designed to link still images to their appropriate GPS coordinates by matching the time stamp produced by each device. In addition, the software program created files compatible with MapSource and ArcView software mapping programs, to allow one to display the flight path and linked photographs. The aerial photographs can also be viewed using Google Earth software. Upon completion of the aerial surveys, identified potential rehabilitation sites were then subject to additional ground truthing surveys.

2.1.2 GROUND TRUTHING SURVEYS

Ground truthing surveys were conducted over the course of the study commencing on April 14th and ending November 4th of 2011. The primary objective of these surveys was to provide additional data and evaluate potential rehabilitation sites. Coordinates of specific sites of interest were recorded using a Garmin GPS unit. Digital photographs were taken using a Canon 30-D SLR camera.

2.1.3 LAND USE CLASSIFICATION

The aerial surveys were also used, along with ground truthing photographs, to identify land use practices along the tributaries within the Dog Lake Watershed. Similar techniques were used to document land use along the shoreline of Dog Lake and Lake Manitoba. Refer to Table 1 for a description of categories used to classify land use within the watershed.

2.1.4 RIPARIAN CLASSIFICATION

Once the aerial and ground truthing surveys were completed, all data was analyzed and the riparian zone corridors along each tributary were classified or grouped into one of three categories.

Class A Habitat - Little or no impact to riparian corridors. The riparian corridor within this category is considered adequate to protect the integrity of the aquatic environment. Typically buffer zones are greater than 10 m on each side of the waterway. Erosion control problems and sediment loading is not a concern.

Class B Habitat - Moderate impacts to riparian corridors. Riparian zones are typically less than 10 m and their function to the filter inputs (nutrients, sediment) into the waterway is degraded in comparison to a riparian zone with a Class "A" classification. Vegetation within the corridors may either be lacking as a result of minimal livestock grazing, is situated near a roadway, and/or agricultural practices encroach upon the waterway.

Class C Habitat - Severe impacts to riparian corridors. Riparian zones are less than 5 m on at least one side of the waterway and nutrient loading is likely. Vegetation within the corridors has extensive damaged as a result of either the presence of feedlots or livestock trampling near watering areas. Buffer zones are inadequate to protect the aquatic environment.

2.1.5 PROJECT SITE EVALUATION

Upon completion of the aerial and ground surveys a list of potential rehabilitation sites was generated. The primary focus was to provide the WIWCD with a list prioritizing sites that have the greatest negative impact on the watershed and are most important to put effort towards enhancing to improve the water quality and fish habitat within the Dog Lake Watershed. Types of sites included within the list included barriers to fish movement, confined cattle access areas negatively impacting the aquatic environment, and those sites with limited riparian zones inadequate to protect the waterways. General guidelines or recommendations on how to improve the habitat and water quality currently found within the Dog Lake Watershed are also provided.

Table 1. List of categories used for classification of land use adjacent to stream corridors in the Dog Lake Watershed.

Land Use Category	General Description of Category
Meadow Grass Vegetation	Grass land along waterways
Agricultural Cropland	Land used to grow crops
Prairie/Natural Grasses	Native grasses used for forage (Native Hay)
Native Pasture	Grass land that is being grazed
Grazed Shrub and Brush	Shrub and brush land that is being grazed
Shrub and Brush	Shrubs and brush habitat
Forest Stands	Treed land
In Channel Reservoir	Dug outs or watering holes along waterway
Marsh and Bogs	Wetlands
Urban Development	Cottage development, housing, campgrounds
Railway Crossing	Railway Infrastructure
Road Crossing	Developed road infrastructure
Roadway Crossing	Undeveloped road infrastructure

2.2 FISH HABITAT ASSESSMENT

Fish habitat is defined as those parts of the environment "on which fish depend directly or indirectly in order to carry out their life processes" (Fisheries and Oceans Canada 1986). This includes habitat used for migration, spawning, feeding and refuge. Diverse habitat makes for good fish habitat. Natural run, riffle, pool habitats found with natural waterways provide the essential characteristics for those fish utilizing the habitats to carry out their life processes. Cover in the form of water depth, woody debris, aquatic vegetation, boulders or undercut banks increase habitat diversity and thus created better fish habitat. Substrates dominated by sand, gravel, cobble and boulders typically are those selected by fish for spawning. All of these characteristics are typically found in pristine waterways undisturbed by man.

Extensive channelization of waterways likely reduced the amount of "good" fish habitat available to the fish community within these specific water bodies. Spring runoff is allowed to leave the land more quickly increasing the chance of stranding eggs, larval or adult fish. In addition, agricultural practices along waterways may also have negative impacts to the aquatic environment as pesticide, chemicals, and nutrients have the potential to enter the water column. Livestock grazing within the waterways likely degrade spawning habitat within waterways as coarse material is pushed beneath the silt and fine particles residing in the waterway. Barriers within waterways impede fish movement and ultimately reduce the available habitat for the fish communities. All of these factors can limit or degrade fish habitat within waterways and affect the state of the fishery and fish communities.

For the purpose of this study, a fish habitat assessment was conducted in conjunction with the riparian survey. Fish habitat was documented along the corridors of each tributary and the lake shore of Lake Manitoba and Dog Lake within the Dog Lake Watershed. Quantitative sampling was however, not conducted. Instead a general description of the habitat observed along each corridor of the tributaries was documented. Notes were also taken when valuable spawning habitat was observed.

2.3 BARRIERS TO FISH MIGRATION

Barriers to fish migration within this study included any structure potentially obstructing fish movement. Barriers that were identified and assessed included those anthropogenic in nature such as: perched culverts, undersized culverts (resulting in high water velocity) bridges, concrete structures, earthen dams, dikes, ford crossings, rock weirs, or commercial fishing nets. Natural barriers such as beaver dams, debris, log jams, or rapids were also assessed and documented. All barriers identified within this survey were photographed and location information recorded using with a Garmin GPS unit. Head differential and flow rates were also documented at each barrier.

The severity of a barrier was prioritized based on a number of key factors including, the location of the barrier, the type of barrier, and the length of time a specific barrier was situated within the watershed impeding fish movement. For example, if a barrier was located at the downstream end of a system, the barrier would likely be ranked as high priority as upstream habitat within the system would be unavailable to those fish migrating upstream to spawn from Lake Manitoba. Alternatively, if a barrier were either at the upper end of the tributary or transitional in nature (i.e. beaver dams), priority would likely be considered low. Each and every barrier has the potential to either segment habitat or reduce the amount of valuable habitat available to those fish communities utilizing the tributaries within the Dog Lake Watershed. Furthermore, the longer a barrier is situated within a tributary and blocking fish movement, the greater impact that barrier will likely have on the fish community. Valuable fish habitat is essential for maintaining and/or improving the fish stocks for those fish utilizing the Dog Lake Watershed.

It is however, important to state that a barrier identified during this study might not necessarily be considered a barrier in subsequent years. For instance, high velocities flowing through a culvert one year may impede fish movement. The same culvert assessed during lower flow conditions may in fact be passable and not considered a barrier.

2.3.1 CULVERT ASSESSMENT

To get a better understanding of flows, discharge, and potential barriers to fish movement, a detailed culvert assessment was conducted over the entire watershed. A total of 90 crossings were identified during the aerial surveys. During this survey 50% of the culverts within the watershed were assess by measuring water velocity, water depth, discharge and diameter of the culverts. A note was also made for those culverts that were perched or had water velocities of 1.0 m/sec or greater.

To determine the amount of water passing each culvert (m^3/s), both upstream and downstream, it was necessary to calculate the surface area of the water passing each culvert and the velocity of that water. To determine the surface area of the water, where the fluid level was less than half the radius of the culvert, the following definite integral was used:

$$2 \cdot \left(\frac{y}{2}\sqrt{r^2 - y^2} + \frac{r^2}{2}\sin^{-1}\frac{y}{r} \right)\Bigg|_0^{depth}$$

where *r* is the radius of the culvert and *y* is the measured water depth (to the nearest cm). The water velocity (m/s), at both the upstream and downstream ends of the culverts was measured using a Swoffer™ (Model 2100) current velocity meter. Measurements were taken at the top (0.8 · depth), middle (0.5 · depth), and bottom (0.2 · depth) of the water column. To calculate discharge (m^3/s), the surface area and the average water velocity were multiplied. This again was calculated for both the upstream and downstream ends of each culvert.

2.4 PHYSICAL CHARACTERISTICS AND TOPOGRAPHY

Prior to conducting fieldwork, each tributary was delineated into three sampling reaches, identified as the upper, middle, and lower reach. In some of the shorter tributaries only one or two reaches were assessed. To gain a better understanding of the physical characteristics of the waterways within the watershed; longitudinal profiles, cross-sectional profiles and sinuosity were assessed to measure slope, channel width, and curvature of the channel within the three sampling reaches of each tributary. Topographical 1:50,000 maps were also used to plot the longitudinal profile of the entire length of each tributary and delineate the watershed boundaries of the tributaries.

2.4.1 LONGITUDINAL PROFILES

Longitudinal profiles were conducted along the entire length of each tributary within the Dog Lake Watershed using topographic maps and Google Earth software. A Top Con laser level and survey rod was also used to measure slope of the water surface, channel bed, and floodplain with selected reaches delineated at the start of the project. Longitudinal profile methodologies were carried out using the methodologies outlined in Stream Channel Reference Sites: An Illustrated Guide to Field Technique (Harrelson et al. 1994). Longitudinal profiles are an important component for better understanding of the topography, hydrology, channel morphology and fish habitat within the sampled reaches.

2.4.2 CROSS-SECTIONAL PROFILES

Cross-sectional profiles were conducted within the sampling reaches delineated prior to the start of the project for each tributary examined within the Dog Lake Watershed. A tape measure was extended across the channel at each cross-section. At 1.0 m intervals, the water depth (m) and velocity (m/s) were recorded. A Swoffer™ (Model 2100) current velocity meter was used to measure the water velocity at 40% ($0.4 \cdot$ depth) of the water column. A Top Con laser level was used to assess elevation of the cross-sectional profiles. Flood plain, water level, and the thalweg (the deepest part of channel bed) were documented. A Garmin GPS unit was used to mark sampling locations.

2.4.3 HYDROLOGY

Water velocity was documented while assessing the flows and discharges during the culvert assessment.

2.5 WATER QUALITY

In order to understand the conditions fish face while utilizing the tributaries of the Dog Lake Watershed some basic water quality parameters were measured in situ (in the field) using a YSI multi meter (model 556) and a LaMotte 2020e/I turbidity meter. Parameters examined including, dissolved oxygen, pH, conductivity, turbidity, and water temperature. Samples were taken daily at random locations in conjunction with ground truthing and fish surveys. A Garmin GPS 276 unit was used to record locations of each sampling site. Samples were collected from April 14th to October 16th 2011. Refer to Appendix A for maps illustrating the sample locations.

Water samples were also collected from Pine Lake Drain, Chippewa Creek Drain, Little Dog Lake Drain, Pioneer Drain, Camper Drain and Ashern Drain. Samples collected were delivered to ALS Laboratory Group located in Winnipeg within 24 hours of their collection. Water quality parameters analyzed included; ammonia (NH_3), chlorophyll a, nitrate + nitrite-N, total phosphorous, total dissolved phosphorous, total dissolved solids, total kjeldahl nitrogen, and total suspended solids. Fecal coliform levels were also measured during these analyzes.

2.5.1 WATER TEMPERATURE

Water temperature loggers (Hobo® -Water Temp Pro) were placed within five of the nine tributaries assessed within the watershed on April 17th to record and monitor water temperature throughout the study. Temperature loggers were positioned in Chippewa Creek Drain, Camper Drain, Pine Lake Drain, Marne Drain and in Ashern Drain. The locations of these loggers are displayed in Appendix A. The loggers were set to record and monitor water temperature every hour for the duration of the project. Minimum and maximum temperatures were therefore recorded daily at approximately 8:00 am and 8:00 pm respectively. All loggers with the exception of two were successfully retrieved on October 22nd 2011. Water temperature (ºC) was also recorded daily during the fish surveys using a YSI multi-meter (model 580).

2.6 FISH UTILIZATION

2.6.1 SPRING

Fish inventories were conducted in the spring and summer of 2011 within the main tributaries of the Dog Lake Watershed. During the spring, the primary method for capturing fish was with hoop-nets. Visual fish surveys (both day and night), backpack electroshocking, and seining were also common methods used when the conditions were favourable. These methods were conducted regularly within each tributary to identify fish movements. Opportunistic interviews with commercial fishermen and area residents also contributed to the fish data collected within this report.

Sampling began on April 17th and concluded on May 18th. The hoop-nets deployed were 1.2 m in diameter and constructed of 1.85 cm^2 nylon mesh. Attached to the first hoop of each net were two, 4.5 m wings, used to guide fish into the traps. The hoop-nets were set and monitored at random locations through out the study area. Captured fish were placed in a holding tank, identified, sex and state of maturity assessed, and fork length (FL) measured. Digital photographs of representative specimens were also taken. All fish were released unharmed. Sampling was conducted to gain a better understanding of which tributaries were being utilized by fish during the spring movements and also to identify important spawning habitats within the sampled reaches. For example, Walleye observed spawning on a gravel bar within a specific location along a tributary would help the WIWCD design a management plan to protect, restore, or enhance areas within the same sample reach.

2.6.2 SUMMER

Summer fish utilization of the Dog Lake Watershed was assessed using a Smith-Root Model LR24 backpack electroshocker. Electrofishing was conducted within each sample reach delineated at the start of the project. Refer to the maps in Appendix A for specific sampling locations. Sampling was conducted between June 23rd and July 5sth 2011. Fish captured were enumerated, identified, had their fork length measured, and were released live. Digital photographs were taken of representative specimens. A voucher specimen of each species was also taken and preserved in 10% formalin to verify species identification.

2.6.3 EGG SAMPLING

Egg sampling was conducted from May 1st to May 17th within the various tributaries of the Dog Lake Watershed. Sampling was conducted over all substrate types (gravel, cobble, boulder, silt, sand, and vegetation), but with more emphasis on areas where available sand, gravel and cobble substrates were present. No attempt was made to try and quantify or standardize egg counts per surface area.

Kick sampling was conducted by wading and disturbing the substrate in an upstream direction while dragging a dip net, with a mesh size of 0.250 mm and a surface area of 0.1 m^2, behind to capture the downstream drift. Eggs collected were counted, preserved in 10% formalin, and identified to family [Percidae (walleye), Catostomidae (suckers), Esocidae (northern pike), or unidentified] using a dissecting scope with 40 X magnification.

2.6.4 LARVAL DRIFT NET SAMPLING

Larval drift nets were used to capture larval fish that successfully hatched within the Dog Lake Watershed during the spring of 2011. Each drift net was positioned on two rebar rods that were embedded into the stream bottom. The traps were positioned into the flow as shown in the photograph to the right. The surface area of each trap opening was 0.02 m^2 and the water velocity (m/sec) and the lengths the traps were set was recorded. The traps were set approximately 0.30 m below the water surface in the faster moving water when possible. Larval fish drifting downstream enter the funnel opening on the upstream end of the trap. Once inside, the larval fish are unable to escape. The mesh size of the nitex mesh lining is 0.250 mm. Larval fish collected were preserved in 10% formalin and then identified using a microscope with 40X magnification. The larval key entitled Identification of Larval Fishes of the Great Lakes Basin with Emphasis on the Lake Michigan Drainage (1983) by Nancy A. Auer was used to confirm identification. Larval fish sampling was conducted at various locations within all drains within the watershed. Sampling dates were chosen based on the stages of development of the eggs collected during the study.

2.7 BENTHIC INVERTEBRATE COLLECTION

Examining the benthic invertebrate communities within these water bodies is an important tool and good indicator for determining poor water quality within the waterways found within the Dog Lake Watershed. The absence of specific invertebrates, such as those in the orders Ephemeroptera, Odonata, and Trichoptera, can signify poor water quality. Invertebrates within these orders are typically sensitive to poor water quality conditions and do not tolerate or inhabit these types of environments. In contrast, invertebrates such as Oligochaeta, (also known as tuberficid worms) or Chironomidae larva (order Diptera) do tolerate poor water quality conditions and sometimes flourish with increased nutrient loading. By identifying the invertebrate communities within a system one is able to determine the condition of the water quality without having to pursue the analysis of costly water quality samples. Examining the invertebrate community provides an additional means for assessing the health of the ecosystem within the waterways. Furthermore, a diverse invertebrate community most often signifies diverse fish habitat and a well balance ecosystem.

Due to a limited budget quantitative invertebrate sampling was not conducted. However, invertebrates were collected as bi-catch to both the egg and larval drift net sampling surveys and were therefore assessed within this survey. Invertebrates collected were identified to order or family level. Sampling was conducted at various locations within each tributary within the Dog Lake Watershed.

3.0 RESULTS AND DISCUSSION

Results of this assessment identified several issues negatively affecting water quality and instream fish habitat within the Dog Lake Watershed. Similar to the two previous studies conducted on the Swan Creek and Lake Francis Watersheds, the same types of impacts were identified within this study and they include:

- Barriers to fish movement segmented habitat and restricted fish from reaching upstream spawning and nursery habitat;
- Extensive channelization of natural waterways reduced fish habitat diversity and altered natural flow regimes;
- Point source nutrient and sediment loading (i.e. confined cattle areas) reduced water quality conditions within the drains assessed;
- Unrestricted livestock access to the tributaries within the watershed degraded spawning habitat and reduced water quality conditions; and,
- Removal and degradation of riparian zones adjacent waterways appeared to limit the ability of the riparian zone to protect the integrity of the aquatic environment

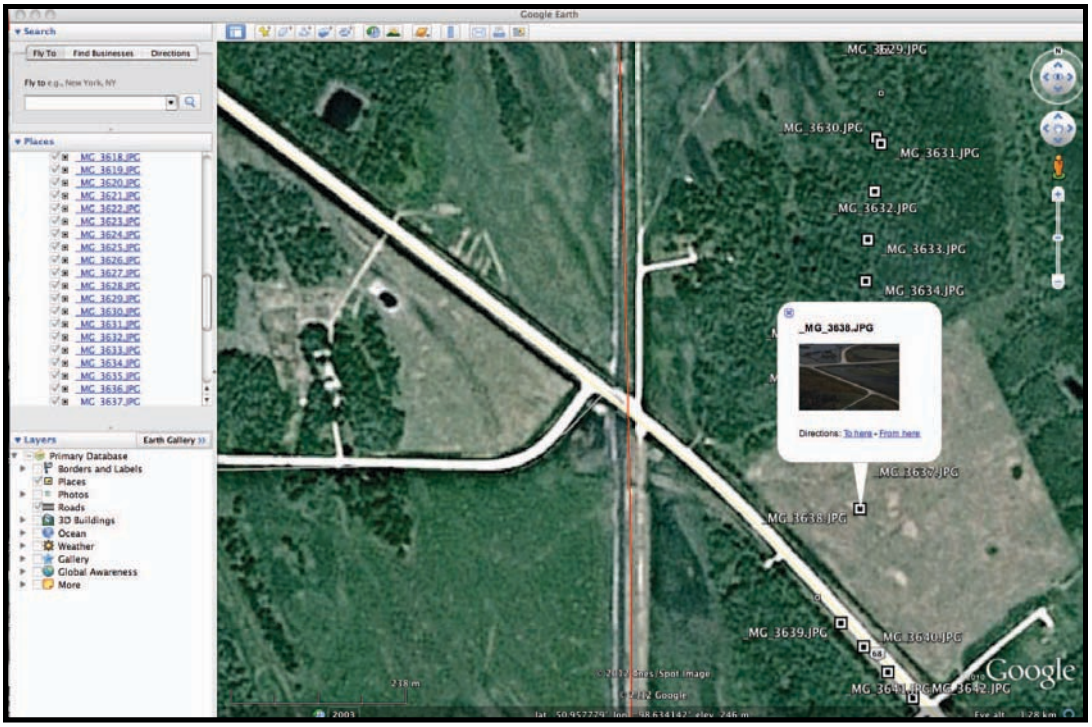
3.1 RIPARIAN & LAND USE CLASSIFICATION & AQUATIC ASSESSMENT

3.1.1 AERIAL SURVEYS

All aerial photographs taken during this project for both flights are included within the attached cd. The photographs are organized and separated into folders, identified by tributary name and flight date. Displayed on each photograph are the tributary name, latitude and longitude, and time and date each photo was taken. In addition, files compatible with MapSource, ArcView, and Google Earth are included within the attached cd. These files allow one to display the flight path and location of the individual photographs using the selected software program (Figure 5).

Representative aerial photographs of each tributary can also be found within Appendix B. These photographs were compiled to provide a general summary of the habitats found along each corridor of the nine main tributaries assessed within the Dog Lake Watershed. All photographs were captured at an altitude of approximately 500 feet.

A)



B)

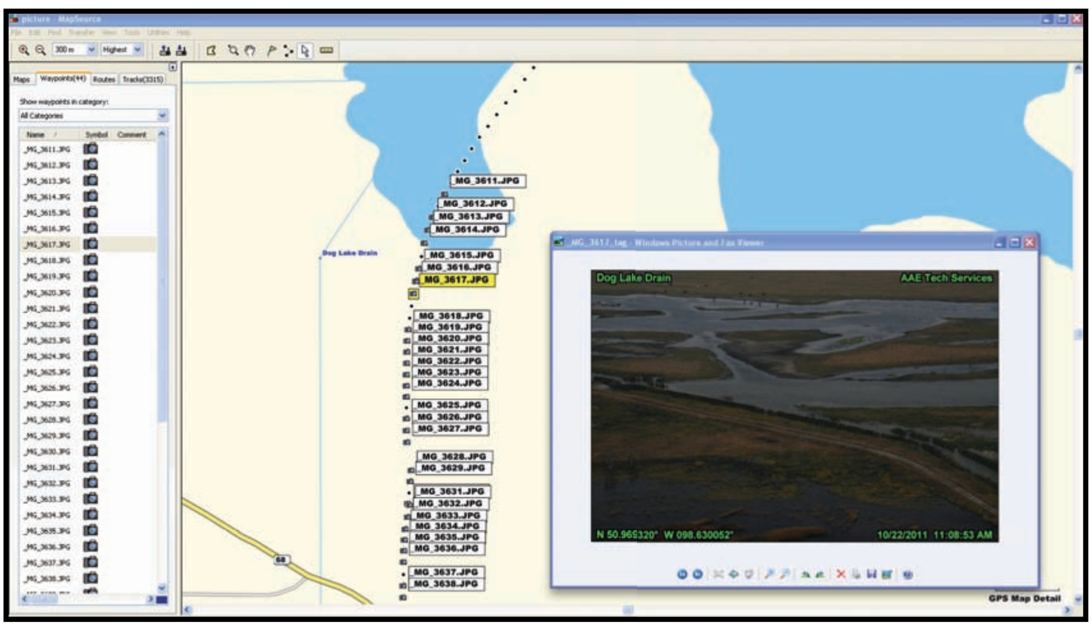


Figure 5. A computer screen image of the flight path and associated aerial photograph of a selected reach within the waterway on Dog Lake Drain using A) Google Earth and B) Map Source software.

3.1.2 LAND USE CLASSIFICATION

A total of 131 km of drains within nine main tributaries located within the Dog Lake Watershed were assessed during this study. Prairie/natural grasses and native pasture were the two most common land use practices identified within the watershed accounting for 41.1 and 24.5%, respectively (Table 2) (Refer to Table 1 for a description of the land use categories selected for this assessment). Both grazed and non-grazed shrub & brush were the next most abundant land use practices within the watershed accounting for 11.2 and 11.5%, respectively. Meadow grasses (4.6%), forest stands (2.2%), agricultural croplands (1.4%) and marsh & bogs (1.3%) accounted for a total of 9.5% of the land used practices identified within the watershed. Finally, in-channel reservoirs (0.7), urban development (0.7%), road crossings (0.6%), roadway crossings (0.5%), and railway crossings (0.1%) accounted for the remaining 2.6% of the land use identified within the watershed. Refer to Table 2 for a summary of the land use practices found along each tributary assessed within the Dog Lake Watershed. Also, refer to section 3.3 for a more in-depth description of the land use practices identified along each drain examined within the Watershed.

Table 2. Land use practices of the tributaries within the Dog Lake Watershed.

Tributary	Land Use Class	# of Reaches	Length (km)	Land Use % of Tributary
Pine Lake Drain	Meadow Grass Vegetation	1	0.38	3.0
	Prairie/Natural Grasses	4	4.55	35.8
	Agricultural Cropland	1	0.97	7.6
	Native Pasture	14	5.66	44.5
	Grazed Shrub and Brush	1	0.40	3.1
	Marsh and Bogs	2	0.38	5.0
	Roadway Crossings	8	0.08	0.6
	Road Crossing	2	0.02	0.2
	Total	**33**	**12.72**	**100**
Chippewa Creek Drain	Shrubs and Brush	1	1.08	7.9
	Prairie/Natural Grasses	9	6.99	51.2
	Forest Stands	3	1.26	9.2
	Native Pasture	6	2.9	21.3
	Grazed Shrub and Brush	1	0.89	6.5
	Marsh and Bogs	1	0.37	2.7
	Road Crossing	3	0.06	0.4
	Roadway Crossing	8	0.09	0.7
	Total	**32**	**13.64**	**100**
Little Dog Lake Drain	Prairie/Natural Grasses	13	13.07	43.0
	In Channel Reservoir	2	0.66	2.2
	Forest Stands	1	0.12	0.4
	Grazed Shrub and Brush	7	7.37	24.2
	Native Pasture	7	5.08	16.7
	Shrub and Brush	3	2.77	9.1
	Road Crossing	11	0.18	0.6
	Roadway Crossing	7	0.08	0.3
	Meadow Grass Vegetation	3	1.07	3.5
	Total	**54**	**30.4**	**100**
Camper Drain	Prairie/Natural Grasses	8	7.43	48.9
	Shrub and Brush	1	1.63	10.7
	Agricultural Cropland	1	0.91	6.0
	Grazed Shrub and Brush	2	1.84	12.1
	Marsh and Bogs	1	0.11	0.7
	Meadow Grass Vegetation	1	0.17	1.1
	Native Pasture	5	2.93	19.3
	Road Crossing	5	0.08	0.5
	Roadway Crossing	4	0.10	0.7
	Total	**28**	**15.20**	**100**
Pioneer Drain	Prairie/Natural Grasses	12	8.69	43.2
	Native Pasture	6	4.37	21.7
	Forest Stand	2	0.52	2.6
	Marsh and Bogs	1	0.31	1.5
	Grazed Shrub and Brush	2	1.91	9.5
	Shrub and Brush	4	3.83	19.1
	Road Crossing	6	0.13	0.6
	Roadway Crossing	6	0.07	0.3
	Meadow Grass Vegetation	1	0.27	1.3
	Total	**40**	**20.10**	**100**

Table 2. Continued….

Tributary	Land Use Class	# of Reaches	Length (km)	Land Use % of Tributary
Marne Drain	Native Pasture	8	6.56	49.1
	Prairie/Natural Grasses	8	6.84	51.2
	Grazed Shrub and Brush	3	0.81	6.1
	Shrub and Brush	4	3.31	24.8
	Forest Stand	1	0.14	1.0
	Road Crossing	6	0.10	0.7
	Roadway Crossing	4	0.05	0.4
	Total	**34**	**13.37**	**100**
Dog Lake Drain	Meadow Grass Vegetation	1	0.96	30.7
	Native Pasture	4	1.7	54.3
	Marsh & Bogs	2	0.42	13.4
	In Channel Reservoir	1	0.02	0.6
	Road Crossings	1	0.02	0.6
	Total	**9**	**2.94**	**100**
Ashern Drain	In Channel Reservoir	1	0.30	1.4
	Forest Stands	3	0.86	4.1
	Grazed Shrub and Brush	2	1.42	6.7
	Meadow Grass Vegetation	2	1.51	7.2
	Native Pasture	7	3.00	14.3
	Prairie/Natural Grasses	12	6.35	30.2
	Road Crossing	8	0.19	0.9
	Roadway Crossing	10	0.12	0.6
	Shrub and Brush	10	2.45	11.6
	Urban Development	1	0.87	4.1
	Total	**56**	**21.05**	**100**
Moosehorn Creek	Meadow Grass Vegetation	1	1.61	91.4
	Marsh & Bogs	1	0.13	7.4
	Road Crossing	1	0.02	1.2
	Total	**3**	**1.76**	**100**
Cumulative Total	Meadow Grass Vegetation	10	5.97	4.6
	Prairie/Natural Grasses	66	53.92	41.1
	Native Pasture	57	32.2	24.5
	Agricultural Cropland	2	1.88	1.4
	Grazed Shrub and Brush	18	14.60	11.2
	Shrub and Brush	23	15.1	11.5
	Forest Stand	10	2.90	2.2
	In Channel Reservoir	4	0.98	0.7
	Marsh & Bogs	8	1.72	1.3
	Urban Development	1	0.87	0.7
	Railway Crossings	1	0.01	0.1
	Road Crossing	43	0.80	0.6
	Roadway Crossing	47	0.59	0.5
	Total	**289**	**131.18**	**100**

3.1.3 RIPARIAN CLASSIFICATION

Refer to Table 3 for a summary of riparian zone classifications along the tributaries within the Dog Lake Watershed. Refer to Appendix A for habitat-featured maps illustrating the different classifications assigned to the riparian zones along the waterways within the Dog Lake Watershed.

A total of 131.18 km of riparian habitat was assessed during this survey. Riparian zones along the corridors of each tributary were more or less sufficient to protect the aquatic environment from pollutants or nutrients entering the waterways. Riparian zones were typically less than the recommended 10 m, but were more often found adjacent hay land (41.1%) or native pastures (24.5%) where chemicals, fertilizers and pesticides are rarely applied. Treed or brush and shrub reaches were identified along 24.9% of the waterways assessed of which 45% of this land supported livestock grazing. Forest stands and shrubs and brush along waterways can increase habitat complexity within a watershed and provide fish with additional cover for refuge and thermal protection.

Class A habitat accounted 24.9% of the total riparian zones classified within the watershed (Table 3). Class A habitat was typically found within the sloughs and marshes along the drains near Lake Manitoba where human impacts were minimal. Class A habitat was also identified along the waterways where riparian fencing was erected preventing cattle from degrading vegetation along the waterways. Class A habitat was identified on all drains within the watershed.

Forty-four percent of the riparian zones examined were categorized as Class B habitat. Class B habitat is characterized by having moderately impacted riparian zones as a result of either marginal livestock grazing or encroachment of agricultural practices upon the waterways. These riparian zones, are typically less than 10 m in width, but appeared adequate to protect the integrity of the aquatic environment. Although unrestricted livestock grazing was evident along most of the waterways within the watershed, grazing was considered light, and impacts appeared to be insignificant to affect the overall filtration function of the riparian zone. Waterways along the roads within the conservation district were also included as Class B habitat, as surface water runoff may likely enter the aquatic environment.

Class C habitat, consisted of severely impacted habitat as a result of extensive erosion and/or extensive cattle trampling around watering areas. Riparian zones within this category are typically less than 5 m in width and appear inadequate to protect the integrity of the aquatic environment. Class C riparian zone habitat accounted for 9.2% of all riparian zones along the waterways. Class C habitat was identified on all tributaries within the watershed but was more apparent along the waterways on Pine Lake Drain (31.6%), Chippewa Creek Drain (20.9%), Little Dog Lake Drain (11.1%), and Pioneer Drain (6.4%). Habitats located adjacent road crossings were also categorized as Class C habitat and were located on all drains. Refer to the Appendix A and the list compiled of potential rehabilitation project sites (Appendix H) for more details regarding the Class C habitats identified within the identified tributaries.

Table 3. Riparian zone classification of the tributaries located within the Dog Lake Watershed.

Tributary	Riparian Zone Classification	# of Reaches	Length (km)	% of Tributary
Pine Lake Drain	Class A	7	6.16	48.4
	Class B	6	2.54	20.0
	Class C	20	4.02	31.6
	Total	**33**	**12.72**	**100**
Chippewa Creek	Class A	9	6.14	45.0
	Class B	8	4.65	34.1
	Class C	15	2.85	20.9
	Total	**32**	**16.34**	**100**
Little Dog Lake Drain	Class A	18	16.53	54.4
	Class B	13	10.50	34.5
	Class C	23	3.37	11.1
	Total	**54**	**30.40**	**100**
Camper Drain	Class A	6	4.70	30.9
	Class B	13	10.32	67.9
	Class C	9	0.18	1.2
	Total	**28**	**15.20**	**100**
Pioneer Drain	Class A	17	12.43	61.8
	Class B	9	6.40	31.8
	Class C	14	1.27	6.4
	Total	**40**	**20.10**	**100**
Marne Drain	Class A	7	4.13	30.9
	Class B	10	9.09	68.0
	Class C	10	0.15	1.1
	Total	**27**	**13.37**	**100**
Dog Lake Drain	Class A	2	0.42	13.3
	Class B	5	2.66	85.4
	Class C	2	0.07	1.3
	Total	**9**	**3.15**	**100**
Ashern Drain	Class A	16	9.31	44.2
	Class B	23	11.44	54.3
	Class C	17	0.30	1.4
	Total	**56**	**21.05**	**100**
Moosehorn Creek	Class A	2	1.74	98.9
	Class B	0	0	0
	Class C	1	0.02	1.1
	Total	**3**	**1.76**	**100**
Cumulative Total	Class A	84	61.54	46.9
	Class B	87	57.60	43.9
	Class C	111	12.23	9.2
	Total	**282**	**131.18**	**100**

3.1.4 FISHERIES ASSESSMENT

All of the drains located within the Dog Lake watershed are straight and channelized to allow water to leave the land as quickly as possible in order to reduce flooding on agricultural land. As a result, fish habitat within the tributaries of the Dog Lake Watershed can be described as uniform with minimal diversity. Run, riffle and pool habitats resulting in diverse flow patterns were observed at only a handful of a reaches within the watershed. More often then not the flows were fairly uniform. When channels begin to meander along the waterways, channels are reshaped and fish habitat is once again lost. This practice was observed during the assessment on Marne Drain (photo to right). In addition, very little cover was observed within any of the tributaries. Nursery and rearing habitats connected to Lake Manitoba and Dog Lake were limited to a few small marshes and bogs within the watershed.

A positive attribute of most of the drains and waterways within the Dog Lake Watershed was the presence of long stretches of sand, gravel, and cobble substrates. This habitat is sought after for spawning by many of the more economically important fish species (i.e. Walleye). Habitats of this nature are typically correlated with elevation change. The greater the drop in elevation, the faster the flows, and the greater the habitat diversity will be for fish to utilize. Camper, Little Dog Lake, Pine Lake, Ashern and Marne drains had elevation drops of 23, 20, 18, 18, and 17 m respectively. This attribute along prevents silt and finer particles from settling out and covering valuable spawning habitat. One site in particular with great spawning habitat was observed on Little Dog Lake Drain where the old 54 hwy crossed the waterway (photo to left). At this site the slope within the drain was 0.27% and run/riffle/pool habitat can be observed. Sand, gravel, and cobble substrates lined the drain bottom providing excellent and diverse habitat for fish to utilize. The riparian zone at this site was also classified in the Class A category.

3.2 BARRIERS TO FISH MIGRATION

Unlike the Swan Creek and Lake Francis watersheds where control structures, gated culverts, perched culverts, culverts with high water velocities, beaver dams, and commercial fishing nets segmented the waterways by impeding fish movements, the barriers observed within this assessment on the Dog Lake Watershed were related solely to high water velocities at numerous culvert crossings. There were however, two exceptions; a commercial fishing net blocked the entire waterway on Ashern Drain during the initial spring fish spawning run, and a beaver dam was blocking fish movements near the upper reaches on Little Dog Lake Drain. Refer to Appendix G for results of the culvert assessment and a list of those crossings with high flows likely impeding fish movements during the spring of 2011.

Left: Commercial fishing net located on Ashern Drain during the spring of 2011.

Right. Beaver dam located at an upstream reach within Little Dog Lake Drain. Photo taken on October 22nd, 2011.

3.2.1 CULVERT ASSESSMENT

Of the 54 culverts at 26 crossing assessed 42.6% were considered barriers to fish movements within the Dog Lake Watershed. Culverts identified as barriers were located on all drains assessed within the watershed. Fish were observed either stacking up beneath the culverts or flows were greater than 1.0 m/s, the standard set by the Department of Fisheries and Oceans Canada. Refer to Appendix G for results of the culvert assessment and a list of those crossings with high flows documented during the spring of 2011.

Although many barriers were identified along the waterways of the Dog Lake watershed as a result of the flooding conditions and high water levels during the spring of 2011, the results observed were likely worst-case scenarios for the region. AAE Tech Services recommends conducting additional monitoring at the culverts identified as barriers under a range of flow conditions to verify results and prioritize a list of those culverts impeding fish movements under normal flow conditions.

Below are a few representative photographs illustrating the high velocities documented at culvert crossings on the drains within the Dog Lake Watershed. Accompanying each photograph is a description of the flows at the crossings along with site location information (tributary name, coordinates, upstream/downstream location, etc…). The locations of each barrier can also be viewed within the land use classification maps produced for each tributary (Appendix B).

Barrier 1. High water velocity at a culvert crossing located on Pioneer Drain.

Water velocity of 2.53 m/s was documented at this culvert crossing located on Pioneer Drain on April 22. The crossing is located at N51.10196 W98.28287.

Barrier 2. Road removed on Little Dog Lake Drain to help alleviate flooding within the conservation district.

Many roads along the drains within the watershed were washed out at culvert crossings due to the flooding conditions and high water volumes within the tributaries.

Barrier 3. High water velocity exiting a culvert located on Marne Drain.

Water velocity at the inlet of these culverts was 1.13 m/s. Flows of 2.38 m/s were documented at the outlet of the culvert. The crossing is located at N51.12615 W98.44383

Barrier 4. Flooded culverts on Little Dog Lake Drain approximately 4 km upstream of Dog Lake.

Water velocities at the inlet of these culverts were not assessed for safety reasons but the outlet had flows of 2.67 and 2.69 m/s on April 22nd. The crossing is located at N51.02335 W98.35000.

3.3 PHYSICAL CHARACTERISTICS

This section of the report summarizes the physical characteristics of the tributaries within the watershed including information regarding the drainage area, slope, length, and average bankfull width and depth. All data is displayed in Appendix D and E. In addition, representative photographs for each tributary are displayed within Appendix C. Descriptions and a summary of the fish habitat within each drain are also included within this section of the report.

Pine Lake Drain

Pine Lake Drain is the 7th longest drain (12.27 km) in the Dog Lake Watershed. The drain flows in a southerly direction from its headwaters located at Pine Lake to Lake Manitoba. The total drainage area of the drain, including Pine Lake, is approximately 60 km^2 (Appendix A1). Native pastured land (44.5%) and prairie and native grassland (35.8%) are the two most abundant land use practices identified along the waterway (Table 2). Agricultural cropland (7.6%), marsh and bogs (5.0%), grazed shrub and brush (3.1%), and meadow grass vegetation (3.0%) were also common land use practices observed adjacent to the drain. Eight undeveloped roadway crossings along with two developed road crossings were documented during the assessment. Average bankfull width of the creek is 11.65 m and average bankfull depth is 0.9 m. The slope of the drain is 0.07%, dropping an average of 0.7 m per 1.0 km of channel.

Fish habitat within Pine Lake Drain could be described as marginal. The lower sections consisted of silt and clay as the dominant substrate types lining the bottom of the drain. Downstream of the culvert crossings gravel and cobble substrates were observed. This habitat may be selected by Walleye for spawning. The riparian zones were well established within the lower reaches of the drain. Emergent vegetation, commonly found along the entire length of the drain, likely provides additional spawning habitat for Northern Pike and Yellow Perch.

Chippewa Creek Drain

Chippewa Creek Drain is a third order 16.34 km long drain flowing in a southerly direction from Long Lake Marsh to Lake Manitoba. The drainage area of 42.0 km^2 is one of the smallest within the watershed. The drain flows predominately through prairie and native grasses (51.2%) through out its entire course. There are seven areas along the drain utilized for livestock grazing and watering. These sections accounted for 27.8% of the total land use identified within the waterway. Riparian damage (Class C Habitat) was identified in these reaches. The overall slope of the Chippewa Creek Drain of 0.07% is similar to that observed on Pine Lake Drain which flows more or less parallel. The other drains within the watershed have steeper gradients. The average bankfull width and bankfull depth were 6.3 and 0.95 m respectively.

No barriers were identified on Chippewa Creek Drain (Appendix A-2). A commercial fishing net was set up on the drain but it was not blocking the entire waterway and preventing fish from reaching upstream spawning grounds.

Fish habitat within the drain is considered marginal. Silt substrates, observed along the entire course of the drain, do not appear to provide fish with the ideal spawning habitat conditions they require. Nursery habitat was however abundant within the drains headwaters at Long Lake Marsh. Walleye, Northern Pike, and White Suckers were captured in the drain during early spring.

<u>Dog Lake Drain</u>

Dog Lake Drain is the second shortest drain within the watershed with a total length of 2.94 km. The drain is the major corridor connecting Dog Lake to Lake Manitoba. Land use along the drain primarily consists of native pasture (54.3%), meadow grass vegetation (30.7%), and marsh & bog habitat (13.4%). One developed road crossing and one in stream reservoir were additional land uses observed along the waterway. Average bankfull width and depth were 11.0 and 2.5 m, respectively. The slope of the drain is essentially zero.

There were no barriers identified on Dog Lake Drain, although a control structure situated in the middle of the drain was built in the late 1990's to regulate water levels. This structure has however not been in operation for quite some time and it currently does not hinder fish movement (Appendix A-7).

Spawning habitat within the drain appears to be limited to submerged vegetation along its banks. The drain bottom is covered by silt and fine particles and will likely not be selected as spawning grounds for walleye. However, this relatively flat drain serves as an important corridor for fish moving between Lake Manitoba and Dog Lake. Fish may move into Dog Lake to feed, spawn, or utilize the lake as nursery habitat. More importantly, the drain allows those fish to leave the lake to overwinter within the deeper waters of Lake Manitoba where oxygen levels are likely higher.

Moosehorn Creek

Moosehorn Creek is the shortest tributary (1.76 km) within the Dog Lake Watershed. Similar to the Dog Lake Drain connecting Dog Lake to Lake Manitoba, Moosehorn Creek connects Moosehorn Lake to Lake Manitoba. The drain allows fish to reach upstream spawning and nursery habitats in Moosehorn Lake and in Ashern Drain. Due to the flooding conditions within Lake Manitoba, average bankfull depth and width on Moosehorn Creek was not assessed during this survey. Slope of the drain is 0.08%. This drain is a third order tributary.

No permanent barriers were identified on Moosehorn Creek (Appendix A-9).

Ashern Drain

Ashern Drain originates upstream of the town of Ashern, MB, and terminates at Moosehorn Lake. The drain is 21.05 km long with a drainage area of approximately 122 km^2. The slope of the drain is 0.15%, dropping an elevation of 1.5 m for every 1 km of the drain. Average bankfull width and depth are 4.75 and 0.60 m respectively.

Ashern Drain flows predominantly through prairie and natural grasses (30.3%), native pasture land (14.3%) and land dominated by shrubs and brush (11.6%). Meadow grass and grazed shrub and brush accounted for 7.2 and 6.7% of the land use along the drain, respectively. Forest stands and urban development each accounted for 4.1% of the land use observed along the drain. In channel reservoirs, and developed and non-developed road crossing represent the remaining land use practices identified along Ashern Drain.

Fish habitat, in terms of spawning habitat, was plentiful along the entire drain. Sand, gravel and sections of cobble where found frequently. Furthermore, fish eggs were found along the entire course of the drain as a result of the favorable conditions and available habitat. The elevation change and relatively constant flows keep silt substrates from settling and covering up the great habitat conditions currently found within the drain. Refer to Appendix C-8 for photographs of spawning habitat that was observed within Ashern Drain.

Little Dog Lake Drain

Little Dog Lake Drain is unique in that there are two equal branches of the drain connecting near their confluence within Dog Lake (Appendix A-3). The branches of the drain were 13.71 and 18.2 km in length. Both branches had gradients among the steepest within the watershed with slopes of 0.15 and 0.12% respectively. Overall, the drain flows predominantly through prairie/natural grasses (43.0%), grazed shrub and brush (24.2%) and native pasture (16.7%). Non-grazed shrub and brush accounted for 9.1% of the total land use practices adjacent to the drain. Two in channel reservoirs were located along the drain accounting for 2.2% of the total land use. Forest stands (0.4%) and meadow grasses (3.5%) combined accounted for 3.9% of the total land use identified within the drain. There were three developed road crossings and eight non-developed road crossings along the drain. Average bankfull width and depth of the drain were 8.8 and 0.9 m, respectively.

A number of velocity barriers were identified within this drain. Refer to Appendix G for a description of flows and location information for the culvert crossings assessed.

Fish habitat, in terms of spawning habitat, was plentiful within the middle sections of the drain. Sand, gravel and cobble, along with run/riffle/pool sequences created great habitat conditions for fish. Similar to Ashern Drain, the elevation change and relatively constant flows keep silt substrates from settling and covering up the great habitat conditions currently found within the drain. Within the lower reaches of the drains riparian degradation was observed and fish habitat was marginal with limited diversity. Refer to Appendix C-3 for photographs of spawning habitat that was observed within Little Dog Lake Drain.

Camper Drain

Camper Darin is a unique drain within the watershed in that it has the greatest slope but the least sinuosity. The drain is essentially straight as an arrow flowing from Camper, MB to Lake Manitoba. The drain is 15.20 km in length with a drainage area of 34 km^2. Because of the small drainage area and the steeper slope of the drain, during dry conditions the waterway likely becomes segmented. Average bankfull width and depth were 10.0 and 0.8 m, respectively. The slope of 0.19% was above average compared to other drains within the watershed.

As a result of the steeper gradient and flooding conditions within the conservation district during 2011, many barriers were identified on Camper Drain. Velocities as high as 2.69 m/s were observed exiting culverts located on the drain. Once flows resided after the initial spring runoff velocity barriers were still identified within the waterway (Appendix A-4).

Fish habitat within this drain was similar to that describe above for Ashern Drain, although the habitat was not as prevalent. Sand gravel, and cobble substrates were found downstream of most culvert crossings and along significant stretches within the waterway. Refer to Appendix C-4 for photographs of the fish habitat observed within Camper Drain.

Pioneer Drain

Pioneer Drain is a third order tributary, 20.1 km long, within a drainage area of 105 km^2. Average bankfull width and depth were 6.3 and 0.96 m, respectively. The slope of 0.12% was average compared to other drains within the watershed. The drain flows predominately through prairie and natural grasses (43.2%), native pastured land (21.7%) and shrub and brush land (19.1%). Grazed shrub and brush (9.5%) and forest stands (2.6%) were also commonly found along side the drain. Meadow grass and marsh and bogs along with road crossings both develop or undeveloped contributed to the remaining 3.7% of the total land use along Pioneer Drain.

One barrier was identified on Pioneer Drain (Appendix A-2). A culvert near the headwaters at hwy No. 6 had velocities greater than 2.0 m/s. Fish were observed piling up downstream of this barrier.

Fish habitat within the drain was more diverse in comparison to the other drains within the watershed. There were sections were shrubs and trees lined the riparian zones providing cover and shade for the fish utilizing this drain. There were also deeper pockets of water where Northern Pike were captured during summer fishing surveys. Gravel, and cobble substrates were commonly found along the drain at various locations. Because Pioneer Drain has a similar slope to Camper Drain and Little Dog Lake Drain, flows were sufficient to prevent silt from covering up the valuable course substrates. The flows within the drain would have also helped to attract fish to the drain. Nursery habitat was also located within downstream reaches of this drain as the waterway widened and deepened creating a more diverse habitat for the fish community. Northern Pike and White Suckers were captured in the drain during early spring.

Marne Drain

Marne Drain is 13.37 km long. It has a drainage area of 26 km^2 and likely only flows after rainfall events or during spring runoff. During the summer fishing surveys sampling was conducted within the lower reaches of the drain only because the upper reaches were dry. The slope of the drain of 0.17% is the second steepest within the watershed. Marne drain empties into Pioneer Drain. Average bankfull width and depth are 3.0 and 0.71 m respectively.

One barrier at one culvert crossing posed a barrier to fish movement on Marne Drain during the spring of 2011. Water velocities of 2.38 m/s were document exiting the culvert crossing

3.4 WATER QUALITY

Limited historical data of water quality trends was available for the Dog Lake Watershed. Manitoba Water Stewardship does not have a water quality station within the Dog Lake Watershed.

Good water quality is the foundation for having a healthy aquatic environment and balanced ecosystem. Fish, wildlife, area residents, agricultural producers, commercial and recreational fishermen and those using the waterways for recreational activities depend on good clean healthy water. Because most of the tributaries run along agricultural land, used for either hay or pastured lands, agricultural practices are the primary focus within this report.

Results of this study indicated that water quality within the tributaries within the region was quite good. Based on the classification system developed by Dodds et al. (1998), using Total Phosphorus (TP) as the indicator, all creeks within Dog Lake Watershed would be classified as Oligotropich to Mesotrophic as TP was well below 0.075mg/L (boundary between Mesotrophic/Eutrophic). The pH within all tributaries ranged from 7.46 to 8.61, with the lowest identified on Little Dog Lake Drain and the highest documented on Camper Drain (Table 4). Dissolved oxygen and water temperatures were well within the standards and normal ranges for Manitoba surface waters during the open water season.

3.4.1 WATER TEMPERATURE

Water temperature data for all the creeks assessed during the 2011 study were similar as was expected. Data for Chippewa Creek Drain, Marne Drain and Pine Lake Drain is shown below in Appendix F. To summarize, water temperature at the start of the study on April 17th was approximately 2°C. Water temperatures steadily rose reaching 14°C on April 28th before the area was inundated by a large winter storm halting fish migrations. After dipping down to 0°C water temperatures peaked again on May 4th reaching temperatures of 15°C. Cool temperatures followed resulting in yet another drop in water temperature. On May 27th water temperature on Chippewa Creek Drain reached 20.7°C at which time the spring spawning run was likely complete.

Average water temperatures for Chippewa Creek Drain were as follows: April (17th-30th) = 7.0°C; May = 12.5°C; June = 19.1°C; July = 22.7°C; August = 20.8°C; September = 14.8°C, and October = 9.7°C. The maximum water temperature documented within the drain was 29.19ºC recorded on July 19th 2011.

Average water temperatures within Pine Lake Drain were as follows: April (17th-30th) = 6.0°C; May = 10.65°C; June = 18.1°C; July = 20.3°C; August = 19.6°C; and September = 14.3°C, and October = 9.9°C. The maximum water temperature of 23.3ºC was recorded July 1st 2011.

Average water temperatures within Marne Drain were as follows: April (17th-30th) = 8.6°C; May = 12.8°C; June = 19.4°C; July = 23.0°C. No data is available for August and September as we believe the drain went dry around July 15th as water temperature fluctuations were not comparable to the other drains within the watershed. The maximum water temperature Marne Drain was 28.8ºC recorded on July 4h of 2011.

Table 4. Water quality data collected in-situ during the watershed assessment.

Tributary	Date	Conductivity (µs/cm)	Temperature (°C)	Dissolved Oxygen (mg/l)	pH	Turbidity (NTU)
Chippewa Creek Drain	28-Apr-11	212	14.22	12.5	7.8	2.95
Chippewa Creek Drain	05-May-11	257	13.31	13.34	8.37	1.73
Chippewa Creek Drain	07-May-11	255	16.41	11.88	8.29	1.87
Chippewa Creek Drain	23-Jun-11	241	24.55	9.83	8.2	2.73
Pine Lake Drain	05-May-11	358	14.33	11.67	8.39	11.7
Pine Lake Drain	06-May-11	359	14.88	11.55	8.38	11.11
Pine Lake Drain	10-May-11	388	16.22	11.11	8.38	10.41
Pine Lake Drain	23-Jun-11	491	22.8	10.92	8.28	3.22
Little Dog Lake Drain	26-Apr-11	433	11.55	13.88	7.99	2.25
Little Dog Lake Drain	28-Apr-11	433	14.12	14.7	8	1.35
Little Dog Lake Drain	05-May-11	487	16.55	12.5	7.46	3.15
Little Dog Lake Drain	05-May-11	417	16.18	10.08	8.61	3.49
Little Dog Lake Drain	24-Jun-11	634	22.84	8.6	8.27	3.01
Camper Drain	26-Apr-11	315	12.85	13.55	8.21	3.99
Camper Drain	28-Apr-11	316	12.99	13.44	8.13	3.55
Camper Drain	05-May-11	315	15.86	13.63	8.19	3.82
Camper Drain	11-May-11	311	17.2	13.01	8.13	1.17
Camper Drain	23-Jun-11	309	20.92	13.3	8.61	0.55
Pioneer Drain	28-Apr-11	386	13.74	13.05	7.73	1.27
Pioneer Drain	05-May-11	388	14.6	13.5	7.8	1.33
Pioneer Drain	07-May-11	349	12.19	12.84	7.91	1.49
Pioneer Drain	24-Jun-11	422	23.8	10.25	7.91	1.01
Marne Drain	26-Apr-11	411	11.65	14.22	7.88	2.88
Marne Drain	28-Apr-11	414	13.87	16.94	7.99	2.17
Marne Drain	10-May-11	422	16.89	13.11	8.13	1.98
Marne Drain	24-Jun-11	576	23.57	13.36	8.22	0.98
Ashern Drain	06-May-11	316	15.49	14.46	8.45	11.3
Ashern Drain	07-May-12	314	16.5	13.8	8.25	2.44
Ashern Drain	11-May-11	322	17	12.44	8.29	1.22
Ashern Drain	24-Jun-11	511	23.59	11.65	7.9	0.45
Dog Lake Drain	08-May-11	255	12.3	11.78	7.88	1.22
Dog Lake Drain	12-May-11	244	15.7	10.88	7.85	2.25

Table 5. Results of water samples collected within the tributaries of the Dog Lake Watershed. Samples were analyzed at ALS Laboratory Group in Winnipeg. Samples were collected on May 10th, 2011.

Water Quality Parameter	Units	Chippewa Creek Drain	Pine Lake Drain	Little Dog Lake Drain	Camper Drain	Ashern Drain	Pioneer Drain
Ammonia (NH3) - Soluble	mg/L	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chlorophyll a	µg/L	5.01	2.01	0.25	0.38	0.44	0.43
Fecal Coliform	CFU/100	23	55	6	2	6	14
Phosphorus, Total	mg/L	0.0398	0.0405	0.0199	0.0154	0.0255	0.0287
Total Dissolved Phosphorus	mg/L	0.0342	0.0308	0.0148	0.0110	0.0179	0.0195
Total Dissolved Solids	mg/L	655	732	223	199	205	228
Total Suspended Solids	mg/L	25	22	<5.0	<5.0	<5.0	<5.0
Nitrate+Nitrite-N	mg/L	<0.071	<0.071	<0.071	<0.071	<0.071	<0.071
Total Kjeldahl Nitrogen (TKN)	mg/L	1.27	1.21	1.07	0.98	1.03	1.07
Total Nitrogen	mg/L	1.27	1.21	1.07	0.98	1.03	1.07

3.5 FISH SPECIES UTILIZATION

A total of 5,489 adult and juvenile fish were captured during the fish surveys conducted on the Dog Lake Watershed during the spring and summer of 2011. During spring surveys, four fish species were identified within the drains including White Sucker, Brook Stickleback, Northern Pike, and Walleye. White Suckers were most abundant (n = 2,409) contributing to 75.6% of the total catch. Brook Stickleback was the next most abundant fish identified within the watershed accounting for 20.9% of the total catch. One hundred Northern Pike, accounting for 3.1% of the total catch, were captured within the watershed during spring surveys. Walleye were captured in Pine Lake Drain and Chippewa Creek Drain only and contributed 0.3% to the total catch. White Sucker and Northern Pike were found within each tributary within the watershed. Refer to Table 6 for a summary of the fish captured within the various drains assessed during the spring of 2011.

Summer fish surveys were conducted between June 23rd and June 27th of 2011. A total of 2,304 fish, representing ten species were captured. Brook Stickleback was the most abundant fish captured during the summer surveys accounting for 44.4% of the total catch. Central Mudminnow was the next most abundant species captured accounting for 32.6% of the total catch. Northern Pike, Common Carp, and Fathead Minnow accounted for 11.8, 8.7, and 6.7% of the total catch respectively. Northern Redbelly Dace (n = 103) accounted for 4.5% of the total catch. Yellow Perch (0.4%), Finescale Dace (0.5%), Iowa Darter (0.75%) and White Sucker (0.04%) were the remaining fish species captured during summer surveys. Refer to Table 7 for a summary of the fish captured within the various drains assessed during the summer of 2011.

Table 6. Fork length distribution of fish captured during spring fish surveys on the Dog Lake Watershed, 2011. Symbols: WHSK – White Sucker; NRPK – Northern Pike; WALL – Walleye; BKSB – Brook Stickleback.

Drain	Species	No.	Mean Fork Length (mm)	Range
Pine Lake Drain	WHSK	135	453.8	410-510
	NRPK	22	453.2	404-642
	WALL	7	591	482-635
Chippewa Creek	WHSK	225	423	382-502
	NRPK	13	481	402-673
	WALL	4	571	541-601
Little Dog Lake	WHSK	382	414.6	332-501
	NRPK	3	-	-
	BKSB	350	-	-
Camper Drain	WHSK	357	378	344-467
	NRPK	15	401	382-444
	BKSB	200	-	-
Pioneer Drain	WHSK	346	405.3	341-498
	NRPK	18	399	362-413
Marne Drain	WHSK	464	393.5	352-482
	NRPK	5	410.2	341-463
	BKSB	115	-	-
Ashern Drain	WHSK	485	412.7	320-483
	NRPK	24	401.2	305-472
Dog Lake Drain	WHSK	15	450	410-511
	WALL	12	-	-

Table 7. Fork length distribution of fish captured during the spring fish surveys on the Dog Lake Watershed, 2011. Symbols: WHSK – White Sucker; NRPK – Northern Pike; WALL – Walleye; BKSB – Brook Stickleback; CARP – Common Carp; YLPR – Yellow Perch; FHMW – Fathead Minnow; CMMW – Central Mudminnow; NRDC – Northern Redbelly Dace; IWDT – Iowa Darter; FSDC – Finescale Dace

Drain	Species	No.	Mean Fork Length (mm)	Range
Pine Lake Drain	CARP	15	644 (1)	644
	NRPK	4	220.5	80-472
	BKSB	335	-	-
	YLPR	1	60 (1)	60
	FHMW	9	-	-
Chippewa Creek	FHMW	33	-	-
	CMMW	75	-	-
	YLPR	1	-	-
	BKSB	43	-	-
	CARP	10	-	-
Little Dog Lake	FHMW	66	-	-
	YLPR	4	70 (1)	70
	BKSB	69	-	-
	CMMW	50	-	-
	NRDC	9	-	-
	IWDT	13	-	-
	CARP	100	-	-
Camper Drain	BKSB	152	-	-
	NRDC	94	-	-
	FHWM	35	-	-
	CMMW	59	-	-
	FSDC	11	-	-
	NRPK	1	80 (1)	80
	IWDT	2	-	-
	CARP	20	-	-
Pioneer Drain	NRPK	26	99.8	62-300
	CMMW	347	-	-
	BKSB	148	-	-
	YLPR	4	85 (1)	85
	CARP	5	-	-
Marne Drain	CMMW	40	-	-
	BKSB	57	-	-
	WHSK	1	95 (1)	95
	FHMW	1	-	-
Ashern Drain	BKSB	218	-	-
	CMMW	181	-	-
	FHMW	11	-	-
	NRPK	4	110.5	86-150
Dog Lake Drain	CARP	50	-	-

Table 8. Fish species potential utilizing the Dog Lake Watershed. Information collected from Stewart and Watkinson (2004).

Common Name	Family	Genus	Species	Occurrence	COSEWIC Status	Known Occurrences
Goldeye	Hiodontidae	*Hiodon*	*alosoides*	Native	not listed	Lake Manitoba
Mooneye	Hiodontidae	*Hiodon*	*tergisus*	Native	not listed	Delta Marsh - Lake Manitoba
Common Carp	Cyprinidae	*Cyprinus*	*carpio*	Introduced	not listed	**Dog Lake Watershed**
Pearl Dace	Cyprinidae	*Margariscus*	*margarita*	Native	not listed	Unknown
Golden Shiner	Cyprinidae	*Notemigonus*	*crysoleucas*	Native	not listed	Lake Manitoba (The Narrows)
Emerald Shiner	Cyprinidae	*Notropis*	*antherinoides*	Native	not listed	Lake Manitoba
Spottail Shiner	Cyprinidae	*Notropis*	*hudsonius*	Native	not listed	**Dog Lake Watershed**
Northern Redbelly Dace	Cyprinidae	*Phoxinus*	*eos*	Native Rare, Tributaries	not listed	Lake Manitoba
Finescale Dace	Cyprinidae	*Phoxinus*	*neogaeus*	Native Rare, Tributaries	not listed	Lake Manitoba
Fathead Minnow	Cyprinidae	*Pimephales*	*promelas*	Native	not listed	**Dog Lake Watershed**
Longnose Dace	Cyprinidae	*Rhinichthys*	*cataractae*	Native	not listed	Unknown
Creek Chub	Cyprinidae	*Semotilus*	*atromaculatus*	Native	not listed	**Dog Lake Watershed**
Quillback	Catostomidae	*Carpiodes*	*cyprinus*	Native	not listed	Lake Manitoba
White Sucker	Catostomidae	*Catostomus*	*commersonii*	Native	not listed	**Dog Lake Watershed**
Bigmouth Buffalo	Catostomidae	*Ictiobus*	*cyprinellus*	Native Rare	special concern	Delta Marsh - Lake Manitoba
Silver Redhorse	Catostomidae	*Moxostoma*	*anisurum*	Native	not listed	unknown
Shorthead Redhorse	Catostomidae	*Moxostoma*	*macrolepidotum*	Native	not listed	Lake Manitoba
Black Bullhead	Ictaluridae	*Ameiurus*	*melas*	Native Recent	not listed	**Dog Lake Watershed**
Brown Bullhead	Ictaluridae	*Ameiurus*	*nebulosus*	Native Recent	not listed	Delta Marsh - Lake Manitoba
Channel Catfish	Ictaluridae	*Ictalurus*	*punctatus*	Native Recent	not listed	Delta Marsh - Lake Manitoba
Tadpole Madtom	Ictaluridae	*Noturus*	*gyrinus*	Native Recent	not listed	Delta Marsh - Lake Manitoba
Northern Pike	Esocidae	*Esox*	*lucius*	Native	not listed	**Dog Lake Watershed**
Central Mudminnow	Umbridae	*Umbra*	*limi*	Native Recent	not listed	**Dog Lake Watershed**
Cisco	Salmonidae	*Coregonus*	*artedi*	Native	not listed	Lake Manitoba
Lake Whitefish	Salmonidae	*Coregonus*	*clupeaformis*	Native	not listed	Lake Manitoba
Rainbow Trout	Salmonidae	*Oncorhynchus*	*mykiss*	Introduced	not listed	Lake Manitoba
Brown Trout	Salmonidae	*Salmo*	*trutta*	Introduced	not listed	Lake Manitoba
Brook Trout	Salmonidae	*Salvelinus*	*fontinalis*	Transplanted (Native Manitoba)	not listed	Lake Manitoba
Trout Perch	Percopsidae	*Percopsis*	*omiscomaycus*	Native	not listed	Lake Manitoba
Burbot	Gadidae	*Lota*	*lota*	Native	not listed	Lake Manitoba
Brook Stickleback	Gasterosteidae	*Culaea*	*inconstans*	Native	not listed	**Dog Lake Watershed**
Ninespine Stickleback	Gasterosteidae	*Pungitius*	*pungitius*	Native	not listed	Lake Manitoba

Table 8. Continued….

Common Name	Family	Genus	Species	Occurrence	COSEWIC Status	Known Occurrences
Mottled Sculpin	Cottidae	*Cottus*	*bairdii*	Native	not listed	Lake Manitoba
Rock Bass	Centrarchidae	*Ambloplites*	*rupestris*	Native	not listed	Lake Manitoba
Iowa Darter	Percidae	*Etheostoma*	*exile*	Native	not listed	**Dog Lake Watershed**
Johnny Darter	Percidae	*Etheostoma*	*nigrum*	Native	not listed	Lake Manitoba
Yellow Perch	Percidae	*Perca*	*flavescens*	Native	not listed	**Dog Lake Watershed**
Logperch	Percidae	*Percina*	*caprodes*	Native	not listed	Lake Manitoba
River Darter	Percidae	*Percina*	*shumardi*	Native	not listed	Lake Manitoba
Sauger	Percidae	*Sander*	*canadensis*	Native	not listed	Lake Manitoba
Walleye	Percidae	*Sander*	*vitreus*	Native	not listed	**Dog Lake Watershed**
Freshwater Drum	Sciaenidae	*Aplodinotus*	*grunniens*	Native	not listed	Lake Manitoba


Walleye


Brook Stickleback

Northern Pike


Common Carp


Iowa Darter


Yellow Perch


White Sucker


Fathead Minnow


Central Mudminnow

Figure 6. Photos of representative fish species captured during the fish inventory within the Dog Lake Watershed, 2011

3.5.1. EGG SAMPLING

Egg sampling was conducted in all drains and tributaries within the Dog Lake Watershed during the spring of 2011. Most effort was however placed on areas were sand, gravel, and cobble substrates were observed as this habitat is typically selected by fish for spawning. A total of 3,082 eggs were collected and identified within the watershed. White Sucker eggs contributed to 93% of the total catch. The remaining 7% (n = 215) of eggs collected were likely Brook Stickleback eggs or Percidae eggs as they were small approximately 1 mm in diameter. These small eggs were captured on Camper Drain, Ashern Drain, and Pioneer Drain. White Sucker eggs were captured on all drains within the watershed with the exception of Dog Lake Drain and Moosehorn Creek. Carp were also observed spawning within most drains within the watershed but egg sampling was conducted earlier in the season, as the main focus was to search for Walleye egg deposition sites. Refer to the habitat classification maps in Appendix A for the location and number of eggs collected within various drain of the Dog Lake Watershed.

3.5.2 LARVAL DRIFT

Larval drift nets were placed on all drains within the watershed with the exception of Dog Lake Drain and Moosehorn Creek. A total of 4,955 larval fish were captured within the watershed. White Sucker larval fish comprised the largest catch accounting for 99% of the total catch. The fish catches were more or less evenly distributed amongst the seven drains. In addition to the White Suckers captured, a total of eleven Northern Pike fry were also captured including nine within Pioneer Drain, one within Little Dog Lake Drain and one within Ashern Drain. Furthermore, while conducting electrofishing surveys, many young-of-the-year (yoy) fish, both Northern Pike and White Suckers, were captured. This signifies successful larval emergence within these waterways. No Walleye fry were captured during this survey. These results do not imply Walleye are not utilizing or successfully spawning within the tributaries of the Dog Lake Watershed.

3.6. BENTHIC INVERTEBRATE COMMUNITY

The invertebrate community within the Dog Lake Watershed, although not heavily sampled, appeared diverse. Odonata, Ephemeroptera, and Trichoptera, the most sensitive species to poor water quality, were collected in all of the tributaries sampled. More effort however should be taken to sample the invertebrate community within known livestock watering areas, areas with limited diversity, and areas where riparian zones appear inadequate. By having a good understanding which types of invertebrates are found within the different tributaries, the WIWCD will be able to determine how healthy each system is. Invertebrates are excellent indicators of poor water quality conditions.

Table 9. Invertebrates (Insects) identified within the sample reaches of each tributary within the Dog Lake Watershed. Sampling was qualitative.

Invertebrates Identified	Pine Lake Drain	Chippewa Creek Drain	Little Dog Lake Drain	Camper Drain	Pioneer Drain	Marne Drain	Ashern Drain
Amphipoda	y	y	y	y	y	y	y
Odonata	y	y	y	y	y	y	y
Trichoptera			y	y	y	y	y
Ephemeroptera			y	y	y	y	y
Hemiptera/Corixidae	y	y	y				y
Diptera/Ceratopogonidae				y	y	y	y
Diptera/Simulidae		y		y	y	y	
Diptera/Chironomidae	y	y	y	y		y	y
Water mites	y		y		y		y
Leeches	y			y		y	y
Planorbidae	y	y	y	y	y	y	y
Lymnaeidae	y	y		y	y	y	
Oligochaetes	y	y			y		
Cladocerans				y		y	

4.0 POTENTIAL REHABILITATION SITES

A list of 8 rehabilitation projects that AAE Tech Services feel are important to improve the aquatic ecosystem within the Dog Lake Watershed can be found within Appendix H. The projects range from riparian enhancement to removing or providing fish passage at those barriers identified within the waterways. General recommendations are also provided to enhance or create fish spawning habitat within the selected tributaries. Efforts are going to have to be put forth to stop a downward trend of decreasing fish habitat occurring around Lake Manitoba (D. Milani 2000). The WIWCD must work and collaborate with local landowners, government agencies, municipalities and producers to jointly improve the conditions within the Dog Lake Watershed and other watersheds within the conservation district.

5.0 SUMMARY

The WIWCD initiated this study to better understand the waterways within the conservation district. Results were intended to assist the WIWCD to effectively restore, enhance, and protect the aquatic environment within their conservation district to develop a healthy aquatic ecosystem for the benefit of all user groups.

Results of this assessment identified a few barriers impeding fish movement, identified damaged riparian zones along waterways, and described the lack of aquatic habitat diversity within the watershed. This study revealed many positives with regards to the health of the watershed. Most tributaries, although very uniform, had riparian zones adequate to provide protection to the aquatic environment. Only 9.2% or 12.2 km of the riparian condition was considered severally impacted. In addition, urban development within the watershed was minimal. Most of the land use along the tributaries was either native prairie grass for forage or native grassland for pasture. These types of environments are not typically associated with excessive nutrient loading to the aquatic environment; with the exception of heavily livestock grazed sections were bank trampling is common.

The results of this survey provided much needed data to understand the state of the fish habitat along the tributaries within the Dog Lake Watershed. As previously stated, there is a severe lack of habitat diversity within the tributaries of this watershed. Nursery habitat was sparse and barriers restricted fish movements within these waterbodies. The drains within the watershed have been straightened and channelized. As a result, a significant amount of habitat has likely been lost. In addition, the majority of habitat remaining within the drains was simple, with limited cover, limited spawning habitat, and a lack of nursery habitat.

Many enhancement efforts can be undertaken to improve the habitat. The WIWCD is going to have to partner with local landowners, commercial fishermen, agricultural producers, municipalities, and government agencies to accomplish the ultimate goal of providing a healthy ecosystem within the watershed to benefit all user groups. This project was intended to provide recommendations on how to improve the health and sustainability of the watershed for user groups and fish and wild life. Numerous recommendations can be found below.

6.0 RECOMMENDATIONS

The recommendations below are based on the results of this study and discussions had with the West Interlake Watershed Conservation District and Provincial and Federal Government Agencies.

- Hold information meetings with local landowners to discuss future plans of the WIWCD. By getting everyone involved within the community will help with future enhancement initiatives.

- Use this report to tackle or enhance the potential rehabilitation sites listed within to improve fish habitat, water quality and the health of the aquatic ecosystem.

- Build spawning shoals within Pine Lake and Chippewa Creek drains to increase habitat diversity and provide additional spawning habitat for fish. These were the only two drains within the watershed Walleye were captured. Fish habitat within these drains was marginal in terms of a lack of valuable Walleye spawning habitat (gravel, cobble substrates). However, nursery and rearing habitat was abundant as the both drains originated from large bodies of water.

- Erect riparian fencing along sections of the waterways within the watershed where cattle have direct access. Efforts should first be directed to the most heavily affected areas on Pine Lake Drain and Chippewa Creek Drain.

- Erect riparian fencing on the upper and lower reaches on Pioneer Drain to prevent cattle from degrading the riparian areas within these sections.

- Work with landowners along the waterways to develop management strategies to limit cattle from entering the waterways.

- Erect riparian fencing along Dog Lake Drain near the headwaters at Dog Lake. Install an off-watering system along the drain if needed to prevent cattle from watering within the in channel reservoir currently located along the drain.

- Conduct similar riparian and aquatic assessment studies on other tributaries within the WIWCD to better understand the fish and fish habitat within those water bodies.

- Conduct more thorough studies on Dog Lake, documenting bathymetry (water depth), dissolve oxygen levels, fish utilization, and the macrophyte communities found within the Lake. Depending on the result of future studies, constructing spawning reefs or shoals may be a good management strategy to increase spawning habitat to ultimately help increase fish stocks within the lake. Currently there appears to be ample spawning habitat for Northern Pike and Yellow Perch.

- Conduct fish surveys along the Lake Manitoba and Dog Lake shoreline to get a better understanding of these habitats and how fish are utilizing them, i.e. spawning, nursery, feeding, refuge.

- Conduct additional monitoring at the culvert crossings identified as barriers during this assessment. The culverts may or may not be barriers under different flow conditions.

7.0 ACKNOWLEDGEMENTS

Thanks to everyone on the West Interlake Watershed Conservation District for giving AAE Tech Services the opportunity to conduct this riparian and aquatic survey on the Dog Lake Watershed.

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8.0 REFERENCES

Agricultural and Rural Development Act. 1968. Soil Capability for agriculture Canada Land Inventory. Ottawa, Canada.

Auer, N.A. (eds). 1982. Identification of larval fishes of the Great Lakes basin with emphasis on the Lake Michigan drainage. Great Lakes Fishery Commission, Ann Arbor, MI 48105. Special Pub. 82-3. 744p

Communications Directorate, Department of Fisheries and Oceans. 1991. The Department of Fisheries and Oceans Policy for the Management of Fish Habitat, Ottawa, Ontario.

Dodds, W.K., J.R. Jones, and E.B. Welch. 1998. Suggested classification of stream trophic state: Distributions of temperate stream types by chlorophyll, total nitrogen, and phosphorus. Wat. Res. 32:1455-1462.

Environment Canada – Climate Weather Office (ECCWO). 2009. www.climate.weatheroffice.ec.gc.ca.

Environment Canada. 1998. Historical stream flow summaries – Manitoba – to 1996. Inland Waters Directorate, Water Resources Branch, Water Survey of Canada. Ottawa, Canada.

Google Inc. (2010). Google Earth (Version 5.2.1.1588) [Software]. Available from http:/earth.google.com.

Harrelson, C.C., C.L. Rawlins, J.P. Potyondy. 1994. Stream channel reference sites: an illustrated guide to field techniques. Gen. Tech. Rep. RM-245. Fort Collins, CO:US Department of Agriculture, Forest Service, Rocky Mountain Forest and Range Experiment Station. 61 p.

Holm. E., N.E. Mandrak, and M.E. Burridge. 2009. The ROM Field Guide to Freshwater Fishes of Ontario. Royal Ontario Museum. Toronto. Canada. 462 p.

Lowdon, M.K. 2007. Hatchery Drain – Fish Passage Survey. A report prepared for Water Stewardship Infrastructure and Operations Division: Regional Operations Branch Interlake Region. Prepared by AAE Tech Services. 49 p.

Lowdon, M.K. 2009. Swan Creek Watershed Riparian and Habitat Assessment. A report prepared for the West Interlake Watershed Conservation District. Prepared by AAE Tech Services. 117 p.

Lowdon, M.K. 2010. Lake Francis Watershed Riparian and Aquatic Assessment. A report prepared for the West Interlake Watershed Conservation District. Prepared by AAE Tech Services. 102 p.

Milani, D.W., and R.D. Milani. 2000. Fish habitat inventory of selected Lake Manitoba north basin tributaries. Phase I report. A report prepared to the Lake Manitoba Fish Enhancement Committee. D. Milani Environmental. 86-p.

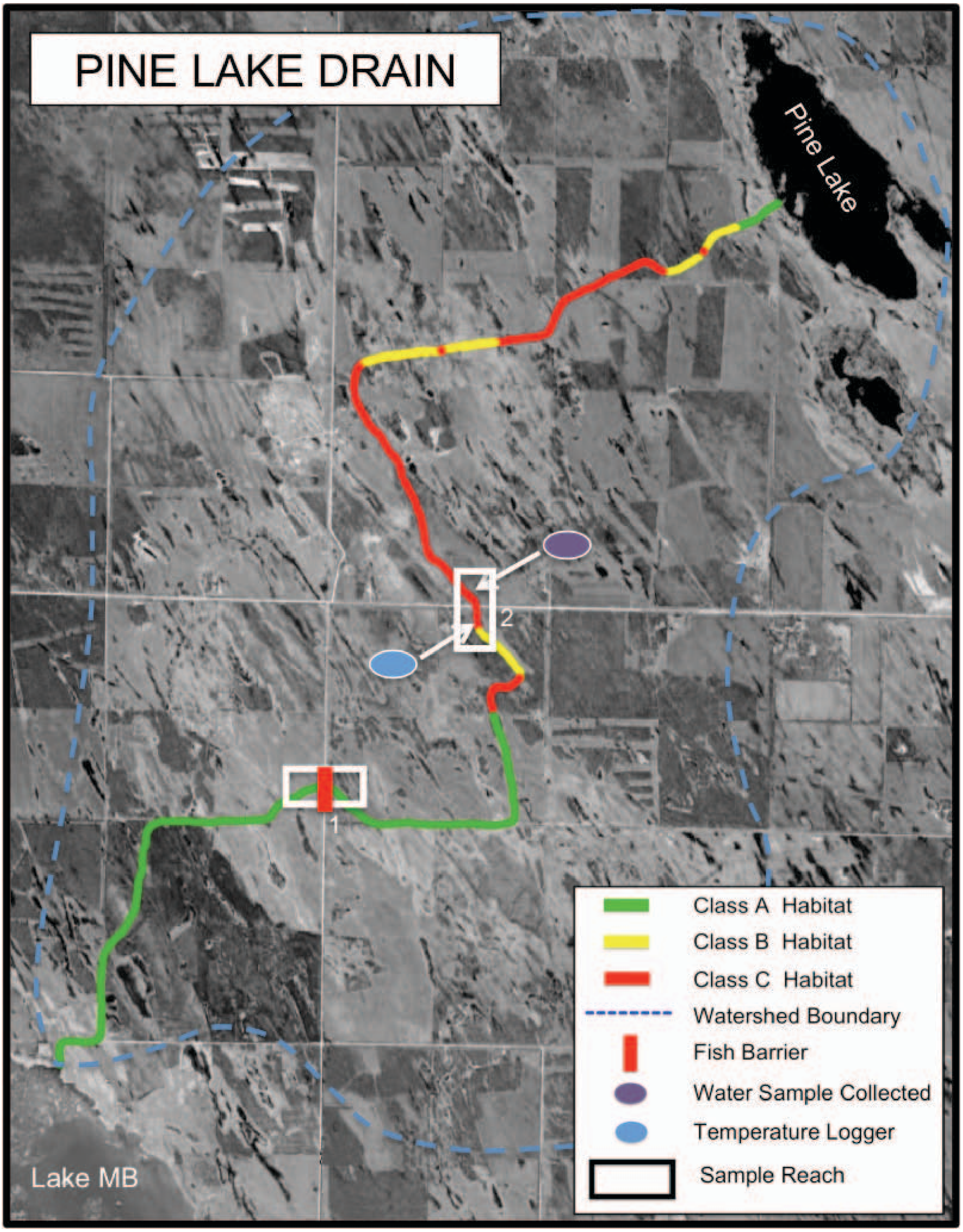
Newbury, R.W. 2008. Sream Restoration Design Manual: Canadian Rivers Institue "Stream Restoration Design". University of New Brunswick, Canada. Newbury Hydraulics Stream Design Manual. 187 p.

Newbury, R.W. and M.N. Gaboury. 1993. Stream analysis and fish habitat design – a field manual. Newbury Hydraulics Ltd. 256 p.

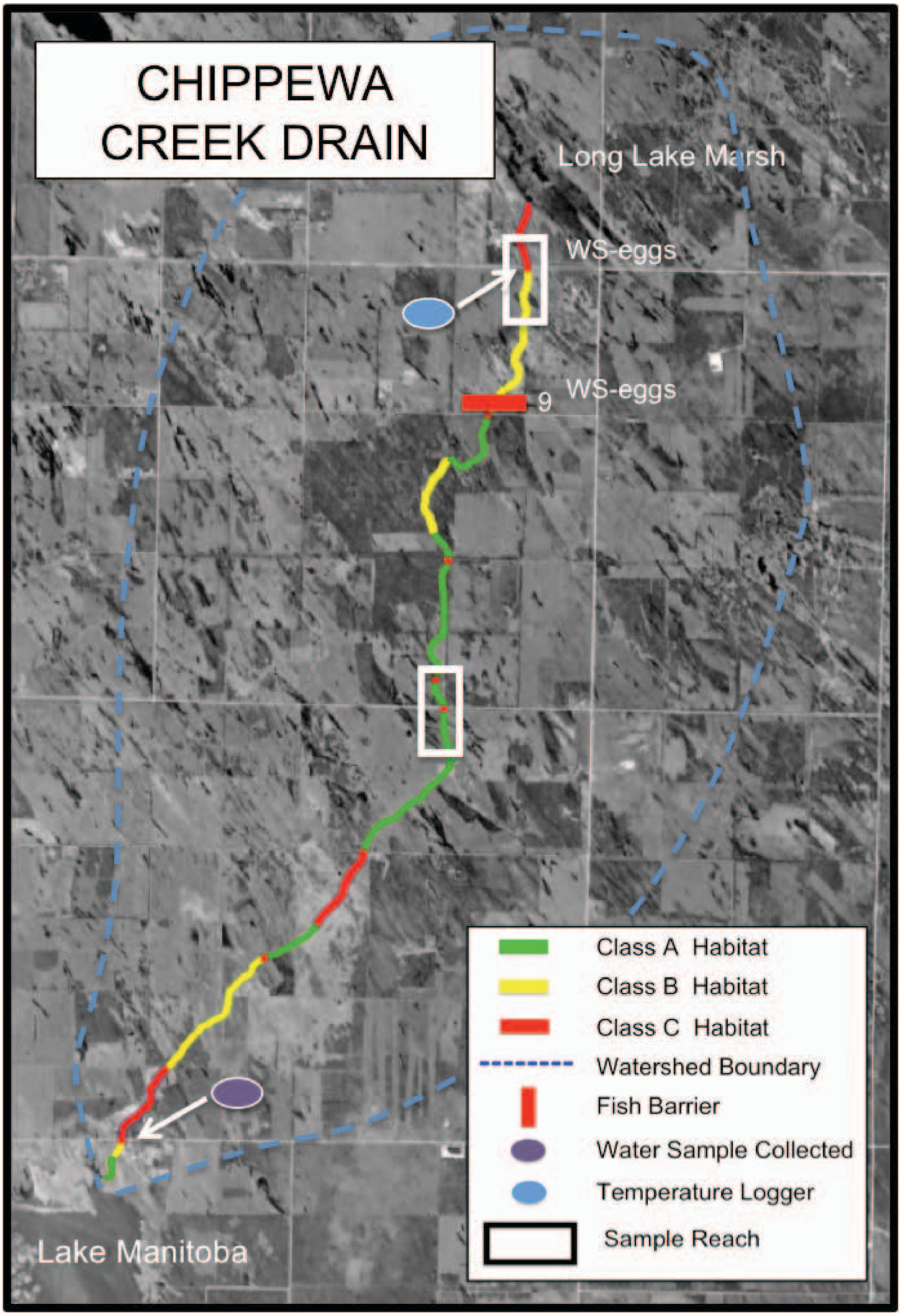
Smith, R. E., H. Veldhuis, G. F. Mills, R. G. Eilers, W. R. Fraser, and G. W. Lelyk. 1998. Terrestrial ecozones, ecoregions, and ecodistricts of Manitoba: An ecological stratification of Manitoba's natural landscapes. Research Branch Technical Bulletin. Land Resource Unit, Brandon Research Centre, Research Branch Agriculture and Agri-Foods Canada.

Stewart. K.W. and D.A. Watkinson. 2004. The freshwater fishes of Manitoba. University of Manitoba Press, Winnipeg, MB. 276p.

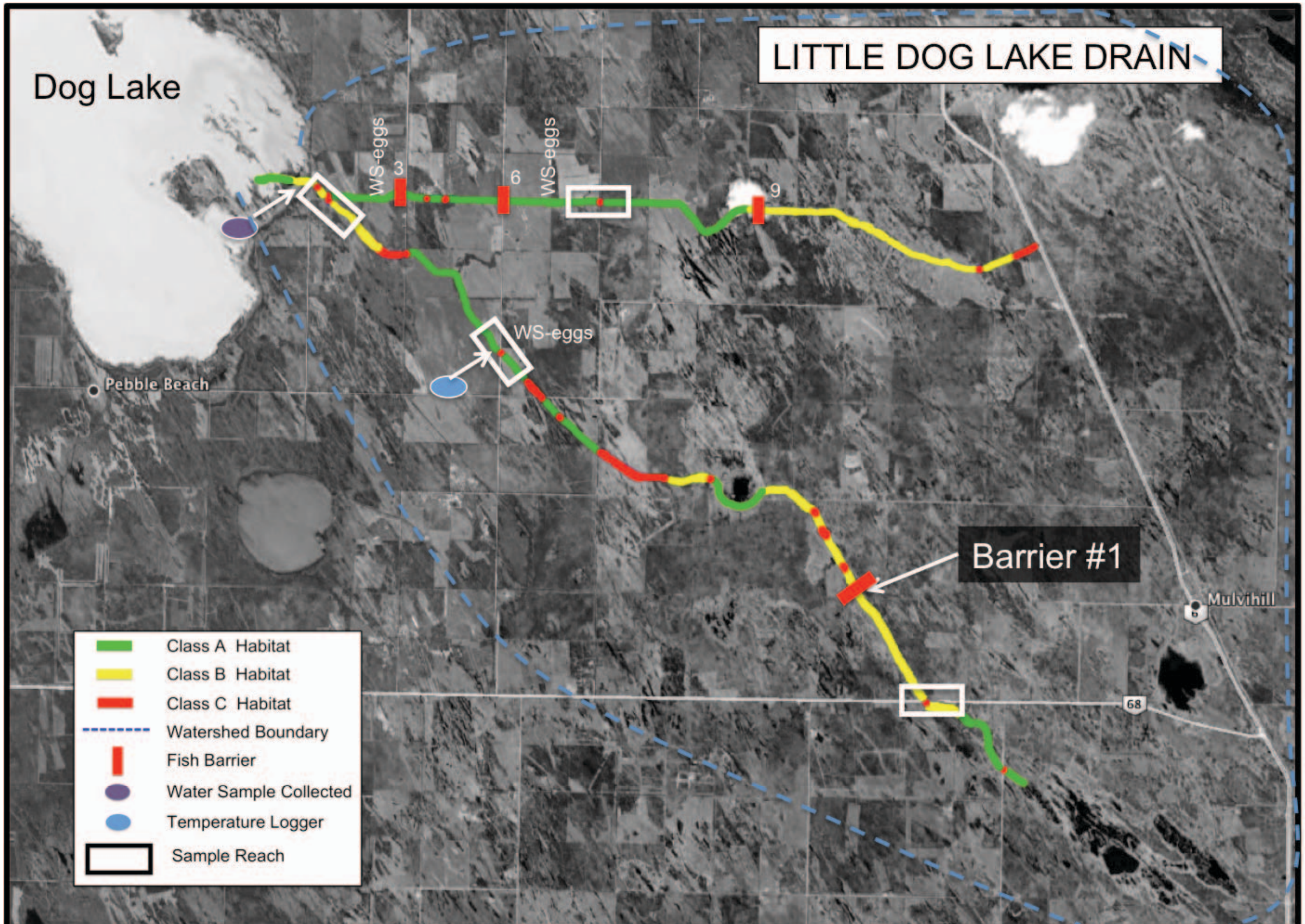
APPENDIX A: Habitat featured maps illustrating the riparian zone classification of the drains within the Dog Lake Watershed. Locations of barriers are included on the maps.



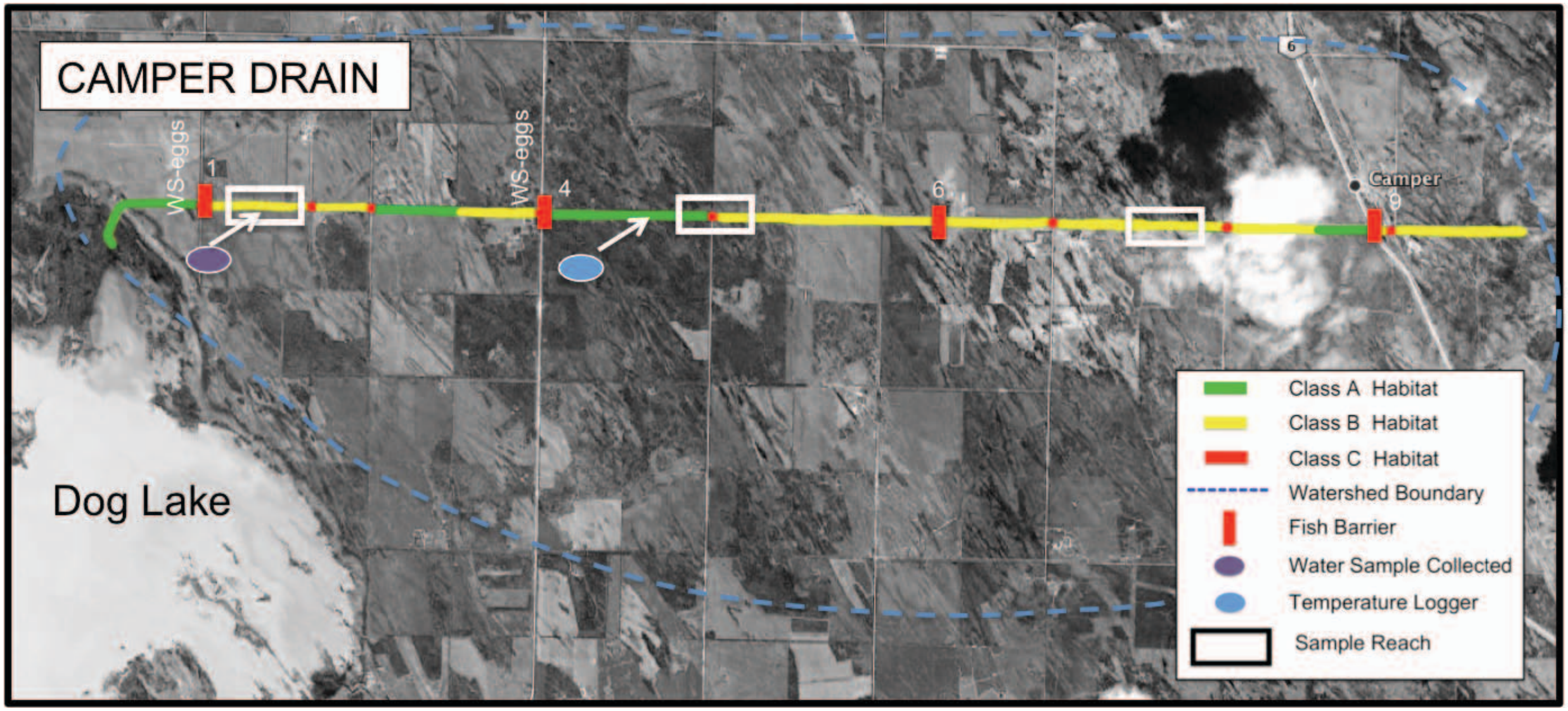
Appendix A-1. Pine Lake Drain riparian zone classification habitat featured map



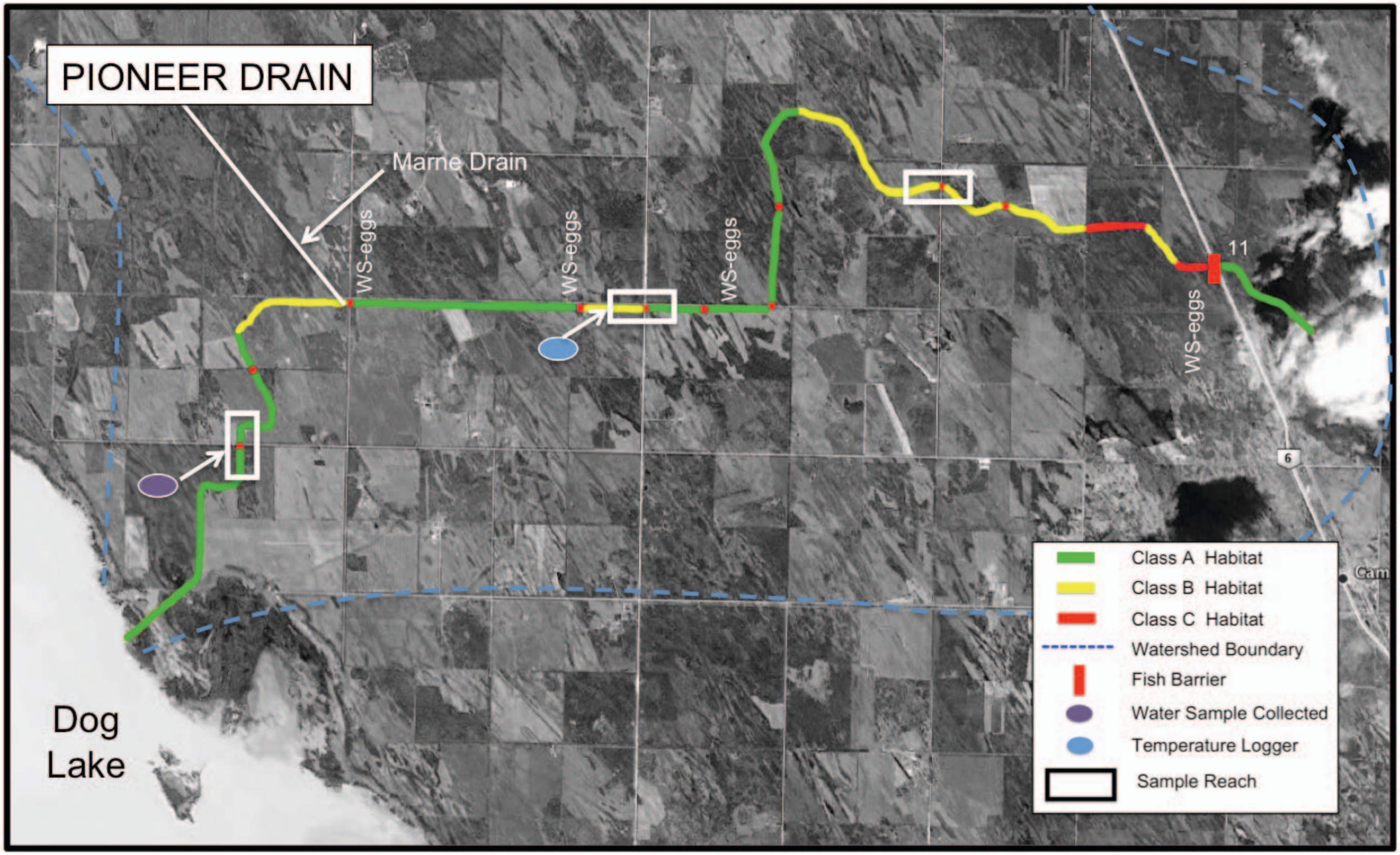
Appendix A-2. Chippewa Creek Drain riparian zone classification featured map**.**



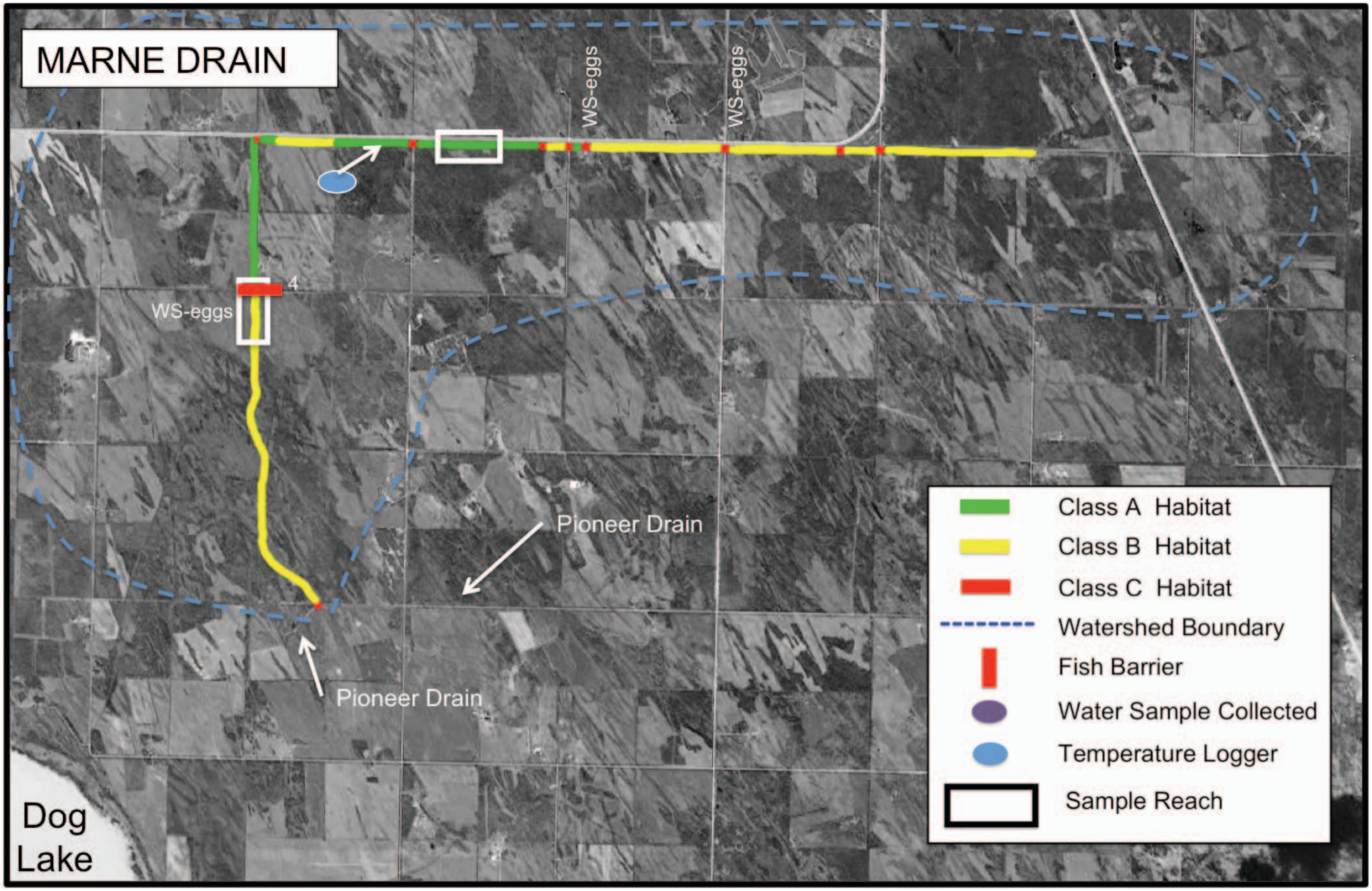
Appendix A-3. Little Dog Lake Drain riparian zone classification featured map.



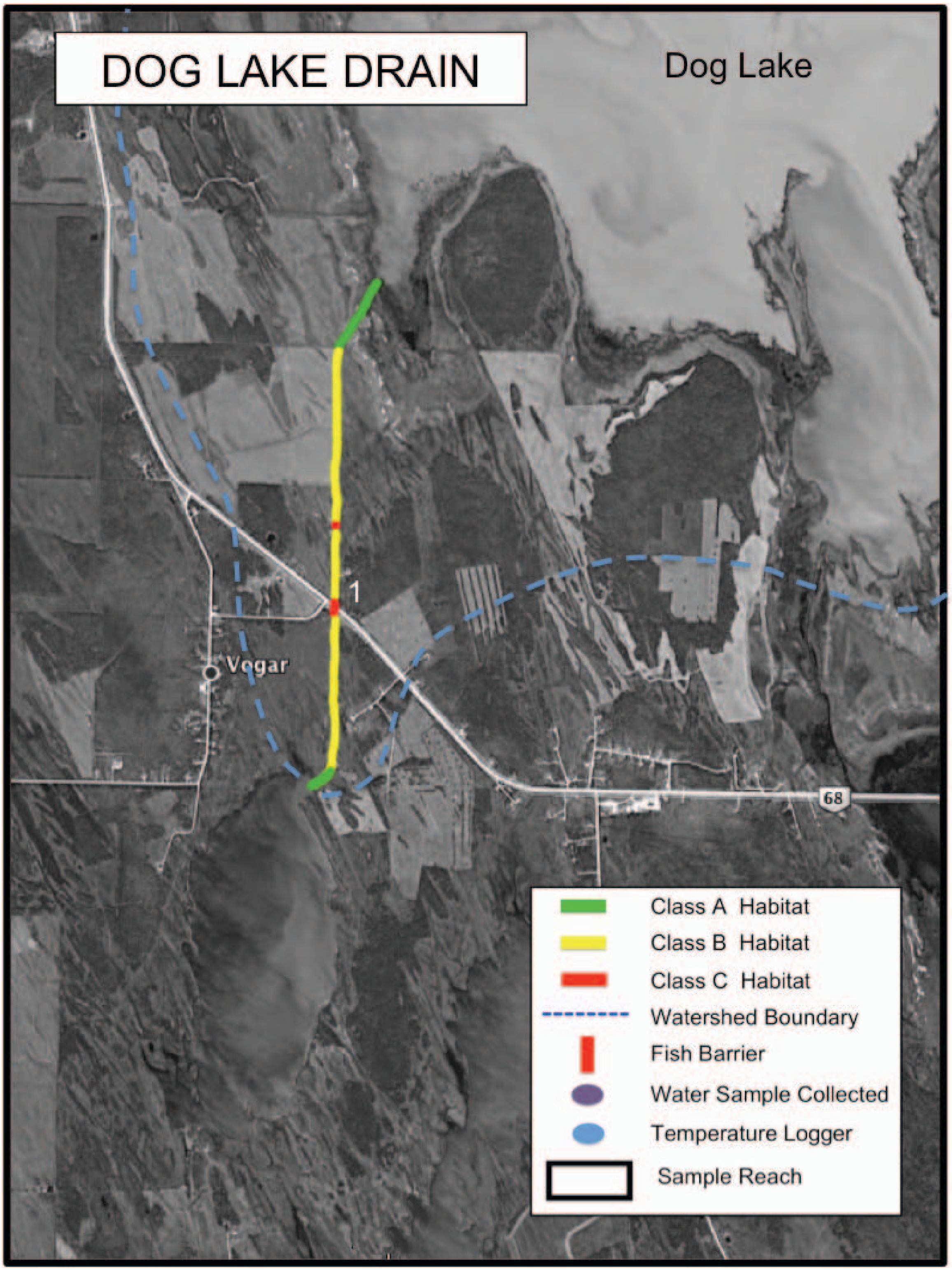
Appendix A-4. Camper Drain riparian zone classification featured map**.**



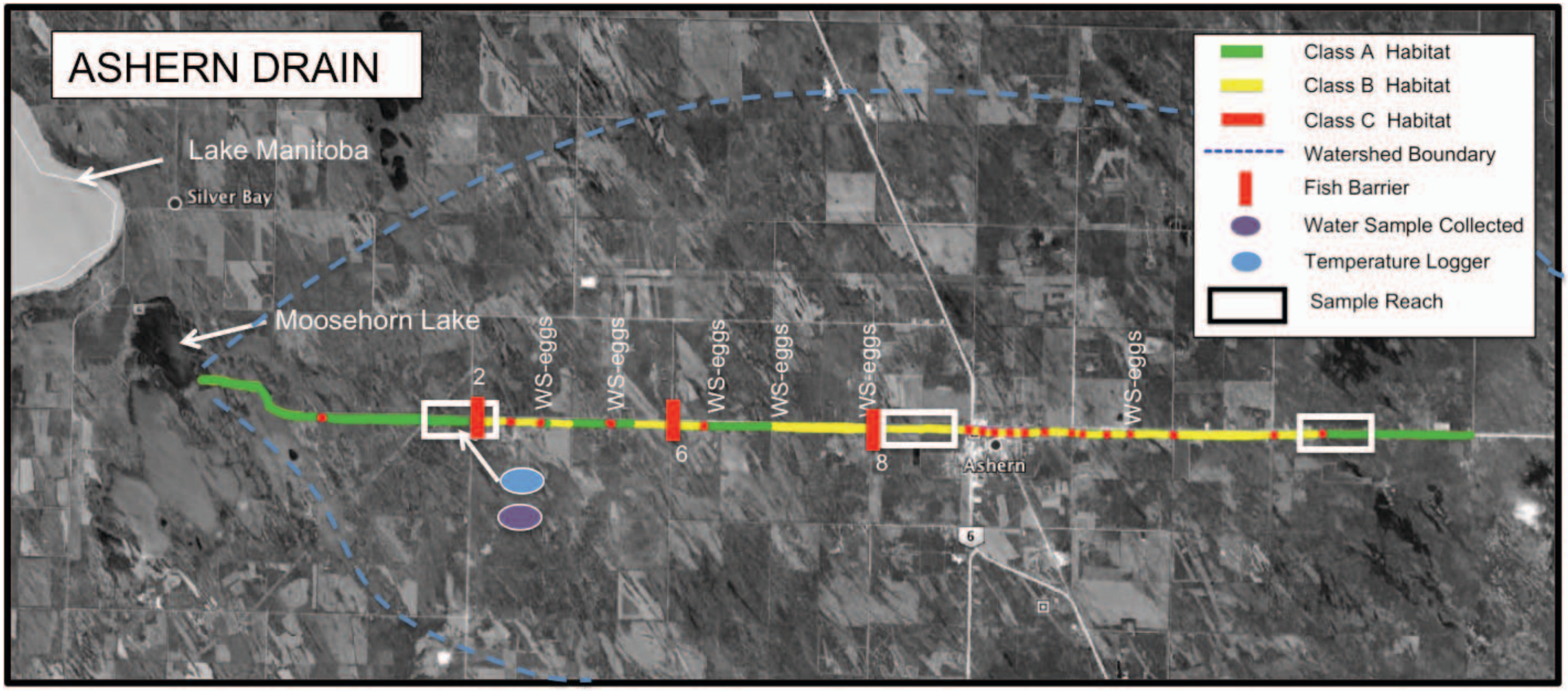
Appendix A-5. Pioneer Drain riparian zone classification featured map.



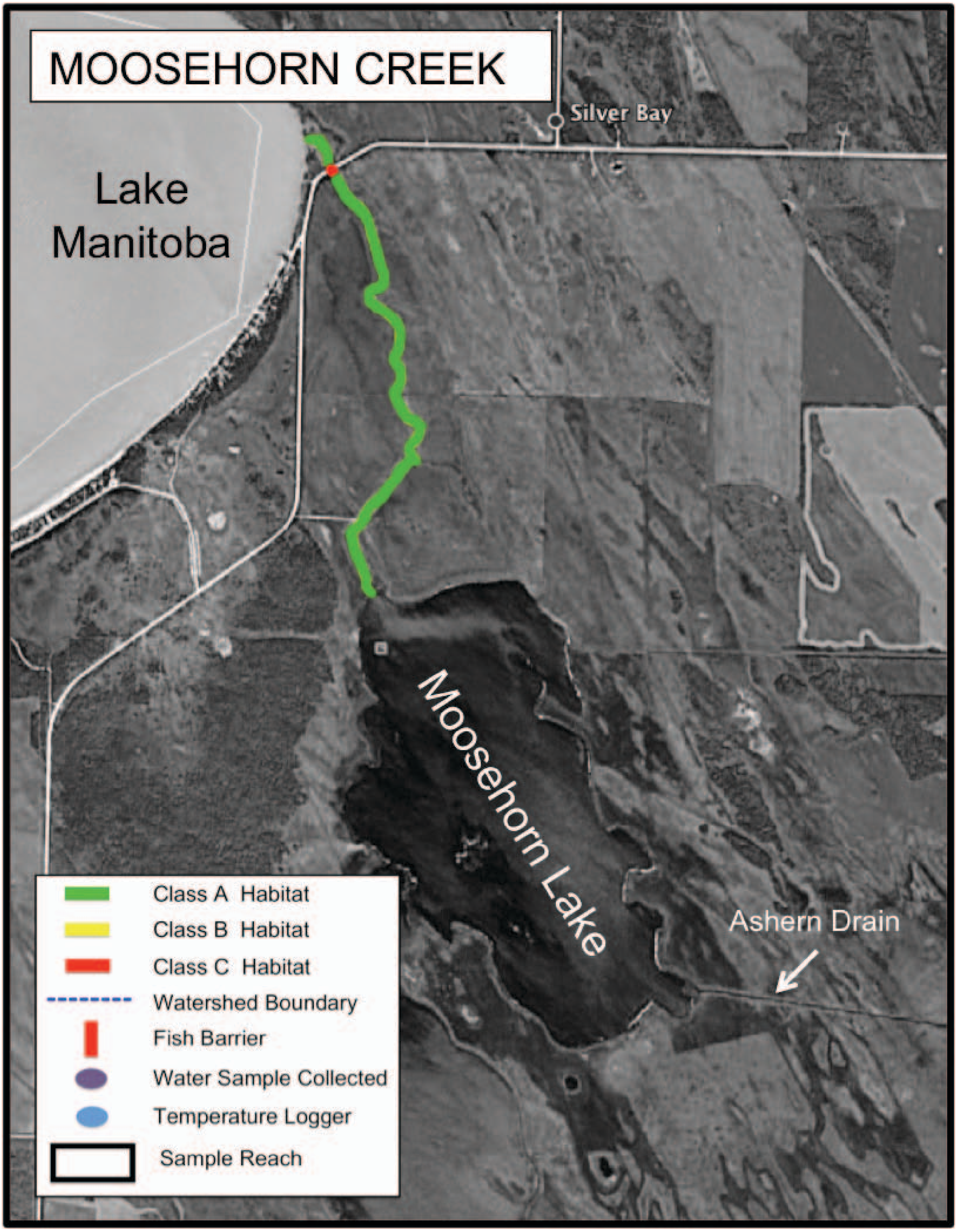
Appendix A-6. Marne Drain riparian zone classification featured map.



Appendix A-7. Dog Lake Drain riparian zone classification featured map.

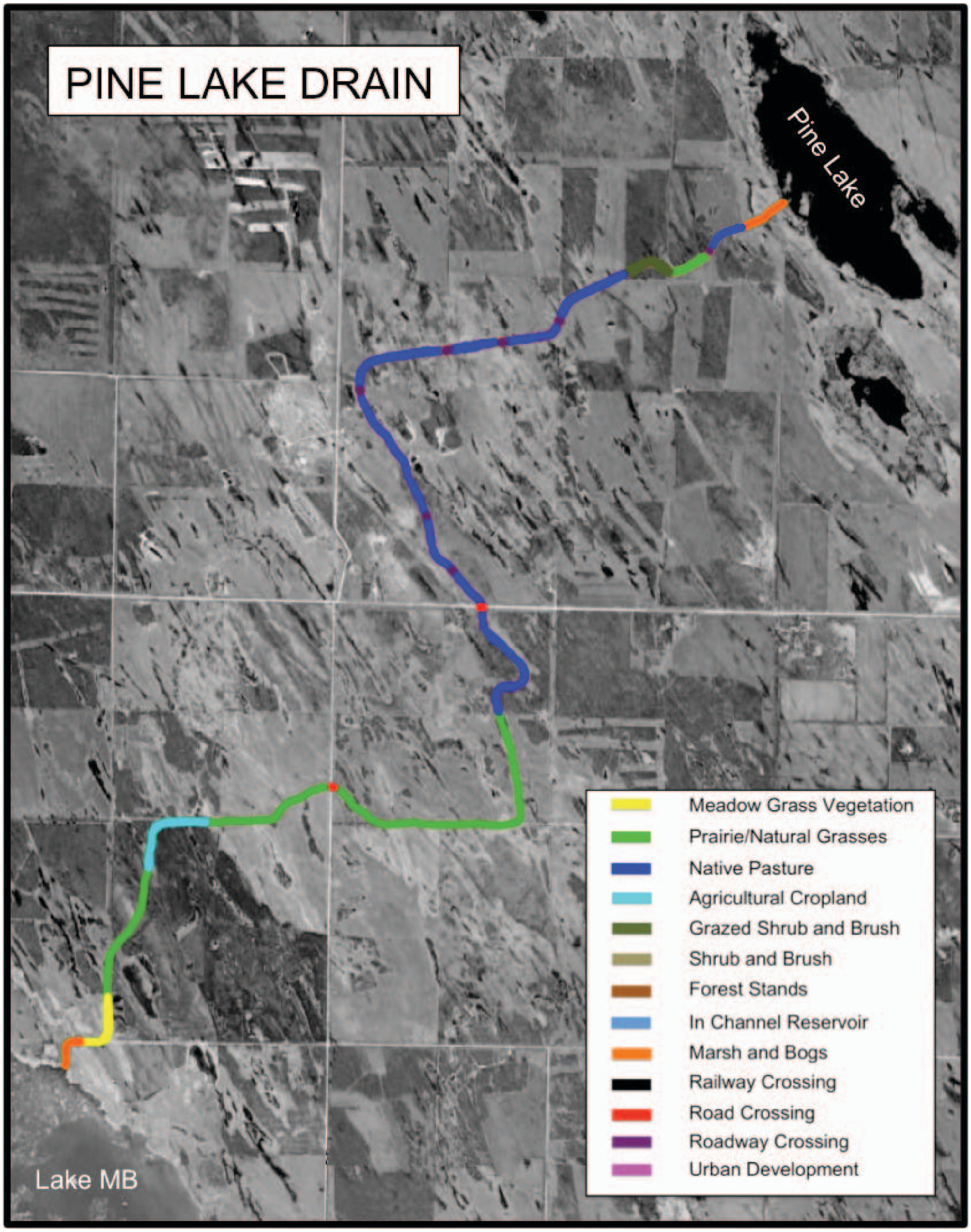


Appendix A-8. Ashern Drain riparian zone classification featured map.

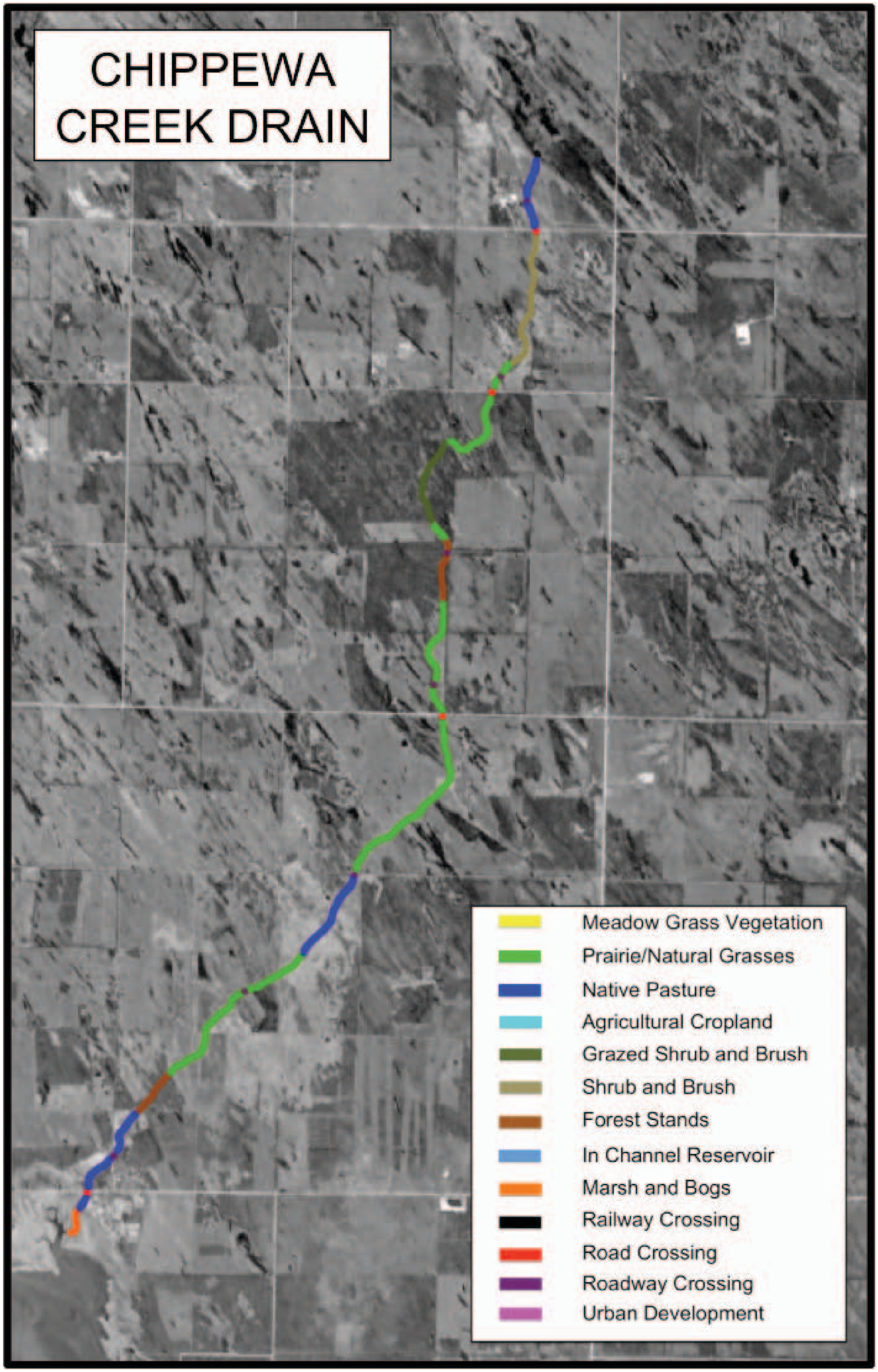


Appendix A-9. Moosehorn Creek riparian zone classification featured map

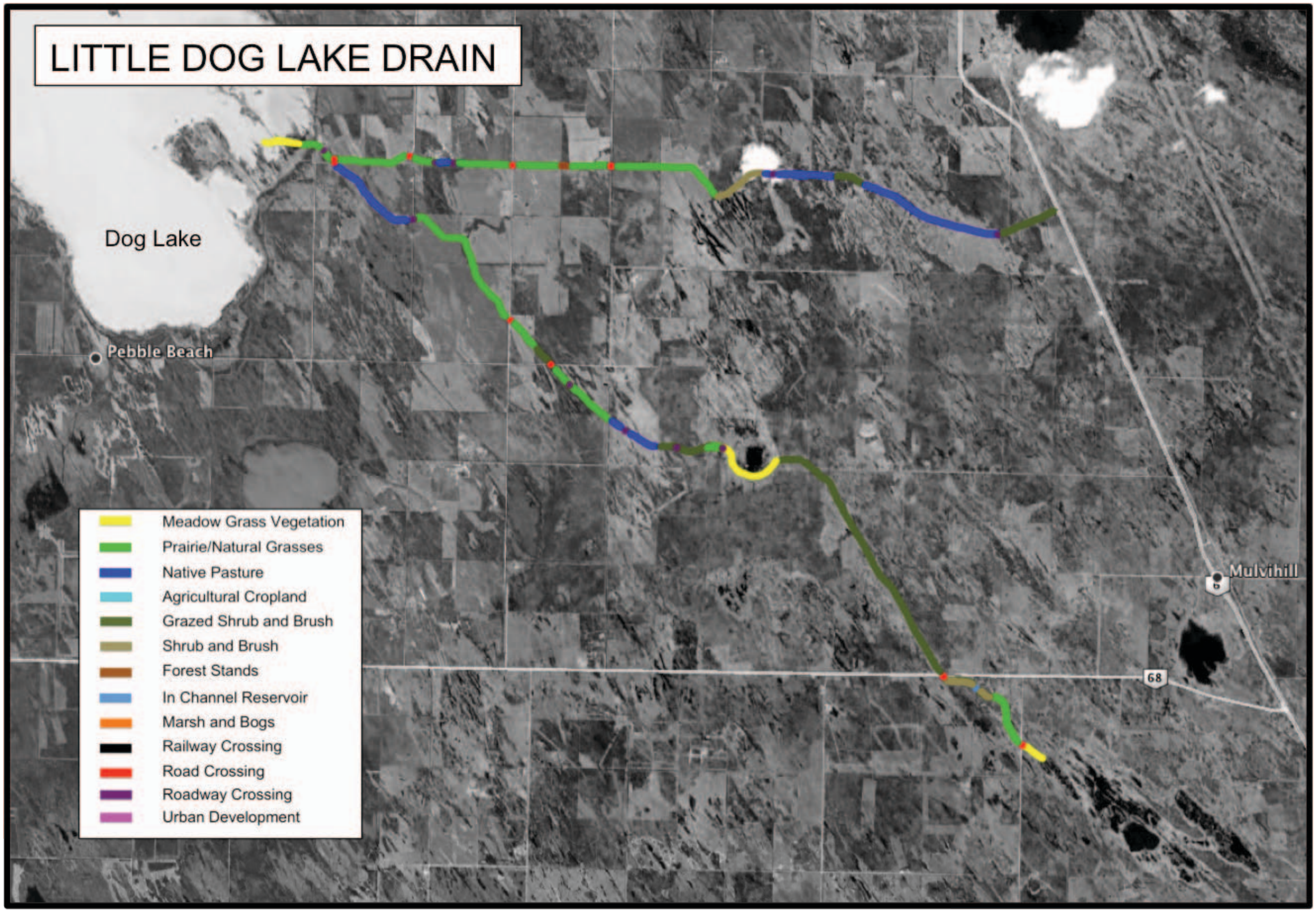
APPENDIX B: Land use classification maps of the drains within the Dog Lake Watershed.



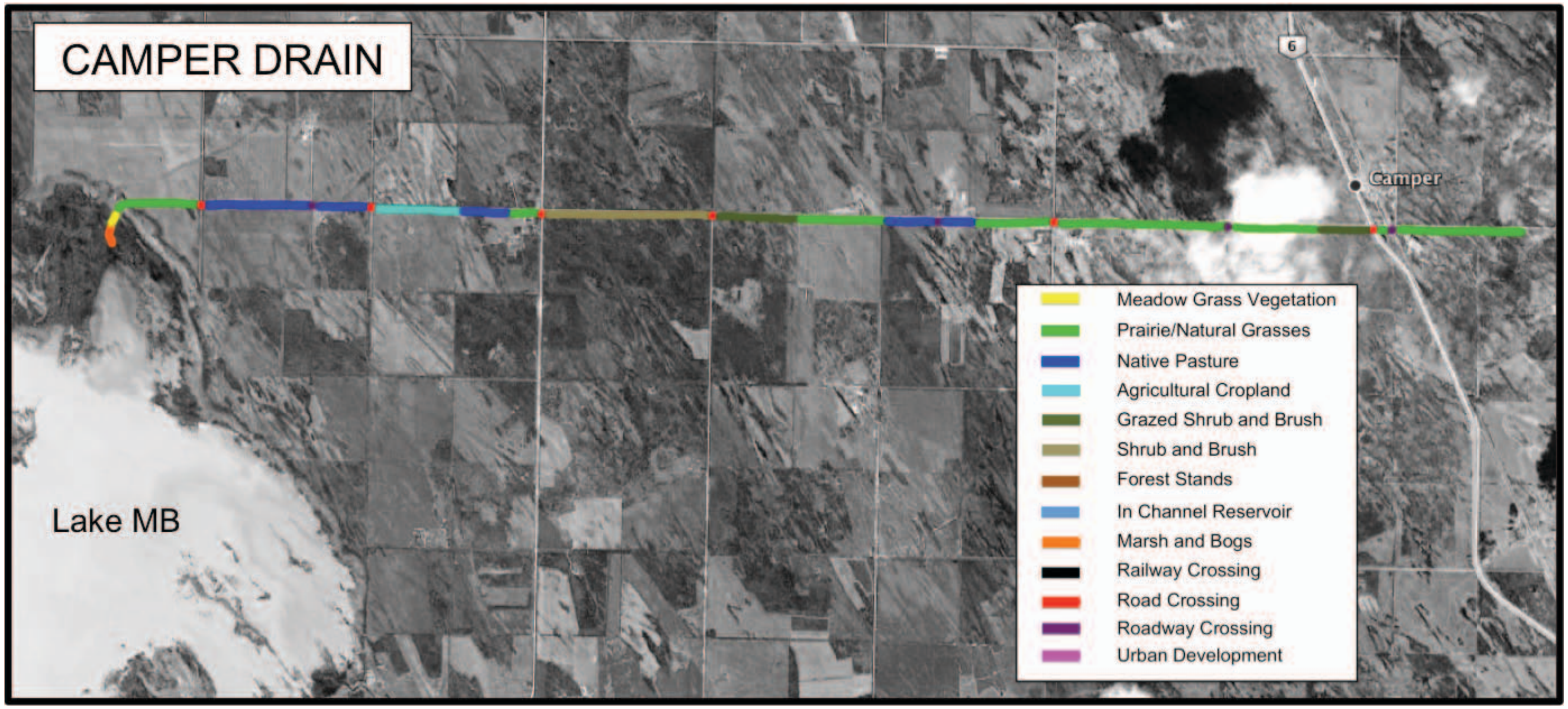
Appendix B-1. Pine Lake Drain land use classification map.



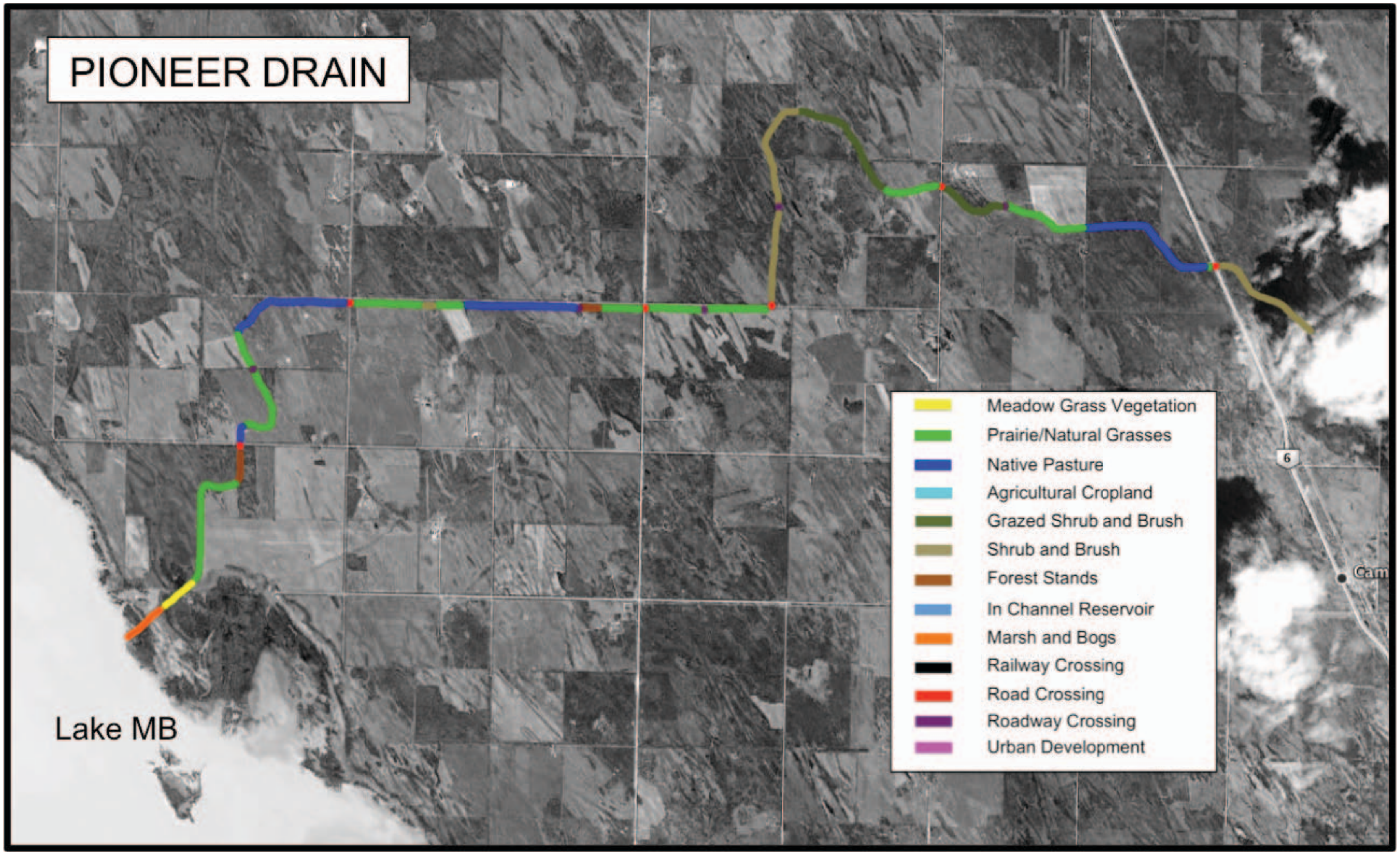
Appendix B-2. Chippewa Creek land use classification map**.**



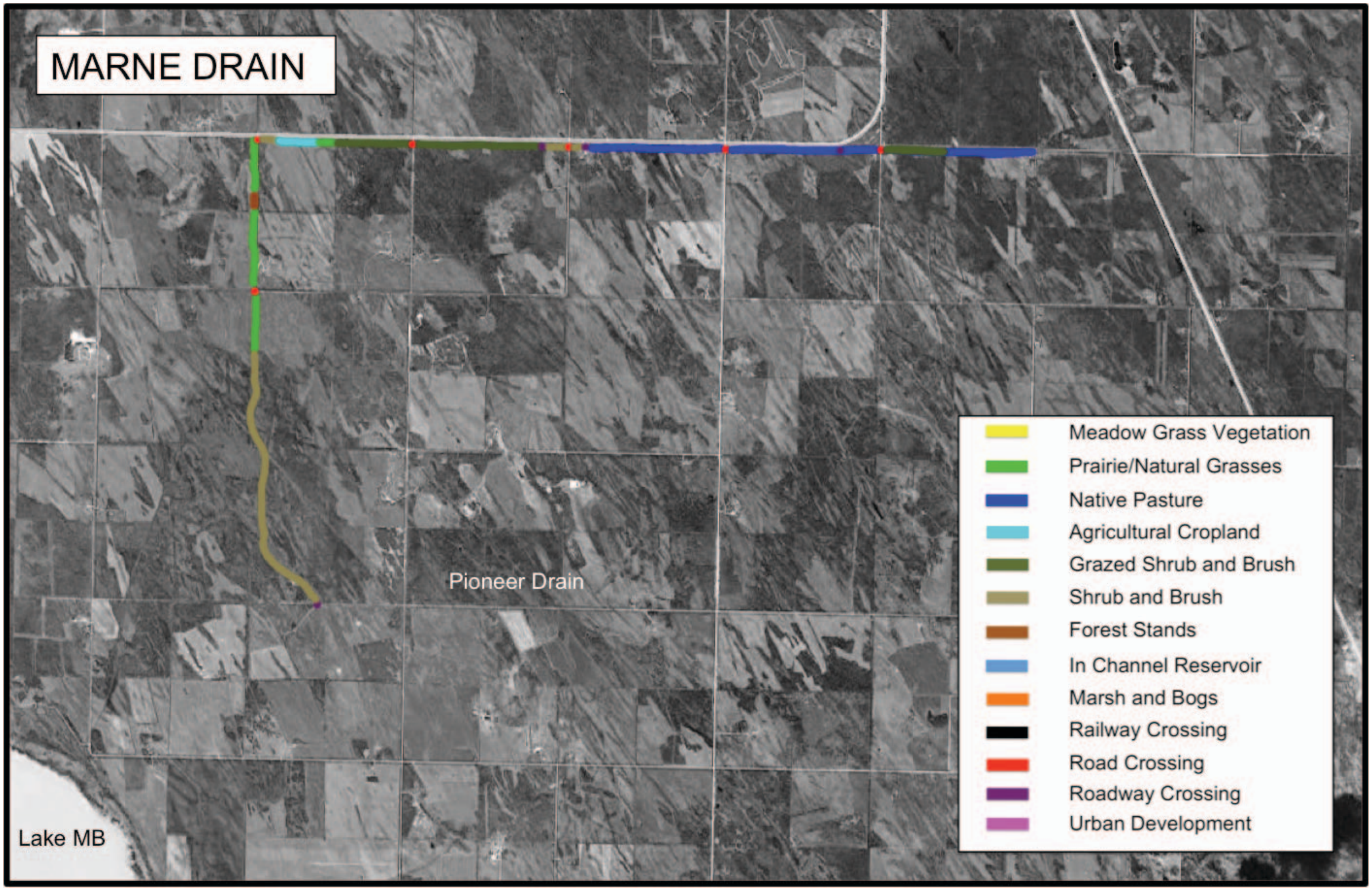
Appendix B-3. Little Dog Lake Drain land use classification map.



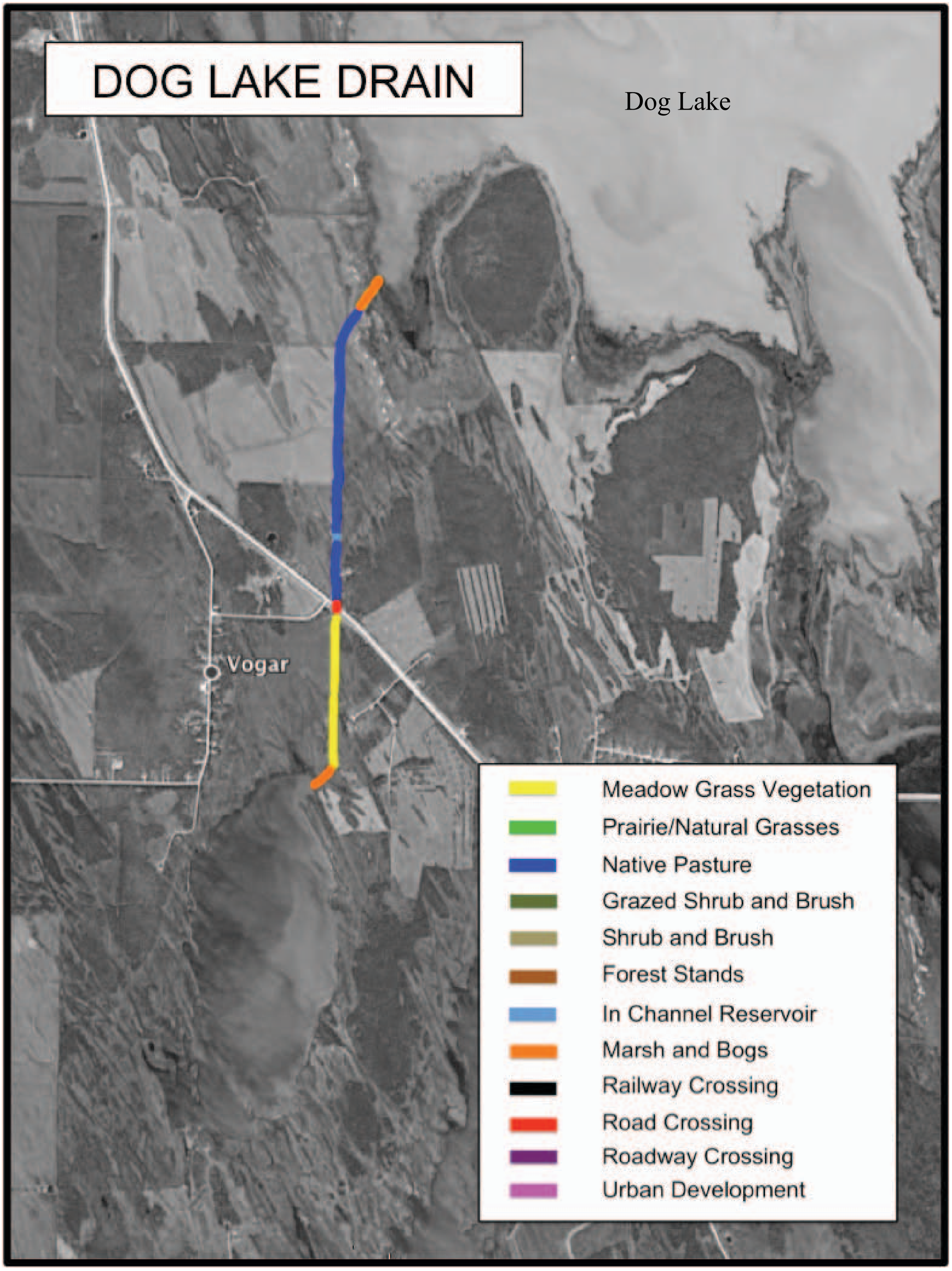
Appendix B-4. Camper Drain land use classification map.



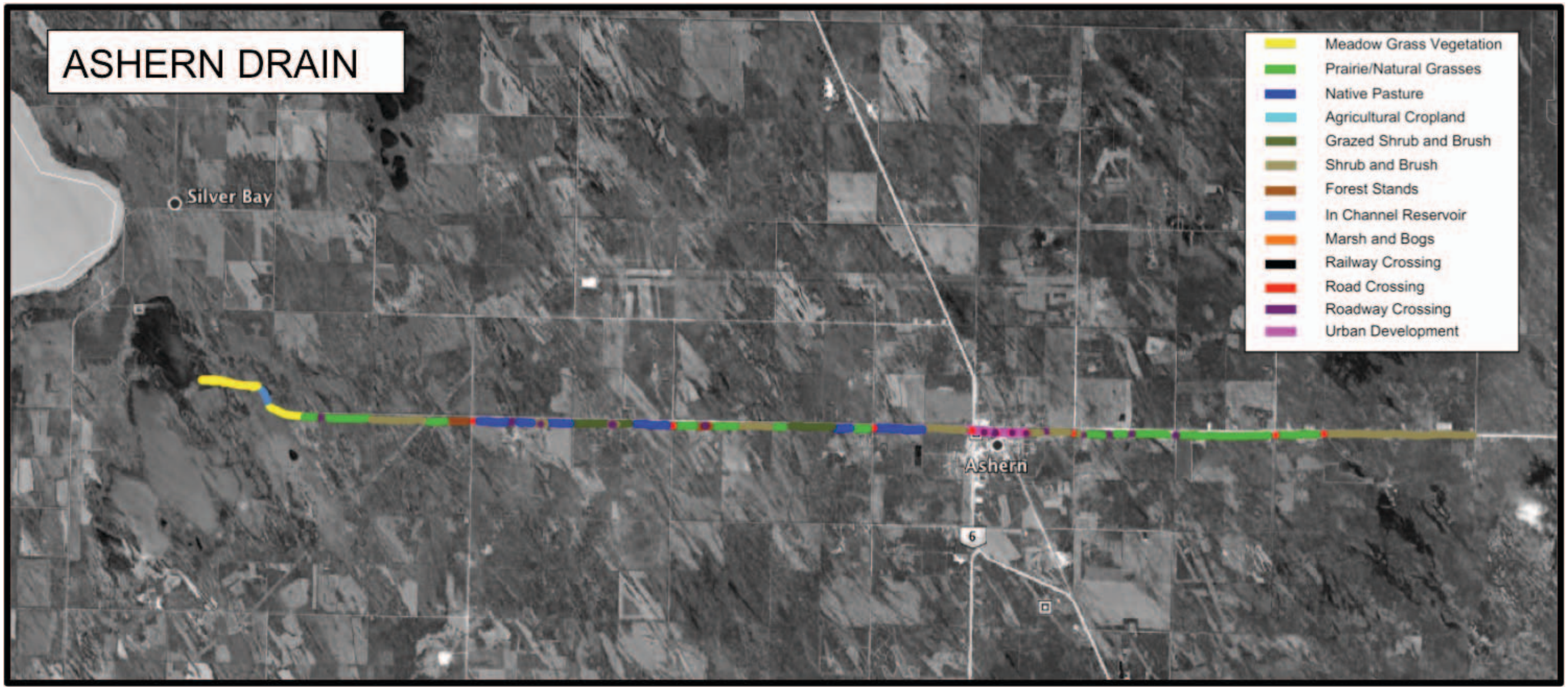
Appendix B-5. Pioneer Drain land use classification map.



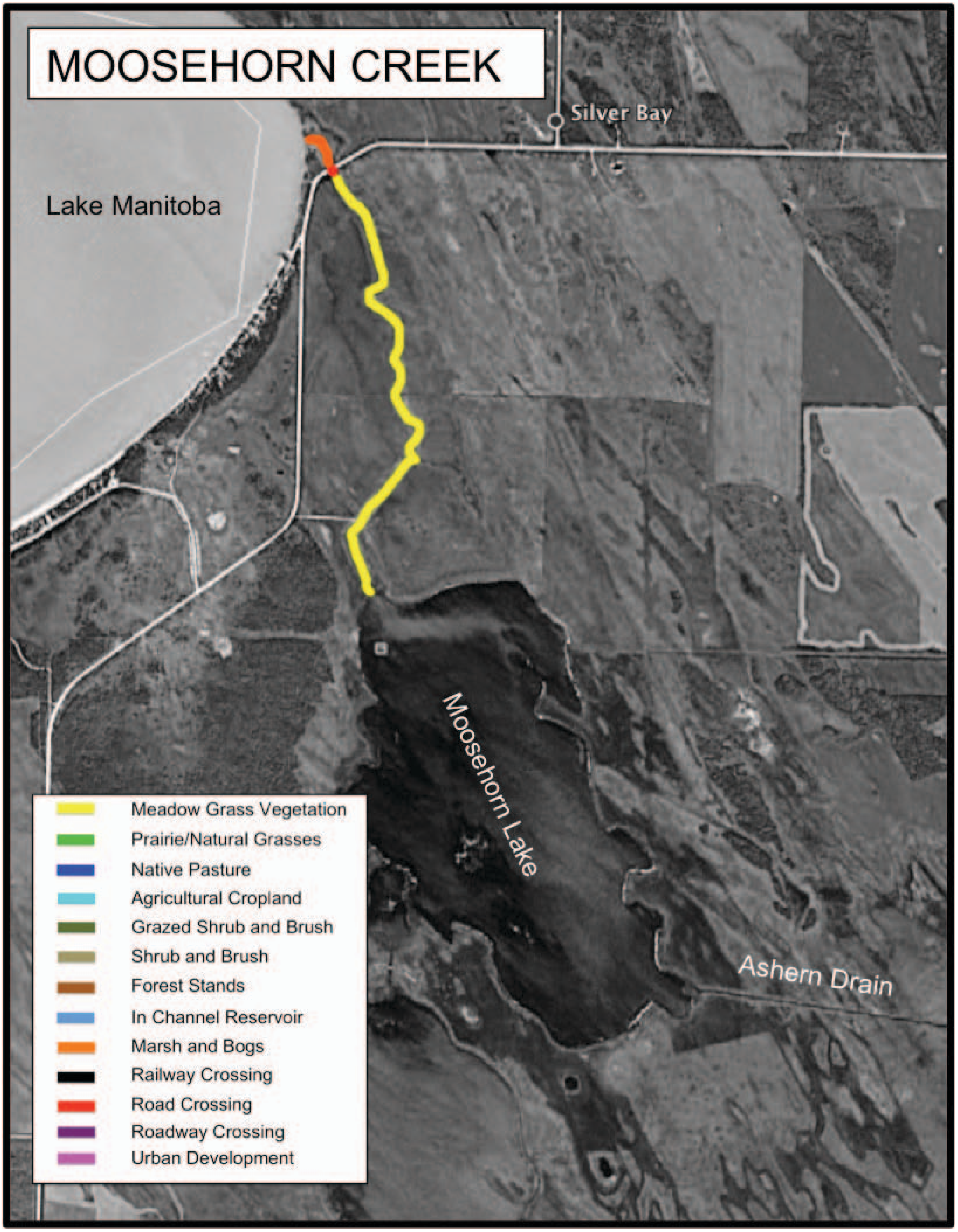
Appendix B-6. Marne Drain land use classification map.



Appendix B-7. Dog Lake Drain land use classification map.



Appendix B-8. Ashern Drain land use classification map.



Appendix B-9. Moosehorn Creek land use classification featured map.

APPENDIX C. Aerial and ground photographs representing the characteristics of the Dog Lake Watershed tributaries.

PINE LAKE DRAIN
(Appendix C-1)

CHIPPEWA CREEK DRAIN
(Appendix C-2)




LITTLE DOG LAKE DRAIN
(Appendix C-3)

CAMPER DRAIN
(Appendix C-4)

PIONEER DRAIN
(Appendix C-5)

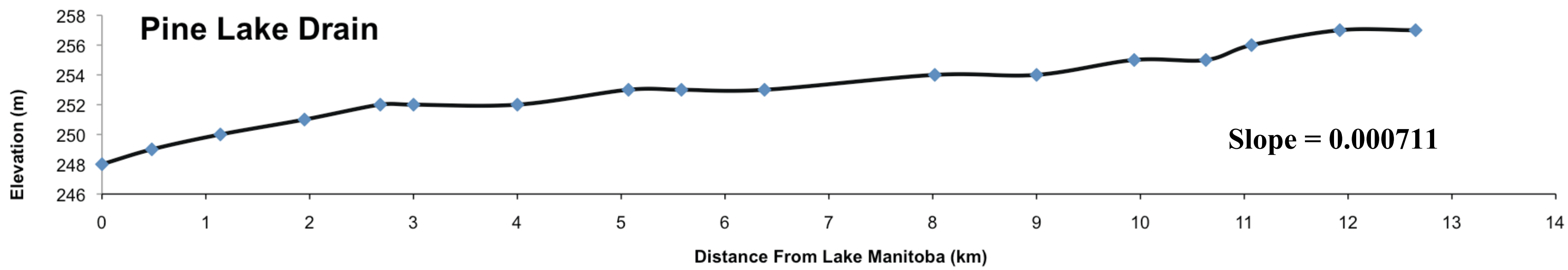
MARNE DRAIN
(Appendix C-6)

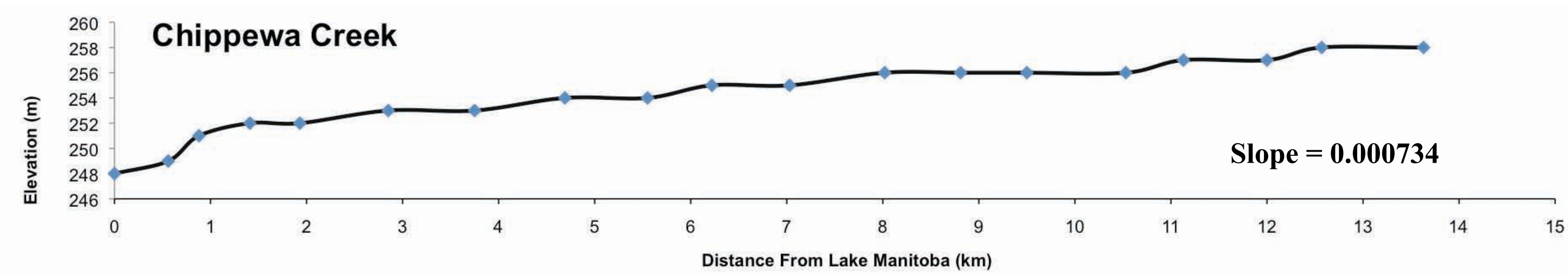
DOG LAKE DRAIN
(Appendix C-7)

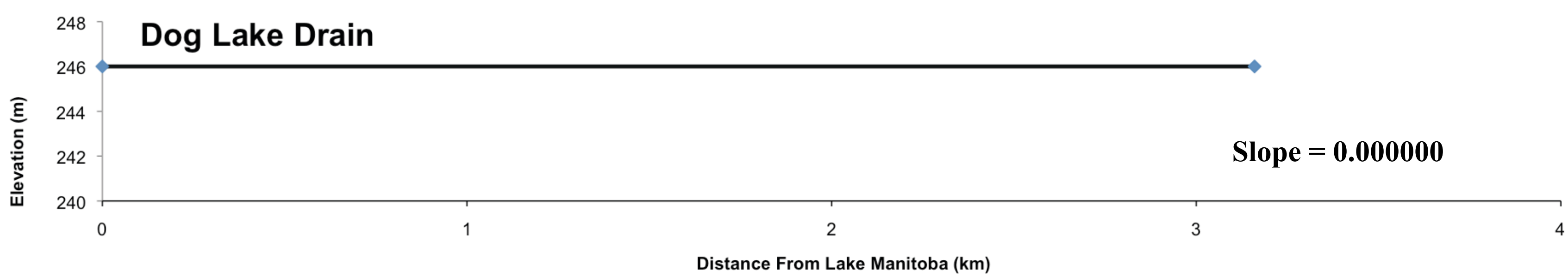
ASHERN DRAIN
(Appendix C-8)

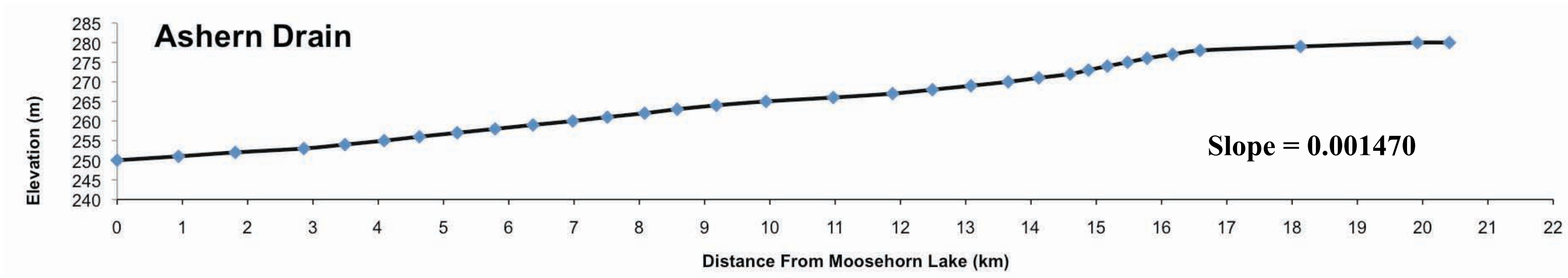

Moosehorn Creek
AAE Tech Services
MOOSEHORN CREEK
(Appendix C-9)
N 51.201840° W 098.543314°
10/22/2011 10:24:24 AM

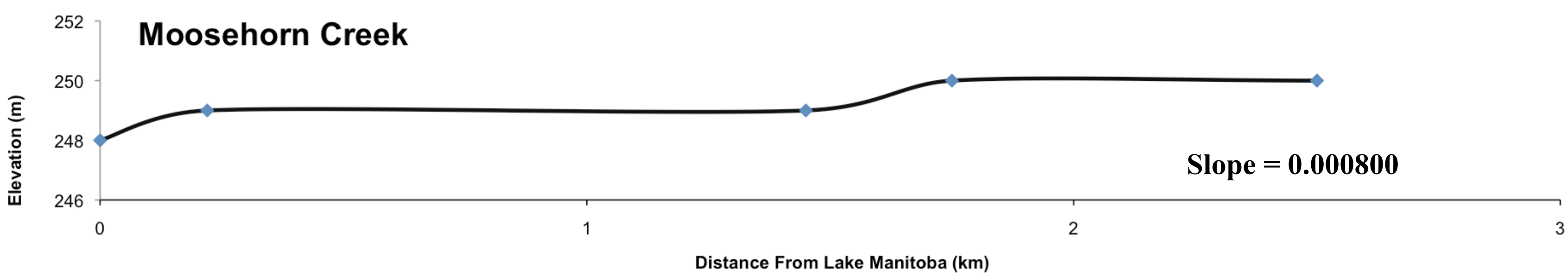
APPENDIX D. Longitudinal profiles incorporating the entire length of each tributary of the Dog Lake Watershed. Produced from 1:50,000 topographic maps and Google Earth Software

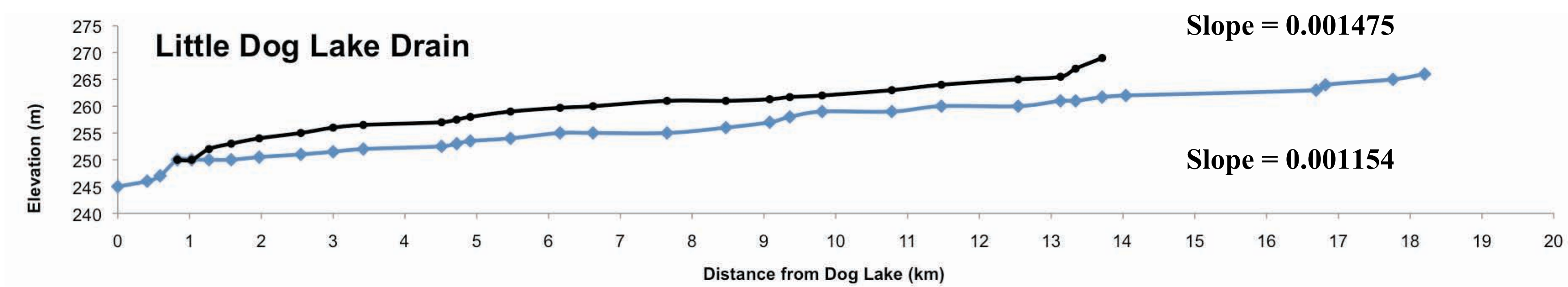

Pine Lake Drain
Slope = 0.000711
Elevation (m)
258
256
254
252
250
248
246
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
Distance From Lake Manitoba (km)

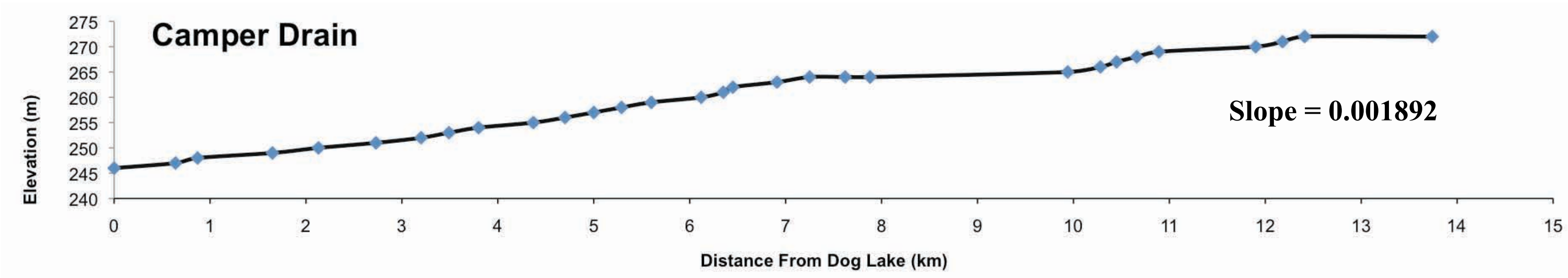

Chippewa Creek
Slope = 0.000734
Elevation (m)
260
258
256
254
252
250
248
246
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Distance From Lake Manitoba (km)

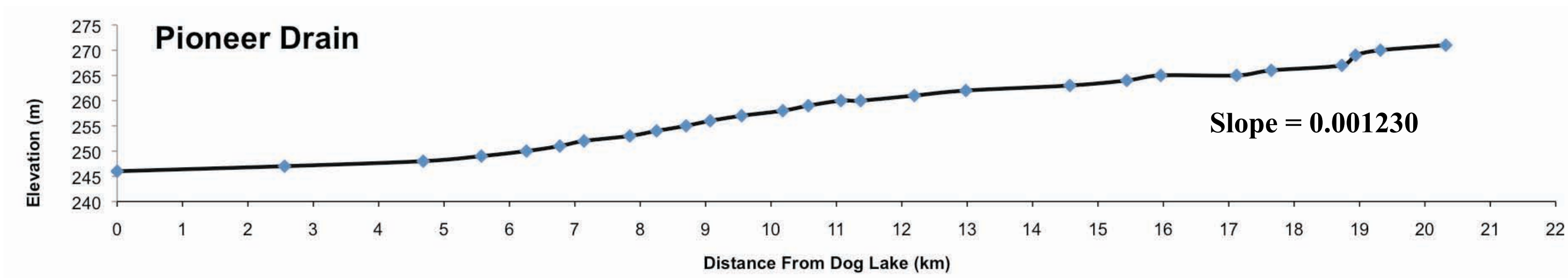

Dog Lake Drain
Slope = 0.000000
Elevation (m)
248
246
244
242
240
0
1
2
3
4
Distance From Lake Manitoba (km)

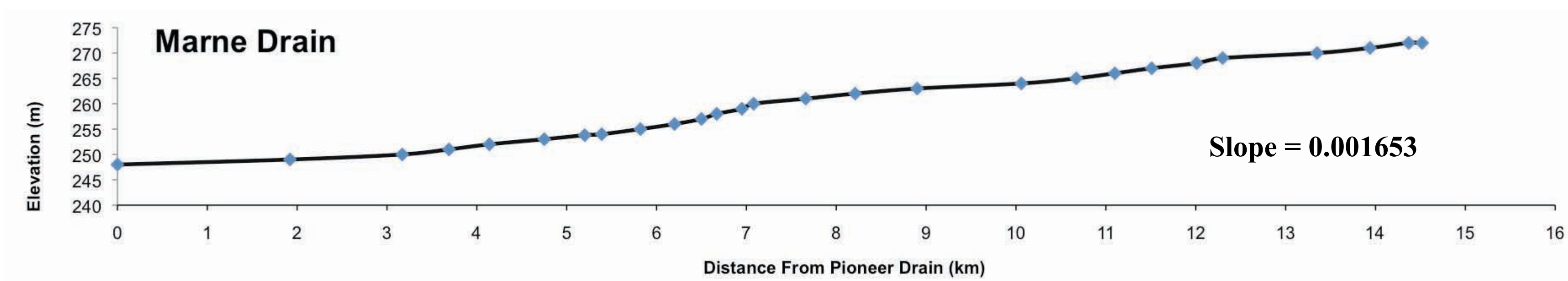

Ashern Drain
Elevation (m)
285
280
275
270
265
260
255
250
245
240
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22
Distance From Moosehorn Lake (km)
Slope = 0.001470


Moosehorn Creek
Elevation (m)
252
250
248
246
0 1 2 3
Distance From Lake Manitoba (km)
Slope = 0.000800

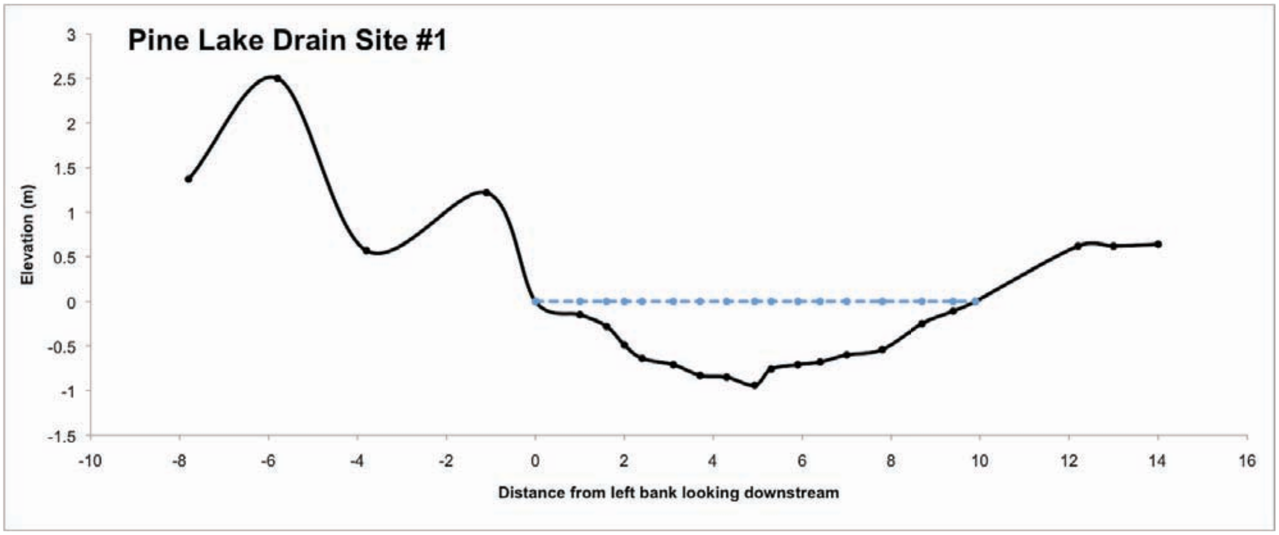

Slope = 0.001475
Little Dog Lake Drain
Elevation (m)
275
270
265
260
255
250
245
240
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Distance from Dog Lake (km)
Slope = 0.001154

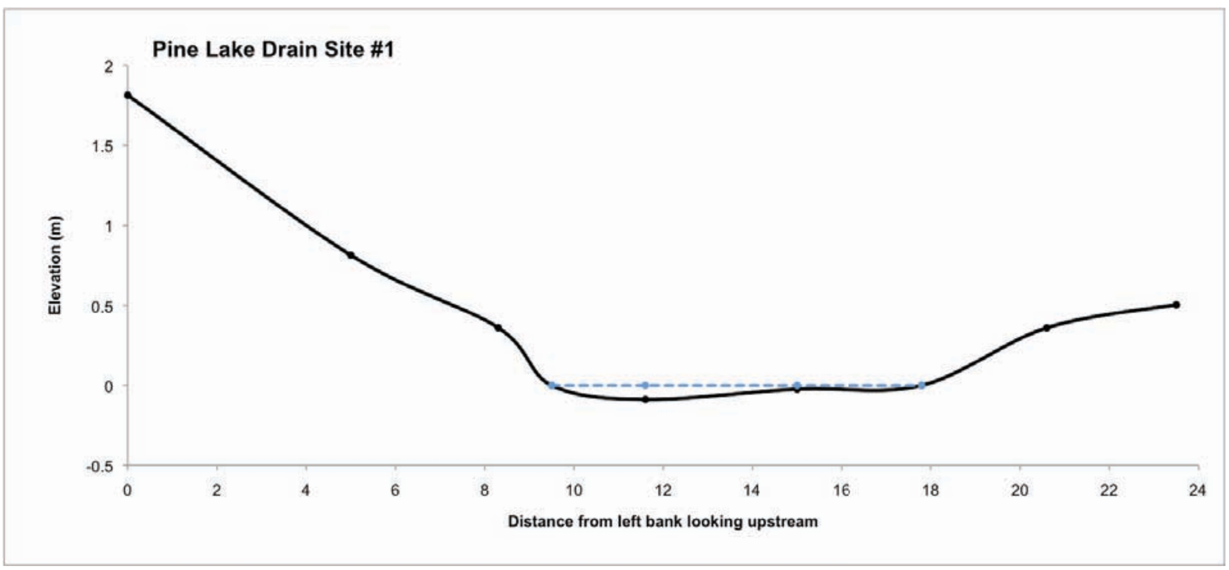

Camper Drain
Slope = 0.001892
Elevation (m)
Distance From Dog Lake (km)


Pioneer Drain
Slope = 0.001230
Elevation (m)
Distance From Dog Lake (km)

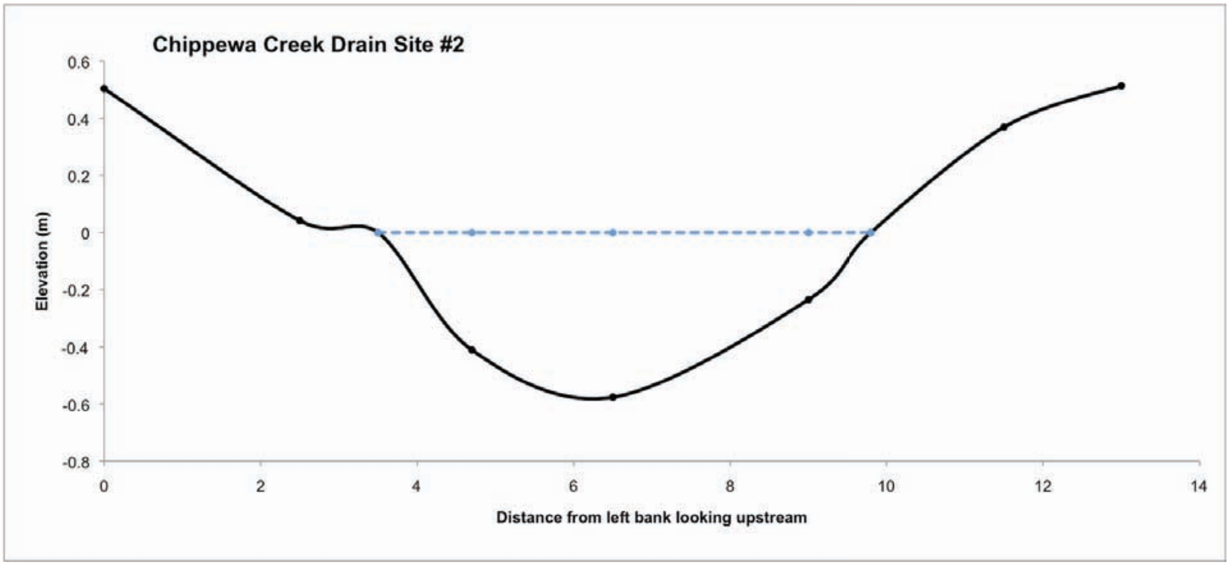

Marne Drain
Slope = 0.001653
Elevation (m)
Distance From Pioneer Drain (km)

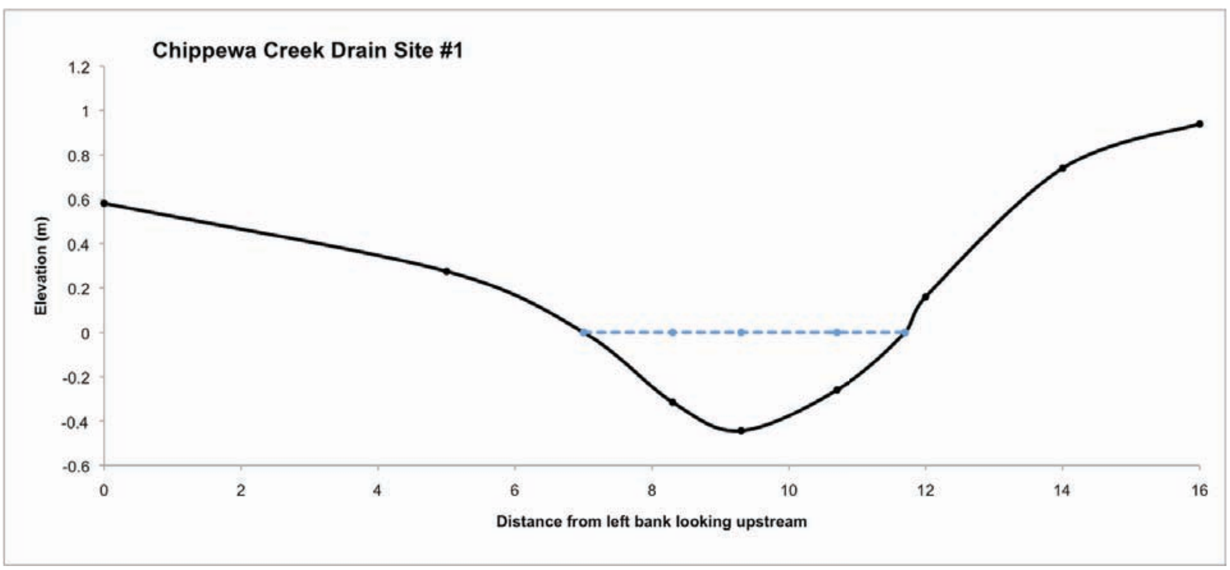
APPENDIX E: Cross-sectional profiles within the selected reaches of the tributaries examined during the 2011 Dog Lake Watershed assessment.



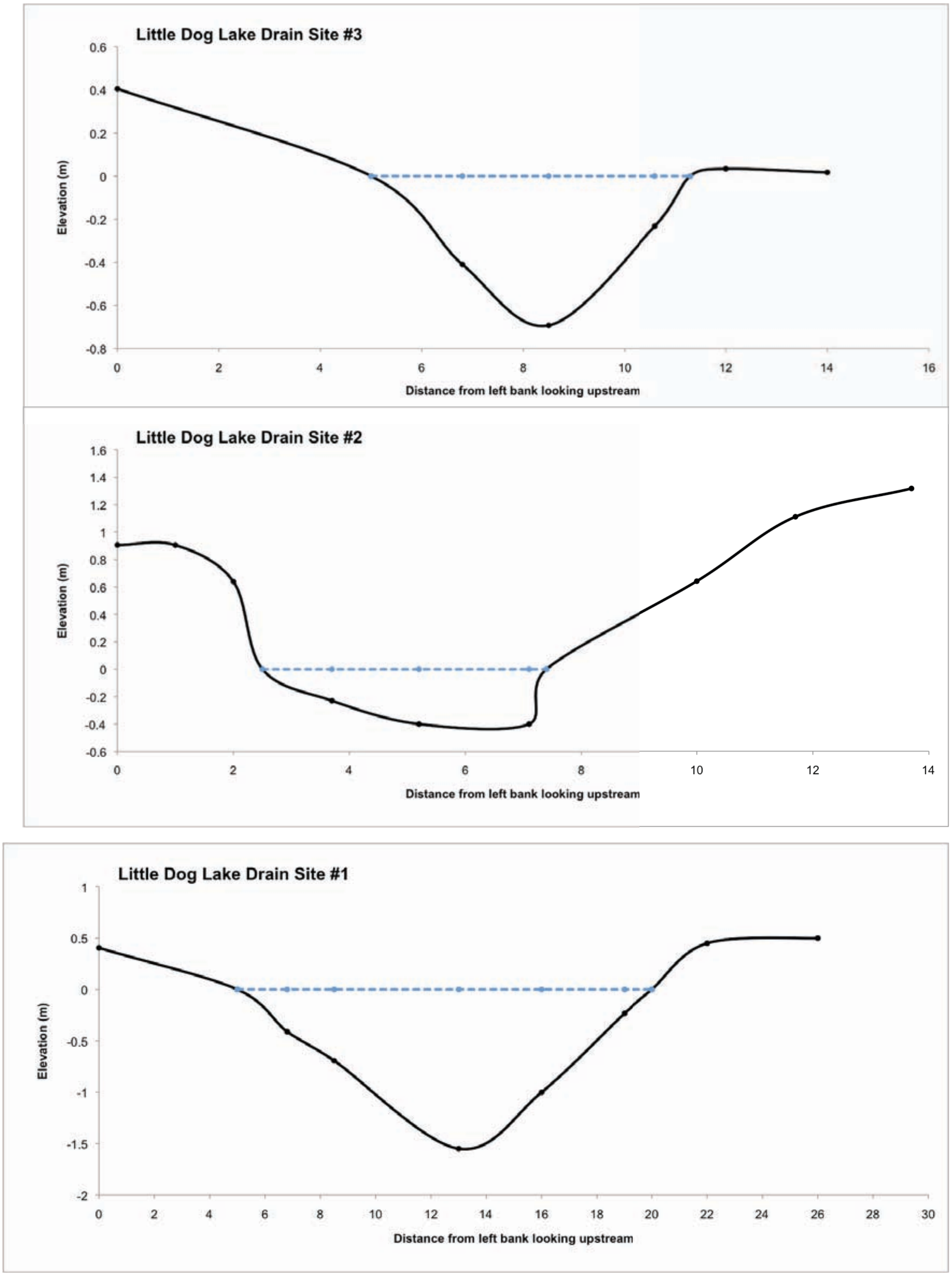


Appendix E-1. Pine Lake Drain cross-sectional profiles for the upper and lower reaches of the tributary.

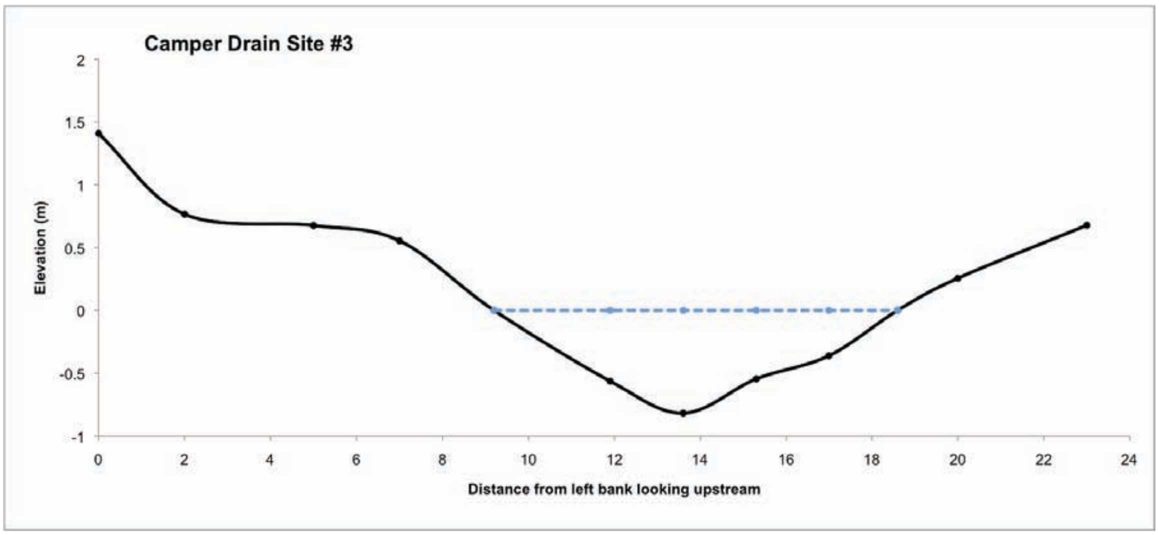




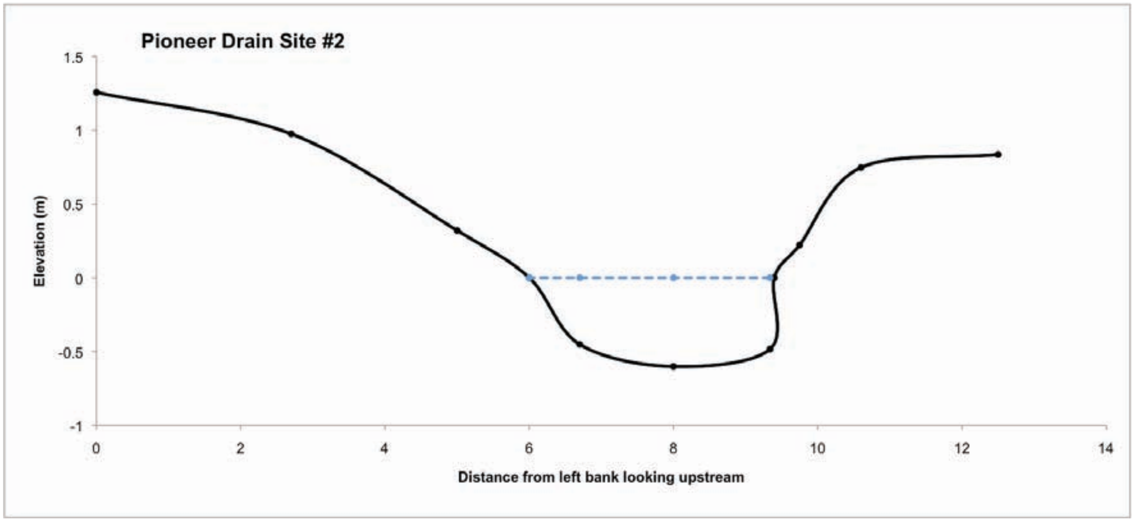
Appendix E-2. Chippewa Creek Drain cross-sectional profiles for the upper and lower reaches of the tributary.

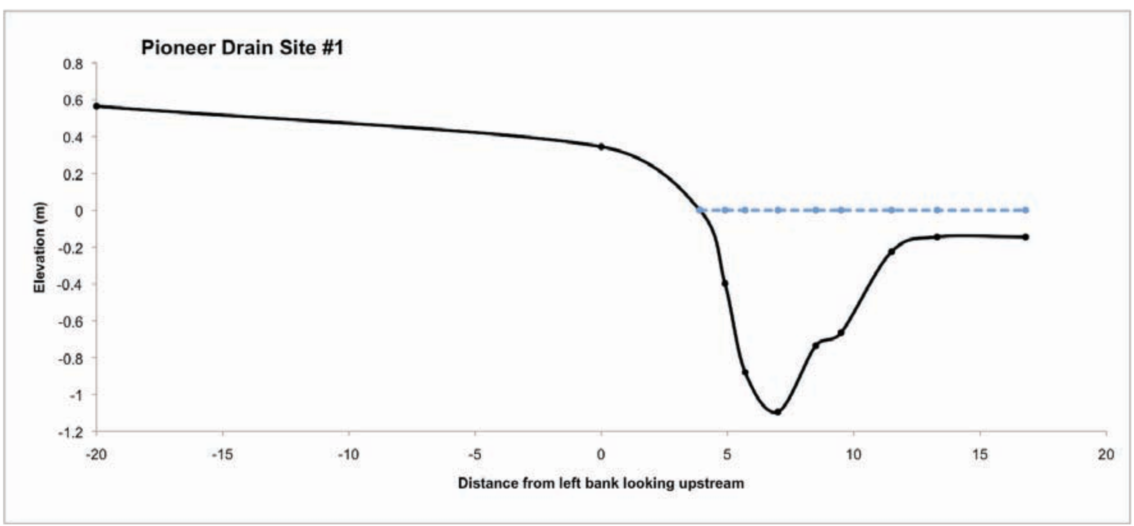


Appendix E-3. Little Dog Lake Drain cross-sectional profiles for the upper, middle and lower reaches of the tributary..

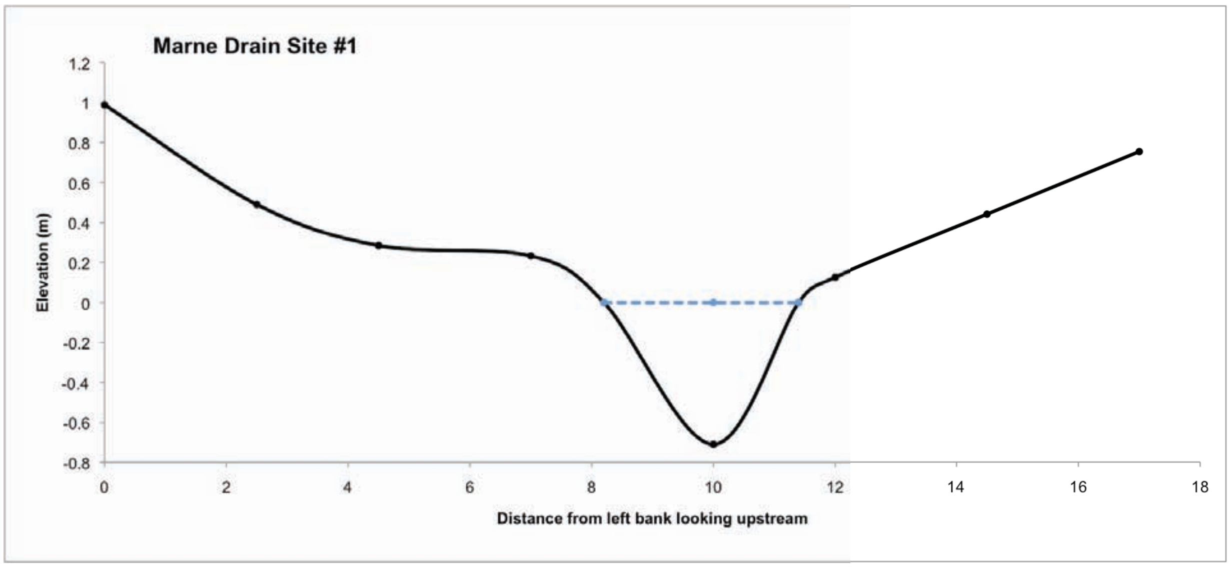


Appendix E-4. Camper Drain cross-sectional profiles for the middle reach of the tributary.

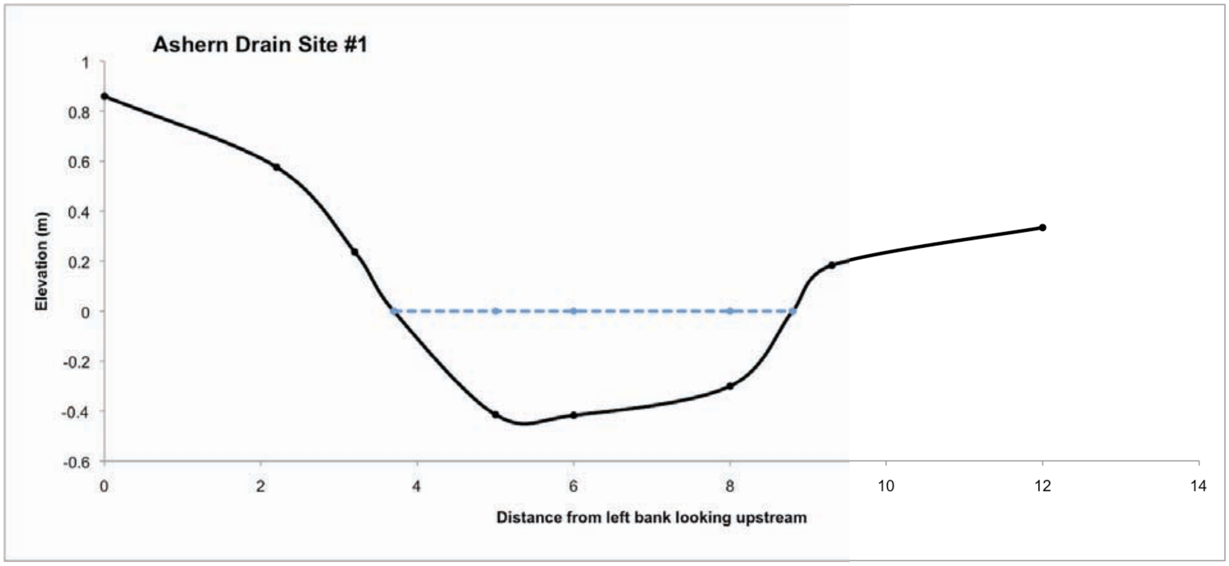


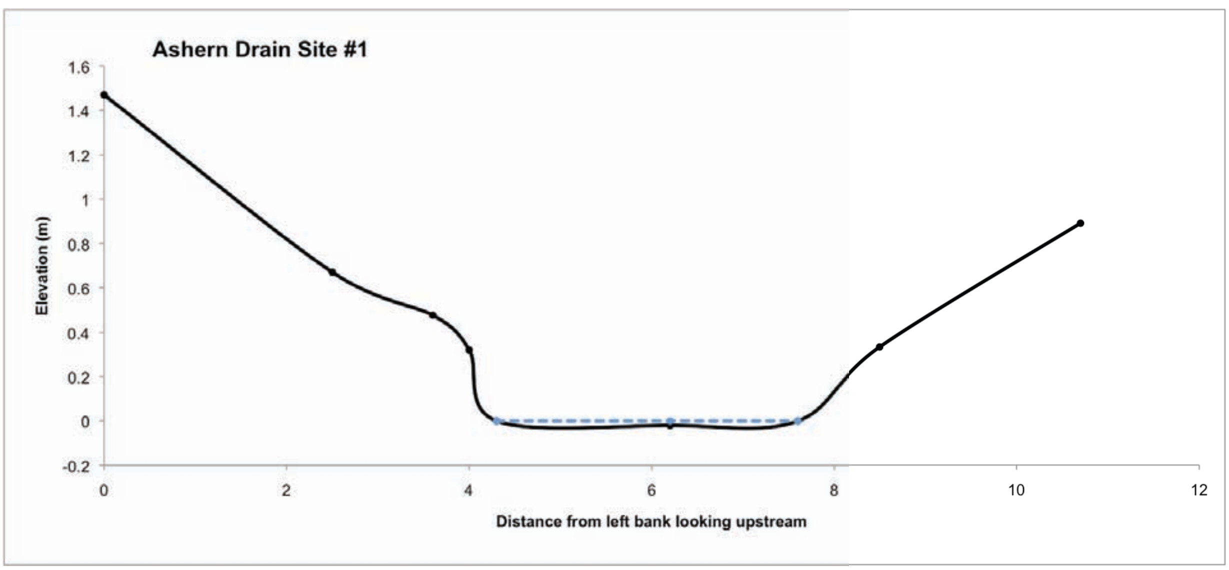


Appendix E-1. Pioneer Drain cross-sectional profiles for the middle and lower reaches of the tributary.

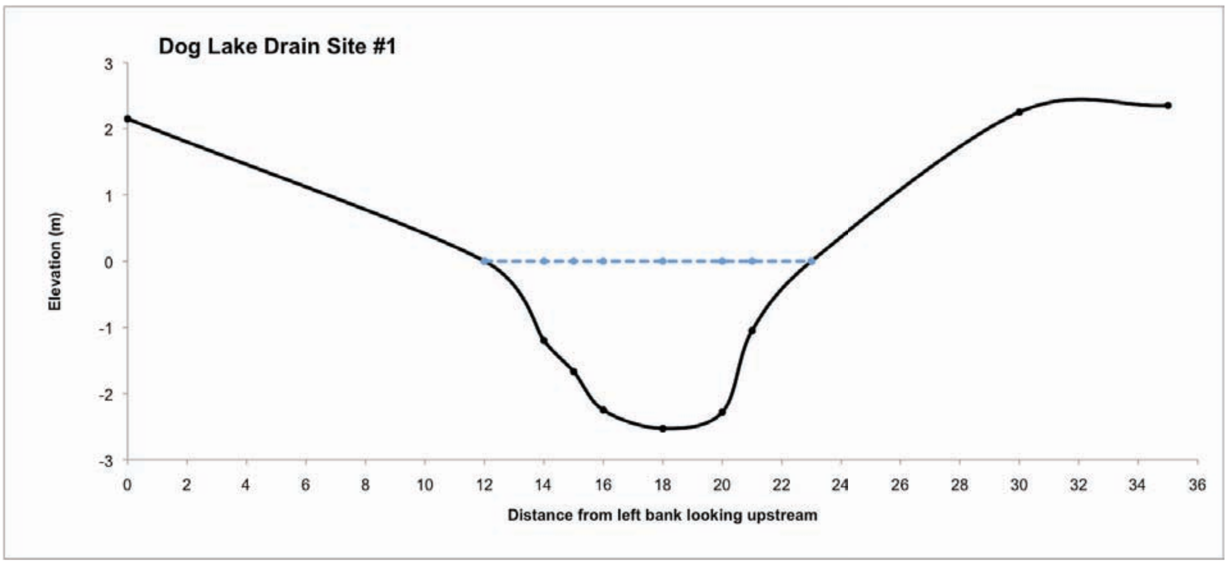


Appendix E-2. Marne Drain cross-sectional profiles for the lower reach of the tributary.



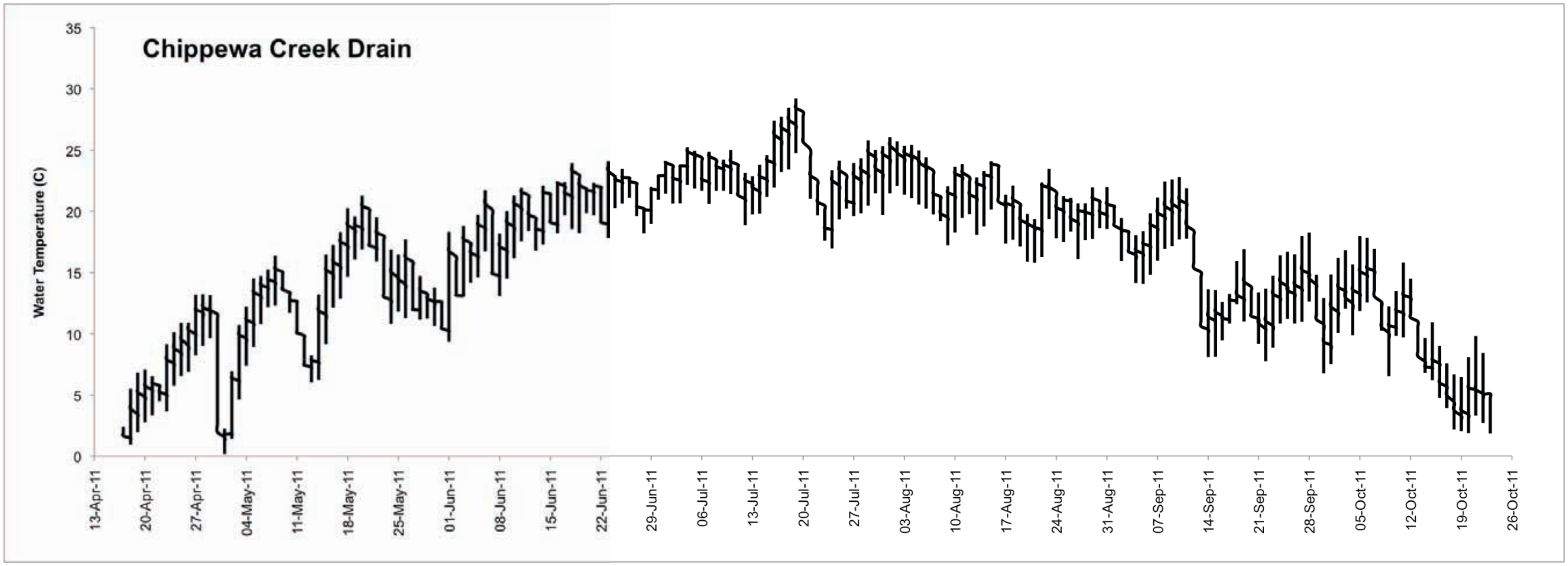


Appendix E-3. Ashern Drain cross-sectional profiles for the upper and lower reaches of the tributary.

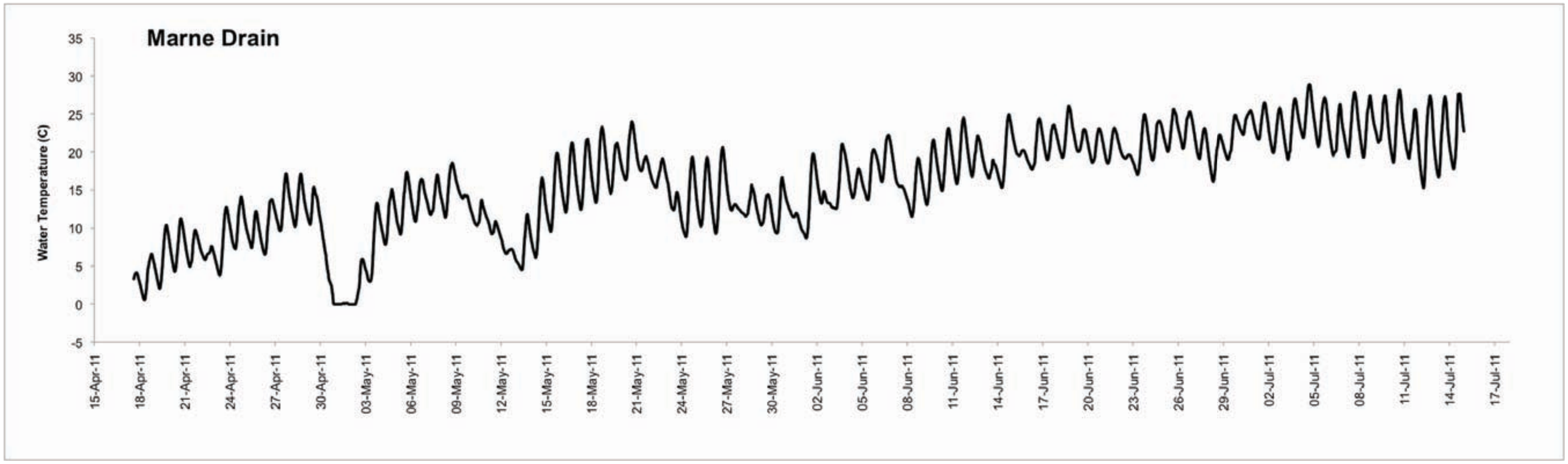


Appendix E-4. Dog Lake Drain cross-sectional profiles for the middle reach of the tributary.

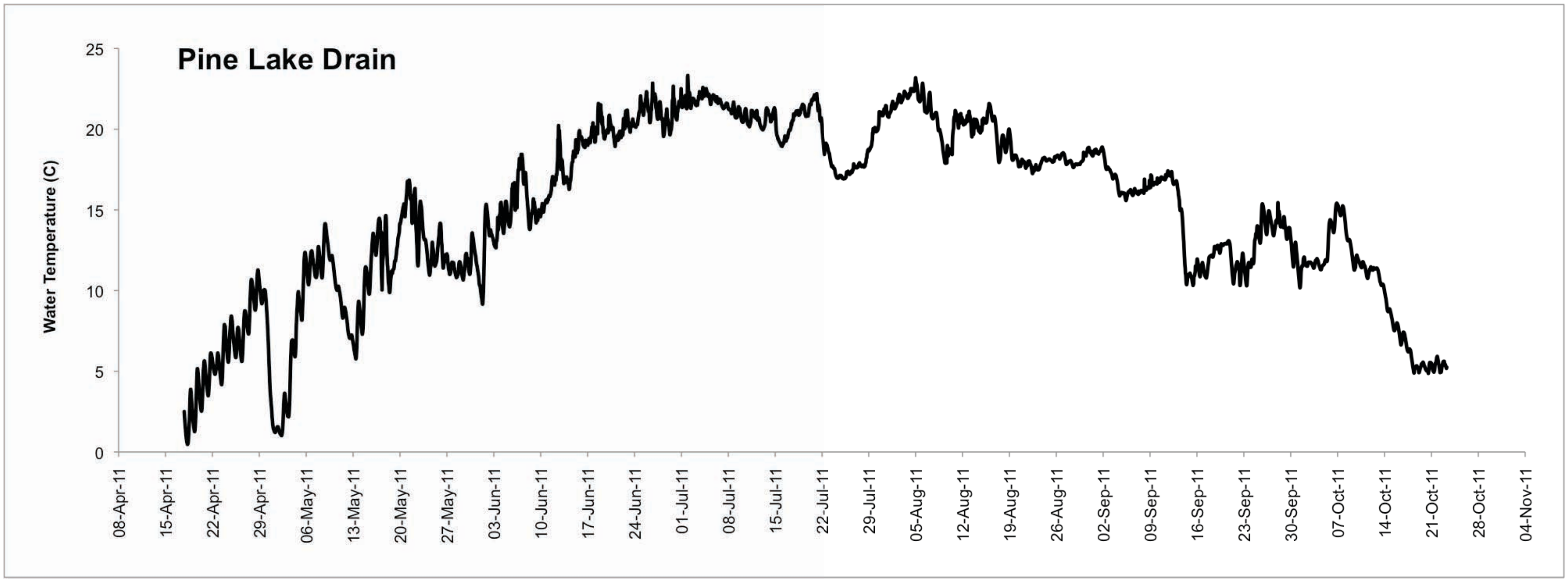
APPENDIX F: Water temperature data for the tributaries within the Dog Lake Watershed.



Appendix F-1. Water temperature within Chippewa Creek Drain during the 2011 open water season.



Appendix F-2. Water temperature within Marne Drain during the 2011 open water season..



Appendix F-2. Water temperature on Pine Lake Drain during the 2011 open water season..

APPENDIX G: Culvert Assessment Dog Lake Drain.

Appendix G-1. Chippewa Creek Drain culvert assessment. Velocity = m/s; Depth = m. Symbols N- North; S- South; NM – North Middle; SM- South Middle, E – East; W - West.

	Date	Longitude	Latitude	Culvert Number(s)	Diameter (m)	Velocity inlet	Depth inlet	Velocity outlet	Depth outlet
3rd order (10)	20-Apr-11	N50.85981	W98.23906	M	1.2	0.69	0.89	0.77	0.88
3rd order (8)	20-Apr-11	N50.84496	W98.24447	E	115	0.98	0.80	0.86	0.70
				W	115	0.85	0.80	0.54	0.75
3rd order (9)	20-Apr-11	N50.84726	W98.24266	E	0.90	0.95	74	1.25	74
				W	0.90	1.02	75	1.28	74
3rd order (10)	5-May-11	N50.85981	W98.23906	M	1.2	0.61	0.75	0.62	0.75

Appendix G-2. Ashern Drain culvert assessment. Velocity = m/s; Depth = m**.** Symbols N- North; S- South; NM – North Middle; SM- South Middle, E – East; W - West.

	Date	Longitude	Latitude	Culvert Number(s)	Diameter (m)	Velocity inlet	Depth inlet	Velocity outlet	Depth outlet
3rd order (8)	21-Apr-11	N51.18510	W98.37375	M	1.10	flooded	flooded	1.9	1.06
3rd order (6)	21-Apr-11	N51.18511	W98.42099	M	1.10	flooded	flooded	?	?
3rd order (2)	21-Apr-11	N51.18494	W98.46726	M	1.50	1.34	1.24	2.54	0.79
3rd order (2)	6-May-11	N51.18494	W98.46726	M	1.50	1.50	1.00	2.03	0.71

Appendix G-3. Pine Lake Drain culvert assessment. Velocity = m/s; Depth = m. Symbols N- North; S- South; NM – North Middle; SM- South Middle, E – East; W - West.

	Date	Longitude	Latitude	Culvert Number(s)	Diameter (m)	Velocity inlet	Depth inlet	Velocity outlet	Depth outlet
3rd order (2)	22-Apr-11	N50.85986	W98.35146	E	1.25	0.36	0.70	0.28	0.61
				M	1.25	0.42	0.66	0.47	0.55
				W	1.25	0.28	0.66	0.15	0.66
3rd order (1)	22-Apr-11	N50.84765	W98.36737	N	1.30	0.77	0.79	1.29	0.65
				S	1.30	1.08	0.73	1.28	0.68
3rd order (2)	22-Apr-11	N50.85986	W98.35146	E	1.25	0.33	0.67	0.31	0.63
				M	1.25	0.40	0.69	0.52	0.60
				W	1.25	0.23	0.65	0.15	0.61

Appendix G-4. Pioneer Drain culvert assessment. Velocity = m/s; Depth = m. Symbols N- North; S- South; NM – North Middle; SM- South Middle, E – East; W - West.

	Date	Longitude	Latitude	Culvert Number(s)	Diameter (m)	Velocity inlet	Depth inlet	Velocity outlet	Depth outlet
3rd order (3)	22-Apr-11	N51.09675	W98.42023	N	1.10	0.85	0.91	0.90	0.76
				S	1.10	0.86	0.97	0.68	0.88
3rd order (5)	22-Apr-11	N51.09672	W98.37336	N	1.30	0.89	1.30	0.90	0.90
				S	1.30	0.77	1.25	0.91	0.89
3rd order (11)	22-Apr-11	N51.10196	W98.28287	M	-	1.58	0.70	2.53	0.65

Appendix G-5. Little Dog Lake Drain culvert assessment. Velocity = m/s; Depth = m.

	Date	Longitude	Latitude	Culvert Number(s)	Diameter (m)	Velocity inlet	Depth inlet	Velocity outlet	Depth outlet
3rd order (6)	17-Apr-11	N51.02335	W98.35000	N	1.30	-	-	2.67	0.93
				S	1.30	-	-	2.69	0.95
3rd order (16)	22-Apr-11	N50.94856	W98.24660	E	1.30	1.20	0.61	0.55	0.73
				M	1.30	1.11	0.82	0.67	0.74
				W	1.30	0.96	0.82	0.79	0.88
3rd order (10)	22-Apr-11	N51.00039	W98.34989	N	1.30	0.64	1.07	0.68	0.95
				M	1.30	0.93	1.20	0.92	1.00
				S	1.30	0.88	1.11	1.03	0.95
3rd order (6)	22-Apr-11	N51.02326	W98.34998	N	1.30	1.12	0.90	1.44	0.77
				S	1.30	1.02	0.97	1.24	0.80
3rd order (3)	22-Apr-11	N51.02362	W98.37534	E	1.30	1.25	1.05	1.90	0.79
				W	1.30	1.14	1.05	2.01	0.80
3rd order (7)	22-Apr-11	N51.02334	W98.32654	N	1.30	1.10	0.87	0.90	0.96
				S	1.30	1.09	0.85	0.98	0.96
3rd order (9)	22-Apr-11	N51.02297	W98.31086	N	-	flooded	flooded	1.13	0.90
				S	-	flooded	flooded	1.48	1.05
3rd order (6)	5-May-11	N51.02335	W98.35000	N	1.30	1.10	0.80	1.73	0.62
				S	1.30	1.10	0.76	1.63	0.69
3rd order (10)	5-May-11	N51.00039	W98.34989	N	1.30	0.65	1.05	0.98	0.87
				M	1.30	1.01	1.10	1.10	0.95
				S	1.30	0.64	1.00	1.07	0.95

Appendix G-6. Camper Drain culvert assessment. Velocity = m/s; Depth = m. Symbols N- North; S- South; NM – North Middle; SM- South Middle, E – East; W - West.

	Date	Longitude	Latitude	Culvert Number(s)	Diameter (m)	Velocity inlet	Depth inlet	Velocity outlet	Depth outlet
3rd order (1)	22-Apr-11	N51.06707	W98.42027	N	-	0.60	0.80	1.81	0.62
				M	-	1.42	0.73	1.69	0.69
				S	-	1.02	0.91	1.26	0.62
3rd order (2)	22-Apr-11	N51.06715	W98.39681	N	-	0.56	0.95	1.06	0.78
				M	-	0.78	0.97	1.21	0.78
				S	-	0.72	0.99	0.94	0.87
3rd order (4)	22-Apr-11	N51.06707	W98.37335	N	-	1.22	0.90	2.35	0.75
				S	-	1.15	0.69	1.91	0.60
3rd order (6)	22-Apr-11	N51.06716	W98.31886	N	-	1.14	0.76	2.60	0.59
				S	-	1.38	0.94	2.56	0.65
3rd order (9)	22-Apr-11	N51.06721	W98.25903	M	1.50	1.9	0.86	fast	-
3rd order (4)	22-Apr-11	N51.06707	W98.37335	N	-	1.01	0.77	2.01	0.70
				S	-	1.05	0.81	2.47	0.55
3rd order (1)	18-May-11	N51.06707	W98.42027	N	-	0.66	0.60	1.63	0.49
				M	-	1.30	0.52	1.41	0.49
				S	-	0.62	0.66	1.33	0.51

Appendix G-7. Marne Drain culvert assessment. Velocity = m/s; Depth = m**.** Symbols N- North; S- South; NM – North Middle; SM- South Middle, E – East; W - West.

	Date	Longitude	Latitude	Culvert Number(s)	Diameter (m)	Velocity inlet	Depth inlet	Velocity outlet	Depth outlet
2nd order (9)	20-Apr-11	N51.14078	W98.36655	N	0.92	0.59	0.56	0.79	0.52
				S	0.92	0.60	0.55	0.64	0.53
2nd order (8)	20-Apr-11	N51.14070	W98.37341	N	0.75	0.27	0.74	0.28	0.54
				M	0.75	0.35	0.75	0.51	0.96
				S	0.75	0.25	0.69	0.27	0.74
2nd order (6)	22-Apr-11	N51.14086	W98.39703	N	0.85	0.52	0.49	0.43	0.48
				M	0.85	0.59	0.35	0.31	0.50
				S	0.85	0.48	0.41	0.50	0.52
2nd order (4)	22-Apr-11	N51.14076	W98.42037	N	0.85	0.42	0.42	0.28	0.50
				M	0.85	0.61	0.60	0.73	0.39
				S	0.85	0.42	0.55	0.28	0.40
2nd order (4)	22-Apr-11	N51.12615	W98.44383	M	1.10	1.13	0.81	2.38	0.54

APPENDIX H: Potential Rehabilitation Sites.

Appendix H. A list of potential rehabilitation sites to improve water quality and fish habitat within the Lake Francis Watershed.

Location	Type	Comment	Rehabilitation Efforts	Benefit	Northing	Easting
Pine Lake Drain	Class C Habitat	- reaches upstream of PTH 417 flow through confined livestock operations - the habitat and riparian zones are severely impact by livestock trampling impacting water quality, fish habitat, and the health of the aquatic environment.	- provide off site watering stations - fence off riparian zone to prevent livestock trampling - Re-seed channel preventing erosion and decreasing turbidity within the waterway	- increase water quality within drain - protect and enhance fish habitat	N50.86109 N50.88220	W98.35262 W98.34013
Chippewa Creek Drain	Class C Habitat	- lower reach of drain near Lake Manitoba flows through confined livestock operations - the habitat and riparian zones are severely impact by livestock trampling impacting water quality, fish habitat, and the health of the aquatic environment.	- provide off site watering stations - fence off riparian zone to prevent livestock trampling - Re-seed channel preventing erosion and decreasing turbidity within the waterway	- increase water quality within drain - protect and enhance fish habitat	N50.77141 N50.78118	W98.30106 W98.29151

Appendix H. Continued…

Location	Type	Comment	Rehabilitation Efforts	Benefit	Northing	Easting
Pine Lake Drain	Fish Habitat Enhancement	- enhancement efforts are need to restore the habitat and provide valuable spawning habitat for the fish communities of Lake Manitoba. - Pine Lake Drain is large drain within the watershed and has great potential to provide excellent spawning habitat for walleye	- provide additional spawning habitat by constructing spawning shoal or riffles within the channel	- creating spawning habitat to increase the spawning success of Lake Manitoba fish species	N50.84765	W98.36737
Pioneer Drain	Class C Habitat	- the habitat downstream of #6 highway flows through unrestricted livestock areas - the habitat and riparian zones are severely impact by livestock trampling impacting water quality, fish habitat, and the health of the aquatic environment along sections of the drain	- fence off riparian zone to prevent livestock trampling - Re-seed channel preventing erosion and decreasing turbidity within the waterway	- increase water quality within drain - protect and enhance fish habitat	N51.08393 N51.08198	W98.43591 W98.43738
Chippewa Creek Drain	Fish Habitat Enhancement	- enhancement efforts are need to restore the habitat and provide valuable spawning habitat for the fish communities of Lake Manitoba. - Chippewa Creek Drain is a large drain within the watershed and has great potential to provide excellent spawning habitat for walleye	- provide additional spawning habitat by constructing spawning shoal or riffles within the channel	- creating spawning habitat to increase the spawning success of Lake Manitoba fish species	N50.81552	W98.25091

Appendix H. Continued…

Location	Type	Comment	Rehabilitation Efforts	Benefit	Northing	Easting
Little Dog Lake Drain	Class C Habitat	- lower reach of drain near Dog Lake flows through confined livestock operations - the habitat and riparian zones are severely impact by livestock trampling impacting water quality, fish habitat, and the health of the aquatic environment.	- provide off site watering stations - fence off riparian zone to prevent livestock trampling - Re-seed channel preventing erosion and decreasing turbidity within the waterway	- increase water quality within drain - protect and enhance fish habitat	N51.02303 N51.02035	W98.38951 W98.38723
Little Dog Lake Drain	Class C Habitat	- reach downstream of Elk Lake flows through livestock operations - the habitat and riparian zones are severely impact by livestock trampling impacting water quality, fish habitat, and the health of the aquatic environment.	- fence off riparian zone to prevent livestock trampling	- increase water quality within drain - protect and enhance fish habitat	N50.98178 N50.98593	W98.31493 W98.32754
Various Drain	Velocity Barriers	- Conduct additional monitoring of the culverts identified as barrier under low flow conditions to determine the impact they may pose long term on the fish communities	- Additional monitoring	- Save money if the problem only exist 1 in every 10 years -if problem is yearly remove barrier by altering culvert crossing	Refer to Appendix G (Culvert Assessment)	