EAST INTERLAKE CONSERVATION DISTRICT: ICELANDIC RIVER WATERSHED RIPARIAN ASSESSMENT SURVEY – WITH EMPHASIS ON THE ICELANDIC RIVER AND ASSOCIATED DRAINS – 2006 and 2007

A Report Prepared
for

by

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EXECUTIVE SUMMARY

The East Interlake Conservation District (EICD) invited North/South Consultants Inc. to conduct the *Icelandic River Watershed – Riparian Assessment Survey.* The primary objective of this survey was to provide the EICD board with a comprehensive overview of riparian and land use conditions affecting the Icelandic River watershed.

The Icelandic River flows through level to depressional areas, comprised of imperfectly to poorly and very poorly drained soils (i.e., clayey to loamy lacustrine) and is subject to flooding when levels in Lake Winnipeg are high or during high precipitation events. Drainage was enhanced in the early 1960s to assist in the removal of surface waters for agriculture and straightened to speed flows.

Water quality of the Icelandic River was assessed using water quality data collected by Manitoba Water Stewardship (i.e., "historical" data, Water Quality Management Section 2006), provincial water quality reports (Green 1996b and 1997), and through collection of *in situ* measurements during the conduct of the field survey in 2006. Historical pH values measured by Manitoba Water Stewardship (2006) in the Icelandic River were in compliance with the Manitoba Water Quality Guidelines (Tier III) for aquatic life and recreation. During the winter months (1994-1998), dissolved oxygen concentrations often failed to comply with the Manitoba Water Quality Objectives (Tier II) for the protection of cool water aquatic life (instantaneous minimum of 3.0 mg/L when $\leq 5°C$); however, during the open-water season dissolved oxygen concentrations were typically in compliance. Green (1997) reported that in 1995 and 1996, ammonia concentrations in the Icelandic River were typically in compliance with the Manitoba Guidelines for the protection of aquatic life, but that concentrations of phosphorous were typically above the narrative guideline for streams (0.05 mg/L).

In situ water quality measurements (collected by North/South Consultants) were taken along the Icelandic River and associated drains in May, July, and October, 2006. With one exception, dissolved oxygen concentrations at all sites were in compliance with the Manitoba Water Quality Objectives for the protection of cool water aquatic life (instantaneous minimum of 5.0 mg/L when $> 5°C$). Measuring amounts of phosphorus and nitrogen within the system was outside the scope of this study.

On May 9, a turbidity reading taken in the Shurkas Drain measured >1000 NTU. This reading was taken during a heavy rain fall event downstream of a non-vegetated field. Sediments were observed being flushed into the Shurkas Drain from a roadside ditch.

Historical fisheries records and investigations indicate that at least 12 families of fish, representing 35 species, have utilized the Icelandic River watershed. None of the species identified are listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered, threatened, or of special concern.

The Icelandic River is considered, historically, to be one of the most important spawning tributaries on the western side of the south basin of Lake Winnipeg for species such as walleye (MWSFB Icelandic River File, 1990). However, agricultural activity and drainage works have impaired the spawning habitat for a variety of recreational and commercial species.

Approximately 151 km of the Icelandic River watershed was classified according to land use/cover. Nearly 100 km (n = 99) of this classification was conducted along the mainstem of the Icelandic River. Representative flights, and subsequent land use/cover classifications, were also completed along the Bluegoose (3 km), North Crooked Lake (9 km), Rembrandt (12 km), Shurkas (7 km), Silver (12 km), Sylvan (4 km), and Vidir drains (5 km).

Throughout the Icelandic River watershed, hayland (25%), pasture/grazing (23%), cropland (19%), and other agricultural land (14%) composed the greatest land use/cover. The remaining classifications comprised residential/commercial (4%), non-forested wetland (4%), mixed forest land (4%), forested wetland (4%), deciduous forest land (2%), and other urban or built up land (1%).

Approximately 151 km of the Icelandic River watershed (Icelandic River and seven associated drains) were rated according to habitat quality. Highly impacted areas (Class C) composed the largest segment (55%), followed by: severely impacted (Class D, 25%); moderately impacted (Class B, 14%); and minimally impacted areas (Class A, 6%).

A total of 28 potential barriers were identified throughout the Icelandic River watershed. The majority of these were identified as beaver or debris dams (n = 15), followed by: fords (n = 9); man-made barriers (n = 2; rubble); the Arborg Dam; and a gradient control structure/fish ladder.

Based on a review of the aerial video, historical information, and groundtruthing, 85 potential rehabilitation sites, prioritized on a scale from 1 to 3, were identified within the

Icelandic River watershed. Based on the objectives outlined in this document, a review of the Icelandic River watershed reveals an area highly impacted by anthropogenic sources. The natural topography of the region and current land use practices continue to place stressors on the watershed.

ACKNOWLEDGMENTS

The Manitoba Water Stewardship Fisheries Branch (Winnipeg) is thanked for conducting a search of their Fisheries Inventory and Habitat Classification System.

Fieldwork described within this report was conducted under Scientific Collection Permits 18-06 and 02-07, issued to North/South Consultants Inc. by Manitoba Water Stewardship, Fisheries Branch.

Members from Manitoba Water Stewardship Fisheries Branch – Gimli and the East Interlake Conservation District are thanked for providing assistance and logistical support during the 2007 fish utilization component of this study.

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1.0 INTRODUCTION

The use of fresh water resources, through practices such as agriculture, urban expansion and development, and recreation has strained this natural commodity. Recent policy developments (e.g., The Manitoba Water Strategy, 2003; *Water Protection Act,* proclaimed in 2006) focus on a number of water protection strategies, with priorities centered on watershed planning and a reduction in nutrient loading to Lake Winnipeg.

With funding obtained by the Manitoba Fisheries Enhancement Initiative fund and the federal Stewardship in Action fund, the East Interlake Conservation District (EICD) retained North/South Consultants Inc. to conduct the *Icelandic River Watershed -Riparian Assessment Survey.* The primary objective of this survey was to provide the EICD board with a comprehensive overview of riparian and land use conditions affecting 3rd order drains (and higher) within the Icelandic River watershed. Specific objectives of the assessment included:

- To identify and assess the quality of riparian and aquatic ecosystem habitat;
- To identify barriers to fish passage and migration;
- To identify utilization of recreationally important fish species in the watershed; and
- To provide a list of potential fisheries-based projects for future works within the Icelandic River watershed.

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

2.0 METHODS

The study area for the Icelandic River watershed riparian assessment survey includes the Icelandic River and the following drains (3rd order sections and higher): Bluegoose; North Crooked Lake; Rembrandt; Shurkas; Silver; Sylvan; and Vidir (Figure 1).

2.1 HISTORICAL REVIEW

2.1.1 Physical and Hydrological Information

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

Using a USGS digital elevation model (DEM), an elevation profile was generated along the Icelandic River. The profile was produced by intersecting points along the Icelandic River watershed polylines with 90 metre Shuttle Radar Topography Mission (SRTM) USGS DEM, using Spatial Analyst extension in ESRI ArcGIS® v.9.

2.1.2 Water Quality

Historical water quality information (1994 – 1998) was obtained from the Water Quality Management Section, Manitoba Water Stewardship (WQMS 2006). The data were sorted and tabulated to assist in the recognition of water quality trends and compared to Manitoba Water Quality Standards, Objectives and Guidelines (Williamson 2002) and Canadian Environmental Quality Guidelines (CCME 1999).

2.1.3 Fish Species Utilization

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

2.2 FIELD SURVEYS

2.2.1 Aerial Videography

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

The aerial videography flight was conducted on September 22, 2006 at an altitude of 500 to 600 m depending on width of stream.

2.2.2 Groundtruthing

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

2.2.3 Physical and Hydrological Information

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

2.2.4 Water Quality

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

2.2.5 Fish Species Utilization

2.2.5.1 Spring 2006

Hoop nets (1.2 m in diameter, constructed of 6.45 cm^2 nylon mesh, and 10.0 m long wings) were deployed (May 8 to 10) to capture fish moving either upstream or downstream (Photo 1). All fish captured were identified to species, measured for fork length (± 1 mm) and

Photo 1. Example of hoop nets used to capture migrating fish. This hoop net was located approximately 100 meters downstream of the Arborg Dam.

weight (± 25 g), classified by sex and state of maturity, and released.

Larval drift traps were deployed (May 8 to 10) to capture either drifting eggs or recently emerging larval fish. The larval drift traps used for this study had an opening 15 x 15 cm

and a 1 m long cod end constructed of 500 µm Nitex mesh. Fine mesh dip nets (500 µm Nitex mesh) were also used to capture drifting larval fish.

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

2.2.5.2 Summer 2006

Fish use within the Icelandic River watershed was assessed during summer over a two day survey period (July 12 to 13). Methods included back-pack electrofishing (Smith-Root Model 15-C), beach seining, dip netting, and visual surveys (Photos 2 and 3). Sampling was conducted at sites throughout the watershed, where access was available, and where spring hoop nets were deployed. All fish collected were identified to species and released. Some of the larger bodied fish were measured for fork length (± 1 mm). A number of the small-

Photo 2. Back-pack electrofishing just downstream of the Arborg Dam.

bodied fish were preserved in the field (10% formaldehyde solution) for subsequent identification.

Photo 3. Beach seine used to capture small bodied fish on the Icelandic River. This location is just downstream on the Arborg Dam.

2.2.5.3 Spring 2007

Hoop nets (described in Section 2.2.5.1) were oriented along the Icelandic River to capture upstream migrating fish (April 10 to 20, 2007). Specific objectives included: determination of species utilization; extent of migration past potential barriers; and identification of specific spawning sites. Hoop net locations were determined based on work conducted in 2006 and included three main sites: downstream of the Arborg Dam; downstream of the Arborg Ford; and downstream of the fish ladder.

All fish captured were identified to species, measured for fork length (± 1 mm) and weight (± 25 g), and classified by sex and state of maturity. Prior to release, fish received a fin clip specific to capture location (left pelvic downstream of Arborg Dam; upper caudal downstream of the Arborg Ford; and right pelvic downstream of the fish ladder) to determine migration extent. Only the distal tip of each fin was removed.

2.2.6 Benthic Invertebrate Collection

Sampling methodology was developed to provide a broad, repeatable characterization of the benthic macroinvertebrate fauna of the Icelandic River and streams in the East Interlake area. Methodologies are based on those described in: Plafkin et al. (1989); Zamora-Munoz and Alba-Tercedor (1996); Wright et al. (2000); and Hughes (2001) for the establishment of rapid bioassessment techniques. Sites were selected in the vicinity of existing water quality stations (if possible) and at those sites where the water was shallow enough to allow wading. If sites were not wadeable, sampling locations were selected and conducted along the shoreline of the stream. In some cases, where the water was too deep and/or fast for a kick net sampler, samples were collected within a 1 km area of the water quality station from a boat using a Tall-Ekman. Regardless of sampling technique, a total of five samples were taken from each sampling site on October 19, 2006.

The kick net used was constructed of 500 µm nitex mesh, having an aperture of approximately 0.25 m^2 (Photo 4). The field technician stood in the selected site with their back facing upstream, kicking up the substrate and then sweeping above the disturbed area to capture dislodged or escaping invertebrates into the kick net. The technician passed over an approximate $1m^2$ area twice in a standard time interval (e.g., 5 minutes), frequently emptying the net contents into a bucket to reduce sample loss and net clogging.

Photo 4. Example of kick net used and collection of invertebrates by technician.

The Tall-Ekman dredge had a 0.023 m^2 opening and had lead weights attached to assist in substrate penetration when lowered from a boat.

Benthic invertebrates were collected from three reaches (lower, middle, upper) along the Icelandic River. Prior to preservation in the field (10% formaldehyde solution), invertebrate samples were rinsed through a 500 µm sieve and placed in individually labelled jars. Invertebrates were then identified to Family and enumerated.

2.3 WATERSHED CLASSIFICATION

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

2.3.1 Land Use/Cover

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

Land use/cover within the Icelandic River watershed was delineated into 10 general categories as outlined below. The categories were developed by North/South Consultants Inc. based on the predominant land use practices found in Manitoba and by implementing classifications described by Anderson et al. (1976). The categories focus on reaches of the watercourses and the predominant land use adjacent to them. Although reaches classified often incorporated more than one land use type, classification of the reach was based on the most intensive land use within the area.

Residential/Commercial: Anderson et al. (1976) define residential as the multiple unit structures of urban cores to houses on lots of more than one acre. Generally, residential strips have uniform size and spacing of structures, linear driveways, and lawn areas. Examples of residential areas are towns or the recently developed ‘suburbs’ of these small towns. The Commercial classification outlines areas used for the sale or production of goods

and services, and may include: warehouses; waste disposal areas; strip developments; junkyards; etc. (Anderson et al. 1976).

Other Agricultural Land: This category is applied when separate land uses cannot be mapped individually and may include residential, commercial, or industrial practices (Anderson et al. 1976). In addition to the Anderson et al. (1976) definition, this classification is also inclusive of farmsteads, holding areas for livestock (i.e., corrals), and structures associated with agricultural practices (e.g., barns, storage silos, etc.). Typically, practices under this category are on a smaller scale than confined feeding operations or mixed urban/built-up land uses (for example).

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

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

Hayland: This category is defined as land used for the production of forage crops for livestock (e.g., alfalfa, timothy, etc.). Hayland crops are often characterized by hay bales spotting the landscape adjacent to watercourses. In the Icelandic and Washow Bay watersheds, hayland is often associated with cropland, where hayland consists of narrow strips along the riparian zone and cropland extends out beyond the hayland.

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

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

Non-Forested Wetland: This category is defined as an area dominated by natural herbaceous vegetation. These areas tend to be more 'natural', have few linear patterns, and are characterized by smooth, undulating textures and random patterns.

Forested Wetland: This category is defined as a wetland with a water table at/near the land surface and dominated by woody vegetation (Anderson et al 1976).

Mixed Forest Land: This classification includes forested areas where evergreens and deciduous trees are growing, yet neither predominates (Anderson et al. 1976). The Icelandic and Washow Bay watersheds contain parcels of mixed forest lands throughout. The contrast between coniferous and deciduous tree species is much more prominent in the fall.

Residential/commercial, other agricultural land, other urban or built-up land, cropland, hayland, and pasture/grazing, are considered to be anthropogenic in origin. Deciduous forest land, non-forested wetland, forested wetland, and mixed forest land are assumed to be in a natural state or area areas that have not necessarily been altered by anthropogenic means.

Although not identified as specific land use/cover drains were identified via aerial videography and groundtruthing efforts. In the context of this report, drains are defined as artificial waterways used for irrigation, drainage, flood prevention, etc. These areas are typically linear and sometimes associated with fords and a marginal/non-existent riparian area.

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

2.3.2 Aquatic Habitat Conditions

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

The classification system was based on identifying potential impacts as a True or False attribute (i.e., 1 or 0 within the geodatabase) within three criteria for each reach. For example: if a reach of stream exhibited a denuded riparian zone on one or both banks, it would receive an attribute value of 1 (true) for the riparian zone criteria. If the stream banks

showed excessive erosion or slumping, this reach would receive an additional value of 1 (true), and so on. The three criteria selected were: channel morphology (hydrologic alterations and channelization), bank stability, and intactness of the riparian zone. These criteria were chosen based on their relative importance to stream health described within the USDA Stream Visual Assessment Protocol (1998) and the ability to interpret these criteria using the quality of the videography.

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

2.3.2.1 Channel Morphology

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

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

True Condition(s):

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

False Condition(s):

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

2.3.2.2 Bank Stability

Stream banks are important transition zones between aquatic and terrestrial systems (Bain and Stevenson 1999). Eroding banks can reduce instream fish cover, reduce water

transparency, smother fish eggs and benthic invertebrates with silt, and infill shallow water habitats (Bain and Stevenson 1999). Although some bank erosion is normal in a healthy watershed system, excessive erosion can occur when riparian areas are degraded, hydrology is altered, or when sediment load is increased (USDA 1998).

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

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

True Condition(s):

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

False Condition(s):

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

2.3.2.3 Riparian Zone Function

The riparian zone is defined as an area adjacent to a body of water or as the transition zone between aquatic and upland areas; it can also be referred to as riparian buffer zone, buffer strip, or vegetation retention zone (Kipp and Callaway 2003; Williams et al. 1997; Bain and Stevenson 1999). The health of the riparian zone is fundamental to the well-being of an entire stream ecosystem (USDA 1998). A healthy riparian zone can: buffer the introduction of pollutants and/or organic matter to a stream; regulate instream algal production via shading; decrease erosion by stabilizing stream banks and dissipating energy during flood

events; provide a source of cover, food, and microclimate control for fish and invertebrates; and act as a travel corridor for terrestrial animals/birds (Williams et al. 1997; USDA 1998; Bain and Stevenson 1999; Koning 1999; AAFC-PFRA 2004b).

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

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

True Condition(s):

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

False Condition(s):

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

2.3.3 Aquatic Habitat Quality Rating

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

- Class D: Stream reaches within this category are severely impacted and generally characterized by altered channels and a heavily altered hydrologic regime. There is a lack of vegetation regeneration within the riparian zone. Because of this, the filtering function of the riparian zone is severely compromised. Bank stability is generally unstable within this class.
- Class C: Stream reaches within this category are highly impacted and generally have altered hydraulic regimes (e.g., channelization, barriers). Bank stability in this class tends to be moderately stable. Reaches with marginal riparian vegetation may have a moderate filtering capacity.

- Class B: Stream reaches in this category are moderately impacted, and typically have a more natural channel morphology and hydrologic regime than Class C reaches. Bank stability in this class tends to be moderately stable. Commonly, a margin of natural vegetation may remain, increasing bank stability and buffering capacity. Some stream reaches in this category have more 'natural' conditions on one bank and a greater amount of impact on the opposite bank.

- Class A: Stream reaches within this category are minimally impacted and tend to have natural channel morphology. The riparian vegetation, which is typically present on both stream banks, provides a high level of buffering capacity, fish habitat, and bank stability.

2.3.4 Potential Barriers

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

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

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

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

Fords are typically defined as low-water stream crossings with bank access allowing either temporary or permanent passage to vehicles and livestock (Fisheries and Oceans - Manitoba Natural Resources 1996; Armantrout 1998). Within this document, ford composition may include naturally occurring materials (e.g., stream bed), transported aggregate (e.g., gravel, boulder, cobble), or a low level composition of cement and culvert. Although allowing some fish passage via culvert placement, the cement culvert ford is considered a potential barrier.

Fish passage may be hindered at these sites by impeding upstream spring migrations during low water events and/or downstream migrations during similar hydrologic conditions. The culverts may also act as velocity barriers or become plugged with debris.

Culverts are also listed as potential impediments to fish migration if they act as velocity barriers, become plugged with debris, or are perched.

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

Given the limitations of aerial videography, location (e.g., under bridges), and logistics involved with groundtruthing, it is expected that some barriers were not identified.

2.3.5 Potential Rehabilitation Sites

Potential rehabilitation sites were determined from a review of the aerial footage and the groundtruthing of specific sites. Once reviewed, sites were prioritized using a scale from 1 to 3. Sites identified as priority 1 (highest priority) were often 'large' in scale, exhibiting multiple environmental issues (e.g., water quality degradation, shoreline erosion, denuded riparian) that may warrant more immediate attention (i.e., rehabilitation efforts). These sites typically had more direct negative impacts to the health of the watershed and fell within Class D and C reaches. Conversely, sites labelled as priority 3 (lowest priority) were often 'smaller' in scale, exhibiting only one environmental concern. However, sites identified as priority 3 are also areas in which long-term planning could be required or where a site cannot be returned to its 'full' potential within a reasonable time frame (USDA 2004). These sites could be located in Class D reaches, but were typically found in Class C and B reaches.

2.3.6 Instream Flow Requirements

A literature review was conducted regarding the instream flow requirements for regionally significant fish species identified in the watershed.

3.0 RESULTS AND DISCUSSION

3.1 HISTORICAL REVIEW

3.1.1 Physical and Hydrological Information

The Icelandic River watershed is approximately 1300 km^2 (Manitoba Water Resources 1983 *in* Green 1996a). Originating west of the community of Poplarfield, the Icelandic River flows in an easterly direction through the larger communities of Arborg and Riverton where it empties into Lake Winnipeg. The entire Icelandic River watershed falls within the Boreal Plains Ecozone and is characterized by forest stands of trembling aspen, balsam poplar, and white spruce (Smith et al. 1998 *in* AAFC-PFRA 2004a). Manitoba maple, green ash, elm, and cottonwood dominate along riverbanks; marshes support reeds, cattails, and sedges; and depressional areas host willows, sedges, and meadow grass (AAFC-PFRA 2004a).

The elevations of and a longitudinal profile for the Icelandic River are illustrated in figures 1 and 2. The watershed is located in the Icelandic River Lowland where elevations vary from 248 m above sea level (masl) in the southwest to 214 masl at Lake Winnipeg (Land Resource Unity 1999). The land is typically level or depressional, comprised of imperfectly to poorly and very poorly drained soils (i.e., clayey to loamy lacustrine) and is subject to flooding when Lake Winnipeg water levels are high or during high precipitation events (Land Resource Unit 1999). Drainage within the watershed was enhanced during the early 1960s to facilitate runoff of surface waters and improve conditions for agriculture (MWSFB, Icelandic River file, circa 1996; Land Resource Unit 1999).

Typically, drains are constructed to either remove excess water from fields or to supply irrigation water to areas that require water (Evanitski, no date; AAFC-PFRA 2004b). Although drains can offer certain agricultural advantages (e.g., earlier planting times), there are environmental concerns associated with them. An accelerated removal of water from fields can place rivers into a flood or near flood stage, increasing the risk of erosion and bank failure (AAFC-PFRA 2004b). Man-made drains are also often associated with marginal riparian zones, which are unable to act as effective buffers (Department of Fisheries and Oceans 1995; AAFC-PFRA 2004b). Portions of the Icelandic River have either been dyked (e.g., near and through the Village of Riverton) to prevent flood events or channelized (e.g., headwaters upstream of Morweena) to improve drainage.

One Environment Canada hydrometric gauging station was identified in the watershed. Located near Riverton, Station # 05SC002, has been recording hydrometric data on the Icelandic River since 1958 (ECWSC 2006). Monthly mean flows for April and July, and the median, upper, and lower quartiles are presented on figures 3 and 4. Monthly daily discharges for 2006 are also provided in Appendix 1.1.

Icelandic River discharges can fluctuate rapidly during the spring freshet, especially during the month of April (Figure 3). Spring discharges, coinciding with precipitation events into the summer, traditionally generate higher flow rates between April and June with peak discharges occurring in April (AAFC-PFRA 2004a).

3.1.2 Water Quality

There are limited data available for 1994, 1997, and 1998; however, a strong set of comparable data are available for 1995 and 1996 (Table 1). Green (1997) provided a detailed evaluation of the 1995 and 1996 data sets discussed here (Figure 5). Table 1 presents the 1995 and 1996 annual means for several water quality parameters measured at multiple sites on the Icelandic River.

The pH values (1995-96) in the Icelandic River were in compliance with the Manitoba Water Quality Guidelines (Tier III) for aquatic life (6.5-9.0) and recreation (5.0-9.0) (Williamson 2002). During the months of February, March, and April, dissolved oxygen concentrations often failed to comply with the Manitoba Water Quality Objectives (Tier II) for the protection of cool water aquatic life (instantaneous minimum of 3.0 mg/L when $\leq$5°C). For example, in February 1995 DO concentrations averaged 2.7 mg/L and ranged from 0.5 to 7.5 mg/L). During the open-water season dissolved oxygen concentrations were typically in compliance. Site WQ1670, near the town of Morweena (Green 1997), was an exception; DO levels were below objective levels (instantaneous minimum of 5.0 mg/L when >5°C) on July 4 (3.9 mg/L), July 19 (4.5mg/L), September 10 (4.5 mg/L), and October 31 (4.8 mg/L) of 1995. These low levels of DO were likely due to the low water levels and flows, which were reported by Green (1997) to have occurred in the upper reaches of the river during the summer of 1995.

Ammonia-N concentrations measured in the Icelandic River in 1995 and 1996 were reportedly below the Manitoba Water Quality Objectives (Tier II) for the protection of aquatic life (Green 1997). Additionally, concentrations of nitrate and nitrite-N were within acceptable limits of the Manitoba Water Quality Objectives for the protection of drinking water and the CCME (1999) guidelines for nitrate for the protection of aquatic life. However,

Green (1997) noted that at the upstream sites near Morweena mean nitrate-nitrite nitrogen concentrations were "significantly" higher than at downstream sites in both 1995 and 1996.

Green (1997) reported that phosphorus concentrations in the Icelandic River in 1995 and 1996 were often higher than the narrative Manitoba Water Quality Guideline for streams (0.050 mg/L), particularly at the downstream sites.

According to Green (1997), in 1996, mean nutrient concentrations (TKN, ammonia-N, and phosphorous) within the Icelandic River showed "substantial" increases near the town of Arborg (WQ1075 and WQ 1076). Green (1997) concluded that the high levels of phosphorus at WQ1076 in 1996 were likely from a source other than the Arborg sewage lagoon based on comparisons between water sampling dates and discharge dates.

A study conducted in 1996 to determine if winter applications of hog manure would affect surface water quality, found that following spring runoff, elevated nutrient (TKN, ammonia, nitrate-nitrite, TP, TDP) levels occurred in the Icelandic River downstream of fields where the manure was applied (Green 1996b).

The Bluegoose drain enters the Icelandic River approximately four kilometres downstream of the town of Arborg. In the spring of 1996, Manitoba Water Stewardship collected samples at three locations along this drain: 5 km; 7 km; and 8.5 km upstream of the confluence with the Icelandic River (Table 2). Based on these data, nutrient levels (N and P) within the Bluegoose drain were high relative to the Icelandic River and the confluence with the drain resulted with a slight change in the water quality of the Icelandic River. This conclusion was based on a qualitative comparison of TN and TP, suspended solids and pH between a site upstream (WQ1663) and a site downstream (WQ1662) of the drain in spring 1996.

Nutrient levels within the Bluegoose drain increased significantly [results of paired t-test performed using SigmaPlot 8.0: ammonia ($p=0.004$), nitrate/nitrite ($p<0.001$), total Kjeldahl nitrogen ($p=0.001$), total phosphorous ($p=0.005$), total dissolved phosphorous ($p=0.005$)] between the 8.5 km and the 7 km sites, indicating that a nutrient source was likely present between these areas. Ammonia concentrations measured in the drain during spring 1996 were in compliance with the Manitoba Water Quality Objectives (Tier II) for the protection of aquatic life, with the exception of the 7 km site on April 17, 1996. Concentrations of nitrate were in compliance with the Manitoba Water Quality Objectives for the protection of drinking water and the CCME (1999) guidelines for the protection of aquatic life. Conversely, total phosphorous concentrations in the drain at or below 7 km upstream from the Icelandic River exceeded allowable limits on all but two sampling dates in April of 1996.

The two main population centers within the Icelandic River watershed are the Town of Arborg and the Village of Riverton. The majority of the population in Arborg receive their water from a treatment plant sourced with groundwater; others maintain their own wells (Town of Arborg, pers. comm., December, 2006). In Riverton the main water source is privately operated wells (Village of Riverton, pers. comm., December, 2006).

3.1.3 Fish Species Utilization

3.1.3.1 Larval Fish

Manitoba Water Stewardship – Fisheries Branch conducted larval drift surveys along the Icelandic River in 1988 and 1989 to identify: the availability of walleye spawning habitat; the extent of utilization by walleye; and spawning habitat that may need protection or rehabilitation (MWSFB Icelandic River File, 1990; Cann 1990). Results and locations of drift sets are presented on Table 3 and Figure 5, respectively.

The majority of walleye eggs and larvae were captured at the downstream station (Site 1) during both sampling years (Figure 5). Results indicated that successful walleye spawning occurred in the Icelandic River in 1988 and 1989.

3.1.3.2 Adult Fish

As a tributary to Lake Winnipeg, the Icelandic River could host up to 60 native freshwater species, eight introduced freshwater species, and one freshwater hybrid species (Stewart and Watkinson 2004). An FIHCS search and fisheries investigations conducted by Milani (2006) indicated that at least 12 families of fish, representing 35 species, have utilized the Icelandic River watershed (Table 4). The Family, common name, genus, species, and abbreviations used of fish species that have been observed in the Icelandic River are presented in Appendix 2.1. None of the species indicated on Table 4 are listed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) as endangered, threatened, or of special concern.

The Icelandic River is considered, historically, to be one of the most important spawning tributaries on the western side of the south basin of Lake Winnipeg for species such as walleye (MWSFB, Icelandic River file, circa 1994). However, agricultural activity and drainage works have impaired the spawning habitat for a variety of recreational and commercial species (MWSFB, Icelandic River file, circa 1994).

In order to improve spawning habitat, Manitoba Conservation - Fisheries Branch constructed 12 pool riffle spawning structures in the Icelandic River in 1988. Shortly thereafter the Arborg Dam was back-filled with field stone and two additional pool riffle structures were constructed to assist fish passage at the dam. In 1996, a fish ladder was installed at a gradient control structure located approximately three km downstream from Morweena (MWSFB, Icelandic River file, circa 1994; Green 1997). A feasibility study for providing fish passage at the Arborg Dam was completed in 2006 (Andrews and Harding 2006). Although complete, the effectiveness and subsequent benefits of these instream works have not been fully determined and are discussed in more detail in Section 3.3.4.

3.1.4 Benthic Invertebrates

No printed or anecdotal information was located regarding the benthic invertebrate community of the Icelandic River watershed. It is assumed, however, that the invertebrate fauna would be comparable to that found in other rivers flowing through agro-Manitoba.

3.2 FIELD SURVEYS

3.2.1 Physical and Hydrological Information

Physical and hydrological data collected along the Icelandic River watershed is presented in Appendices 3.1 and 3.2, respectively. Sample locations are presented in Table 5 and illustrated in Figure 6. Discharge measurements collected at locations in the watershed are presented on Table 6.

Work conducted on the ground primarily consisted of fisheries surveys, verifying aerial classifications, obtaining still photographs of physical conditions, and the collection of *in situ* (i.e., measured in the field) water quality data.

Discharge of the Icelandic River (at Site 1) was 1.902 m^3/s on May 10 and decreased to 0.215 m^3/s on July 13, 2006. Discharge on the Rembrandt Drain (at Site 14) was 0.531 m^3/s on May 9 and 0.112 m^3/s on July 12, 2006 (Appendix 3.2). Discharges on the remainder of the drains during the summer sampling period were negligible.

On May 10, 2006, velocities in the middle of the Arborg Dam culvert outlet measured 2.59 and 3.02 m/s (Photo 5).

3.2.2 Water Quality

Water quality data were collected by North/South Consultants along the Icelandic River and associated drains in May, July, and October, 2006 (Tables 5 and 7, Figure 6). Dissolved oxygen concentrations at all sites consistently failed to comply with the Manitoba Water Quality Objectives for the protection of aquatic life (Williamson 2000; 9.5mg/L) with one exception (Site Code 18 on the Icelandic River in July; DO=13.72 mg/L).

On May 9, a turbidity reading taken in the Shurkas Drain measured >1000 NTU (Table 7). This reading was taken during a heavy rain fall event downstream of a non-vegetated field. Sediments were observed being flushed into the Shurkas Drain from a roadside ditch.

Photo 5. Arborg Dam culvert outlet and drift trap placement on May 8, 2006.

3.2.3 Fish Species Utilization

Biological information collected for fish species captured during the spring and summer fish utilization surveys in 2006 are presented in Appendices 4.1 and 4.2, respectively. Spring fishing results from 2007 are presented in Appendix 4.3.

3.2.3.1 Spring 2006

3.2.3.1.1 Larval Fish

A total of 21 larval fish were captured along the Icelandic River and Rembrandt Drain during the spring of 2006 (Tables 5 and 8, Figure 6). The majority (n = 15) were catostomids (e.g., white sucker) and percids (e.g., walleye, yellow perch) captured at the Arborg Dam culvert outlet (Site Code 2, DT2) (Photo 5). The capture location of these larval fish indicated that suckers and percids had spawned upstream of the Arborg Dam that year.

The capture of four catostomid larvae on the Rembrandt Drain suggested that successful sucker spawning also occurred at least five km upstream (Table 8, Figure 6).

3.2.3.1.2 Adult Fish

Two hoops nets (oriented to capture fish moving in upstream and downstream directions) were set in the Icelandic River downstream of the Arborg Dam from May 8 to 10 (Table 5, Figure 6, Photo 1). Given the late sampling period and warm water temperatures (>13.0^{o}C) it was surmised that the spring migration of fish had passed prior to sampling. The catch was comprised of five northern pike and three rock bass.

3.2.3.2 Summer 2006

Between July 12 and 13, a total of 316 fish (representing 16 species) were captured in the Icelandic River watershed (Table 9). The majority of fish captured were brook stickleback (n = 106) and longnose dace (n = 67).

A total of three northern pike were captured, two of which were likely young-of-the-year, with fork lengths of 110 mm (Study Point 17) and 115 mm (Study Point 22) (Photo 6). Two young-of-the-year white suckers (mean length of 33 mm) were captured upstream of the fish ladder (Study Point 19).

3.2.3.3 Spring 2007

Biological Information

Hoop nets were set at six locations on the Icelandic River from April 10 to 20, 2007 (Table 5, Figure 6). A total of 558 fish, representing four species were captured (Table 10). White suckers (n = 321) composed the greatest proportion of the catch, followed by walleye (n = 188), northern pike (n = 46), and black bullhead (n = 3) (Table 10, Appendix 4.3).

Photo 6. Northern pike captured by back-pack electrofishing just downstream of the Arborg Dam.

White sucker lengths and weights ranged from 212 to 575 mm (average 483 mm) and 650 to 3200 g (average 2164 g), respectively (Appendix 4.3). Seventy-three of the 90 white suckers examined for sex and state of maturity were males: 21 were preparing to spawn; 44 were ripe; and eight were spent. Ripe and spent males were first observed on April 15, (corresponding to a water temperature of 8.0 ^{o}C), however the majority of the spent males (n = 7) were captured on April 18 and 19 (water temperature range of 7.5 to 9.0 ^{o}C). The remaining 17 white suckers examined for sex and state of maturity were females either preparing to spawn (n = 7), in ripe condition (n = 7), or spent (n = 3). The ripe and spent females were captured on April 19 and 20.

Walleye lengths and weights ranged from 312 to 774 mm (average 512 mm) and 300 to 8500 g (average 1815 g), respectively (Appendix 4.3). Sex and state of maturity were determined for 85 walleye; 80 of which were males either preparing to spawn (n = 27) or in spawning condition (n = 53). The five females observed were preparing to spawn (n = 3) or in ripe condition (n = 2). Ripe males and females were first observed on April 15, corresponding to a water temperature of 8.0 ^{o}C.

Northern pike lengths and weights ranged from 306 to 922 mm (average 472 mm) and 200 to 6600 g (average 970 g), respectively (Appendix 4.3). Sex and state of maturity was determined for 36 northern pike, 30 of which were males. Eleven males and one female were preparing to spawn in the current year, six males and three females were ripe (first captured on April 16 at a water temperature of 6.0 ^{o}C), and13 males and two females were in spent condition (captured from April 17 to 20).

Mark/Recaptures and Fish Movements

A total of 523 fish were marked by fin clip to determine extent of movement between sampling locations (Appendix 4.3). None of these were subsequently recaptured at any of the hoop net locations during the 2007 spring survey.

In the spring of 2007, over 96% of the fish were captured in hoop nets 1, 4, and 6; locations all downstream of the Arborg Dam (Tables 5 and 10, Figure 7). The data suggest that although walleye, white sucker, and (to a lesser extent) northern pike utilize the Icelandic River their upstream migration may be impeded by the Arborg Dam.

3.2.4 Benthic Invertebrates

Results of the benthic invertebrate investigations have been provided as a separate data report to the manager of EICD (North/South Consultants 2007).

3.3 WATERSHED CLASSIFICATION

A summary of the aerial videography of the Icelandic River watershed is provided in Appendix 5.1.

3.3.1 Land Use/Cover

Approximately 151 km of the Icelandic River watershed was classified according to land use/cover (Table 11, figures 8 and 9); including nearly 100 km (n = 99) of the mainstem of the Icelandic River. The remaining land use/cover classifications from aerial video was completed for the Bluegoose (3 km), North Crooked Lake (9 km), Rembrandt (12 km), Shurkas (7 km), Silver (12 km), Sylvan (4 km), and Vidir drains (5 km) (Table 10).

Throughout the Icelandic River watershed hayland (25%), pasture/grazing (23%), cropland (19%), and other agricultural land (14%) composed the greatest land use/cover. The remaining classifications comprised residential/commercial (4%), non-forested wetland (4%), mixed forest land (4%), forested wetland (4%), deciduous forest land (2%), and other urban or built up land (1%).

Pasture/grazing (29%), hayland (26%), and other agricultural land (15%) comprised the greatest land use/cover along the Icelandic River. The remaining classifications were comprised of: cropland (7%); residential/commercial and non-forested wetland (each at 6%, respectively); mixed forest land and forested wetland (each at 5%, respectively); other urban or built up land (1%); and deciduous forest land (<1%).

Of the 99 km of the Icelandic River reviewed, nearly 44% was classified as 'drain'. With the exception of the Rembrandt Drain (58% drain), all other drains reviewed were completely channelized.

3.3.2 Aquatic Habitat Conditions

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

3.3.3 Aquatic Habitat Quality Ratings

Approximately 151 km of the Icelandic River watershed (Icelandic River and seven associated drains) were rated according to habitat quality (Table 12, Figures 10 and 11). Highly impacted areas (Class C) composed the largest segment (55%), followed by: severely impacted (Class D, 25%); moderately impacted (Class B, 14%); and minimally impacted areas (Class A, 6%).

Approximately 99 km of the Icelandic River were rated according to habitat quality. Highly impacted areas (Class C) composed the largest segment (42%), followed by: severely impacted (Class D, 31%); moderately impacted (Class B, 21%); and minimally impacted areas (Class A, 5%).

The relatively high percentage of Class C and D reaches for the combined watershed and/or the Icelandic River itself is attributable to the degree of channelization found throughout this area. As discussed in Section 3.1.1, drains are often associated with marginal to non-existent riparian areas, erosive banks, and modified flow regimes, all of which are considered when determining aquatic habitat quality.

3.3.4 Potential Barriers

A total of 28 potential barriers were identified throughout the Icelandic River watershed (Figures 10 and 11) (Appendix 5.2). The majority of these were identified as beaver or debris dams (n = 15), followed by fords (n = 9), man-made barriers (n = 2; rubble), the Arborg Dam, and a gradient control structure/fish ladder. Most of the beaver/debris dams (located on the Rembrandt Drain) are small in nature and are likely temporary barriers. Likewise, most of the fords are located in the upper reaches of the watercourses where spring flows could be sufficient to pass migratory fish or where a limited number of non-migratory species may occur.

From the mouth of the Icelandic River to the gradient control structure/fish ladder, there are a series of potential barriers that may impede fish passage to more 'natural' stretches of river located upstream (e.g., Icelandic River at Morweena) (Figure 10, Appendix 5.2).

The first of these barriers is a cement ford located approximately five km downstream of the town of Arborg (Appendix 5.2, Figure 10) (Photo 7). The ford has five culverts and is

Photo 7. Cement ford located approximately 5 km downstream of the town of Arborg on the Icelandic River.

approximately 20 m in length. In 1990, Manitoba Fisheries Branch conducted a longitudinal profile in the vicinity of this ford (MWSFB, Icelandic River file, circa 1990) and found that it should not be a barrier to fish passage with respect to: a) adequate flows in the spring; and b) the presence of culverts to provide additional upstream access. However, under certain water levels fords of this nature can act as barriers to both upstream and downstream migrations of fish (e.g. velocity barrier, inadequate flows, etc.). Without proper maintenance, the culverts can also become fouled with debris. Therefore, all fords of this nature are classified as potential barriers to fish passage (as discussed in Section 2.3.4). A similar barrier was identified approximately two km downstream of the gradient control structure/fish ladder (Figure 10). This ford has previously washed out, but has since been repaired.

The Arborg Dam consists of a sheet piling crest and riprap, as well as a 10 m long x 1.0 m wide culvert for fish passage and flow and was identified as a possible barrier to fish migration (Andrews and Harding 2006). In 1990, Manitoba Water Stewardship recognized that the Arborg Dam and culvert may be acting as a fish barrier. The result was the construction of two rock riffles downstream of the dam in order to provide a backwater effect and subsequent fish passage at the culvert (MWSFB, Icelandic River file, circa 1991: Gaboury et al. 1995). In the fall of 1990, field inspections of the riffle structures indicated fish passage would now be possible at the culvert (MWSFB, Icelandic River file, circa 1991). Currently, the riffle structures (i.e., Riffle 2) are in need of repair as they are causing shoreline erosion (Photo 8).

Photo 8. Riffle 2, located downstream of the Arborg Dam.

Although fish passage over the Arborg Dam is possible under certain hydrologic conditions (e.g., flows such that fish can swim over the dam), it is likely limited both over the dam and through the culvert. Drift samples collected at the downstream end of the culvert in the spring of 2006 indicated some degree of spawning of catostomids (e.g., white sucker) and percids (e.g. walleye, yellow perch) upstream of the dam. Although fish may have passed the dam during periods of higher flows when the entire dam face was under water, fish passage through the culvert is unlikely. Velocity readings taken on May 10 at the downstream end of the Arborg Dam culvert averaged 2.8 m/s. Under low flow conditions, Andrews and Harding (2006) reported velocities in excess of 1.5 m/s. On May 10, adult carp were also observed at the Arborg Dam, being held back at the base of the steel plate structure. Water velocities taken on May 10 at the steel plate structure averaged 0.8 m/s.

Still downstream of the fish ladder, one beaver dam located under the Framnes Bridge may temporarily block movements of fish (Photo 9). Another section of the Icelandic River, report ID #55, had an altered flow regime and what appeared (by video) to be an instream obstruction. This site is likely a barrier to fish migration and warrants additional investigation.

Photo 9. Beaver dam located under the Framnes Bridge, May 8 2006.

In 1969, the Water Resources Branch constructed a concrete drop structure on the Icelandic River to decrease the channel gradient of the river and to minimize channel degradation post-channel and dyke reconstruction (MWSFB, Icelandic River file, circa 1996) (Photo 10). As this structure effectively blocked spawning migrations of fish (i.e., walleye to upstream

Photo 10. Gradient control structure and modified Denil fish ladder (on right).

natural reaches) plans were devised to include fish passage at this site. By 1996, a modified Denil fish ladder was implemented at the gradient control structure and initial reports indicated that the ladder was successful at allowing fish passage (i.e., walleye, northern pike, and suckers) (MWSFB, Icelandic River file, circa 1998).

Currently, the effectiveness of the fish ladder is questionable. Investigations in the spring and late summer of 2006 indicated that velocities (observed) at the ladder may be too great to adequately allow passage of spring spawning species (Photo 11). In addition, the outlet located on the upstream side of the dam was blocked with debris (Photo 12). This blockage may prevent fish passage both upstream and downstream of the ladder. In late summer, one deceased northern pike was observed on the upstream side of the outlet, washed against the debris. The effectiveness of the ladder at passing fish in the spring should be reviewed. However, the efficiency of the ladder is also decreased by any downstream barriers (man-made or natural) that may also impede the passage of fish.

Photo 11. Flow conditions observed at the downstream side of the gradient control structure fish ladder, July 12. 2006.

Photo 12. Debris clogging upstream end of fish ladder.

3.3.5 Potential Rehabilitation Sites

Based on a review of the aerial video, historical information, and groundtruthing, 85 potential rehabilitation sites, prioritized on a scale from 1 to 3, were identified within the Icelandic River watershed (Figures 10 and 11, Appendix 5.2). The majority of sites were rated as Priority 3 sites (n = 55 or 65%), followed by Priority 1 (n = 19 or 22%) and Priority 2 sites (n = 11 or 13%).

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

Typically, strategies for mitigating impacts to a watershed could fall into the following general categories: removing barriers to fish movement to allow fish to access upstream habitat; ensuring adequate stream flow to maintain aquatic habitat; enhancing instream aquatic habitat; enhancing riparian conditions; and eliminating point and non-point sources of water quality degradation. Most of these strategies overlap to some degree. For example,

enhancing riparian conditions not only helps to eliminate non-point sources of habitat degradation but also enhances instream aquatic habitat.

In addition to having positive effects, mitigative activities can also result in indirect negative effects. For example, dam removal, which is often viewed as an obvious solution for stream rehabilitation, can have short-term negative effects on the hydraulic regime, sediment loads, and bank stability. Factors to be considered when decommissioning a barrier include: age, construction, purpose, and condition of the structure; and impacts of reservoir drawdown, including change in hydraulic regime, sediment transport, bank destabilization, water quality, and re-vegetation of riparian areas (Stanley and Doyle 2003). There may also be concerns raised by local stakeholders and/or property owners. Mitigative works should be selected carefully, taking full consideration of the effects on stream processes and landowners.

3.3.6 Instream Flow Requirements

Instream flow can be defined as the level of flow required to sustain the existing aquatic habitat and fish community in a particular stream or stream segment (Annear and Conder 1984; Stalnaker et al. 1995; IFNC 1999). Instream flow studies typically are used to determine a minimum flow value which compromises between habitat changes and water needs for development and/or off stream consumption. Biologists have found the application of instream flow modeling useful in the last several decades, using the process for quantifying the impacts of channelization or hydrological modifications of rivers (Lamouroux and Jowett 2005). However, there does not appear to be an agreement on which method is the best to employ or which method is the least biased (Clipperton et al. 2003). Annear and Conder (1984) reviewed four methods (Tennant, wetted perimeter curves, habitat retention models, and physical habitat simulation models) for bias and found the Tennant method to be the least so.

Whatever method is employed, it must be recognised that a single flow determination will neither protect nor guarantee suitable environmental conditions for all organisms (and life stages) found in a riverine system. Bovee (1982: *in* Clipperton et al. 2003) outlined some ecological considerations when determining IFNs, in particular: flows determined to be beneficial for one life stage may be detrimental to another life stage; a flow developed for one species may be detrimental to another; varying amounts of water are required throughout the year to accommodate different species and their life stages; a level of flow designated for one portion of stream may not provide useable habitat in another; and an increase in water does not equate to an increase in habitat production.

Although fisheries investigations during the course of this study revealed the presence of three regionally significant fish species (i.e., walleye, northern pike, and white sucker) a number of smaller species (e.g., cyprinids and sticklebacks) also were located. As suggested, the development of instream flow requirements for the entire watershed, based on three species, would not be ecologically sound. It is suggested that instream flow needs be developed on a 'site specific' basis, using this document as a baseline to identify potential locations within the watershed where instream works or enhancements could be conducted. Instream flow needs projects developed within Manitoba are discussed in MacDonell and Remnant (1999) and IFNC (1999). The Instream Flow Council (2007) has also compiled an extensive reference list on the subject.

4.0 OVERVIEW

Based on the objectives outlined in this document (review of historical water quality, fish utilization, and compilation of existing physical conditions and land use, etc.), a review of the Icelandic River watershed revealed an area moderately to highly impacted by anthropogenic sources. The natural topography of the region, current land use practices, and an existing rural population, continue to place stressors on the watershed.

For example, heavy spring rains in 2006 resulted in the 'ponding' of water on an un-vegetated field (Photo 13). The ponded water then transported sediments into a roadside ditch, which would eventually make its way to the Icelandic River.

Photo 13. Ponded water on an un-vegetated field and subsequent run off into a road side ditch.

Turbidity readings taken at the Shurkas Drain, downstream of the runoff were greater than 1000 NTU (Photo 14). Although not measured during this study, this direct runoff could contain elevated levels of phosphorus and nitrogen. The implementation of newly proposed buffer setback distances and modified land use practices could assist in the reduction of erosion and improve water quality (Manitoba Water Stewardship 2005).

Photo 14. Shurkas Drain and roadside ditch where a turbidity reading was greater than 1000 NTU.

As previously discussed, the Icelandic River is considered, historically, to be one of the most important spawning tributaries on the western side of the south basin of Lake Winnipeg for species such as walleye. Investigations of spring spawning migrations in 2007 indicated that walleye still utilize the Icelandic River as a spawning area in some capacity. However, access to suitable spawning areas along the Icelandic River (and associated drains) is most likely impaired by a number of instream barriers and the rapid 'flush' of spring flow out of the system (accelerated by channelization). A focussed effort towards improving fish populations would require a clearer understanding of current fish communities utilizing this system. Improving fish passage would require rehabilitation efforts at the furthest downstream obstruction with continued efforts working upstream.

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TABLES, FIGURES, AND APPENDICES

Table 1. Summary of selected water quality parameters collected on the Icelandic River, by Manitoba Water Stewardship – Water Quality Management Section (WQMS 2006).

PARAMETER	UNIT	Year	
		1995	1996
pH		8.17	8.19
Specific conductance	µS/cm	812	n/a
Dissolved Oxygen	mg/L	11.96	<0.1
Turbidity	NTU	n/a	n/a
TSS	mg/L	15.1	35.2
BOD	mg/L	n/a	n/a
Dissolved ammonia-N	mg/L	0.09	0.08
Dissolved nitrate/nitrite-N	mg/L	0.29	0.34
Total Kjeldahl Nitrogen (TKN)	mg/L	0.5	1.46
Total Nitrogen[1]	mg/L	0.81	1.8
Total Phosphorus	mg/L	0.16	0.18
Total dissolved phosphorus	mg/L	0.06	0.12
Chlorophyll *a*	µg/L	7.78	n/a

Table 2. Summary of selected water quality parameters collected on the Bluegoose Drain (sites are in km from Icelandic River), by Manitoba Water Stewardship – Water Quality Management Section (WQMS) (2006).

PARAMETER	UNIT	DISTANCE (km)		
		5	**7**	**8.5**
pH	µS/cm	7.76	7.79	7.58
Specific conductance	mg/L	230	224	179
TSS	mg/L	4.45	7.73	3.25
BOD	mg/L	3.1	3.55	2.5
Dissolved ammonia-N	mg/L	1.16	1.63	0.03
Dissolved nitrate/nitrite-N	mg/L	1.61	1.71	0.06
Total Kjeldahl Nitrogen (TKN)	mg/L	2.76	3.19	0.84
Total Phosphorus	mg/L	0.53	0.95	0.09
Total dissolved phosphorus	mg/L	0.48	0.88	0.06

Table 3. Total counts of eggs and larval drift, by species, captured during drift sampling conducted by Manitoba Water Stewardship – Fisheries Branch, on the Icelandic River, 1988 to 1989 (Source data: MWSFB, Icelandic River file, circa 1990; Cann 1990).

Year/Site	Walleye		Sucker		Northern pike		Percids		Quillback		Other	
	Eggs	Larvae	Eggs	Larvae	Eggs	Larvae	Eggs	Larvae	Eggs	Larvae	Eggs	Larvae
1988 -Site 1 (d/s station)	340	5	312	70	8878	12	1970	154	132	12	-	4
1989 - Site 1 (d/s station)[1]	717	7	4032	7	-	-	700	20	-	-	686	7
1988 -Site 2 (u/s station)	3	3	441	467	43	2	9	175	-	18	75	7
1989 - Site 2 (u/s station)	3	-	3010	9	-	-	5	27	-	-	273	13

[1] Both 'live' and 'dead' counted in total
d/s = downstream; u/s = upstream

Table 4. Fish species known to, or possibly, utilizing the Icelandic River watershed. Information based on Manitoba Water Stewardship – Fisheries Branch FIHCS search results, field work conducted by Milani (2006), and information provided in Stewart and Watkinson (2004). List of abbreviations provided in Appendix 2.1.

ABBREVIATION	COSEWIC LISTING[1]	Icelandic River		Icelandic Drain		Crooked Lake Drain		Silver Drain		Rembrandt Drain		Sylvan Drain
		FIHCS[2]	Milani[3]	FIHCS[2]	Milani[3]	FIHCS[2]	Milani[3]	FIHCS[2]	Milani[3]	FIHCS[2]	Milani[3]	Milani[3]
QUILL	Not listed	Common										
SHRD	Not listed	Common										
SLRD	Not listed	Common										
WHSC	Not listed	Common	Y	Common	Y					Unknown	Y	Y
BLCR	Not listed	Rare										
RCBS	Not listed	Unknown	Y									
BLSH	Not listed	Unknown										
CARP	Not listed	Common	Y			Unknown	Y					
EMSH	Not listed	Unknown										
FTMN	Not listed	Common	Y	Unknown	Y							Y
FNDC	Not listed		Y									Y
GLSH	Not listed	Unknown	Y									
LNDC	Not listed	Common	Y							Unknown	Y	
MMSH	Not listed	Rare										
NRDC	Not listed	Unknown										Y
PRDC	Not listed	Unknown										
SPSH	Not listed	Unknown										
WDSH	Not at risk	Unknown										
WBDC	Not listed	Common	Y									
NRPK	Not listed	Common				Unknown	Y	Unknown	Y	Unknown	Y	
BURB	Not listed	Common										
BRST	Not listed	Unknown	Y	Unknown	Y			Unknown	Y			Y
GOLD	Not listed	Common										

Table 4. Continued.

ABBREVIATION	COSEWIC LISTING[1]	Icelandic River		Icelandic Drain		Crooked Lake Drain		Silver Drain		Rembrandt Drain		Sylvan Drain
		FIHCS[2]	Milani[3]	FIHCS[2]	Milani[3]	FIHCS[2]	Milani[3]	FIHCS[2]	Milani[3]	FIHCS[2]	Milani[3]	Milani[3]
BLBL	Not listed	Unknown	Y									
BRBL	Not listed	Common										
TDMD	Not listed	Unknown	Y									
WHBS	Not listed	Unknown										
IWDR	Not listed	Unknown	Y							Unknown	Y	
JHDR	Not listed	Common	Y							Common	Y	
RVDR	Not listed	Unknown	Y									
SAUG	Not listed	Common										
WALL	Not listed	Common										
YLPR	Not listed	Common	Y									
FRDR	Not listed	Common										
CNMD	Not listed	Common						Unknown	Y	Unknown	Y	Y

[1] Distribution/listing in Lake Winnipeg drainage as per Stewart and Watkinson (2004)
[2] FIHCS listing from Manitoba Water Stewardship - Fisheries Branch (2006)
[3] Milani (2006) source data Y = observed and/or captured

Table 5. Reference list of sites visited and work conducted throughout the Icelandic River watershed, by North/South Consultants, 2006 and 2007.

STUDY POINT	SITE CODE(S)	DESCRIPTION	UTM (14U) easting	UTM (14U) northing	WORK CONDUCTED in situ	hoops	pictures	discharge	velocities	drift traps	inverts	dip net	seine	electro	physical
1	IR1	Icelandic River d/s of Arborg Dam	625482	5640770	Y	Y	Y	Y							
2	DT2	Icelandic River drift trap at culvert	625411	5640812			Y		Y	DT2					
3	FB1	Icelandic River at Framnes Bridge	619245	5645615			Y								
4	DT3	Icelandic River u/s Framnes Bridge	619570	5643968	Y		Y			DT3					
5	GB1	Icelandic River at Geyser Bridge	633267	5642648	Y		Y								
6	NCD1	North Crooked Lake Drain	634454	5646322	Y		Y								
7	DT4	Icelandic River near NCD	635282	5645990			Y			DT4					
8	VD1	Vidir Drain	619533	5650535			Y								
9	IR2	Icelandic River at fish ladder	615020	5650347	Y		Y	Y				Y			
10	IR3	Icelandic River erosion	611987	5650370			Y								
11	SYL1	Sylvan Drain	611213	5651469	Y		Y								
12	SD1	Shurkas Drain	606285	5648605	Y		Y								
13	IR4	Icelandic River headwaters	606427	5640488			Y								
14	RD1	Rembrandt Drain	619748	5639404	Y		Y	Y				DN1		E2, E3	Y
15	SILD1	Silver Drain	624616	5640187			Y								
16	BGD1	Blue Goose Drain	631178	5640571			Y								
17	IFORD	Icelandic River and town ford	630926	5640620			Y						BS1	E1	Y
18	E4	Icelandic River headwaters	606365	5643490	Y		Y							E4	Y
19	ICE/SYL1	Icelandic and Sylvan Drain	611238	5650263	Y		Y	Y						E5	Y
20	IR2B	Icelandic River u/s from fish ladder	614652	5650437	Y		Y								
21	IFORD2	Cement ford d/s of fish ladder	616629	5650301			Y								
22	DAM	Icelandic R., rock pile d/s of Arborg Dam	625409	5640820	Y		Y						BS2	E8	
23	R3	Icelandic R.; Riffle 3 d/s of Arborg Dam	625588	5640641			Y							E6	
24	R2	Icelandic R.; Riffle 2 d/s of Arborg Dam	625505	5640766			Y	Y						E7	
25	INL	Icelandic R.; invert site; lower reach	640412	5650979	Y		Y				Y				Y
26	INM	Icelandic R.; invert site; middle reach	620432	5642385	Y		Y		Y		Y				Y
27	INU	Icelandic R.; invert site; upper reach	608549	5648741	Y		Y				Y				Y

Table 5. Continued.

STUDY POINT	SITE CODE(S)	DESCRIPTION	UTM (14U) easting	UTM (14U) northing	WORK CONDUCTED in situ	hoops	pictures	discharge	velocities	drift traps	inverts	dip net	seine	electro	physical
28	Hoop 1	Icelandic R.; downstream of Arborg Dam (2007)	625250	5640724		Y									
29	Hoop 2	Icelandic R.; downstream of fish ladder (2007)	615120	5650269		Y									
30	Hoop 4	Icelandic R.; downstream of cement ford (2007)	631105	5640770		Y									
31	Hoop 5	Icelandic R.; off the Nelson Line Road (2007)	621399	5641271		Y									
32	Hoop 6	Icelandic R.; on 'Riffle 5' (2007)	637326	5647363		Y									
33	Hoop 7	Icelandic R.; upstream of Arborg Dam (2007)	620437	5642382		Y									

Description of Work Conducted:
in situ = water quality parameters measured in the field
hoops = hoop nets set for adult migrating fish
pictures = digital 'still' photos
discharge = hydrologic measurement
velocities = taken at culverts, surface, or at riffle base
drift trap = stationary (fine mesh) trap collecting drifting fish eggs and larval fish
inverts = invertebrate collection site
dip net = fine mesh dip net used for larval fish
seine = beach seine for summer fish utilization
electro = backpack electrofishing unit used to capture small bodied fish
physical = physical parameters recorded (e.g., substrate compaction, composition)

Table 6. Discharges and velocities recorded by North/South Consultants Inc. throughout the Icelandic River watershed, 2006.

DATE	STUDY POINT	LOCATION	CODE	DISCHARGE (m3/sec)	AVG. CULVERT VELOCITY (m/s)
12-Jul-06	19	ICE/SYL1		0.115	
10-May-06	1	IR1	Culvert		2.59
10-May-06	1	IR1	Culvert		3.02
10-May-06	1	IR1	Riffle		0.83
10-May-06	1	IR1		1.902	
13-Jul-06	1	IR1		0.215	
13-Jul-06	1	IR1	Culvert		0.40
9-May-06	9	IR2		0.574	
9-May-06	14	RD1		0.531	
12-Jul-06	14	RD1		0.112	
19-Oct-06	26	INM	Surface		0.10

Table 7. Water quality data collected *in situ* (i.e., in the field) from the Icelandic River watershed, 2006.

DATE	LOCATION	SITE	Dissolved Oxygen	Temperature (oC)	Turbidity (NTU)	Specific Conductance (mS/cm^3)
8-May-06	Icelandic River	IR1	8.60	15.8	89	0.688
8-May-06	Icelandic River	DT3	8.65	15.9	59	0.708
9-May-06	Icelandic River	GB1	6.86	13.4	137	0.694
9-May-06	North Crooked Lake Drain	NCD1	3.90	14.6	51	0.930
9-May-06	Icelandic River	IR2	8.73	15.1	31	0.707
9-May-06	Sylvan Drain	SYL1	9.39	17.8	12	0.531
9-May-06	Shurkas Drain	SD1	9.24	13.3	>1000	0.068
9-May-06	Rembrandt Drain	RD1	9.21	16.7	22	0.650
11-Jul-06	14U0640423 5651045	Riverton	7.54	22.0	48	0.706
12-Jul-06	Icelandic River	IFORD	5.79	24.2	224	0.621
12-Jul-06	Rembrandt Drain	RD1	8.84	22.2	99	0.604
12-Jul-06	Icelandic River	E4	13.72	28.4	33	0.444
12-Jul-06	Icelandic River	ICE/SYL1	8.91	23.0	25	0.613
12-Jul-06	Icelandic River	IR2B	7.45	25.4	43	0.600
12-Jul-06	Icelandic River	DT3	7.52	25.3	42	0.594
13-Jul-06	Icelandic River near NCD	DT4	5.59	25.1	154	0.646
19-Oct-06	Icelandic River	INL	-	2.0	-	-
19-Oct-06	Icelandic River	INM	-	2.0	-	-
19-Oct-06	Icelandic River	INU	-	2.0	-	-

Table 8. Larval drift trap and fine mesh dip net results from the Icelandic River and Rembrandt Drain, 2006.

LOCATION	SITE CODE	METHOD	DATE	SPECIES					TOTALS
				WHSC	Percids	Catostomids	Unidentified Cyprinids	Unidentified larval species	
Icelandic River	2	DT2	9-May-06	-	-	-	1	1	2
Icelandic River	2	DT2	10-May-06	1	7	5		2	15
Icelandic River	4	DT3	9-May-06	-	-	-	-	-	0
Icelandic River	7	DT4	10-May-06	-	-	-	-	-	0
Rembrandt Drain	14	DN1	9-May-06	-	-	4	-	-	4
TOTALS				1	7	9	1	3	21

Table 9. Summer fish utilization results, by location and date, from the Icelandic River watershed study area, 2006.

DATE	LOCATION	STUDY POINT	CODE	SPECIES[1]															TOTALS
				BLBL	BRST	BURB	CNMD	FNDC	FTMN	GLSH	JHDR	LGPR	LNDC	NRDC	NRPK	RCBS	TDMD	WBDC	WHSC	
12-Jul-06	Icelandic River	17	BS1	-	-	-	-	-	-	-	5	-	-	-	1	1	16	6	-	29
12-Jul-06	Icelandic River	22	BS2	-	-	-	-	-	-	24	-	-	-	-	-	1	1	-	-	26
12-Jul-06	Icelandic River	17	E1	-	-	-	1	-	-	-	2	-	-	-	-	-	-	-	-	3
12-Jul-06	Icelandic River	18	E4	-	18	-	-	-	-	-	-	-	-	6	-	-	-	-	-	24
13-Jul-06	Icelandic River	23	E6	3	-	-	-	-	-	-	7	-	25	-	-	-	2	-	-	37
13-Jul-06	Icelandic River	24	E7	-	-	-	-	-	-	-	1	-	36	-	-	-	-	-	-	37
13-Jul-06	Icelandic River	22	E8	-	-	3	-	-	-	-	2	1	6	-	2	2	-	-	-	16
12-Jul-06	Icelandic R./Sylvan Drain	19	E5	-	31	-	3	3	-	-	2	-	-	-	-	-	-	-	2	41
12-Jul-06	Rembrandt Drain	14	E2	-	40	-	11	-	12	-	6	-	-	-	-	-	-	-	-	69
12-Jul-06	Rembrandt Drain	14	E3	-	17	-	7	-	4	-	6	-	-	-	-	-	-	-	-	34
12-Jul-06	Sylvan Drain		Visual	-	Y	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
TOTALS				3	106	3	22	3	16	24	31	1	67	6	3	4	19	6	2	316

[1] For a list of codes refer to Appendix 2.1.

Table 10. Catch of fish species, by count and hoop net location, along the Icelandic River, spring 2007.

HOOP NET	LOCATION ID *	DATE		SPECIES				TOTALS
		In	Out	Black bullhead	Northern pike	Walleye	White sucker	
1	28	11-Apr	20-Apr	1	36	108	74	219
2	29	11-Apr	19-Apr	-	1	-	6	7
4	30	11-Apr	20-Apr	2	1	59	143	205
5	31	14-Apr	17-Apr	-	7	1	2	10
6	32	16-Apr	20-Apr	-	1	20	95	116
7	33	19-Apr	20-Apr	-	-	-	1	1
TOTALS				3	46	188	321	558

* Refer to Figure 6 for location of hoops set in Icelandic River

Table 11. Total number of reaches (by land use/cover), length of watercourse classified, percentage of reach by land use/cover, and percent of canal in the Icelandic River watershed study area, 2006.

LAND USE/COVER	# OF REACHES	TOTAL LENGTH OF REACHES (km)	% OF REACHES (km)	CANAL LENGTH (km)	% CANAL
Icelandic River					
Cropland	4	7	7		
Deciduous Forest Land	1	0	(~.5)		
Forested Wetland	3	5	5		
Hayland	6	26	26		
Mixed Forest Land	5	5	5		
Nonforested Wetland	2	6	6		
Other Agricultural Land	10	15	15		
Other Urban or Built-up Land	1	1	1		
Pasture/Grazing	12	28	29		
Residential/Commercial	3	6	6		
Total along Icelandic	47	99	100	44	44
Bluegoose Drain					
Cropland	2	3	100		
Total along Bluegoose	2	3	100	3	100
North Crooked Lake Drain					
Hayland	6	8	96		
Other Agricultural Land	1	0	4		
Total along North Crooked	7	9	100	9	100
Rembrandt Drain					
Cropland	3	3	22		
Deciduous Forest Land	4	3	26		
Forested Wetland	2	1	12		
Mixed Forest Land	1	1	10		
Nonforested Wetland	1	1	6		
Other Agricultural Land	1	2	14		
Pasture/Grazing	2	1	11		
Total along Rembrandt	14	12	100	7	58

Table 11. Continued.

LAND USE/COVER	# OF REACHES	TOTAL LENGTH OF REACHES (km)	% OF REACHES (km)	CANAL LENGTH (km)	% CANAL
Shurkas Drain					
Cropland	2	6	95		
Other Agricultural Land	1	0	5		
Total along Shurkas	3	7	100	7	100
Silver Drain					
Cropland	1	2	14		
Hayland	2	3	22		
Other Agricultural Land	2	2	14		
Pasture/Grazing	4	5	42		
Residential/Commercial	1	1	8		
Total along Silver	10	12	100	12	100
Sylvan Drain					
Cropland	2	3	66		
Other Agricultural Land	2	1	34		
Total along Sylvan	4	4	100	4	100
Vidir Road Drain					
Cropland	4	5	90		
Other Agricultural Land	1	1	10		
Total along Vidir	5	5	100	5	100
Combined					
Cropland	18	28	19		
Deciduous Forest Land	5	4	2		
Forested Wetland	5	6	4		
Hayland	14	37	25		
Mixed Forest Land	6	6	4		
Nonforested Wetland	3	6	4		
Other Agricultural Land	18	21	14		
Other Urban or Built-up Land	1	1	1		
Pasture/Grazing	18	35	23		
Residential/Commercial	4	7	4		
Total Combined	92	151	100	90	60

Table 12. Total number of reaches (by habitat quality rating), length of watercourse classified, and percentage of reach by rating in the Icelandic River watershed study area, 2006

HABITAT QUALITY RATING	# OF REACHES/RATING	TOTAL LENGTH OF REACHES (km)	PERCENT OF RATING BY km
Icelandic River			
Class 'A'	3	5	5
Class 'B'	14	21	21
Class 'C'	19	42	42
Class 'D'	11	31	31
Total Along Icelandic	47	99	100
Bluegoose Drain			
Class 'C'	1	2	52
Class 'D'	1	2	48
Total Along Bluegoose	2	3	100
North Crooked Lake Drain			
Class 'C'	6	8	96
Class 'D'	1	0	4
Total Along Crooked Lake Drain	7	9	100
Rembrandt Drain			
Class 'A'	6	5	38
Class 'B'	1	0	4
Class 'C'	6	5	44
Class 'D'	1	2	14
Total Along Rembrandt Drain	14	12	100
Shurkas Drain			
Class 'C'	3	7	100
Total Along Shurkas Drain	3	7	100
Silver Drain			
Class 'C'	8	9	78
Class 'D'	2	3	22
Total Along Silver Drain	10	12	100

Table 12. Continued.

HABITAT QUALITY RATING	# OF REACHES/RATING	TOTAL LENGTH OF REACHES (km)	PERCENT OF RATING BY km
Sylvan Drain			
Class 'C'	4	4	100
Total Along Sylvan Drain	4	4	100
Vidir Road Drain			
Class 'C'	5	5	100
Total Along Vidir Road Drain	5	5	100
Combined			
Class 'A'	9	10	6
Class 'B'	15	22	14
Class 'C'	52	82	55
Class 'D'	16	37	25
Total Combined	92	151	100

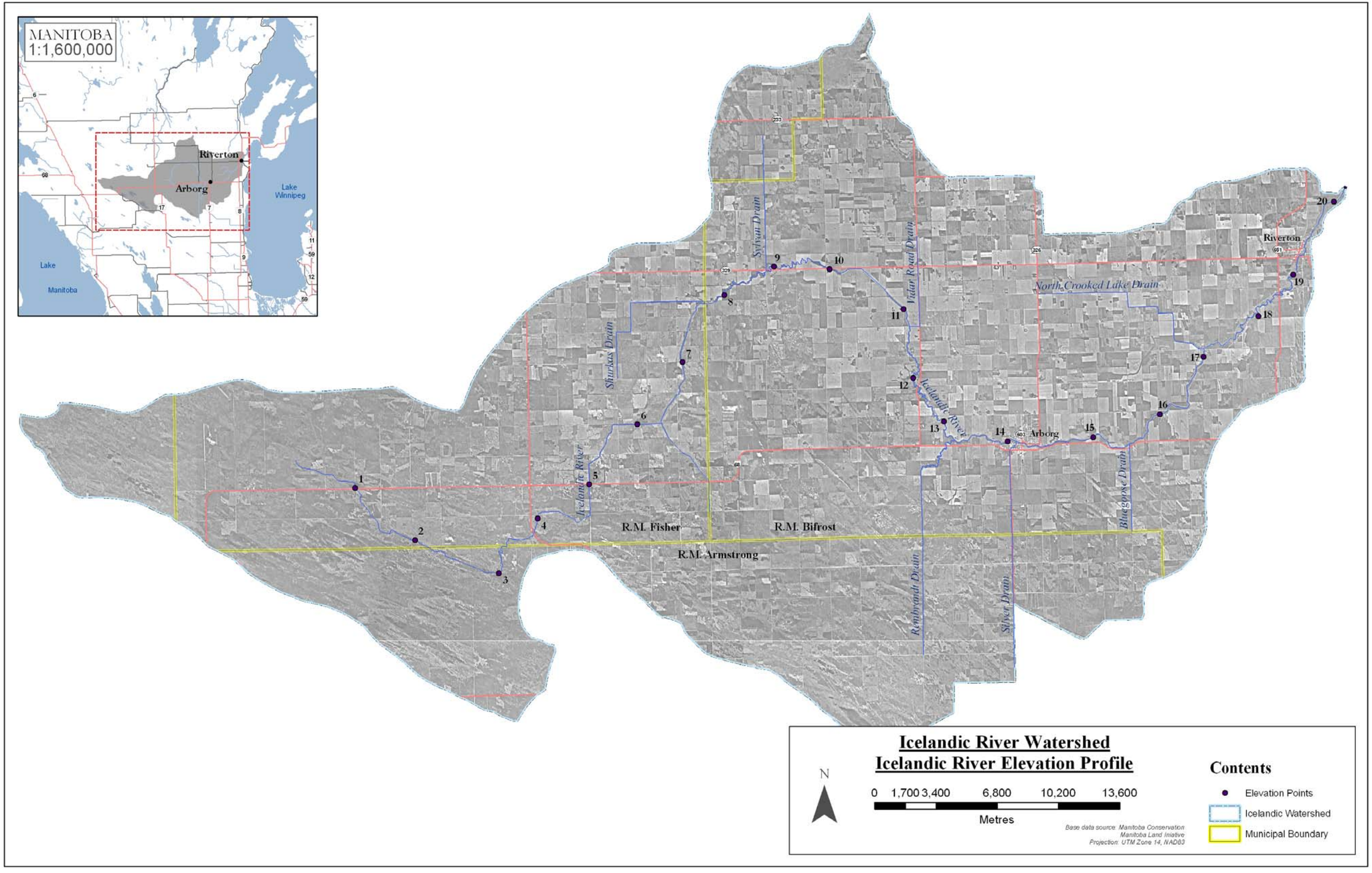


Figure 1. The Icelandic River watershed study area and elevation points used to generate the Icelandic River elevation profile, 2006.

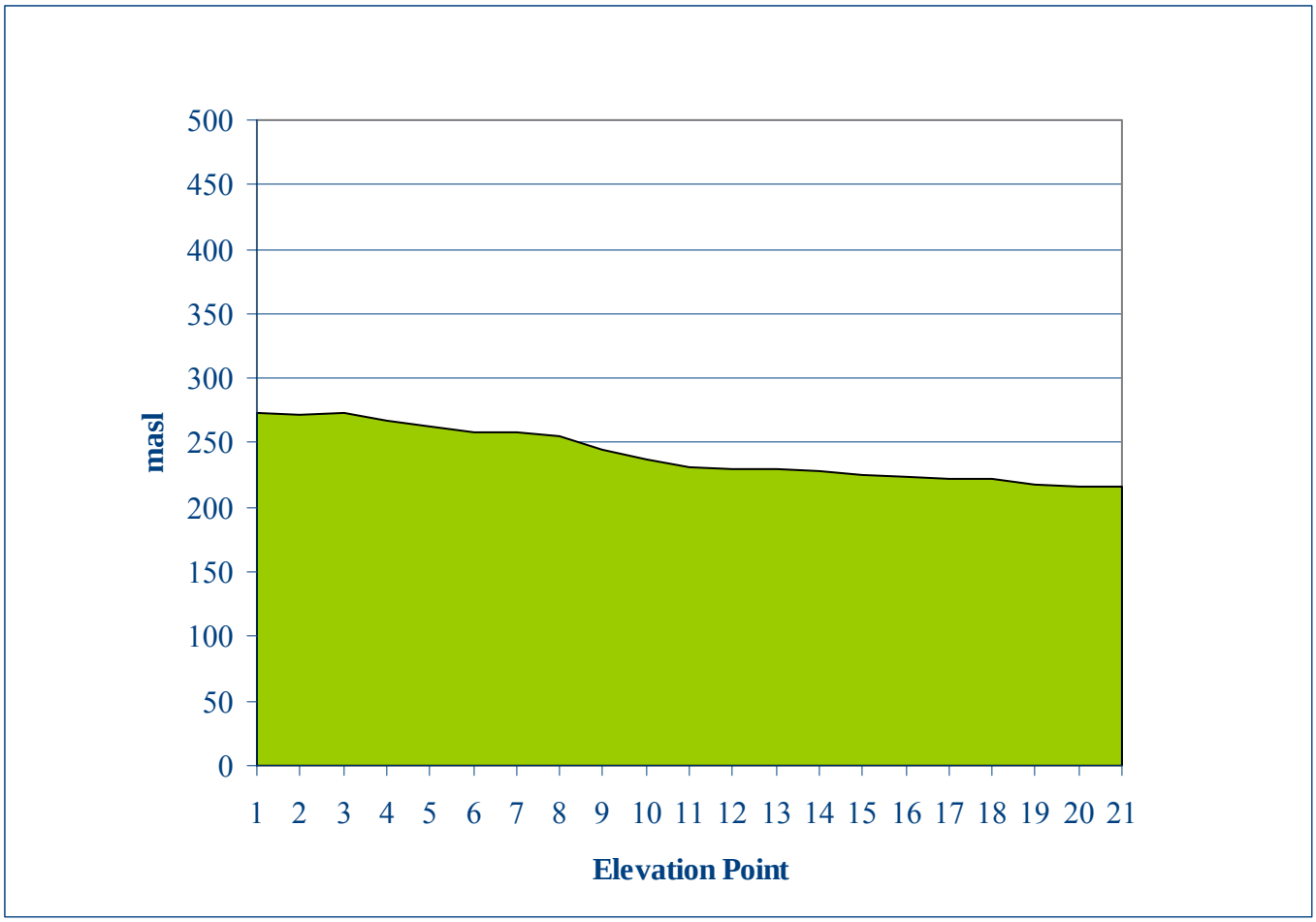


Figure 2. Elevation profile of the Icelandic River (elevation in masl).

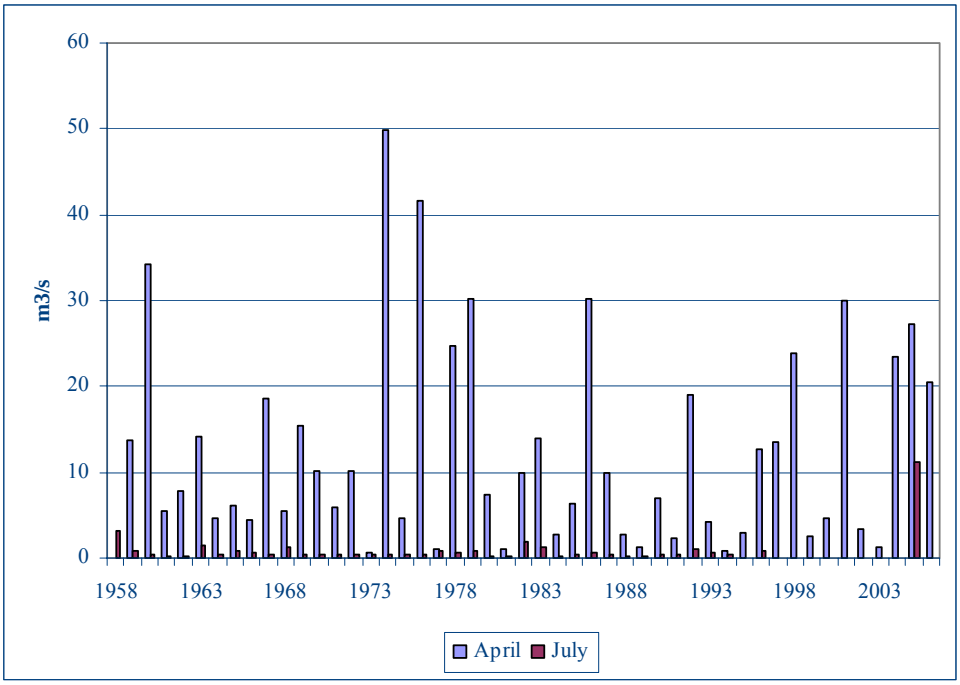


Figure 3. Mean monthly discharges in the Icelandic River (Station #05SC002 near Riverton) from 1958 to 2006 (Source: Environment Canada, Water survey of Canada, 2006).

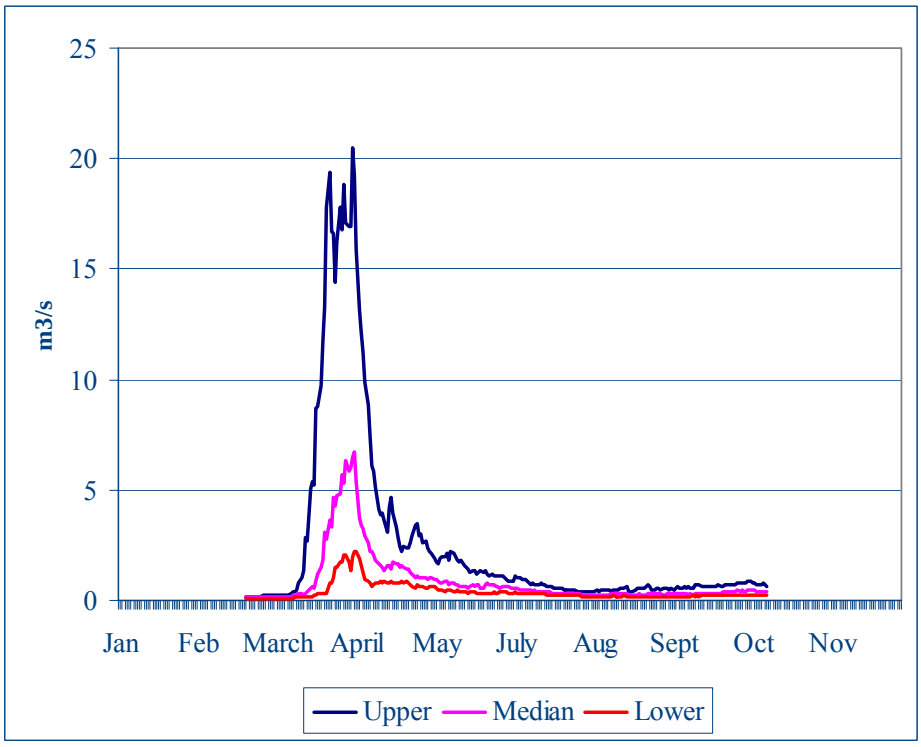


Figure 4. Median, upper and lower quartile flows for the Icelandic River (Station #05SC002 near Riverton) from 1958 to 2006 (Source: Environment Canada, Water Survey of Canada, 2006).

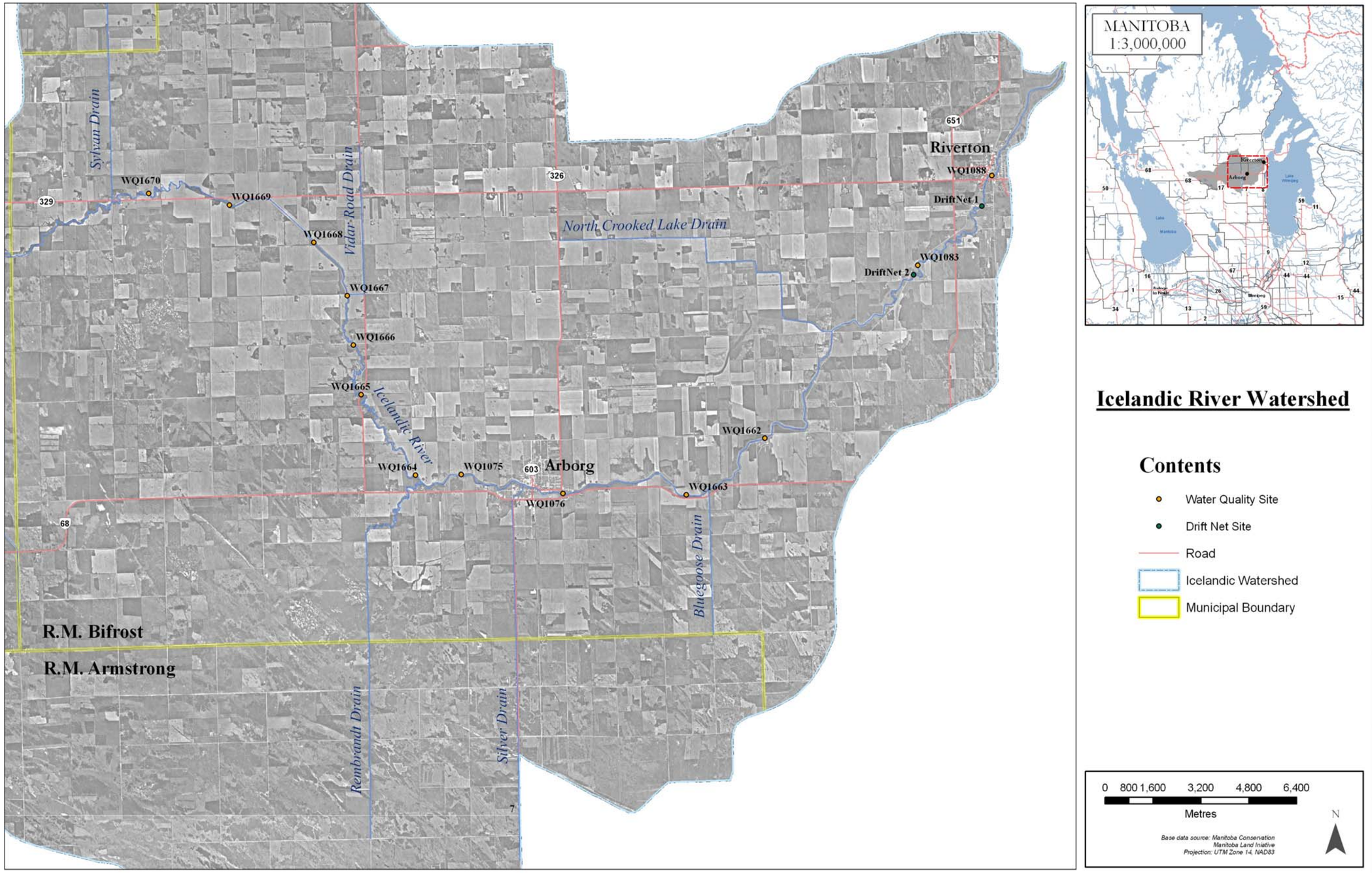


Figure 5. Location of Manitoba Water Stewardship-Water Quality Management sites (Green 1997) and Manitoba Water Stewardship-Fisheries Branch drift sampling locations (Cann 1990).

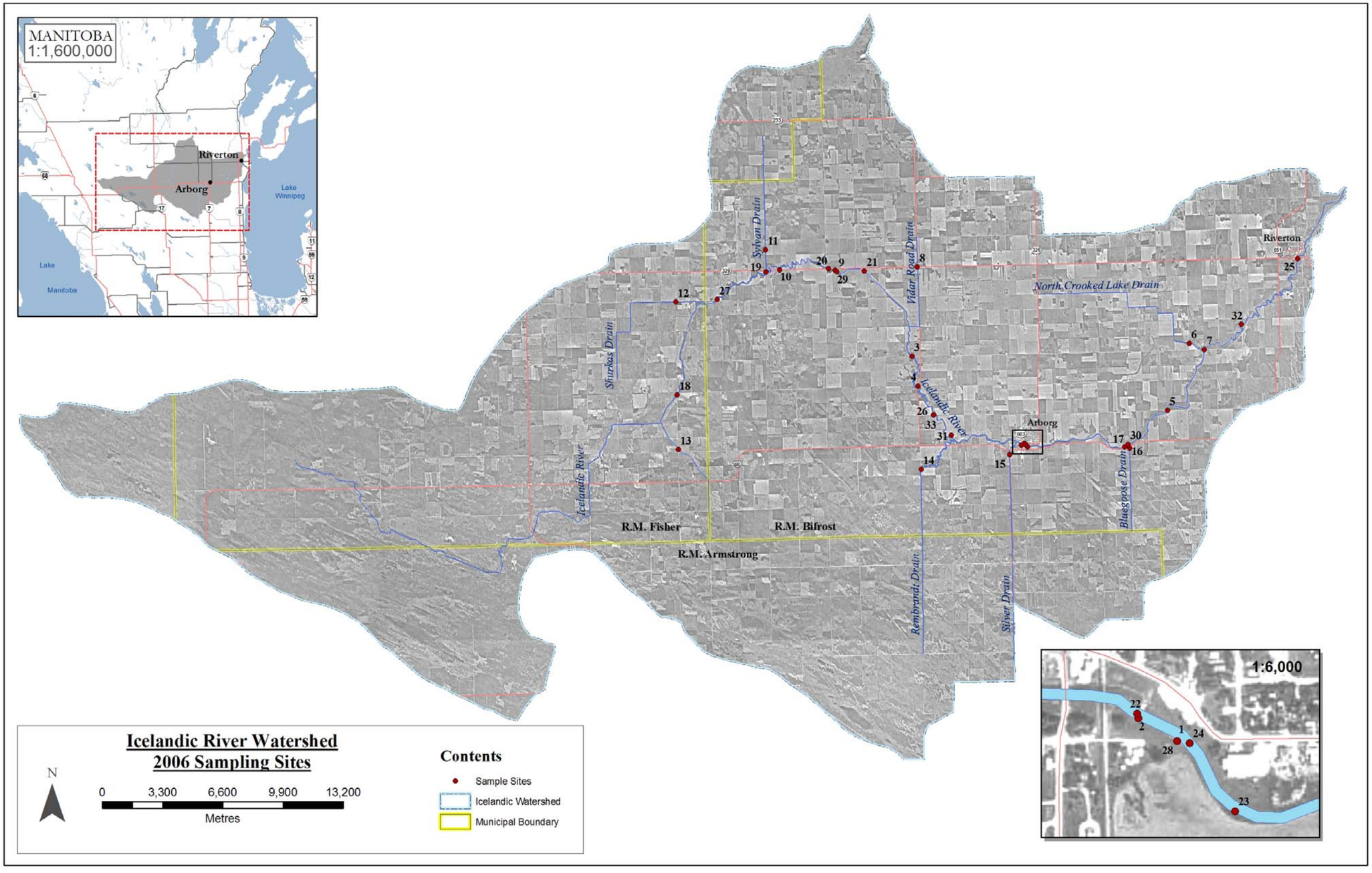
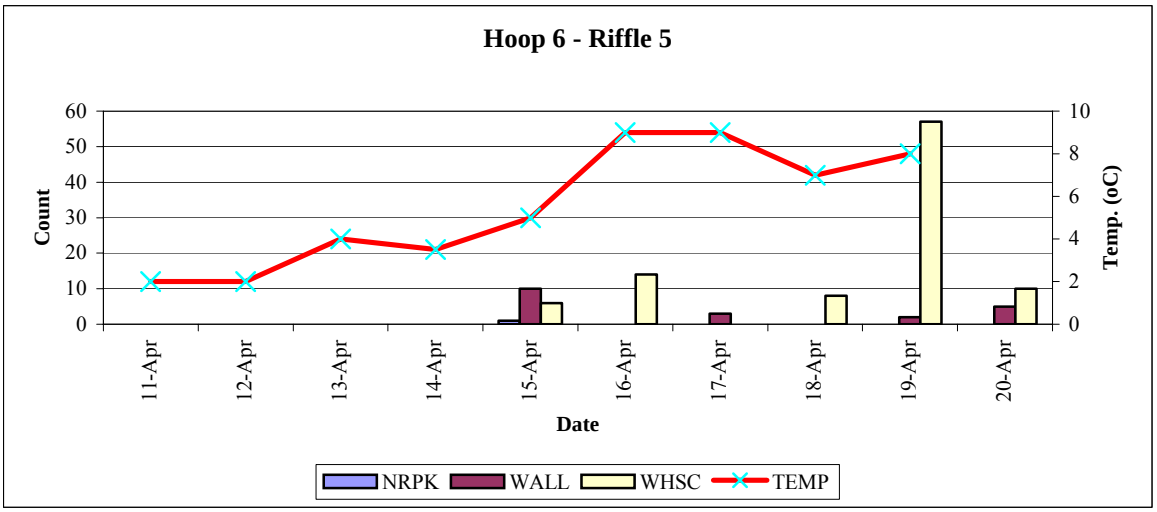
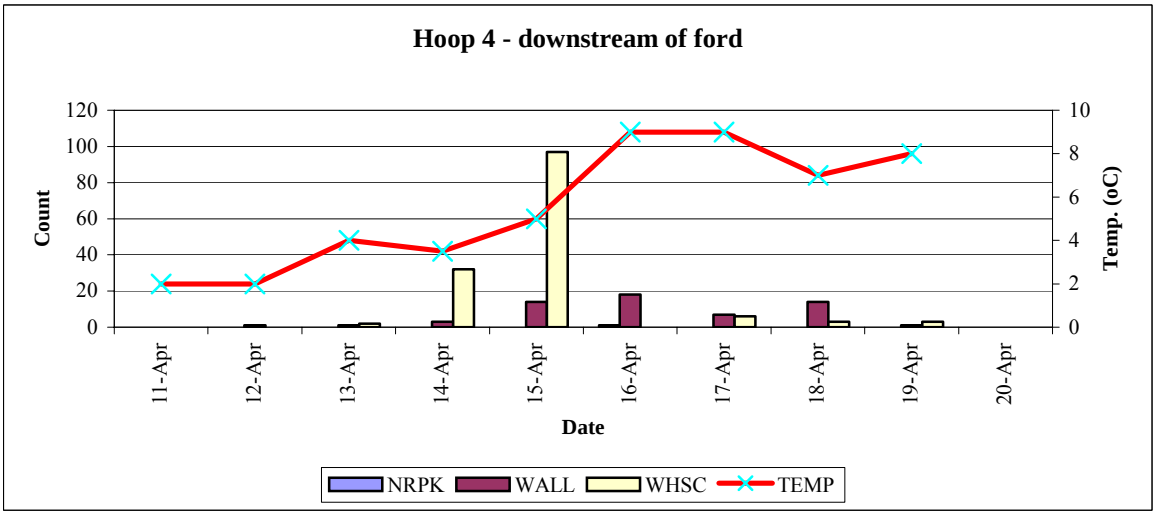


Figure 6. Sampling sites visited throughout the Icelandic River watershed study area, 2006 and 2007. Sampling techniques used at each site are described on Table 5.





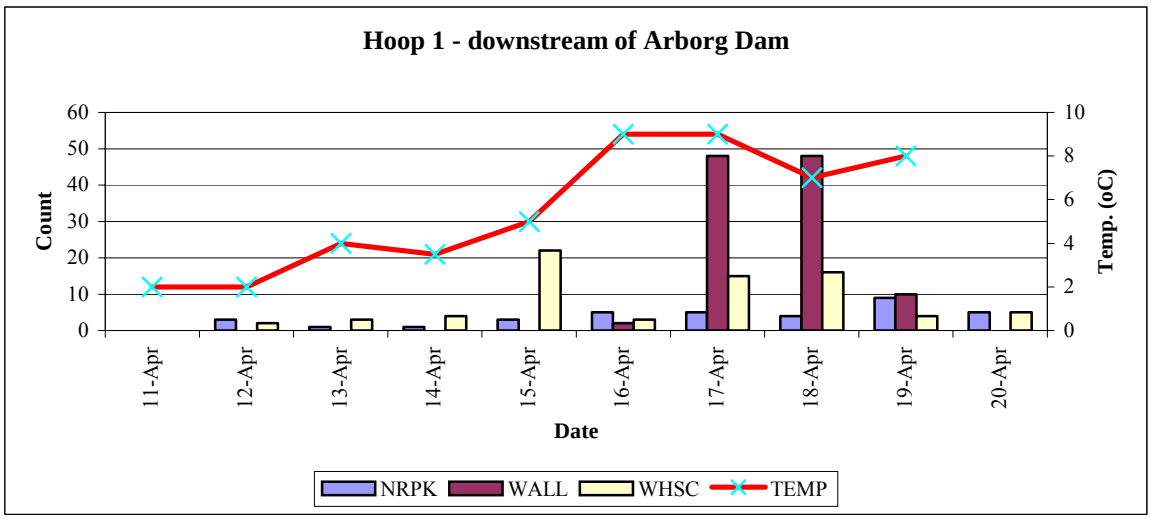


Figure 7. Fish catch, by date and water temperature, at Hoops 1, 4, and 6, spring 2007.

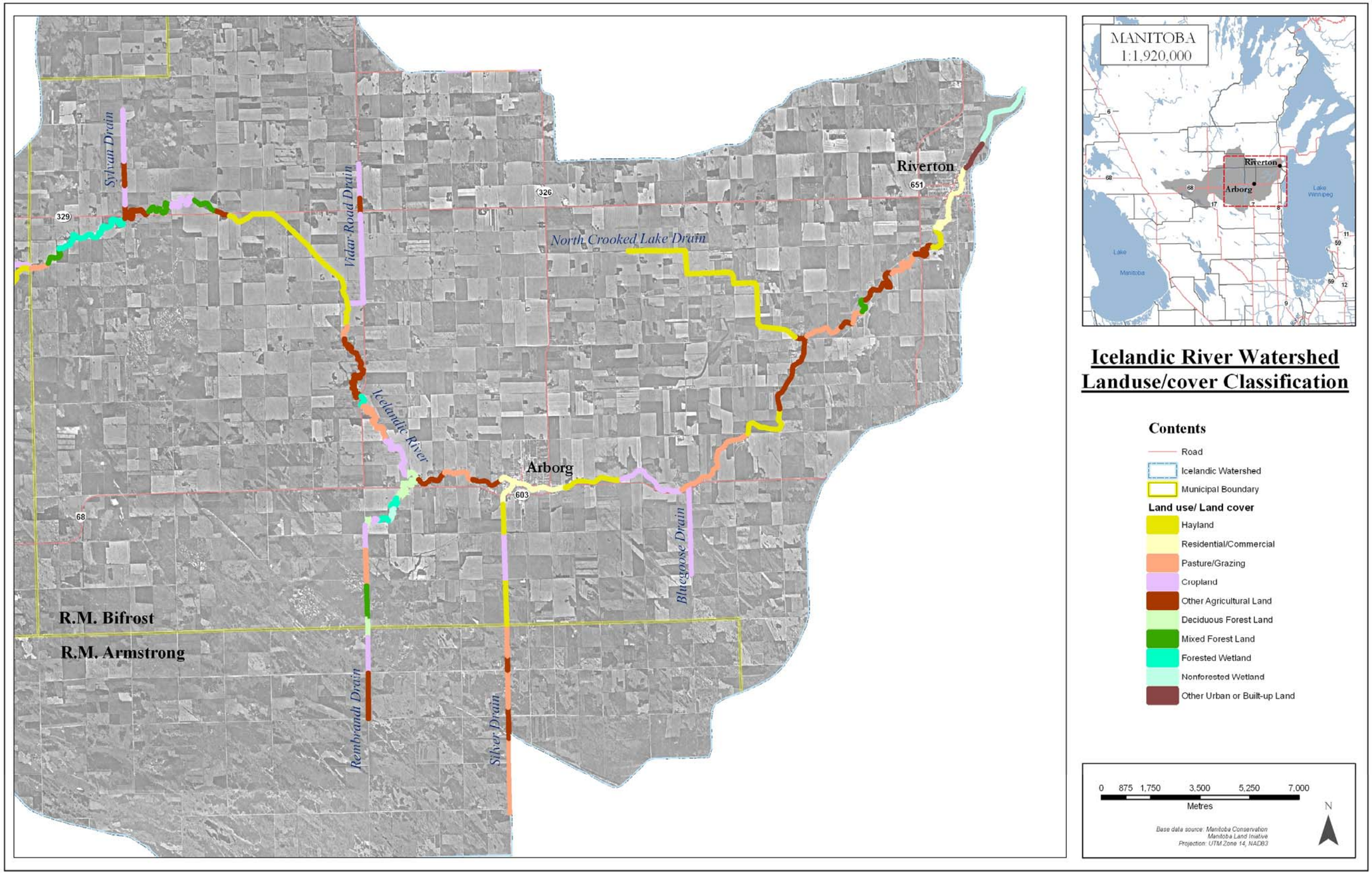


Figure 8. General land use/cover classifications based on aerial footage, within the lower section of the Icelandic River watershed study area, 2006.

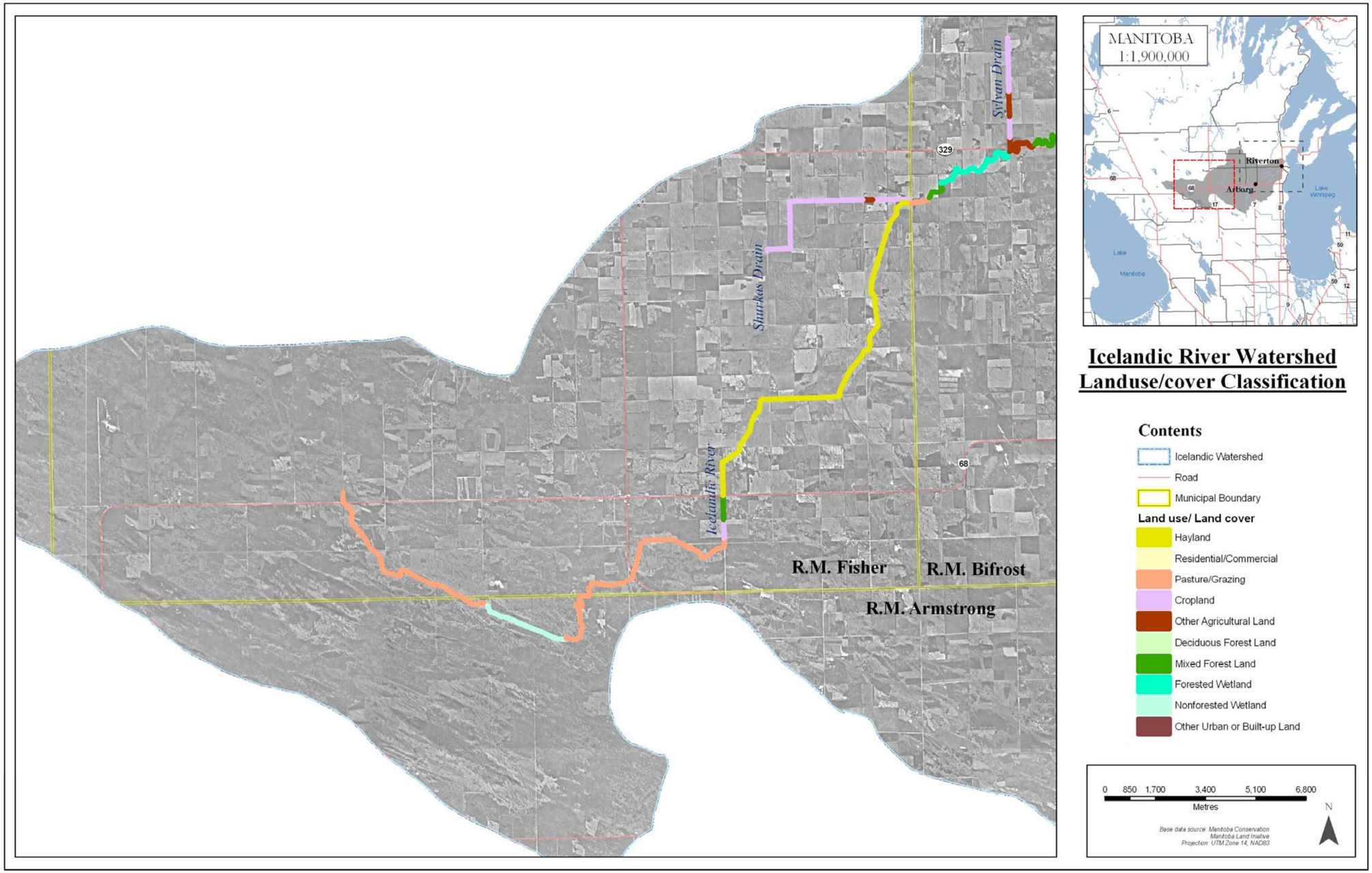


Figure 9. General land use/cover classifications based on aerial footage, within the upper section of the Icelandic River watershed study area, 2006.

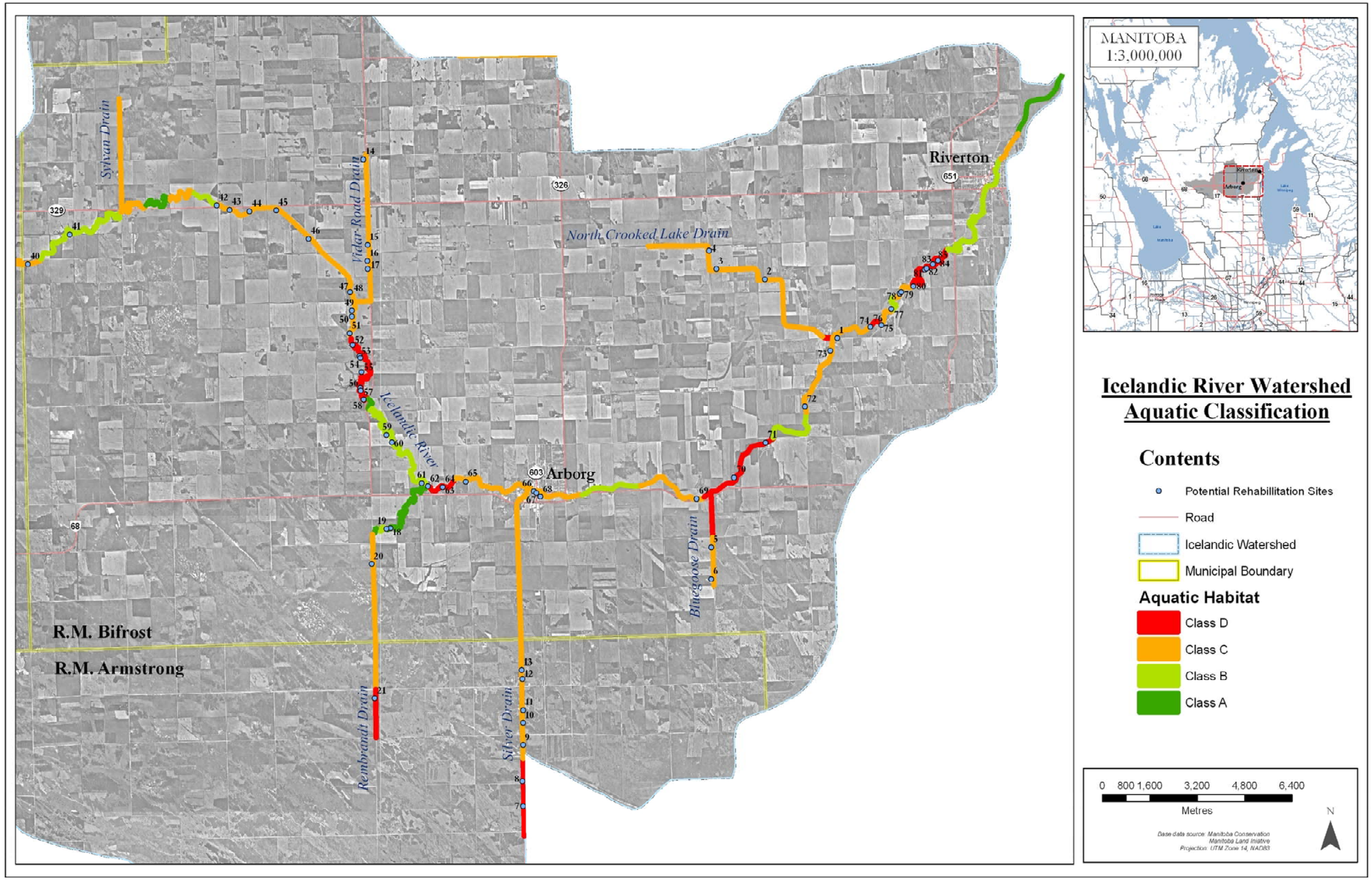


Figure 10. Aquatic habitat quality ratings and potential rehabilitation sites identified within the lower section of the Icelandic River watershed study area, 2006.

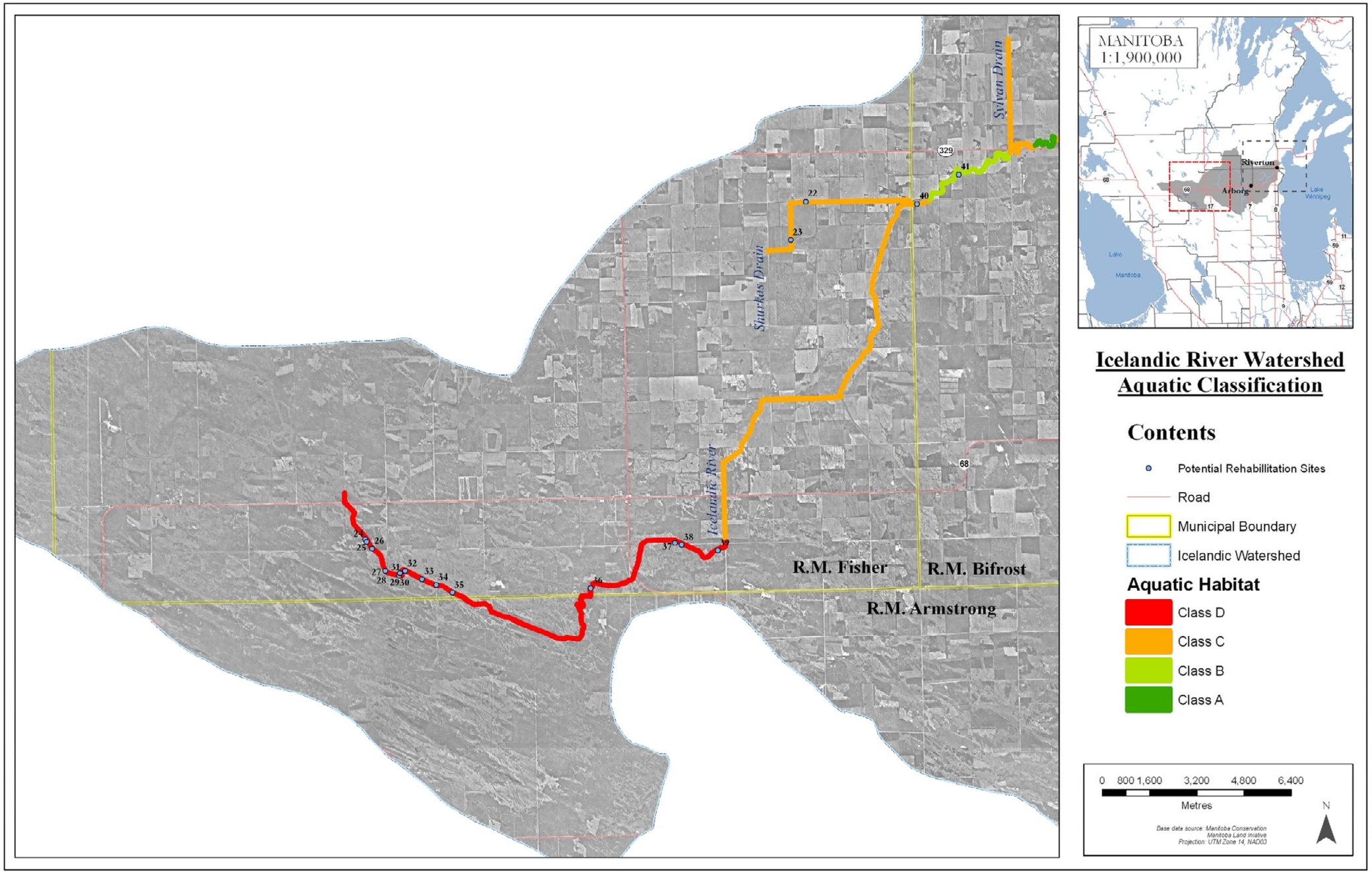


Figure 11. Aquatic habitat quality ratings and potential rehabilitation sites identified within the upper section of the Icelandic River watershed study area, 2006.

Appendix 1.1 Monthly 2006 flows (Station #05SC002, near Riverton) (Source: Environment Canada, Water Survey of Canada, 2006).

2006	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	-	-	0.162 B	1.03 B	1.02	10	-	-	-	-	-	-
2	-	-	0.159 B	2.86 B	1.04	7.97	-	-	-	-	-	-
3	-	-	0.152 B	10.3 B	1.15	6.95	-	-	-	-	-	-
4	-	-	0.144 B	24.9 B	1.21	5.7	-	-	-	-	-	-
5	-	-	0.151 B	46.6 B	1.18	4.95	-	-	-	-	-	-
6	-	-	0.149 B	75.2 B	1.14	5.29	-	-	-	-	-	-
7	-	-	0.154 B	65.9	1.08	4.38	-	-	-	-	-	-
8	-	-	0.156 B	59.3	0.989	3.27	-	-	-	-	-	-
9	-	-	0.172 B	53.3	0.93	2.55	-	-	-	-	-	-
10	-	-	0.173 B	45.6	1.06	2.15	-	-	-	-	-	-
11	-	-	0.154 B	44.2	1.33	1.89	-	-	-	-	-	-
12	-	-	0.158 B	52.8	1.11	1.73	-	-	-	-	-	-
13	-	-	0.167 B	36.6	1.04	1.55	-	-	-	-	-	-
14	-	-	0.164 B	22.8	0.967	1.34	-	-	-	-	-	-
15	-	-	0.166 B	16	0.935	1.18	-	-	-	-	-	-
16	-	-	0.168 B	11.9	0.905	1.16	-	-	-	-	-	-
17	-	-	0.171 B	8.87	0.847	1.07	-	-	-	-	-	-
18	-	-	0.167 B	6.58	0.785	1.03	-	-	-	-	-	-
19	-	-	0.155 B	4.94	0.727	1.11	-	-	-	-	-	-
20	-	-	0.151 B	3.98	0.73	1.01	-	-	-	-	-	-
21	-	-	0.149 B	3.41	0.733	0.945	-	-	-	-	-	-
22	-	-	0.144 B	2.89	0.675	0.881	-	-	-	-	-	-
23	-	-	0.141 B	2.51	0.626	0.802	-	-	-	-	-	-
24	-	-	0.142 B	2.15	0.547	0.756	-	-	-	-	-	-
25	-	-	0.159 B	1.78	0.509	0.643	-	-	-	-	-	-
26	-	-	0.173 B	1.55	0.528	0.608	-	-	-	-	-	-
27	-	-	0.186 B	1.39	0.574	0.584	-	-	-	-	-	-
28	-	-	0.227 B	1.24	0.94	0.541	-	-	-	-	-	-
29	-		0.284 B	1.13	10.3	0.473	-	-	-	-	-	-
30	-		0.462 B	1.04	18.4	0.426	-	-	-	-	-	-
31	-		0.830 B		14.8		-	-		-		-
Mean			0.196	20.4	2.22	2.43						
Max			0.830 B	75.2 B	18.4	10						
Min			0.141 B	1.03 B	0.509	0.426						
Total			6.09	612.75	68.807	72.939						
Total Dam3			526	52900	5940	6300						

Appendix 2.1 List of fish species potentially utilizing the Icelandic River watershed, including: Family name; genus and species; common name; and abbreviation used in the Icelandic River watershed, riparian assessment survey, 2006.

FAMILY	COMMON NAME	ABBREVIATION	GENUS	SPECIES
Catostomidae	Quillback	QUILL	*Carpiodes*	*cyprinus*
Catostomidae	Shorthead redhorse	SHRD	*Moxostoma*	*macrolepidotum*
Catostomidae	Silver redhorse	SLRD	*Moxostoma*	*anisurum*
Catostomidae	White sucker	WHSC	*Catostomus*	*commersoni*
Centrarchidae	Black crappie	BLCR	*Pomoxis*	*nigromaculatus*
Centrarchidae	Rock bass	RCBS	*Ambloplites*	*rupestris*
Cyprinidae	Blacknose shiner	BLSH	*Notropis*	*heterolepis*
Cyprinidae	Carp	CARP	*Cyprinus*	*carpio*
Cyprinidae	Emerald shiner	EMSH	*Notropis*	*atherinoides*
Cyprinidae	Fathead minnow	FTMN	*Pimephales*	*promelas*
Cyprinidae	Finescale dace	FNDC	*Phoxinus*	*neogaeus*
Cyprinidae	Golden shiner	GLSH	*Notemigonus*	*crysoleucas*
Cyprinidae	Longnose dace	LNDC	*Rhinichthys*	*cataractae*
Cyprinidae	Mimic shiner	MMSH	*Notropis*	*volucellus*
Cyprinidae	Northern redbelly dace	NRDC	*Phoxinus*	*eos*
Cyprinidae	Pearl dace	PRDC	*Margariscus*	*margarita*
Cyprinidae	Spottail shiner	SPSH	*Notropis*	*hudsonius*
Cyprinidae	Weed shiner	WDSH	*Notropis*	*texanus*
Cyprinidae	Western blacknose dace	WBDC	*Rhinichthys*	*obtusus*
Esocidae	Northern pike	NRPK	*Esox*	*lucius*
Gadidae	Burbot	BURB	*Lota*	*lota*
Gasterosteidae	Brook stickleback	BRST	*Culaea*	*inconstans*
Hiodontidae	Goldeye	GOLD	*Hiodon*	*alosoides*
Ictaluridae	Black bullhead	BLBL	*Ameiurus*	*melas*
Ictaluridae	Brown bullhead	BRBL	*Ameiurus*	*nebulosus*
Ictaluridae	Tadpole madtom	TDMD	*Noturus*	*gyrinus*
Moronidae	White bass	WHBS	*Morone*	*chrysops*
Percidae	Iowa darter	IWDR	*Etheostoma*	*exile*
Percidae	Johnny darter	JHDR	*Etheostoma*	*nigrum*
Percidae	Logperch	LGPR	*Percina*	*caprodes*
Percidae	River darter	RVDR	*Percina*	*shumardi*
Percidae	Sauger	SAUG	*Sander*	*canadensis*
Percidae	Walleye	WALL	*Sander*	*vitreus*
Percidae	Yellow perch	YLPR	*Perca*	*flavescens*
Sciaenidae	Freshwater drum	FRDR	*Aplodinotus*	*grunniens*
Umbridae	Central mudminnow	CNMD	*Umbra*	*limi*

Appendix 3.1 Physical information (substrate composition/compaction, water depths, and comments) collected throughout the Icelandic River watershed, by North/South Consultants Inc., 2006.

DATE	LOCATION	SITE	SIDE	DISTANCE FR. SHORE (m)	DEPTH (m)	SUBSTRATE Composition	SUBSTRATE Compaction	OTHER
8-May-06	Icelandic River	FB1						Beaver dam under bridge, no passage
8-May-06	Icelandic River	DT3						Minimal flow
9-May-06	North Crooked Lake Drain	NCD1						Low flow, duck weed and algae forming
9-May-06	Vidir Drain	VD1						Minimal water, algae around culverts
9-May-06	Icelandic River	IR2	LB	0.5	0.88	Gravel/mud	Medium	
9-May-06	Icelandic River	IR2		1.0	0.80	Gravel/mud	Medium	
9-May-06	Icelandic River	IR2		1.5	0.56	Gravel/mud	Medium	
9-May-06	Icelandic River	IR2		2.0	0.40	Gravel/mud	Medium	
9-May-06	Icelandic River	IR2		2.5	0.28	Gravel/mud	Medium	
9-May-06	Icelandic River	IR2		3.0	0.14	Gravel/mud	Medium	
9-May-06	Icelandic River	IR2	RB	3.5	Shore			
9-May-06	Shurkas Drain	SD1						Extreme field erosion/siltation
9-May-06	Icelandic River	IR4						Minimal flow, reeds and cattails present
9-May-06	Rembrandt Drain	RD1	RB	0.5	0.12	Gravel/cobble	Hard	
9-May-06	Rembrandt Drain	RD1		1.0	0.20	Gravel/cobble	Hard	
9-May-06	Rembrandt Drain	RD1		1.5	0.22	Gravel/cobble	Hard	
9-May-06	Rembrandt Drain	RD1		2.0	0.20	Gravel/cobble	Hard	
9-May-06	Rembrandt Drain	RD1		2.5	0.22	Gravel/cobble	Hard	
9-May-06	Rembrandt Drain	RD1		3.0	0.26	Gravel/cobble	Hard	
9-May-06	Rembrandt Drain	RD1		3.5	0.30	Gravel/cobble	Hard	
9-May-06	Rembrandt Drain	RD1		4.0	0.28	Gravel/cobble	Hard	

Appendix 3.1 Continued.

DATE	LOCATION	SITE	SIDE	DISTANCE FR. SHORE (m)	DEPTH (m)	SUBSTRATE Composition	SUBSTRATE Compaction	OTHER
9-May-06	Rembrandt Drain	RD1		4.5	0.24	Gravel/cobble	Hard	
9-May-06	Rembrandt Drain	RD1	LB	5.0	0.20	Gravel/cobble	Hard	
9-May-06	Silver Drain	SILD1						Minimal/no flow or water
9-May-06	Bluegoose Drain	BGD1						Minimal/no flow or water
10-May-06	Icelandic River	Arborg Dam	RB	1.0	0.75	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		2.0	1.00	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		3.0	1.00	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		4.0	1.05	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		5.0	1.15	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		6.0	1.1	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		7.0	0.85	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		8.0	1.05	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		9.0	1.05	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		10.0	1.1	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		11.0	0.8	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		12.0	1.1	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		13.0	1.05	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam		14.0	0.75	Silt/Mud	Medium	
10-May-06	Icelandic River	Arborg Dam	LB	14.3	Shore			
12-Jul-06	Bluegoose Drain	BGD1						Dry
12-Jul-06	Icelandic River	IFORD	LB	0.0	0.04	Gravel	Medium	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		1.0	0.17	Cobble	Hard	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		2.0	0.30	Gravel/Cobble	Soft	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		3.0	0.30	Cobble	Hard	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		4.0	0.44	Gravel	Medium	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		5.0	0.57	Gravel/Cobble	Hard	Immediately d/s of ford

Appendix 3.1 Continued.

DATE	LOCATION	SITE	SIDE	DISTANCE FR. SHORE (m)	DEPTH (m)	SUBSTRATE Composition	SUBSTRATE Compaction	OTHER
12-Jul-06	Icelandic River	IFORD		6.0	0.60	Cobble	Hard	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		7.0	0.62	Cobble	Hard	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		8.0	0.66	Cobble	Hard	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		9.0	0.70	Gravel/Cobble	Medium	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		10.0	0.68	Gravel/Cobble	Medium	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		11.0	0.68	Gravel/Cobble	Medium	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		12.0	0.68	Gravel/Cobble	Medium	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		13.0	0.60	Gravel/Cobble	Medium	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		14.0	0.52	Gravel	Medium	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		15.0	0.54	Gravel	Medium	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		16.0	0.46	Silt/Gravel	Medium	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		17.0	0.30	Cobble/Gravel	Hard	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD		18.0	0.16	Cobble/Gravel	Medium	Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD	RB	18.3	shore			Immediately d/s of ford
12-Jul-06	Icelandic River	IFORD	LB	1.0	0.27	Gravel	Medium	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD		2.0	0.48	Cobble/Gravel	Medium	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD		3.0	0.8	Cobble/Gravel	Medium	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD		4.0	1.01	Gravel	Medium	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD		5.0	1.01	Gravel/Cobble	Medium	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD		6.0	0.62	Boulder	Hard	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD		7.0	0.61	Boulder	Hard	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD		8.0	0.66	Gravel/Cobble	Medium	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD		9.0	0.61	Gravel/Cobble	Medium	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD		10.0	0.57	Silt/Gravel	Soft	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD		11.0	0.27	Silt	Soft	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD		12.0	0.3	Silt	Soft	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD		13.0	0.4	Silt	Soft	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD	RB	14.0	0.32	Silt	Soft	Immediately u/s of ford
12-Jul-06	Icelandic River	IFORD	RB	1.0	0.25	Silt	Soft	30 m d/s of ford, aquatic plants

Appendix 3.1 Continued.

DATE	LOCATION	SITE	SIDE	DISTANCE FR. SHORE (m)	DEPTH (m)	SUBSTRATE Composition	SUBSTRATE Compaction	OTHER
12-Jul-06	Icelandic River	IFORD		2.0	0.26	Silt	Soft	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD		3.0	0.26	Silt	Soft	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD		4.0	0.23	Silt	Soft	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD		5.0	0.29	Silt	Soft	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD		6.0	0.3	Silt	Soft	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD		7.0	0.32	Silt	Soft	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD		8.0	0.29	Silt	Soft	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD		9.0	0.27	Silt	Soft	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD		10.0	0.27	Silt	Soft	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD		11.0	0.28	Silt/Gravel	Soft	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD		12.0	0.26	Gravel/Silt	Medium	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD		13.0	0.28	Gravel/Silt	Medium	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD		14.0	0.27	Silt/Gravel	Soft	30 m d/s of ford, aquatic plants
12-Jul-06	Icelandic River	IFORD	LB	15.0	0.23	Silt/Gravel	Soft	30 m d/s of ford, aquatic plants
12-Jul-06	Silver Drain	SILD1						Dry
12-Jul-06	Rembrandt Drain	RD1	RB	0.5	0.09	Cobble/Gravel	Hard	
12-Jul-06	Rembrandt Drain	RD1		1.0	0.06	Cobble/Gravel	Hard	
12-Jul-06	Rembrandt Drain	RD1		1.5	0.1	Cobble/Gravel	Hard	
12-Jul-06	Rembrandt Drain	RD1		2.0	0.11	Cobble/Gravel	Hard	
12-Jul-06	Rembrandt Drain	RD1		2.5	0.14	Cobble/Gravel	Hard	
12-Jul-06	Rembrandt Drain	RD1		3.0	0.16	Cobble/Gravel	Hard	
12-Jul-06	Rembrandt Drain	RD1		3.5	0.14	Cobble/Gravel	Hard	
12-Jul-06	Rembrandt Drain	RD1		4.0	0.1	Cobble/Gravel	Hard	
12-Jul-06	Rembrandt Drain	RD1		4.5	0.06	Cobble/Gravel	Hard	
12-Jul-06	Rembrandt Drain	RD1	LB	4.6	Shore			
12-Jul-06	Icelandic River	ICE/SYL1	RB	0.25	0.3	Gravel/Silt	Medium	
12-Jul-06	Icelandic River	ICE/SYL1		0.50	0.32	Gravel/Silt	Medium	
12-Jul-06	Icelandic River	ICE/SYL1		0.75	0.42	Sand/Gravel	Medium	

Appendix 3.1 Continued.

DATE	LOCATION	SITE	SIDE	DISTANCE FR. SHORE (m)	DEPTH (m)	SUBSTRATE Composition	SUBSTRATE Compaction	OTHER
12-Jul-06	Icelandic River	ICE/SYL1		1.00	0.34	Silt/Gravel	Medium	
12-Jul-06	Icelandic River	ICE/SYL1		1.25	0.36	Silt/Gravel	Medium	
12-Jul-06	Icelandic River	ICE/SYL1		1.50	0.34	Silt/Gravel	Medium	
12-Jul-06	Icelandic River	ICE/SYL1		1.75	0.3	Silt/Gravel	Medium	
12-Jul-06	Icelandic River	ICE/SYL1		2.00	0.25	Silt/Gravel	Soft	
12-Jul-06	Icelandic River	ICE/SYL1	LB	2.20	Shore		Soft	
19-Oct-06	Icelandic River	INL		Middle	2.2	Silt/Gravel	Medium	No macrophytes
19-Oct-06	Icelandic River	INM		12.4 wetted	0.41	Silt	Soft	
19-Oct-06	Icelandic River	INU		2.5 wetted	0.25	Clay/boulder	Hard	

Appendix 3.2 Hydrology data collected throughout the Icelandic River watershed by North/South Consultants Inc., 2006.

DATE	LOCATION	SIDE	DISTANCE	WIDTH	DEPTH	AREA	REV.	SEC.	VELOCITY	DISCHARGE (m^3/sec)	COMMENTS
9-May-06	IR2	LB	0.00	0.25	-	-	-	-	-	-	
9-May-06	IR2		0.50	0.5	0.88	0.44	30	48.2	0.42	0.187	
9-May-06	IR2		1.00	0.5	0.80	0.4	30	45.4	0.45	0.180	
9-May-06	IR2		1.50	0.5	0.56	0.28	27	43.4	0.42	0.119	
9-May-06	IR2		2.00	0.5	0.40	0.2	19	51.2	0.25	0.051	
9-May-06	IR2		2.50	0.5	0.28	0.14	12	44.1	0.19	0.026	
9-May-06	IR2		3.00	0.5	0.14	0.07	11	45.6	0.16	0.012	
9-May-06	IR2	RB	3.50	0.25	-	-	-	-	-	**0.574**	
9-May-06	RD1	RB	0.00	0.25	-	-	-	-	-	-	
9-May-06	RD1		0.50	0.5	0.12	0.06	13	42.1	0.21	0.013	
9-May-06	RD1		1.00	0.5	0.20	0.1	30	42.5	0.48	0.048	
9-May-06	RD1		1.50	0.5	0.22	0.11	40	48.4	0.56	0.062	
9-May-06	RD1		2.00	0.5	0.20	0.1	37	46.6	0.54	0.054	
9-May-06	RD1		2.50	0.5	0.22	0.11	37	45.8	0.55	0.061	
9-May-06	RD1		3.00	0.5	0.26	0.13	40	43.6	0.62	0.081	
9-May-06	RD1		3.50	0.5	0.3	0.15	30	43.1	0.47	0.071	
9-May-06	RD1		4.00	0.5	0.28	0.14	31	41.5	0.51	0.071	
9-May-06	RD1		4.50	0.5	0.24	0.12	30	40.5	0.50	0.061	
9-May-06	RD1	LB	5.00	0.25	0.2	0.05	11	40.2	0.19	0.009	
										0.531	
10-May-06	IR1	Culvert	-	-	-	-	155	40.7	2.59	-	
10-May-06	IR1	Culvert	-	-	-	-	135	30.4	3.02	-	
10-May-06	IR1	Riffle	-	-	-	-	50	41	0.83	-	
10-May-06	IR1	RB	0	0.50	-	-	-	-	-	-	
10-May-06	IR1		1	1	0.75	0.75	9	42.7	0.14	0.108	

Appendix 3.2 Continued.

DATE	LOCATION	SIDE	DISTANCE	WIDTH	DEPTH	AREA	REV.	SEC.	VELOCITY	DISCHARGE (m^3/sec)	COMMENTS
10-May-06	IR1		2	1	1	1	12	42.1	0.19	0.195	
10-May-06	IR1		3	1	1	1	12	45.3	0.18	0.181	
10-May-06	IR1		4	1	1.05	1.05	16	41.4	0.26	0.277	
10-May-06	IR1		5	1	1.15	1.15	17	42.2	0.27	0.316	
10-May-06	IR1		6	1	1.1	1.1	14	41.9	0.23	0.251	
10-May-06	IR1		7	1	0.85	0.85	8	41.4	0.13	0.112	
10-May-06	IR1		8	1	1.05	1.05	7	43.3	0.11	0.116	
10-May-06	IR1		9	1	1.05	1.05	7	43.4	0.11	0.116	
10-May-06	IR1		10	1	1.1	1.1	6	48.5	0.08	0.093	
10-May-06	IR1		11	1	0.8	0.8	3	40	0.05	0.041	
10-May-06	IR1		12	1	1.1	1.1	2	48.8	0.03	0.032	
10-May-06	IR1		13	1	1.05	1.05	3	40.1	0.05	0.054	
10-May-06	IR1		14	0.65	0.75	0.4875	1	37.9	0.02	0.009	
10-May-06	IR1	LB	14.3	0.15	-	-	-	-	-	**1.902**	
12-Jul-06	RD1	RB	0.0	0.25	-	-	-	-	-	-	SV
12-Jul-06	RD1		0.5	0.5	0.09	0.045	13	42.3	0.21	0.009	SV
12-Jul-06	RD1		1.0	0.5	0.06	0.03	13	42.8	0.21	0.006	SV
12-Jul-06	RD1		1.5	0.5	0.1	0.05	9	46.2	0.13	0.007	SV
12-Jul-06	RD1		2.0	0.5	0.11	0.055	16	42.2	0.26	0.014	SV
12-Jul-06	RD1		2.5	0.5	0.14	0.07	15	43	0.24	0.017	SV
12-Jul-06	RD1		3.0	0.5	0.16	0.08	20	41	0.33	0.027	SV
12-Jul-06	RD1		3.5	0.5	0.14	0.07	16	43.4	0.25	0.018	SV
12-Jul-06	RD1		4.0	0.5	0.1	0.05	16	43.5	0.25	0.013	SV
12-Jul-06	RD1		4.5	0.3	0.06	0.018	8	41.1	0.13	0.002	SV
12-Jul-06	RD1	LB	4.6	0.05	-	-	-	-	-	**0.112**	
12-Jul-06	ICE/SYL1	RB	0.00	0.13	-	-	-	-	-	-	
12-Jul-06	ICE/SYL1		0.25	0.25	0.3	0.075	18	41.6	0.30	0.022	

Appendix 3.2 Continued.

DATE	LOCATION	SIDE	DISTANCE	WIDTH	DEPTH	AREA	REV.	SEC.	VELOCITY	DISCHARGE (m^3/sec)	COMMENTS
12-Jul-06	ICE/SYL1		0.50	0.25	0.32	0.08	13	41.6	0.21	0.017	
12-Jul-06	ICE/SYL1		0.75	0.25	0.42	0.105	8	42.4	0.13	0.014	
12-Jul-06	ICE/SYL1		1.00	0.25	0.34	0.085	10	44.8	0.15	0.013	SV
12-Jul-06	ICE/SYL1		1.25	0.25	0.36	0.09	13	42.9	0.21	0.019	SV
12-Jul-06	ICE/SYL1		1.50	0.25	0.34	0.085	7	46	0.10	0.009	
12-Jul-06	ICE/SYL1		1.75	0.25	0.3	0.075	10	44.3	0.15	0.012	
12-Jul-06	ICE/SYL1		2.00	0.225	0.25	0.05625	11	42.8	0.18	0.010	
12-Jul-06	ICE/SYL1	LB	2.20	0.1	-	-	-	-	-	**0.115**	
13-Jul-06	IR1	RB	0.0	0.25	-	-	-	-	-	-	
13-Jul-06	IR1		0.5	0.5	0.12	0.06	6	43.3	0.10	0.006	SV
13-Jul-06	IR1		1.0	0.5	0.14	0.07	11	43.5	0.17	0.012	SV
13-Jul-06	IR1		1.5	0.5	0.16	0.08	11	43.3	0.17	0.014	SV
13-Jul-06	IR1		2.0	0.5	0.16	0.08	12	44	0.19	0.015	SV
13-Jul-06	IR1		2.5	0.5	0.12	0.06	12	42.5	0.19	0.012	SV
13-Jul-06	IR1		3.0	0.5	0.12	0.06	15	41.1	0.25	0.015	SV
13-Jul-06	IR1		3.5	0.5	0.18	0.09	15	41.1	0.25	0.022	SV
13-Jul-06	IR1		4.0	0.5	0.24	0.12	16	42.5	0.26	0.031	
13-Jul-06	IR1		4.5	0.5	0.2	0.1	11	42.6	0.18	0.018	
13-Jul-06	IR1		5.0	0.5	0.22	0.11	10	42.6	0.16	0.018	
13-Jul-06	IR1		5.5	0.5	0.14	0.07	12	41.4	0.20	0.014	SV
13-Jul-06	IR1		6.0	0.5	0.2	0.1	12	44.7	0.18	0.018	
13-Jul-06	IR1		6.5	0.5	0.14	0.07	13	43.6	0.20	0.014	SV
13-Jul-06	IR1		7.0	0.4	0.12	0.048	10	45.3	0.15	0.007	SV
13-Jul-06	IR1	LB	7.3	0.15	-	-	-	-	-	**0.215**	
13-Jul-06	IR1	Culvert	-	-	-	-	25	41.2	0.4	-	
19-Oct-06	INM	Across	-	12.4 wetted	-	-	-	-	0.1	-	SV
19-Oct-06	INL	Across	-	2.5 wetted	-	-	-	-	0	-	Pools

Appendix 4.1 Fish species captured in hoop nets set in the Icelandic River, spring, 2006.

LOCATION	SITE CODE	DATE	TIME	FISH #	COUNT	SPECIES[1]	LENGTH (mm)	WEIGHT (g)	SEX	MATURITY	COMMENTS[2]
Icelandic River	IRH2	9-May-06	8:15	1	1	RCBS	214	250			u/s moving
Icelandic River	IRH2	9-May-06	8:15	2	1	RCBS	195	200			u/s moving
Icelandic River	IRH2	9-May-06	8:15	3	1	NRPK	~300				Lost
Icelandic River	IRH2	10-May-06	9:35	4	1	NRPK	393	400			
Icelandic River	IRH2	10-May-06	9:35	5	1	RCBS	249	400			
Icelandic River	IRH1	10-May-06	9:35	6	1	NRPK	416	500			d/s moving
Icelandic River	IRH1	10-May-06	9:35	7	1	NRPK	430	600	Male	Spent	
Icelandic River	IRH1	10-May-06	9:35	8	1	NRPK	550		Female		

[1] Species code list presented in Appendix 2.
[2] Carp were also observed swimming at the base of the Arborg Dam on May 10.

Appendix 4.2 Summer fishing results and biological information collected in the Icelandic River watershed, 2006.

LOCATION	STUDY POINT[1]	METHOD[2]	DATE	COUNT	SPECIES[3]	LENGTH (mm)	COMMENTS
Icelandic River	17	BS-1	12-Jul-06	1	NRPK	110	
Icelandic River	17	BS-1	12-Jul-06	16	TPMD		
Icelandic River	17	BS-1	12-Jul-06	5	JHDR		
Icelandic River	17	BS-1	12-Jul-06	6	BLDC		
Icelandic River	17	BS-1	12-Jul-06	1	RCBS		
Icelandic River	17	E1	12-Jul-06	1	CNMD		
Icelandic River	17	E1	12-Jul-06	2	JHDR		
Rembrandt Drain	14	E2	12-Jul-06	11	CNMD		
Rembrandt Drain	14	E2	12-Jul-06	6	JHDR		
Rembrandt Drain	14	E2	12-Jul-06	40	BRST		
Rembrandt Drain	14	E2	12-Jul-06	12	FHMN		
Rembrandt Drain	14	E3	12-Jul-06	7	CNMD		
Rembrandt Drain	14	E3	12-Jul-06	6	JHDR		
Rembrandt Drain	14	E3	12-Jul-06	17	BRST		
Rembrandt Drain	14	E3	12-Jul-06	4	FHMN		
Icelandic River	18	E4	12-Jul-06	18	BRST		
Icelandic River	18	E4	12-Jul-06	6	NRDC		
Sylvan Drain		Visual	12-Jul-06		BRST		
Icelandic/Sylvan	19	E5	12-Jul-06	3	CNMD		
Icelandic/Sylvan	19	E5	12-Jul-06	31	BRST		
Icelandic/Sylvan	19	E5	12-Jul-06	2	JHDR		
Icelandic/Sylvan	19	E5	12-Jul-06	1	WHSC	33	
Icelandic/Sylvan	19	E5	12-Jul-06	1	WHSC	32	
Icelandic/Sylvan	19	E5	12-Jul-06	3	FNDC		
Icelandic River	23	E6	13-Jul-06	25	LNDC		d/s of Arborg Dam
Icelandic River	23	E6	13-Jul-06	7	JHDR		d/s of Arborg Dam
Icelandic River	23	E6	13-Jul-06	2	TDMD		d/s of Arborg Dam
Icelandic River	23	E6	13-Jul-06	3	BLBL		d/s of Arborg Dam
Icelandic River	24	E7	13-Jul-06	36	LNDC		d/s of Arborg Dam
Icelandic River	24	E7	13-Jul-06	1	JHDR		d/s of Arborg Dam
Icelandic River	22	E8	13-Jul-06	1	BURB	200	d/s of Arborg Dam

Appendix 4.2 Continued.

LOCATION	STUDY POINT[1]	METHOD[2]	DATE	COUNT	SPECIES[3]	LENGTH (mm)	COMMENTS
Icelandic River	22	E8	13-Jul-06	1	BURB	205	d/s of Arborg Dam
Icelandic River	22	E8	13-Jul-06	1	BURB	160	d/s of Arborg Dam
Icelandic River	22	E8	13-Jul-06	1	RCBS	200	d/s of Arborg Dam
Icelandic River	22	E8	13-Jul-06	1	NRPK	243	d/s of Arborg Dam
Icelandic River	22	E8	13-Jul-06	1	NRPK	115	d/s of Arborg Dam
Icelandic River	22	E8	13-Jul-06	6	LNDC		d/s of Arborg Dam
Icelandic River	22	E8	13-Jul-06	1	LGPR		d/s of Arborg Dam
Icelandic River	22	E8	13-Jul-06	2	JHDR		d/s of Arborg Dam
Icelandic River	22	E8	13-Jul-06	1	RCBS	yoy	d/s of Arborg Dam
Icelandic River	22	BS-2	13-Jul-06	1	RCBS	yoy	d/s of Arborg Dam
Icelandic River	22	BS-2	13-Jul-06	1	TDMD		d/s of Arborg Dam
Icelandic River	22	BS-2	13-Jul-06	24	GLSH		d/s of Arborg Dam

[1] Refer to Table 5 and Figure 6.
[2] BS- = Beach seines; E = Back-pack electrofishing
[3] Refer to Appendix 2.1 for species codes

Appendix 4.3 Spring fishing results and biological information collected from fish captured in the Icelandic River, 2007.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Arborg Dam	1	0		2007-04-11	14:50					
Fish ladder	2	0		2007-04-12	9:20					
d/s Ford	4	1	WALL	2007-04-12	11:25	528	1800	M	7	CAUD
d/s Arborg Dam	1	1	NRPK	2007-04-12	12:30	471	825	M	7	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-12	12:30	526	1175	M	7	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-12	12:30	485	800	F	2	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-12	12:30	463	1475	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-12	12:30	394	900			LPEL
d/s Arborg Dam	1	1	BLBL	2007-04-12	12:30	240	125			
Fish ladder	2	1	WHSC	2007-04-13	10:15	500	2000			RPEL
d/s Ford	4	1	WALL	2007-04-13	13:45	560	2300			CAUD
d/s Ford	4	1	WHSC	2007-04-13	13:45	560	2000			CAUD
d/s Ford	4	1	WHSC	2007-04-13	13:45	520	2300			CAUD
d/s Arborg Dam	1	1	NRPK	2007-04-13	14:30	445	700	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-13	14:30	400	900	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-13	14:30	455	1400			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-13	14:30	520	2150			LPEL
Fish ladder	2	1	NRPK	2007-04-14	8:00	385	300			RPEC
d/s Arborg Dam	1	1	NRPK	2007-04-14	8:30	485	925	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-14	8:30	399	950	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-14	8:30	487	2175			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-14	8:30	482	2000	M		LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-14	8:30	504	2125			LPEL
d/s Ford	4	1	WALL	2007-04-14	9:15	538	1950			CAUD
d/s Ford	4	1	WALL	2007-04-14	9:15	500	1425	M	7	CAUD
d/s Ford	4	1	WALL	2007-04-14	9:15	563	2175			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	526	2500			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	575	2950			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	549	2700			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	524	2925			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	492	1775	M	7	CAUD

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Ford	4	1	WHSC	2007-04-14	9:15	514	2325			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	539	2525			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	526	2500			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	518	2400			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	499	1750	M	7	CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	474	1725	M	7	CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	459	1750			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	539	2375			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	481	1750	M	7	CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	479	1700			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	516	2425			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	547	2575			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	457	1500	M	7	CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	498	2050			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	513	2575			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	536	2725			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	468	2000			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	425	1400	M	7	CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	500	2225	F	2	CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	519	2600			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	526	2800			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-14	9:15	-	-			CAUD
Riffle 5	6	1	WALL	2007-04-15	11:50	502	1600	M	7	LCAUD
Riffle 5	6	1	WALL	2007-04-15	11:50	489	1200	F	3	LCAUD
Riffle 5	6	1	WALL	2007-04-15	11:50	380	650	M	7	LCAUD
Riffle 5	6	1	WALL	2007-04-15	11:50	420	700	M	7	LCAUD
Riffle 5	6	1	WALL	2007-04-15	11:50	372	500	M	7	LCAUD

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
Riffle 5	6	1	WALL	2007-04-15	11:50	400	700	M	7	LCAUD
Riffle 5	6	1	WALL	2007-04-15	11:50	420	800	M	7	LCAUD
Riffle 5	6	1	NRPK	2007-04-15	11:50	410	450	M	7	LCAUD
Riffle 5	6	1	WHSC	2007-04-15	11:50	480	1600	F	2	LCAUD
Riffle 5	6	1	WHSC	2007-04-15	11:50	482	1600	M	7	LCAUD
Riffle 5	6	1	WHSC	2007-04-15	11:50	459	1400			LCAUD
Riffle 5	6	1	WALL	2007-04-15	11:50	456	1000	M	7	LCAUD
Riffle 5	6	1	WALL	2007-04-15	11:50	377	600	M	7	
Riffle 5	6	1	WALL	2007-04-15	11:50	405	650	M	7	
Riffle 5	6	1	WHSC	2007-04-15	11:50	352	650	M	7	
Riffle 5	6	1	WHSC	2007-04-15	11:50	400	1100			
Riffle 5	6	1	WHSC	2007-04-15	11:50	484	1650	M	9	
Fish ladder	2			2007-04-15	12:00					
Nelson Line Road	5	1	NRPK	2007-04-15	12:30	306	500			RPEL
Nelson Line Road	5	1	NRPK	2007-04-15	12:30	326	550	M	7	RPEL
d/s Arborg Dam	1	1	NRPK	2007-04-15	13:10	485	800			
d/s Arborg Dam	1	1	NRPK	2007-04-15	13:10	600	1700	M	7	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-15	13:10	480	800	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	462	1650			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	495	2400			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	560	2500			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	468	1700			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	520	2400			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	502	2000			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	460	1500			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	520	2100			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	484	2000			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	510	2000			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	520	2400			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	430	1200	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	430	1250	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	450	1250	M	7	LPEL

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	535	2600			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	502	1800			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	495	1800			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	510	2100			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	480	1800	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	390	900	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	438	1250	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-15	13:10	520	2550			LPEL
d/s Ford	4	1	WALL	2007-04-15	14:15	680	4000	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	650	8500	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	662	3500			CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	570	2100	M	7	CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	488	1500	M	7	CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	380	700	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	670	3950			CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	570	2400			CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	620	3000			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	480	1900	M	8	CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	450	1600	M	8	CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	560	3200			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	530	3000			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	525	3000			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	560	3000			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	440	1200	M	8	CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	485	2600			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	470	1750			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	395	1050			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	448	1700	M	7	CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	520	2750			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	470	2000			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	485	1900			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	435	1500			CAUD

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Ford	4	1	WHSC	2007-04-15	14:15	525	1500			CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	405	800	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	545	2400			CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	585	2550			CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	570	4300			CAUD
d/s Ford	4	1	WALL	2007-04-15	14:15	695	4000			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
d/s Ford	4	1	WHSC	2007-04-15	14:15	-	-			CAUD
Fish ladder	2	0		2007-04-16	11:00					
Riffle 5	6	1	WHSC	2007-04-16	12:30	456	1400			LCAUD
Riffle 5	6	1	WHSC	2007-04-16	12:30	463	1600	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-16	12:30	466	1500	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-16	12:30	495	1850	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-16	12:30	466	1550	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-16	12:30	496	2400	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-16	12:30	443	1400	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-16	12:30	470	1800	M	8	LCAUD

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
Riffle 5	6	1	WHSC	2007-04-16	12:30	427	1200	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-16	12:30	485	1800	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-16	12:30	510	1850	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-16	12:30	482	1900	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-16	12:30	497	2000	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-16	12:30	535	1250	M	8	LCAUD
Nelson Line Road	5	1	NRPK	2007-04-16	13:20	830	4600	F	3	RPEL
Nelson Line Road	5	1	NRPK	2007-04-16	13:20	372	400	M	7	RPEL
Nelson Line Road	5	1	NRPK	2007-04-16	13:20	471	700			RPEL
Nelson Line Road	5	1	WHSC	2007-04-16	13:20	454	1500	M	8	RPEL
Nelson Line Road	5	1	WHSC	2007-04-16	13:20	452	1500			RPEL
Nelson Line Road	5	1	NRPK	2007-04-16	13:20	435	500	M	8	RPEL
Nelson Line Road	5	1	NRPK	2007-04-16	13:20	312	200	M	8	RPEL
Nelson Line Road	5	1	WALL	2007-04-16	13:20	469	1200			RPEL
d/s Arborg Dam	1	1	WALL	2007-04-16	13:45	393	700	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-16	13:45	409	750	M	8	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-16	13:45	608	1900	F	3	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-16	13:45	385	400	M	8	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-16	13:45	499	900	M	8	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-16	13:45	471	800	M	8	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-16	13:45	432	650	M	8	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-16	13:45	500	1800			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-16	13:45	350	650	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-16	13:45	212	-			LPEL
d/s Ford	4	1	WALL	2007-04-16	15:15	527	1650	M	7	CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	631	3400			CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	530	1600	M	7	CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	555	2000	M	7	CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	505	1500	M	7	CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	510	1550	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	587	2300	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	401	750	M	8	CAUD

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Ford	4	1	WALL	2007-04-16	15:15	444	1000			CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	568	2200			CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	448	1000	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	535	1800	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	428	1000	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	530	1800	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	420	900			CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	625	2900			CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	408	700	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-16	15:15	442	1150	M	8	CAUD
d/s Ford	4	1	NRPK	2007-04-16	15:15	480	850	M	7	CAUD
Riffle 5	6	1	WALL	2007-04-17	12:30	342	300	M	8	LCAUD
Riffle 5	6	1	WALL	2007-04-17	12:30	447	1000			LCAUD
Riffle 5	6	1	WALL	2007-04-17	12:30	356	450	M	8	LCAUD
Fish ladder	2	1	WHSC	2007-04-17	14:30	450				
Nelson Line Road	5	0		2007-04-17	15:00					
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	538	1900			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	640	3100			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	621	2600	M	7	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	544	2000			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	540	1900	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	590	2250	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	520	1800	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	513	1600	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	550	2200			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	454	1400			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	500	1400	M	7	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	440	1000	M	7	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	412	700	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	712	4500			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	383	600	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	504	1400	M	8	LPEL

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	430	900	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	515	1650			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	579	2500			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	538	1600	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	402	800	M	8	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-17	16:00	598	2000	M	9	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	478	1700			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	493	1800	M	8	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	513	2200			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	505	2500			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	433	1400	M	8	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	481	2200			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	454	1500	M	8	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	504	2300			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	433	1300	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	487	2000			LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-17	16:00	515	1000	M	7	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-17	16:00	485	1000			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-17	16:00	-	-			LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-17	16:00	-	-			LPEL
d/s Ford	4	1	WALL	2007-04-17	17:15	720	-			CAUD
d/s Ford	4	1	WALL	2007-04-17	17:15	700	-			CAUD
d/s Ford	4	1	WALL	2007-04-17	17:15	572	-			CAUD
d/s Ford	4	1	WALL	2007-04-17	17:15	577	-	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-17	17:15	519	-	M	7	CAUD
d/s Ford	4	1	WALL	2007-04-17	17:15	533	-	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-17	17:15	461	-	F	2	CAUD
d/s Ford	4	1	WHSC	2007-04-17	17:15	511	-			CAUD
d/s Ford	4	1	WHSC	2007-04-17	17:15	551	-			CAUD
d/s Ford	4	1	WHSC	2007-04-17	17:15	542	-			CAUD
d/s Ford	4	1	WHSC	2007-04-17	17:15	545	-			CAUD
d/s Ford	4	1	WHSC	2007-04-17	17:15	536	-	M	8	CAUD

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Ford	4	1	WHSC	2007-04-17	17:15	470	-	M	8	CAUD
Fish ladder	2	1	WHSC	2007-04-18	11:45	462	1400			RPEL
Fish ladder	2	1	WHSC	2007-04-18	11:45	400	1000	M	8	RPEL
Fish ladder	2	1	WHSC	2007-04-18	11:45	503	2300			RPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	774	5600			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	558	2050	M	7	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	645	3400			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	605	2900			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	597	3000			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	515	1700	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	492	1500	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	513	1500	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	595	2700			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	605	3100	F	2	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	554	2200			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	537	1700	M	7	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	520	1650			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	615	3500	M	7	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	516	2400			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	507	2200			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	546	2500			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	503	2000			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	470	1650	F	2	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	515	2300	F	2	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	502	1900			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	442	1200	M	9	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	478	1700	M	8	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	482	2000			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	438	1350	M	8	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	480	1500	M	8	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	521	2500			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	495	1700	M	8	LPEL

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	510	2250			LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-18	12:30	374	900	M	8	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-18	12:30	472	900	M	9	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-18	12:30	470	700	M	9	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-18	12:30	490	900	M	9	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-18	12:30	495	900	F	3	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Arborg Dam	1	1	WALL	2007-04-18	12:30	-	-			LPEL
d/s Ford	4	1	WALL	2007-04-18	14:00	620	3100	M	7	CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	553	1900	M	7	CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	426	750	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	653	3000	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	384	550	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	545	1800	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	455	1000	M	8	CAUD
d/s Ford	4	1	WHSC	2007-04-18	14:00	527	2200			CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	417	700	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	712	4700			CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	718	5500			CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	623	3000			CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	445	1000	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	371	500	M	8	CAUD
d/s Ford	4	1	WALL	2007-04-18	14:00	312	300	M	8	CAUD
d/s Ford	4	1	WHSC	2007-04-18	14:00	536	2400	M	8	CAUD
d/s Ford	4	1	WHSC	2007-04-18	14:00	550	2600			CAUD
Riffle 5	6	1	WHSC	2007-04-18	16:00	470	1500	F	2	LCAUD
Riffle 5	6	1	WHSC	2007-04-18	16:00	479	1900			LCAUD
Riffle 5	6	1	WHSC	2007-04-18	16:00	456	1500	M	7	LCAUD
Riffle 5	6	1	WHSC	2007-04-18	16:00	451	1350	M	9	LCAUD
Riffle 5	6	1	WHSC	2007-04-18	16:00	476	1700	M	9	LCAUD
Riffle 5	6	1	WHSC	2007-04-18	16:00	472	1550	M	9	LCAUD
Riffle 5	6	1	WHSC	2007-04-18	16:00	521	2600	M	8	LCAUD

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
Riffle 5	6	1	WHSC	2007-04-18	16:00	505	2100			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	474	1500	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	510	2100			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	435	1400	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	500	1900			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	506	2200			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	465	1600	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	473	1700	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	494	1800	M	9	LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	443	1400			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	465	1700	M	9	LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	445	1300	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	447	1200	M	8	LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	425	1200	M	9	LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	387	1000	F	4	LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	534	2700	F	4	LCAUD
Riffle 5	6	1	WALL	2007-04-19	10:40	376	600	M	8	LCAUD
Riffle 5	6	1	WALL	2007-04-19	10:40	415	900	M	7	LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Riffle 5	6	1	WHSC	2007-04-19	10:40	-	-			LCAUD
Fish ladder	2	1	WHSC	2007-04-19	12:00	490	-			
d/s Arborg Dam	1	1	WHSC	2007-04-19	12:50	555	3000	F	3	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-19	12:50	510	2400	F	2	LPEL
d/s Arborg Dam	1	1	WHSC	2007-04-19	12:50	514	2700			LPEL

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
d/s Arborg Dam	1	1	WHSC	2007-04-19	12:50	547	2450	F	3	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-19	12:50	445	1000	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-19	12:50	518	1500	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-19	12:50	590	2600	F	3	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-19	12:50	404	800	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-19	12:50	492	1300	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-19	12:50	425	900	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-19	12:50	468	1200	M	8	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-19	12:50	510	1400	F	2	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-19	12:50	544	1700			LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-19	12:50	922	6600			LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-19	12:50	510	900	M	9	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-19	12:50	387	400	M	9	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-19	12:50	480	600	M	9	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-19	12:50	405	500	M	9	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-19	12:50	405	400	M	9	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-19	12:50	455	600	M	9	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-19	12:50	400	400	M	9	LPEL
d/s Arborg Dam	1	1	WALL	2007-04-19	12:50	432	800	M	8	LPEL
d/s Arborg Dam	1	1	NRPK	2007-04-19	12:50	-	-			LPEL
d/s Ford	4	1	WALL	2007-04-19	14:00	399	750	M	8	CAUD
d/s Ford	4	1	WHSC	2007-04-19	14:00	540	3000	F	3	CAUD
d/s Ford	4	1	WHSC	2007-04-19	14:00	547	2650	F	3	CAUD
d/s Ford	4	1	WHSC	2007-04-19	14:00	450	1500	M	8	CAUD
d/s Ford	4	1	BLBL	2007-04-19	14:00	220	200			CAUD
d/s Ford	4	1	BLBL	2007-04-19	14:00	100	-			CAUD
Riffle 5	6	1	WHSC	2007-04-20	8:05	459	1800	M	8	
Riffle 5	6	1	WHSC	2007-04-20	8:05	375	900	M	8	
Riffle 5	6	1	WHSC	2007-04-20	8:05	527	2500			
Riffle 5	6	1	WHSC	2007-04-20	8:05	430	1100			
Riffle 5	6	1	WHSC	2007-04-20	8:05	543	2350	F	2	
Riffle 5	6	1	WHSC	2007-04-20	8:05	533	2400			

Appendix 4.3 Continued.

Site Description	Hoop #	Total Catch	Fish Species	Check Date (y/m/d)	Check Time (h:m)	Fork Length (mm)	Weight (g)	Sex ID[1]	Maturity ID[1]	Clip[2]
Riffle 5	6	1	WHSC	2007-04-20	8:05	459	1400	F	3	
Riffle 5	6	1	WHSC	2007-04-20	8:05	446	1200	M	8	
Riffle 5	6	1	WALL	2007-04-20	8:05	530	1800			
Riffle 5	6	1	WALL	2007-04-20	8:05	387	700	M	8	
Riffle 5	6	1	WALL	2007-04-20	8:05	475	1200			
Riffle 5	6	1	WALL	2007-04-20	8:05	399	600	M	8	
Riffle 5	6	1	WALL	2007-04-20	8:05	390	600	M	8	
Riffle 5	6	1	WHSC	2007-04-20	8:05	438	1400	M	8	
Riffle 5	6	1	WHSC	2007-04-20	8:05	425	1300	M	8	
d/s Ford	4	0		2007-04-20	9:00					
Under Bridge	7	1	WHSC	2007-04-20	9:15	450	1400			
d/s Arborg Dam	1	1	WHSC	2007-04-20	9:35	570	2700	F	3	
d/s Arborg Dam	1	1	WHSC	2007-04-20	9:35	474	1900	M	8	
d/s Arborg Dam	1	1	WHSC	2007-04-20	9:35	540	2700	F	3	
d/s Arborg Dam	1	1	WHSC	2007-04-20	9:35	502	1800	M	8	
d/s Arborg Dam	1	1	WHSC	2007-04-20	9:35	520	2500	F	4	
d/s Arborg Dam	1	1	NRPK	2007-04-20	9:35	457	650			
d/s Arborg Dam	1	1	NRPK	2007-04-20	9:35	408	550	M	9	
d/s Arborg Dam	1	1	NRPK	2007-04-20	9:35	378	300	M	9	
d/s Arborg Dam	1	1	NRPK	2007-04-20	9:35	471	600	F	4	
d/s Arborg Dam	1	1	NRPK	2007-04-20	9:35	415	400	F	4	

[1] Sex and Maturity Codes Used:
F = Female
F2 = Female preparing to spawn in the current year
F3 = A female, ripe and ready to spawn in the current year
F4 = A spent female
M = Male
M7 = Male preparing to spawn in the current year
M8 = A male, ripe and ready to spawn in the current year
M9 = A spent male

[2] Clip identification:
CAUD = upper caudal tip
LCAUD = lower caudal tip
LPEL = lower pelvic
RPEL = right pelvic
RPEC = right pectoral

Appendix 5.1 Aerial video summary, including basic site descriptions, of the Icelandic River watershed, completed for the Icelandic River watershed riparian assessment survey, 2006.

Area	Type	Composition	Comment	Time	TAPE NAME
North Crooked Lake Drain	Operation		Larger, with grazing and access, RB, noted for Icelandic River	00:00:55	ICELANDIC1
North Crooked Lake Drain	Road crossing	2 culverts		00:01:00	ICELANDIC1
North Crooked Lake Drain	Road crossing	1 culvert		00:01:23	ICELANDIC1
North Crooked Lake Drain	Road crossing	3 culverts	Gravel road	00:02:31	ICELANDIC1
North Crooked Lake Drain	Road crossing	3 culverts	Sharp bend and possible site of bank instability	00:03:05	ICELANDIC1
North Crooked Lake Drain	Road crossing	4 culverts	Sharp bend and possible site of bank instability	00:03:57	ICELANDIC1
North Crooked Lake Drain	Road crossing	3 culverts	Sharp bend and possible site of bank instability	00:04:26	ICELANDIC1
North Crooked Lake Drain	Road crossing	3 culverts		00:05:06	ICELANDIC1
Bluegoose Drain	Road crossing	2 culverts	Travels under main road	00:10:06	ICELANDIC1
Bluegoose Drain	Road crossing	2 culverts (?)	Travels under main road	00:10:41	ICELANDIC1
Bluegoose Drain	Grazing		Grazing with dugout on opposite side of road from drain (?)	00:10:54	ICELANDIC1
Bluegoose Drain	Grazing		Grazing on opposite side of road from drain with evidence of cattle	00:11:18	ICELANDIC1
Bluegoose Drain	Road crossing	1 culvert (?)	Under gravel road	00:11:18	ICELANDIC1
Silver Drain	Road crossing	1 culvert (?)	Onto private property	00:15:21	ICELANDIC1
Silver Drain	Operation		Smaller operation, cattle with corral/feeding area; fencing possible	00:15:24	ICELANDIC1
Silver Drain	Road crossing	2 culverts (?)	Travels under main road	00:15:45	ICELANDIC1
Silver Drain	Operation		Small, with evident feeding areas adjacent to drain; no fencing?	00:15:53	ICELANDIC1
Silver Drain	Road crossing	2 culverts (?)	Onto private property	00:16:15	ICELANDIC1
Silver Drain	Road crossing	2 culverts (?)	Onto private property	00:16:21	ICELANDIC1
Silver Drain	Salvage		Possible salvage/wrecking yard adjacent to drain	00:16:28	ICELANDIC1
Silver Drain	Road crossing	2 culverts (?)	Travels under main road	00:16:32	ICELANDIC1
Silver Drain	Grazing		Pasture with cattle on RB, possibly fenced but minimal buffer	00:16:48	ICELANDIC1
Silver Drain	Road crossing	3 culverts (?)	Onto private property	00:16:53	ICELANDIC1
Silver Drain	Dugout		Dugout off drain (not attached) and possible grazing along RB	00:17:00	ICELANDIC1
Silver Drain	Road crossing	2 culverts (?)	Travels under main road	00:17:15	ICELANDIC1
Silver Drain	Road crossing	1 culvert (?)	Onto private property	00:17:17	ICELANDIC1
Silver Drain	Road crossing	1 culvert (?)	Onto private property	00:17:24	ICELANDIC1
Silver Drain	Barrier	Man-made	Possible barrier along dyke to reduce water velocity (?)	00:17:27	ICELANDIC1
Silver Drain	Grazing		Pasture with cattle on RB, possibly fenced but minimal buffer	00:17:35	ICELANDIC1
Silver Drain	Road crossing	1 culvert (?)	Onto private property	00:17:37	ICELANDIC1
Silver Drain	Road crossing	2 culverts (?)	Travels under main road	00:17:54	ICELANDIC1

Appendix 5.1 Continued.

Area	Type	Composition	Comment	Time	TAPE NAME
Silver Drain	Road crossing	2 culverts (?)	Travels onto field	00:18:03	ICELANDIC1
Silver Drain	Road crossing	2 culverts (?)	Onto private property	00:18:16	ICELANDIC1
Silver Drain	Road crossing	2 culverts (?)	Onto private property	00:18:24	ICELANDIC1
Silver Drain	Dugout		Dugout off drain (not attached) along RB; no grazing evident	00:18:31	ICELANDIC1
Silver Drain	Road crossing	3 culverts (?)	Main road	00:18:32	ICELANDIC1
Silver Drain	Homestead		Along RB of drain	00:18:35	ICELANDIC1
Silver Drain	Road crossing	3 culverts (?)	Onto cropland/machinery access	00:19:02	ICELANDIC1
Silver Drain	Road crossing	3 culverts (?)	Main road	00:19:12	ICELANDIC1
Silver Drain	Road crossing	3 culverts (?)	Main intersection; drain takes north east turn towards Icelandic River	00:19:45	ICELANDIC1
Silver Drain	Road crossing	2 culverts (?)		00:19:56	ICELANDIC1
Vidir Drain	Cropland		Bare field adjacent to drain; some grasses in drain	00:25:14	ICELANDIC1
Vidir Drain	Road crossing	2 culverts (?)	Onto private property	00:25:41	ICELANDIC1
Vidir Drain	Road crossing	3 culverts	Main road	00:25:43	ICELANDIC1
Vidir Drain	Road crossing	3 culverts (?)	Possible erosion	00:26:19	ICELANDIC1
Vidir Drain	Cropland		Bare field; bale storage; manure piles?; adjacent to drain	00:26:31	ICELANDIC1
Vidir Drain	Road crossing	3 culverts (?)	Possible erosion	00:26:37	ICELANDIC1
Vidir Drain	Road crossing	3 culverts (?)	Main road; another drain/ditch intersects at this point	00:26:57	ICELANDIC1
Vidir Drain	Road crossing	No culverts evident	Onto private property	00:27:14	ICELANDIC1
Vidir Drain	Road crossing	3 culverts (?)	Main road	00:27:35	ICELANDIC1
Vidir Drain	Road crossing	No culverts evident	Onto private property	00:27:42	ICELANDIC1
Vidir Drain	Road crossing	2 culverts (?)	Onto private property	00:27:45	ICELANDIC1
Vidir Drain	Road crossing	2 culverts (?)	Onto private property	00:27:50	ICELANDIC1
Rembrandt Drain	Road crossing	2 culverts	Main road	00:31:53	ICELANDIC1
Rembrandt Drain	Barrier	Beaver dam (?)	Slight impoundment of water	00:31:58	ICELANDIC1
Rembrandt Drain	Barrier	Beaver dam (?)	Slight impoundment of water	00:32:11	ICELANDIC1
Rembrandt Drain	Barrier	Beaver dam (?)	Two beaver dams (?) in view	00:32:16	ICELANDIC1
Rembrandt Drain	Barrier	Beaver dam	Large impoundment of water; fish passage unlikely	00:32:20	ICELANDIC1
Rembrandt Drain	Barrier	Beaver dam	Impoundment of water; fish passage unlikely	00:32:31	ICELANDIC1
Rembrandt Drain	Barrier	Beaver dam	Two dams; Impoundment of water; fish passage unlikely	00:32:49	ICELANDIC1
Rembrandt Drain	Homestead		Possible grazing and cattle access to drain RB	00:33:10	ICELANDIC1
Rembrandt Drain	Cropland		Adjacent to drain; possible bank erosion on LB	00:33:16	ICELANDIC1
Rembrandt Drain	Riffle		Appears to be section of shallow gravel riffle areas	00:33:23	ICELANDIC1

Appendix 5.1 Continued.

Area	Type	Composition	Comment	Time	TAPE NAME
Rembrandt Drain	Road crossing	2 culverts	Gravel beds in area and shallow	00:33:27	ICELANDIC1
Rembrandt Drain	Drain		A secondary drain flowing in	00:34:10	ICELANDIC1
Rembrandt Drain	Grazing		Possible grazing and cattle access to drain RB; might be fenced	00:34:12	ICELANDIC1
Rembrandt Drain	Road crossing	Gravel with culvert?	Allows access to RB field; tracks evident	00:34:15	ICELANDIC1
Rembrandt Drain	Ford	drain bed	Possible ford crossing thru drain, tracks evident	00:34:30	ICELANDIC1
Rembrandt Drain	Barrier	Boulder?	Water impounded; fish passage beyond this point unlikely	00:35:06	ICELANDIC1
Rembrandt Drain	Ford	drain bed	Allows access to road and RB field; tracks evident	00:35:24	ICELANDIC1
Rembrandt Drain	Road crossing	1 culvert	Main road	00:35:47	ICELANDIC1
Rembrandt Drain	Industrial		Construction on drain in progress; establishing industrial complex?	00:36:00	ICELANDIC1
Rembrandt Drain	Road crossing	1 culvert	Main road	00:36:28	ICELANDIC1
Sylvan Drain	Road crossing	3 culverts	Main road	00:45:16	ICELANDIC1
Sylvan Drain	Road crossing	1 culvert	Onto private property	00:45:47	ICELANDIC1
Sylvan Drain	Road crossing	2 culverts	Onto private property	00:46:00	ICELANDIC1
Sylvan Drain	Road crossing	2 culverts (?)	Main road	00:46:45	ICELANDIC1
Shurkas Drain	Road crossing	1 culvert	Onto private property	00:50:37	ICELANDIC1
Shurkas Drain	Road crossing	?	Onto private property	00:50:54	ICELANDIC1
Shurkas Drain	Road crossing	1 culvert	Main road	00:50:58	ICELANDIC1
Shurkas Drain	Road crossing	?	Field access	00:51:33	ICELANDIC1
Shurkas Drain	Corner		Sharp bend and possible site of bank instability	00:51:47	ICELANDIC1
Shurkas Drain	Road crossing	2 culverts	Main road	00:52:29	ICELANDIC1
Shurkas Drain	Corner		Sharp bend and possible site of bank instability	00:52:30	ICELANDIC1
Shurkas Drain	Ford	drain bed	Machinery crossing	00:52:52	ICELANDIC1
Icelandic R.	Road crossing	Culverts	Active crossing over drain/Icelandic River	00:01:46	ICELANDIC2
Icelandic R.	Road crossing	Culverts	Active crossing over drain/Icelandic River	00:01:51	ICELANDIC2
Icelandic R.	Road crossing	Culverts	Active crossing over drain/Icelandic River	00:02:06	ICELANDIC2
Icelandic R.	Grazing		Livestock through drain/river? extensive; eroding banks?	00:02:21	ICELANDIC2
Icelandic R.	Road crossing	Culverts	Active crossing over drain/Icelandic River	00:02:24	ICELANDIC2
Icelandic R.	Grazing		Livestock through drain/river? extensive; eroding banks? (from 00:02:21)	00:02:24	ICELANDIC2
Icelandic R.	Road crossing	Culverts	Active crossing over drain/Icelandic River; erosion site?	00:02:35	ICELANDIC2
Icelandic R.	Road crossing	Culverts	Active crossing over drain/Icelandic River	00:02:46	ICELANDIC2
Icelandic R.	Road crossing	Culverts	Active crossing over drain/Icelandic River; washouts possible?	00:03:05	ICELANDIC2
Icelandic R.	Grazing	Wooded pasture	Both sides?	00:03:05	ICELANDIC2

Appendix 5.1 Continued.

Area	Type	Composition	Comment	Time	TAPE NAME
Icelandic R.	Road crossing	Culverts	Active crossing over drain/Icelandic River; washouts possible?	00:03:28	ICELANDIC2
Icelandic R.	Grazing	Wooded pasture	Both sides?	00:03:28	ICELANDIC2
Icelandic R.	Dugout?		Dugout on RB with active grazing? Or fenced access point? (used?)	00:03:34	ICELANDIC2
Icelandic R.	Dugout		Trenched dugout on RB with grazing; point source?	00:03:50	ICELANDIC2
Icelandic R.	Barrier	Beaver dam?	Water impounded, not likely debris; man-made - rock or velocity check?	00:04:16	ICELANDIC2
Icelandic R.	Dugout		Dugout in RB of channel. For grazing (currently)?	00:04:19	ICELANDIC2
Icelandic R.	Road crossing		With culverts but possible bank erosion	00:04:32	ICELANDIC2
Icelandic R.	Road crossing	Culverts	Active crossing over drain/Icelandic River	00:04:36	ICELANDIC2
Icelandic R.	Grazing		Heavy grazing both sides but fenced?; minimal buffer	00:04:36	ICELANDIC2
Icelandic R.	Dugout		Dugout in RB of channel. For grazing?; distinct water color change	00:04:56	ICELANDIC2
Icelandic R.	Road crossing		With culverts	00:05:30	ICELANDIC2
Icelandic R.	Road crossing	Culverts	Ford crossing with grazing?	00:07:48	ICELANDIC2
Icelandic R.	Road crossing	Culverts	Active crossing over drain/Icelandic River	00:08:12	ICELANDIC2
Icelandic R.	Road crossing	Culverts	Unsure if culverts are present, gravel ford?	00:08:37	ICELANDIC2
Icelandic R.	Erosion		Possible bank failure on RB corner	00:08:41	ICELANDIC2
Icelandic R.	Road crossing		Hwy. crossing with possible bank failure at culverts	00:09:29	ICELANDIC2
Icelandic R.	Ford?	Earth?	Man made with no obvious passage for water? Under hydro towers	00:09:58	ICELANDIC2
Icelandic R.	Grazing	Wooded pasture	Heavy grazing both sides? erosion?	00:10:39	ICELANDIC2
Icelandic R.	Dugout		Small dugout on LB with grazing activity? nutrient load?	00:10:46	ICELANDIC2
Icelandic R.	Grazing	Pasture	Pasture with livestock next to drain; no riparian; feeding area	00:11:32	ICELANDIC2
Icelandic R.	Road crossing		Possible bank failure	00:12:33	ICELANDIC2
Icelandic R.	Road Crossing		Road Crossing with three culverts; sharp corner could erode	00:13:05	ICELANDIC2
Icelandic R.	Road Crossing		Road Crossing with three culverts	00:13:33	ICELANDIC2
Icelandic R.	Ford	Cement and culvert?	Active machinery crossing	00:14:34	ICELANDIC2
Icelandic R.	Road Crossing		Road Crossing with three culverts	00:14:47	ICELANDIC2
Icelandic R.	Road crossing	Culverts (?)	Sharp bend and possible site of bank failure	00:15:54	ICELANDIC2
Icelandic R.	Road Crossing	Bridge	Two bends	00:16:46	ICELANDIC2
Icelandic R.	Ford	Box culvert (?)	Water on both sides	00:17:20	ICELANDIC2
Icelandic R.	Road Crossing	Bridge (?)	Water on both sides	00:17:34	ICELANDIC2
Icelandic R.	Road crossing	Culverts (?)	Possible erosion at site	00:18:18	ICELANDIC2

Appendix 5.1 Continued.

Area	Type	Composition	Comment	Time	TAPE NAME
Icelandic R.	Road crossing	Culvert and gravel (?)	Active crossing over drain/Icelandic River	00:18:52	ICELANDIC2
Icelandic R.	Road crossing	4 large culverts	Culverts are under a main roadway	00:19:09	ICELANDIC2
Icelandic R.	Grazing		Possible, but may also be fenced	00:19:23	ICELANDIC2
Icelandic R.	Ford	Gravel (?)	Adjacent to farmstead	00:19:23	ICELANDIC2
Icelandic R.	Road crossing	4 large culverts	Culverts are under a main roadway	00:19:30	ICELANDIC2
Icelandic R.	Water color		Distinct change: What is source or reason?	00:20:39	ICELANDIC2
Icelandic R.	Barrier (?)	Natural	Possible beaver activity or natural debris	00:20:54	ICELANDIC2
Icelandic R.	Road crossing	4 large culverts		00:21:54	ICELANDIC2
Icelandic R.	Road crossing		No evidence of impoundment; Gravel top with culvert (?)	00:23:41	ICELANDIC2
Icelandic R.	Drains		Drains entering river beside operation (see 00:26:56 or 27:32)	00:25:23	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Main roadway	00:25:33	ICELANDIC2
Icelandic R.	Fish Ladder	Concrete	Fish entrance/exit blocked?; velocities	00:26:39	ICELANDIC2
Icelandic R.	Bank Failure		Banks appeared to fail and may cause barriers to fish at certain levels	00:28:14	ICELANDIC2
Icelandic R.	Ford	Concrete 4 culvert	Visited on ground; previously washed out; barrier	00:28:44	ICELANDIC2
Icelandic R.	Drain Input	Culvert?	On RB, appears to drain a potential grazing area	00:29:23	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Main roadway	00:29:26	ICELANDIC2
Icelandic R.	Drain Input		Possible bank failure on RB and LB, upstream end	00:30:17	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Main roadway: No apparent blockage; erosion at drains?	00:30:17	ICELANDIC2
Icelandic R.	Hayland	Bales	Very close to river; no buffer; erosion possible at sites; site for example	00:30:29	ICELANDIC2
Icelandic R.	Grazing	Pasture	Access to river?; slumping and erosion	00:30:34	ICELANDIC2
Icelandic R.	Operation		Smaller scale, but concentrated feeding and grazing evident; close to river	00:30:45	ICELANDIC2
Icelandic R.	Barrier	Beaver dam	Main roadway; Framnes Bridge and beaver dam underneath	00:30:58	ICELANDIC2
Icelandic R.	Dugout		Trenched dugout on RB with grazing (?)	00:31:11	ICELANDIC2
Icelandic R.	Grazing		Possible grazing and river access on RB; no riparian	00:31:13	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Onto private property (?)	00:31:21	ICELANDIC2
Icelandic R.	Multiple Issues		Potential grazing, nil riparian; altered flow regime via dam (?) (00:31:28)	00:31:25	ICELANDIC2
Icelandic R.	Grazing		Potential grazing on RB (again at 00:31:40)	00:31:38	ICELANDIC2
Icelandic R.	Bank Failure		LB on outside bend; due to natural course or cattle access/nil riparian	00:31:40	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Main roadway	00:31:43	ICELANDIC2

Appendix 5.1 Continued.

Area	Type	Composition	Comment	Time	TAPE NAME
Icelandic R.	Crop		Bare cropland along RB; potential for direct sediment input	00:31:50	ICELANDIC2
Icelandic R.	Grazing		Possible grazing and river access on LB; minimal riparian; old dugout	00:32:28	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Main roadway	00:32:32	ICELANDIC2
Icelandic R.	Crop		Bare cropland along LB; potential for direct sediment input	00:32:37	ICELANDIC2
Icelandic R.	Tributary		Small 'tributary' entering river; water color dark brown	00:33:28	ICELANDIC2
Icelandic R.	Barrier	Beaver?	Small barrier with slight impoundment d/s of tributary	00:33:30	ICELANDIC2
Icelandic R.	Grazing		Possible grazing on both sides of river	00:33:38	ICELANDIC2
Icelandic R.	Corral		Holding areas for livestock adjacent to LB of river	00:33:57	ICELANDIC2
Icelandic R.	Grazing		Possible grazing and river access on RB; minimal riparian	00:33:57	ICELANDIC2
Icelandic R.	Drain Input		LB	00:34:19	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Main roadway	00:34:19	ICELANDIC2
Icelandic R.	Grazing		Possible grazing and river access on LB; minimal riparian	00:34:24	ICELANDIC2
Icelandic R.	Crossing	Walking Bridge	Located in the town of Arborg	00:35:13	ICELANDIC2
Icelandic R.	Drain Input		LB	00:35:23	ICELANDIC2
Icelandic R.	Crossing	Train (?)	Still active?	00:35:34	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Main roadway	00:35:34	ICELANDIC2
Icelandic R.	Barrier	Sheet metal and rock	Arborg Dam	00:35:39	ICELANDIC2
Icelandic R.	Riffle	Cobble/boulder	Riffle 1 downstream of Arborg Dam; possible bank instability	00:35:44	ICELANDIC2
Icelandic R.	Riffle	Cobble/boulder	Riffle 2 downstream of Arborg Dam; eroding shoreline	00:35:52	ICELANDIC2
Icelandic R.	Drain Input		LB	00:36:20	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Well used	00:38:10	ICELANDIC2
Icelandic R.	Ford	Cement and culvert	Well used; possible barrier at high flows and if debris in area	00:38:54	ICELANDIC2
Icelandic R.	Grazing		Start of extensive grazing and cattle access on both sides of river (?)	00:39:38	ICELANDIC2
Icelandic R.	Grazing		End of extensive grazing area and cattle access from 39:38; turbidity?	00:40:29	ICELANDIC2
Icelandic R.	Drain Input		LB	00:40:56	ICELANDIC2
Icelandic R.	Drain Input		LB	00:41:07	ICELANDIC2
Icelandic R.	Drain Input		LB; is erosion evident here?	00:41:28	ICELANDIC2
Icelandic R.	Operation		Larger operation on RB (again at 00:43:19?)	00:41:41	ICELANDIC2
Icelandic R.	Drain Input		LB	00:41:57	ICELANDIC2
Icelandic R.	Grazing	Pasture/feeding	Grazing, feeding, corral, access, minimal riparian (LB); RB hayland	00:44:16	ICELANDIC2

Appendix 5.1 Continued.

Area	Type	Composition	Comment	Time	TAPE NAME
Icelandic R.	Drain Input		LB	00:44:20	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Well used	00:44:20	ICELANDIC2
Icelandic R.	Operation		Large operation on LB, fenced(?), adjacent to river, minimal buffer	00:45:07	ICELANDIC2
Icelandic R.	Barrier	Beaver/debris	Unable to determine composition; small/slight	00:46:02	ICELANDIC2
Icelandic R.	Homestead		LB with minimal buffer, cattle grazing?	00:46:02	ICELANDIC2
Icelandic R.	Barrier	Beaver dam?	Larger in scale	00:46:28	ICELANDIC2
Icelandic R.	Riffle	Cobble/boulder	Man made? Check provincial records	00:46:55	ICELANDIC2
Icelandic R.	Riffle	Cobble/boulder	Man made?	00:46:58	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Well used	00:46:59	ICELANDIC2
Icelandic R.	Operation		Larger operation on LB with grazing, holding areas, and access (?)	00:47:16	ICELANDIC2
Icelandic R.	Barrier	Beaver dam or debris	Small with minimal impoundment	00:47:50	ICELANDIC2
Icelandic R.	Grazing		Potential cattle grazing area on RB	00:47:53	ICELANDIC2
Icelandic R.	Barrier	Beaver dam or debris	Small with minimal impoundment	00:48:04	ICELANDIC2
Icelandic R.	Dugout		Trenched on RB with potential cattle access and adjacent grazing	00:48:11	ICELANDIC2
Icelandic R.	Dugout		Dugout on LB for watering?; access appears evident	00:48:11	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Main roadway	00:48:27	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Main roadway	00:50:03	ICELANDIC2
Icelandic R.	Road crossing	Bridge	Main roadway	00:50:20	ICELANDIC2
Icelandic R.	Drain Input		LB	00:51:09	ICELANDIC2
Icelandic R.	Tributary		Small tributary on LB?	00:51:17	ICELANDIC2
Bluegoose Drain			Mouth of Bluegoose Drain and Icelandic River	00:10:02	ICELANDIC1
Silver Drain			Silver Drain meets Icelandic River	00:19:57	ICELANDIC1
Sylvan Drain			Sylvan Drain and the Icelandic River	00:45:12	ICELANDIC1
Shurkas Drain			Shurkas Drain and Icelandic River	00:50:13	ICELANDIC1

Appendix 5.2 Index of potential rehabilitation sites, including barriers, identified throughout the Icelandic River watershed, 2006.

RPT ID	DISC	VTR TIME	TYPE	COMMENT	PRIORITY	UTM		WATERCOURSE
						Easting	Northing	
1	1	00:00:55	Operation	Larger, with grazing and access, RB, noted for Icelandic River	1	635426	5646004	North Crooked Lake Drain
2	1	00:03:05	Road crossing	Sharp bend and possible site of bank instability	3	632980	5647993	North Crooked Lake Drain
3	1	00:03:57	Road crossing	Sharp bend and possible site of bank instability	3	631343	5648339	North Crooked Lake Drain
4	1	00:04:26	Road crossing	Sharp bend and possible site of bank instability	3	631092	5648958	North Crooked Lake Drain
5	1	00:10:54	Grazing	Grazing with dugout on opposite side of road from drain (?)	3	631169	5638944	Bluegoose Drain
6	1	00:11:18	Grazing	Grazing on opposite side of road from drain with evidence of cattle	3	631172	5637874	Bluegoose Drain
7	1	00:15:24	Operation	Smaller operation, cattle with corral/feeding area; fencing possible	2	624811	5630209	Silver Drain
8	1	00:15:53	Operation	Small, with evident feeding areas adjacent to drain; no fencing?	2	624786	5631050	Silver Drain
9	1	00:16:28	Salvage	Possible salvage/wrecking yard adjacent to drain	3	624805	5632268	Silver Drain
10	1	00:16:48	Grazing	Pasture with cattle on RB, possibly fenced but minimal buffer	3	624808	5633007	Silver Drain
11	1	00:17:00	Dugout	Dugout off drain (not attached) and possible grazing along RB	3	624806	5633442	Silver Drain
12	1	00:17:27	Barrier	Possible barrier along dyke to reduce water velocity (?)	3	624783	5634485	Silver Drain
13	1	00:17:35	Grazing	Pasture with cattle on RB, possibly fenced but minimal buffer	3	624761	5634799	Silver Drain
14	1	00:25:14	Cropland	Bare field adjacent to drain; some grasses in drain	3	619414	5652041	Vidir Drain
15	1	00:26:19	Road crossing	Possible erosion	3	619552	5649149	Vidir Drain
16	1	00:26:31	Cropland	Bare field; bale storage; manure piles?; adjacent to drain	3	619549	5648608	Vidir Drain
17	1	00:26:37	Road crossing	Possible erosion	3	619553	5648340	Vidir Drain
18	1	00:33:10	Homestead	Possible grazing and cattle access to drain RB	3	620327	5639590	Rembrandt Drain
19	1	00:33:16	Cropland	Adjacent to drain; possible bank erosion on LB	3	620189	5639572	Rembrandt Drain
20	1	00:34:12	Grazing	Possible grazing and cattle access to drain RB; might be fenced	3	619691	5638380	Rembrandt Drain
21	1	00:36:00	Industrial	Construction on drain in progress; establishing industrial complex?	3	619797	5633843	Rembrandt Drain
22	1	00:51:47	Corner	Sharp bend and possible site of bank instability	3	604302	5648584	Shurkas Drain
23	1	00:52:30	Corner	Sharp bend and possible site of bank instability	3	603791	5647275	Shurkas Drain
24	2	00:02:21	Grazing	Livestock through drain/river? extensive; eroding banks?	1	589378	5637105	Icelandic R.
25	2	00:02:24	Grazing	Livestock through drain/river? extensive; eroding banks? (from 00:02:21)	1	589432	5637024	Icelandic R.
26	2	00:02:35	Road crossing	Active crossing over drain/Icelandic River; erosion site?	3	589618	5636784	Icelandic R.
27	2	00:03:05	Road crossing	Active crossing over drain/Icelandic River; washouts possible?	3	590065	5636026	Icelandic R.
28	2	00:03:05	Grazing	Both sides?	3	590065	5636026	Icelandic R.
29	2	00:03:28	Road crossing	Active crossing over drain/Icelandic River; washouts possible?	3	590529	5635875	Icelandic R.
30	2	00:03:28	Grazing	Both sides?	3	590529	5635875	Icelandic R.

Appendix 5.2 Continued.

RPT ID	DISC	VTR TIME	TYPE	COMMENT	PRIORITY	UTM		WATERCOURSE
						Easting	Northing	
31	2	00:03:34	Dugout?	Dugout on RB with active grazing? fenced access point? (not used?)	3	590558	5635953	Icelandic R.
32	2	00:03:50	Dugout	Trenched dugout on RB with grazing; point source?	2	590737	5636024	Icelandic R.
33	2	00:04:19	Dugout	Dugout in RB of channel. For grazing (currently)?	3	591308	5635753	Icelandic R.
34	2	00:04:36	Grazing	Heavy grazing both sides but fenced?; minimal buffer	3	591782	5635553	Icelandic R.
35	2	00:04:56	Dugout	Dugout in RB of channel. For grazing?; distinct water color change	1	592332	5635292	Icelandic R.
36	2	00:08:41	Erosion	Possible bank failure on RB corner	3	597020	5635441	Icelandic R.
37	2	00:10:39	Grazing	Heavy grazing both sides? erosion?	1	599869	5636979	Icelandic R.
38	2	00:10:46	Dugout	Small dugout on LB with grazing? nutrient loads?	2	600100	5636920	Icelandic R.
39	2	00:11:32	Grazing	Pasture with livestock next to drain; no riparian; feeding area	2	601320	5636716	Icelandic R.
40	2	00:19:23	Grazing	Possible, but may also be fenced	3	608072	5648502	Icelandic R.
41	2	00:20:39	Water color	Distinct change: What is source or reason?	1	609482	5649500	Icelandic R.
42	2	00:25:23	Drains	Drains entering river beside operation (see 00:26:56 or 27:32)	2	614450	5650488	Icelandic R.
43	2	00:26:39	Fish Ladder	Fish entrance/exit blocked?; velocities	1	614883	5650342	Icelandic R.
44	2	00:28:14	Bank Failure	Banks appeared to fail and may cause barriers to fish at certain levels	2	615562	5650287	Icelandic R.
45	2	00:28:44	Ford	Visited on ground; previously washed out; barrier	3	616465	5650319	Icelandic R.
46	2	00:29:23	Drain Input	On RB, appears to drain a potential grazing area	3	617553	5649359	Icelandic R.
47	2	00:30:17	Drain Input	Possible bank failure on RB and LB, upstream end	3	618960	5647560	Icelandic R.
48	2	00:30:17	Road crossing	Main roadway: No apparent blockage; erosion at drains?	3	618960	5647560	Icelandic R.
49	2	00:30:29	Hayland	Very close to river; no buffer; erosion possible at sites; site for example	3	619029	5646934	Icelandic R.
50	2	00:30:34	Grazing	Access to river?; slumping and erosion	2	619018	5646733	Icelandic R.
51	2	00:30:45	Operation	Smaller scale, but concentrated feeding and grazing evident; close to river	1	618949	5646167	Icelandic R.
52	2	00:30:58	Barrier	Main roadway; Framnes Bridge and beaver dam underneath	3	619054	5645776	Icelandic R.
53	2	00:31:11	Dugout	Trenched dugout on RB with grazing (?)	2	619282	5645398	Icelandic R.
54	2	00:31:13	Grazing	Possible grazing and river access on RB; no riparian	3	619313	5645331	Icelandic R.
55	2	00:31:25	Multiple Issues	Potential grazing, nil riparian; altered flow regime via dam (?) (00:31:28)	1	619349	5644860	Icelandic R.
56	2	00:31:38	Grazing	Potential grazing on RB (again at 00:31:40)	3	619305	5644322	Icelandic R.
57	2	00:31:40	Bank Failure	LB on outside bend; due to natural course or cattle access/nil riparian	2	619316	5644244	Icelandic R.
58	2	00:31:50	Crop	Bare cropland along RB; potential for direct sediment input	3	619422	5643923	Icelandic R.
59	2	00:32:28	Grazing	Possible grazing and river access on LB; minimal riparian; old dugout	3	620194	5642736	Icelandic R.
60	2	00:32:37	Crop	Bare cropland along LB; potential for direct sediment input	3	620372	5642487	Icelandic R.
61	2	00:33:30	Barrier	Small barrier with slight impoundment d/s of tributary	3	621386	5641114	Icelandic R.

Appendix 5.2 Continued.

RPT ID	DISC	VTR TIME	TYPE	COMMENT	PRIORITY	UTM		WATERCOURSE
						Easting	Northing	
62	2	00:33:38	Grazing	Possible grazing on both sides of river	3	621591	5641012	Icelandic R.
63	2	00:33:57	Corral	Holding areas for livestock adjacent to LB of river	1	622095	5640977	Icelandic R.
64	2	00:33:57	Grazing	Possible grazing and river access on RB; minimal riparian	3	622095	5640977	Icelandic R.
65	2	00:34:24	Grazing	Possible grazing and river access on LB; minimal riparian	3	622870	5641163	Icelandic R.
66	2	00:35:39	Barrier	Arborg Dam	1	625165	5640837	Icelandic R.
67	2	00:35:44	Riffle	Riffle 1 downstream of Arborg Dam; possible bank instability	3	625254	5640774	Icelandic R.
68	2	00:35:52	Riffle	Riffle 2 downstream of Arborg Dam; eroding shoreline	1	625397	5640645	Icelandic R.
69	2	00:38:54	Ford	Well used; possible barrier at high flows and if debris in area	3	630673	5640579	Icelandic R.
70	2	00:39:38	Grazing	Start of extensive grazing and cattle access on both sides of river (?)	1	631944	5641302	Icelandic R.
71	2	00:40:29	Grazing	End of extensive grazing area and cattle access from 39:38; turbidity?	1	633007	5642475	Icelandic R.
72	2	00:41:41	Operation	Larger operation on RB (again at 00:43:19?)	2	634333	5643690	Icelandic R.
73	2	00:44:16	Grazing	Grazing, feeding area, corral, access, and minimal riparian (LB); RB hayland	1	635188	5645583	Icelandic R.
74	2	00:45:07	Operation	Large operation on LB (fenced?), adjacent to river, minimal buffer	1	636551	5646387	Icelandic R.
75	2	00:46:02	Barrier	Unable to determine composition; small/slight	3	636922	5646451	Icelandic R.
76	2	00:46:02	Homestead	LB with minimal buffer, cattle grazing?	3	636922	5646451	Icelandic R.
77	2	00:46:28	Barrier	Larger in scale	3	637255	5646980	Icelandic R.
78	2	00:46:55	Riffle	Man made? Check provincial records	3	637537	5647506	Icelandic R.
79	2	00:46:58	Riffle	Man made?	3	637594	5647553	Icelandic R.
80	2	00:47:16	Operation	Larger operation on LB with grazing, holding areas, and access (?)	1	638001	5647748	Icelandic R.
81	2	00:47:50	Barrier	Small with minimal impoundment	3	638386	5648311	Icelandic R.
82	2	00:47:53	Grazing	Potential cattle grazing area on RB	3	638444	5648354	Icelandic R.
83	2	00:48:04	Barrier	Small with minimal impoundment	3	638661	5648501	Icelandic R.
84	2	00:48:11	Dugout	Trenched on RB with potential cattle access and adjacent grazing	1	638828	5648624	Icelandic R.
85	2	00:48:11	Dugout	Dugout on LB for watering?; access appears evident	1	638828	5648624	Icelandic R.