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6.0 AQUATIC ENVIRONMENT

6.1 INTRODUCTION

The Red River Floodway and the proposed Red River Floodway Expansion Project (the Project) are situated near the City of Winnipeg, in Southern Manitoba. This chapter presents an evaluation of the potential effects of the Project on the aquatic environment.

6.2 ASSESSMENT APPROACH AND METHODOLOGY

6.2.1 Categories of Potential Impact

The Guidelines (Section 6.2 "*Aquatic Environment*") require that "*the environmental impact statement shall describe the existing aquatic biological resources and associated* ***habitats*** *in watercourses, wetlands and other waterbodies*" for the following environmental components:

- water quality (Guidelines Section 6.2.1);
- lower trophic levels (Guidelines Section 6.2.2);
- aquatic **invertebrates** (Guidelines Section 6.2.3);
- fish and clam:
  - habitat (Guidelines Section 6.2.4);
  - populations (Guidelines Section 6.2.5); and
- aquatic **species at risk** (Guidelines Section 6.2.6).

Potential impacts to those aquatic environmental components listed in the Guidelines are discussed within this EIS in the following Sections:

- Surface Water Quality (Section 6.3);
- Aquatic Habitat (Section 6.4);
- Lower Trophic Levels and Aquatic Invertebrates (Section 6.5);
- Fish and Clam Populations[1] (Section 6.6); and
- Aquatic species at Risk (Section 6.7).

The Project effects could be cumulative and could include effects from of a number of other physical works and activities in the region. Sections 2.2.2 and 2.2.3 outline the general types of other "future actions" whose environmental effects on the aquatic environment could act in a cumulative fashion with the Project.

[1] The *Fisheries Act* includes shellfish (e.g., clams) and crustaceans under the definition of "fish" and therefore will be discussed in Section 6.6. All other invertebrates are discussed in Section 6.5.

While Section 2.2.3 outlines a broad range of future activities, the potential effects of these activities, from the perspective of overlap with possible aquatic-related Project effects, are as follows:

- Changes to water quality
  - It is anticipated that the Project construction may alter water quality with respect to suspended sediment, nutrients and pesticides. These potential effects are not anticipated to persist after Project construction. Suspended sediment effects are also possible from other activities such as infrastructure projects (dykes, roads, bridges/pipe crossings, and **shoreline** stabilization).
  - Nutrient levels in the aquatic environment could be altered by other activities like wastewater treatment plants/lagoons, impoundments and changes to farm practices. While the nature of any future initiatives on this issue are uncertain, it is likely that these activities will result in reduced nutrient loadings to the environment, precluding any cumulative effects with those of Project construction (No changes to nutrient issues as a result of the Project are anticipated after construction). Both the province of Manitoba and the State of Minnesota are implementing nutrient management plans.
  - Pesticide effects are not an anticipated factor of any activities listed in Section 2.2.3. While pesticides are used in regional agricultural practice and municipal/private plant (i.e., weed) control, these practices are not anticipated to substantively change during Project construction. The issue is addressed in Section 6.3 as a component of Project compliance to regulatory thresholds in the Red River.

- Changes to aquatic habitat
  - Potential changes to the aquatic habitat in the region are anticipated if additional physical work in the aquatic environment occurs (i.e., road/bridge infrastructure, stream crossings, dykes and shoreline erosion protection) and could result in a cumulative effect with the Project construction plans, but only if these activities occurred during the construction period.

- Changes to aquatic populations
  - Aquatic populations may be affected by water quality or habitat changes (as discussed above) or by changes in river flow characteristics and impairment in water movement of aquatic organisms. Operational changes to the Floodway Inlet Control Structure, potentially associated with more frequent summer operations or other operational considerations (change in operations or flows associated with other components of the Red River Flood Protection System may effect fish movement capabilities and patterns in the region. No changes in the operations of the Floodway are planned as a component of the Project. Fish movement through the Floodway Inlet Control Structure is further explored in supplemental documentation.

These potential cumulative effects were evaluated as an integral part of the assessment and were integrated into the determination of the significance of the residual effects.

Other projects, like Devils Lake, could also affect aquatic populations in the region; however, these effects primarily relate to changes in water quality (i.e., dissolved solids) or foreign biota and do not overlap with the anticipated effects of the Project. No potential for cumulative effects with the Project have been identified.

6.2.2 Approach to Impact Assessment

As outlined in Chapter 2 and Section 5.2.2, the assessment approach involves evaluating the effects of the proposed expansion compared to the baseline of the Existing Floodway. The Existing Floodway and Red River are described as part of the existing baseline environment that is assessed with respect to potential effects of the Project.

The Guidelines (Section 2.3.2, "Scope") notes that:

> *The environmental assessment for the Project shall include consideration of the environmental effects of all undertakings associated with the site preparation, construction, maintenance, operations and the final disposition of all components of the proposed Red River Floodway Expansion, including any required infrastructure modifications or development*.

The various stages of the assessment of the potential aquatic effects evaluated are as follows:

- pre-construction includes activities such as field studies, land surveys and the drilling of holes for testing aggregate;
  - In compliance with the "Principles of Environmental Assessment" issued by the International Association for Impact Assessment (IAIA), the assessment also includes a review of the potential environmental effects of the assessment-related activities that have or will occur prior to Project construction (e.g., field studies to support the EIA and engineering design).
- construction includes site preparation activities such as clearing and **grubbing**, as well as construction activities; and
- maintenance and Operations, are defined for the two modes in terms of activity:
  - operation-inactive; i.e., when the Expanded Floodway is present, but floodwater from the Red River is not being diverted into the Floodway; and
  - operation-active; i.e., when floodwater from the Red River is being diverted into the Expanded Floodway.

A habitat-based approach to obtaining scientific information for the aquatic and **terrestrial** environmental assessment has been used to identify the ecological components, processes and flows that are required to maintain a fully functioning **ecosystem**. Although a broad range of environmental components has been considered in the environmental impact assessment, the determination of whether or not impacts are "significant" focuses on the major environmental components of the aquatic ecosystem. The status of these major aquatic ecosystem components function as "indicators" of the health of the aquatic environment and include:

- surface water quality;
- lower tropic levels and aquatic invertebrates; and
- fish and clam habitat and populations.

The aquatic environmental components identified in the Guidelines form the basis for the assessment of the Project's predicted effects and impacts on the environment. The analysis of data collected to assess Project effects on the aquatic ecosystem were evaluated in conjunction with information gained through local and knowledge in determining the significance of impacts.

The aquatic environmental studies were developed and implemented in response to the federal/provincial Guidelines. Where available aquatic information did not exist or was insufficient, aquatic environmental field studies were initiated to address information gaps/data deficiencies (Appendix 6D). Table 6.2-1 summarizes the aquatic studies that were completed prior to the final draft submission of this EIS and those that will be conducted during the regulatory review phase of this Project (due to the seasonal nature of those studies). Environmental studies were coordinated with the needs of Project planning/design and scheduling. Over the course of the environmental studies, adjustments were made in their scope to account for study findings and additional identified information deficiencies and to accommodate developments in the Project design.

Aquatic environmental studies were conducted using standard methodologies and protocols as described in Appendix 6D. Additional aquatic environmental studies recommended for the purpose of monitoring and follow-up during Project construction and operation are described for each aquatic component in Sections 6.3.5 to 6.7.5.

As outlined in Section 2.3, the significance of potential effects of the Project on the aquatic environment are determined primarily through the assessment of the nature (positive, adverse, or neutral), duration (short- or long-term), magnitude (small, moderate or large) and geographic extent (project site, local or region) of an effect (Figure 2.3-1).

As indicated in Section 2.1, there is no plan or timetable for decommissioning or final disposition for the Project. As such, an evaluation of the potential effects of final disposition on aquatic resources cannot be predicted at this time. Prior to Project decommissioning, should it proceed, the necessary assessments and plans to meet regulatory requirements of the day will occur.

6.2.3 Study Area Definition – Aquatic Assessment

The "Guidelines" Section 2.3.2 "Scope" notes that:

> *The geographic scope of the investigations shall include those local areas directly impacted by the undertakings associated with the Project and also the zones within which there may be environmental effects that are regional or global in their nature. The*

EIS should identify the spatial and temporal boundaries used in the assessment and the rational for the selection of those boundaries.

Specific to the assessment of the potential environmental impacts of the Project on the aquatic environment, the following definitions of the spatial boundaries or geographical extent of the effect were used:

- project site effects
  - those effects that are generally confined to the footprint area of construction: i.e. the expanded Floodway Right-of-way (ROW), the expanded West Dyke ROW and the section of the Red River downstream from the Floodway Outlet where construction and riprap deposition will take place.
- local effects
  - site preparation and construction activities including the area along and adjacent to the West Dyke ROW and the area adjacent to and, in particular, immediately downstream of the Project site that may be affected;
  - operations considerations include the same area as that for construction activities but also encompass the geographic area where water levels may be altered by the Project; generally the area of the Floodway combined with the Red River from Ste. Agathe downstream to Lake Winnipeg.
- regional effects
  - Effects associated with an area more broadly defined and guided by Section 48.1 of the Inclusion List Regulations of the Canadian Environmental Assessment Act, that states "*physical activities... that are intended to threaten the continued existence of a biological population in an* ***ecodistrict****, either directly or through the alteration of its habitat*". Therefore, the federal ecodistricts that overlap the Project site area were used to define the scope of the assessment of regional aquatic effects on fish populations in the Red River.

The temporal boundary of the aquatic assessment consisted of the following:

- short-term
  - pre-construction EIS field studies;
  - site preparation and construction-related effects.
- long-term
  - maintenance and operations (inactive and active).

Table 6.2-1
Summary of Aquatic Environment Study Methods

DISCIPLINE	METHODS	LOCATION	TIMELINE
Water Quality	Existing information for the Red River re: sediment, nutrients & other parameters	Existing MB Conservation data records and other available information	Historical datasets (1970 to 2003)
Aquatic Habitat	Flight video images and still photography documentation of aquatic habitat GPS-linked video of Floodway Channel to support mapping	Floodway (Channel, Inlet and Outlet), Red River (approx. 1km upstream and 2 km downstream of the Floodway Outlet)	Floodway and Red River near Floodway Outlet: Sept. 19, 2003 (low flow baseline) and April 12, 2004 (Floodway in-use) West Dyke: June 9, 2004
	Bottom substrate sampling and GPS-linked **Bathymetry** mapping	Red River (approx. 1km upstream and 2 km downstream of the Floodway Outlet)	Fall 2003, winter 2003/04 and spring 2004
	Descriptions of Floodway Channel characteristics (including width, depth, various water quality parameters, bottom substrate and aquatic vegetation descriptions) during reconnaissance and other terrestrial studies of the Floodway	At representative habitat types along the length of the Floodway Channel	Fall, and winter, 2003 Winter and spring, 2004
	Aquatic vegetation surveys	Floodway Low Flow Channel	Spring, summer and fall 2004 (1970 to 2000)
Lower Trophic Levels and Aquatic Invertebrates	Existing Information for the Red River	Red River	Available reports and datasets (1970 to 2000)
Fish and Clam Populations	Existing Information for the Red River	Red River	Available reports and datasets
	Fish sampling (gill netting, seine netting, minnow traps)	Red River up to 100m downstream of Floodway Outlet along the East shoreline and in Floodway Channel and West Dyke drainage ditches	September / early October, 2003 (Red River & Floodway), March 2004 in Floodway and June 2004 in West Dyke drainage ditches
	Reconnaissance for potential summer fish kills	Floodway Low flow Channel	July 2004
	Acoustic underwater digital imaging of fish movements	Floodway Inlet Structure	April/May 2004

6.3 SURFACE WATER QUALITY

6.3.1 Approach and Methodology

6.3.1.1 Effects Assessment

The *Guidelines for the Preparation of an Environmental Impact Statement for the Red River Floodway Expansion Project* require that:

> sufficient detail shall be provided regarding the pre-project water quality and temperature parameters to predict the effect of the Project on surface water quality and groundwater quality and how it would relate to human consumption, recreation and aquatic biota, and to compare post-project water quality conditions.

The effects of the Project on groundwater quality are considered in Chapter 5. Baseline surface water quality information for the Red River at St. Norbert and Selkirk was obtained from Manitoba Water Stewardship. Monthly data from 1970 to 2003 was available. Potential changes in surface water quality included on estimates of the amounts of fertilizers and herbicides that will be used during Floodway construction. Probable effects on total suspended solids were discussed in Section 5.5. The potential effects on aquatic life due to effects on surface water quality are discussed in Sections 6.4, 6.5 and 6.6.

6.3.1.2 Sources of Effects

The use of fertilizers (containing phosphorus, nitrogen and potassium), herbicides (glyphosate and 2,4-D amine) or spills of chemicals during construction or maintenance have the potential to affect surface water quality. The potential for changes in sedimentation associated with Project construction and operation was also evaluated.

6.3.2 Existing Environment

Surface water quality data for the Red River was obtained from Manitoba Water Stewardship. Data was selected for two locations in the Red River; at St. Norbert near the inlet, and in Selkirk at the Selkirk Bridge. The fertilizers and herbicides that will be used in the revegetation plan have the potential to affect surface water quality. It was, therefore, necessary to understand the baseline concentrations of herbicides and fertilizers in surface water. The herbicides that may be used (i.e., glyphosate and 2,4-D amine). Surface water quality data was obtained for these parameters as well as for the major nutrients (i.e., phosphorous, nitrogen, potassium). Baseline information for the total suspended solids was also obtained and was discussed in Section 5.5.

The guidelines also require provision of pre-Project surface water temperatures. Furthermore, the guidelines require that the effects of the Project on mercury levels in fish be evaluated. To enable this analysis, the baseline mercury concentrations in surface water were obtained. The baseline surface water quality data for the St. Norbert location is shown in Table 6.3-1; the data for the Selkirk location is shown in Table 6.3-2. Graphical illustrations of surface water quality parameters can be found in

Appendix 6A. The Manitoba Surface Water Quality Standards, Objectives and Guidelines (Manitoba Conservation 2002) and the Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CCME 1999) for these parameters are shown in Table 6.3-3.

Tables 6.3-1 and 6.3-2 indicate that the seasonal concentration of phosphorous in the Red River peaks at both St. Norbert and Selkirk (0.18 and 0.22 mg/L) occur in April, although a smaller peak also occurs at St. Norbert in August. The total nitrogen concentrations peak at Selkirk from January to March and at St. Norbert in April. Concentrations of both phosphorous and nitrogen (Total Kjeldahl Nitrogen plus Nitrate) are typically slightly higher at the Selkirk location. The mean annual loading of total nitrogen at Selkirk is 32,765 tonnes/year; the mean annual loading of phosphorous in this location is 4,905 tonnes/year (Bourne *et al*. 2002). Less data on potassium concentrations was available for the St. Norbert location, so seasonal trends are not readily apparent. Potassium concentrations in Selkirk peak during December to January. Concentrations of 2,4-D amine peak in March at the Selkirk location and are typically consistent at the St. Norbert location. The concentrations of 2,4-D amine are slightly higher at the Selkirk location during the spring and the concentrations in both locations are approximately the same for the rest of the year. The data for glyphosate showed that the concentration of substances was below detectable limits. A review of available mercury information on Red River water demonstrated that this component is below the detection limits of the analysis performed. Baseline total suspended solids concentration is discussed in Chapter 5.

Table 6.3-1
Surface Water Quality in the Red River at St. Norbert near the Floodway Inlet Gates

Parameters	Month[1]											
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Total Phosphorous (mg/L)	0.07 - 0.31	0.08 – 0.31	0.07 – 0.36	0.18 – 0.56	0.13 – 0.40	0.12 – 0.38	0.18 – 0.57	0.16 – 0.49	0.14 – 0.29	0.12 – 0.23	0.14 – 0.27	0.10 – 0.28
Total Ammonia (mg/L)	N/A[2]	N/A[2]	N/A[2]	0.05 – 0.45	0.02 – 0.33	0.03 – 0.32	N/A[2]	N/A[2]	N/A[2]	N/A[2]	0.04 – 0.11	0.05 – 0.43
Dissolved Nitrate-Nitrite (mg/L)	0.14 - 0.53	0.32 – 0.74	0.04 – 2.48	0.49 – 2.75	0.11 – 1.14	0.03 – 0.90	0.26 – 0.81	0.21 – 0.79	0.09 – 0.51	0.02 – 0.44	0.02 – 0.76	0.03 – 0.39
Total Kjeldahl Nitrogen (mg/L)	0.90 – 1.65	0.80 – 1.60	0.82 – 1.98	1.08 – 2.24	0.83 – 1.40	0.85 – 1.40	0.80 – 1.33	0.80 – 1.58	0.82 – 1.44	0.80 – 1.32	0.93 – 1.56	0.95 – 1.45
Extractable Potassium (mg/L)	5.50 – 11.00	N/A[2]	N/A[2]	6.54 – 10.54	N/A[2]	N/A[2]	6.58 – 8.41	N/A[2]	N/A[2]	5.08 – 8.56	N/A[2]	N/A[2]
2,4-D (µg/L)	0.06 – 0.10	N/A[2]	0.05	0.07 – 0.66	N/A[2]	N/A[2]	0.09 – 0.22	0.171 – 0.18	N/A[2]	0.07 – 0.12	N/A[2]	N/A[2]
Glyphosate (µg/L)	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]
Temperature (^{o}C)	0	0	0 – 0.95	0 – 5.90	7.00 – 16.50	14.90 – 21.05	19.00 – 25.00	19.25 – 24.25	13.00 – 19.50	7.50 – 13.00	0 – 5.90	0 – 0.45
Mercury (µg/L)	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]	BDL[3]

Notes:

1. Surface water quality parameters stated are ranges of measured data from the 10th percentile to the 90th percentile. Ranges are based on data from 1978 to 2003
2. There was either no or minimal data collected during these months
3. BDL = Below Detectable Limits
4. Graphical illustrations of parameters are found in Appendix 6A
5. Total Suspended Solids data is presented in Chapter 5.

Table 6.3-2
Surface Water Quality in the Red River at Selkirk Downstream of the Floodway Outlet

Parameters	Month[1]											
	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Total Phosphorous (mg/L)	0.20 – 0.51	0.18 – 0.53	0.22 – 0.52	0.22 – 0.69	0.20 – 0.51	0.18 – 0.33	0.17 – 0.45	0.20 – 0.51	0.20 – 0.38	0.22 – 0.35	0.19 – 0.37	0.13 – 0.45
Total Ammonia (mg/L)	0.89 – 4.66	0.80 – 5.37	0.75 – 3.62	0.25 – 1.24	0.17 – 0.47	0.08 – 0.38	0.03 – 0.38	0.10 – 0.67	0.08 – 1.08	0.28 – 1.91	0.68 – 2.45	0.66 – 3.75
Dissolved Nitrate-Nitrite (mg/L)	0.34 – 0.69	0.31 – 0.83	0.50 – 1.72	0.58 – 2.43	0.18 – 1.09	0.16 – 0.91	0.15 – 0.80	0.21 – 0.70	0.15 – .83	0.17 – 0.65	0.09 – 0.72	0.11 – 0.56
Total Kjeldahl Nitrogen (mg/L)	1.70 – 4.53	1.65 – 4.60	1.61 – 4.08	1.20 – 2.40	1.07 – 1.92	0.90 – 1.65	0.80 – 1.58	0.80 – 1.81	1.10 – 1.92	1.06 – 2.52	1.27 – 2.93	1.47 – 3.29
Extractable Potassium	6.99 – 12.45	7.10 – 8.60	7.34 – 10.92	6.90 – 9.96	7.61 – 9.92	7.00 – 9.90	6.86 – 10	7.22 – 11.00	7.38 – 10.7	6.90 – 9.52	6.57 - 9.58	8.50 – 12.42
2,4-D (μg/L)	0.08 – 0.16	0.10 – 0.99	0.17 – 3.00	0.11 – 0.53	0.06 – 0.14	0.06 – 0.92	0.07 – 0.24	0.06 – 0.13	0.08 – 0.23	0.06 – 0.23	0.054 – 0.23	0.06 – 0.50
Glyphosate (μg/L)	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]
Temperature (^{o}C)	0	0	0	0 – 9.00	7.85 – 15.30	16.00 – 23.19	19.00 – 26.1	18.60 – 25.00	13.00 – 19.70	7.50 – 14.7	0 – 6.40	0 – 0.08
Mercury (μg/L)	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]	BDL[2]

Notes:

1. Surface water quality parameters stated are ranges of measured data from the 10th percentile to the 90th percentile. Ranges are based on data from 1970 to 2003
2. BDL = Below Detectable Limits
3. IMAC = Interim Maximum Acceptable Concentration
4. Graphical illustrations of parameters are found in Appendix 6A
5. Total Suspended Solids data is presented in Chapter 5.

Table 6.3-3
Surface Water Quality Guidelines

Parameters	Manitoba Surface Water Quality Standards, Objectives and Guidelines			Canadian Council of Ministers of the Environment		
	Drinking Water Quality	Freshwater Aquatic Life	Recreation	Drinking Water	Freshwater Aquatic Life	Recreation
Total Phosphorous (mg/L)	NV[1]	NV	NV	NV	NV	NV
Total Ammonia (mg/L)	NV	Temperature and pH dependent (Tier II)	NV	NV	Temperature and pH Dependent	NV
Dissolved Nitrate-Nitrite (mg/L)	NV	NV	NV	NV	NV	NV
Total Kjeldahl Nitrogen (mg/L)	NV	NV	NV	NV	NV	NV
Extractable Potassium (mg/L)	NV	NV	NV	NV	NV	NV
2,4-D (μg/L)	100[3]	NV	NV	100[2]	4.0	NV
Glyphosate (μg/L)	280	65	NV	280	65	NV
Temperature (^{o}C)	≤ 15^{o}C	Tier II Site Specific Objective	NV	≤ 15^{o}C[3]	Narrative	Narrative

Notes:
1. NV = No Value
2. IMAC = Interim Maximum Acceptable Concentration
3. Aesthetic Objective

6.3.3 Effects and Mitigation

This section provides an overview of the effects that were considered in the assessment of potential impacts of the Project on surface water quality.

Should other projects with similar potential effects on surface water quality occur, a cumulative effect on Red River surface water quality is possible. This could include projects or shoreline stabilization/erosion control and related infrastructure projects where adverse effects on water quality may occur of a similar nature to those associated with the Project. Should these projects proceed during the Project construction phase, the cumulative effects will need to be considered. There are no declared plans for such projects in the next five years, with the exception of the City of Winnipeg infrastructure projects discussed in Chapter 2. Other projects, such as the Devils Lake Diversion Project have different water quality concerns than herbicides and nutrients. The potential effects relate to salinity and dissolved solids.

6.3.3.1 Construction

For the Floodway Channel and Crossings, the majority of construction-related impacts to surface water quality will result from mechanical disturbance of the Floodway Channel (i.e. riprap deposition, Low Flow Channel re-contouring and widening of the Floodway Channel). Physical disruption of the Floodway Channel are scheduled to occur in four sections (stages) over four years, likely beginning in the summer of 2005 at the upstream south-end by the Floodway Inlet Control Structure and ending at the northern or downstream end in 2008 (Section 4.4). This construction sequence will minimize downstream aquatic impacts resulting from increased sedimentation in the Floodway Channel over the four-year construction period. Increased sedimentation is expected from:

- in-stream modification of the Floodway Channel and/or deposition of riprap at selected sites;
- runoff from the newly exposed soils of the excavated Floodway side slopes during rain events;
- increased suspended sediment from flood waters flowing over newly excavated land in the Floodway during flood events in the construction years;
- construction activities related to the extension of the Floodway Outlet Structure along the east bank of the Red River; and
- the deposition of riprap along selected shoreline sections of the Red River in the vicinity of the Floodway Inlet and Outlet Structures.

The related potential effects of sedimentation on surface water quality for the Floodway Channel and the Red River are discussed in Section 5.5. This analysis showed that if severe events such as a 1 in 20 year rainstorm or a 1 in 50 year flood occurs without mitigation during construction, then there could be large increases in the sediment concentrations in the Red River. These increases would still be within the natural variation of sediment concentrations in the Red River. Although it is unlikely there will be measurable increases in sediment in the Red River without mitigation, extensive mitigation by an erosion control plan ($6 Million) is still being proposed (Section 5.5) and will address this effect.

Potential effects on surface water quality that could occur during the construction period include the potential for hazardous materials used to be released into surface water through accidental spills. This potential effect could occur anywhere along the West Dyke, the Floodway Inlet, the Floodway Channel, the Floodway Outlet, and the Red River north of the outlet. Potential effects on surface water quality will be mitigated through the use of appropriate construction management practices as specified in the Environmental Protection Plan (EPP; such as designated refueling sites outside the channel and rapid response and clean-up of any spills).

There is also a potential for herbicides and fertilizers used in the revegetation plan to be released into surface water. The anticipated amounts of fertilizers and herbicides that will be applied along the Floodway Channel are shown in Tables 6.3-4 and 6.3-5 (Dickerson *pers. comm.* 2004).

Table 6.3-4
Estimated Amounts of Herbicides and Fertilizers that Will Be Used During the Construction of the Expanded Floodway

Herbicide	Location	Year				
		2005	2006	2007	2008	2009
Total Glyphosate used each year (kg)		830	1,250	1,250	830	830
Total 2,4-D amine used each year (kg)	in Borrow Area	55	82	82	55	55
Total nitrogen to be used (kg)		15,000 – 22,500	22,000 – 33,000	22,000 – 33,000	15,000 – 22,500	15,000 – 22,500
Total phosphorous to be used (kg)		36,000 – 47,000	54,000 – 71,000	54,000 – 71,000	36,000 – 47,000	36,000 – 47,000
Total potassium to be used (kg)		30,000 – 40,000	44,000 – 49,000	44,000 – 49,000	30,000 – 43,000	30,000 – 43,000

There could be a potential effect on surface water quality if the fertilizers and herbicides used in the revegetation plan are washed into the Floodway Channel and then into the Red River. In order to evaluate the potential significance of increased loading of fertilizers and herbicides, the potential herbicide and fertilizer load that could enter the Red River was calculated based on a "worst-case" scenario where all of the fertilizer or herbicide applied is washed into the river. This analysis assumes that all fertilizers and herbicides used in the revegetation plan are carried to the river without the benefit of allowances for plant uptake, soil binding, chemical decay or mitigation measures such as the use of Best Management Practices. It does not evaluate the actual effects following implementation of the Environmental Protection Plan (EPP).

The calculations of worst-case scenario changes in water quality concentrations are provided in Appendix 6B. Table 6.3.5 shows the potential increase in loading of herbicides to the Red River if the "worst-case" scenario were to occur and compares these values to the baseline data. These values are then compared to the lowest surface water quality guidelines values (Table 6.3-6). The results show that even if the unlikely "worst-case" scenario were to occur, the concentrations of glyphosate and 2,4-D amine will be well below guidelines. Since the actual application of herbicide will be done in accordance with Best Management Practices, effects will be much less than predicted by the "worst case" analysis. Effects are expected to be minor and not significant.

The maximum amount of fertilizers that will be used in one year is shown in Table 6.3-7. This information was used to calculate the potential change in surface water quality concentrations and was compared to the existing baseline conditions (Table 6.3-7). No surface water quality guidelines are specified for nutrients, so the analysis was conducted by comparing the "worst-case" scenario increase in loading to the mean annual nutrient loading for the Red River at Selkirk (Bourne et. al. 2002; Table 6.3-7). For nitrogen, if the "worst-case" scenario were to occur, the potential increase in annual nutrient loading would be less than 0.1% of loadings in Selkirk. For phosphorous, the potential increase in the annual load to the Red River or Lake Winnipeg in the unlikely "worst case" event may cause a 1.4% increase. Annual nutrient loading for potassium was not available and could not be compared.

The application rate will be carefully reviewed after soil tests are completed. Actual fertilization rates depend upon other factors, such as which species are used (native vs. introduced), the ability to re-utilize topsoil, and timing of the seeding. The expected application rate will create a much lower release of nutrients to the river than is estimated with the "worst case" analysis.

The effects of Project construction on surface water quality is expected to be small, short-term, adverse, regional and not significant.

Potential effects on surface water quality will be mitigated through the use of appropriate construction management practices as specified in the Environmental Protection Plan. It is very unlikely that the "worst-case" scenario changes in surface water quality will occur. The Project effects on water quality will be a component of the monitoring program and follow-up procedures outlined in the EPP (Section 6.3.5).

The effects of changes in water quality on aquatic life are discussed in Sections 6.5.3 and 6.6.3.

6.3.3.2 Operation - Inactive

The deposition of materials from the use of recreational vehicles (i.e., ATVs, snowmobiles) when the Floodway is inactive has the potential to affect surface water quality. The actual amount of deposition will be dependent upon the amount of recreational use in the area, so the potential effects on surface water quality are uncertain. This type of utilization is also a component of the Existing Floodway. It is unlikely that the present use is affecting surface water quality. The development of future recreational

opportunities will need to include requirements to manage effects on surface water quality, such as from motorized vehicle use. No Project-related effects are anticipated.

Table 6.3-5
Potential Load Releases of Herbicides into the Red River Between Lockport and Selkirk During Construction of the Expanded Floodway

Substance	Project maximum amount herbicide used during one year (tonnes)[1]	Typical baseline concentrations in the Red River at Selkirk (mean and 90th percentile)[2]		Potential "worst-case"[3] scenario increase in load to Red River in one year		Comments
		50th µg/L	90th µg/L	Based on minimum flows[4]	Based on average flows[5]	
Glyphosate	1.2	BDL[6]	BDL[6]	Anticipated loading of 2.9 µg/L + natural concentrations BDL = **2.9 µg/L**	Anticipated loading of 0.3 µg/L + natural concentrations BDL = **0.3 µg/L**	The anticipated "worst-case" scenario **could increase the concentrations of glyphosate to above detectable limits**
2,4-D amine	0.082	0.120 µg/L	0.232 µg/L	Anticipated loading of 0.2 µg/L + average natural concentrations of 0.1 µg/L = **0.3 µg/L**	Anticipated loading of 0.02 µg/L + average natural concentrations of 0.12 µg/L = **0.14 µg/L**	The anticipated "worst-case" scenario **could increase 2,4-D - amine concentrations to greater than the 90th percentile value concentration in a low flow year**

Notes:
1. Source: Dickerson *pers. comm.* 2004
2. Source: Water Quality Management Section, 2004
3. "Worst-case" assumes all herbicides used in a year are released into the Red River
4. Minimum flow from May 1 to Sept 30 is 33 m^3/s
5. Average flow from May 1 to Sept 30 is 296 m^3/s
6. BDL = Below Detectable Limits (detectable limit for glyphosate is 2 µg/L; Young *pers. comm.* 2004)

Table 6.3-6
Comparison of Potential Changes in Herbicide Concentrations to Surface Water Quality Existing Guidelines

Substance	Typical baseline concentrations (50th percentile)	Minimum guideline for surface water quality	Potential "worst-case"[1] scenario increase in load to Red River in one year		Comments
			Based on minimum flows[3]	Based on average flows[4]	
Glyphosate (µg/L)	BDL[2]	65	Anticipated loading of 2.9 µg/L + natural concentrations that are below detectable limits = **2.9 µg/L**	Anticipated loading of 0.3 µg/L + natural concentrations that are below detectable limits= **0.3 µg/L**	The anticipated "worst-case" scenario change in surface water quality concentrations **will be below the minimum surface water quality guideline**
2,4-D amine (µg/L)	0.12	4	Anticipated loading of 0.2 µg/L + average natural concentrations of 0.1 µg/L = **0.3 µg/L**	Anticipated loading of 0.02 µg/L + average natural concentrations of 0.12 µg/L = **0.14 µg/L**	The anticipated "worst-case" scenario change in surface water quality concentrations **will be well below the minimum surface water quality guideline**

Notes:

1. "Worst-case" assumes all herbicides used in a year are released into the Red River
2. BDL = Below Detectable Limits (detectable limit for glyphosate is 2 µg/L; Young *pers. comm.* 2004)
3. Minimum flow from May 1 to Sept 30 is 33 m^3/s
4. Average flow from May 1 to Sept 30 is 296 m^3/s

Table 6.3-7
Comparison of Potential Changes in Nutrient Loading Due to the Project at Selkirk and Lake Winnipeg

Substance	Potential "worst-case"[1] scenario increase in loading (tonnes) in one year[2]	Mean annual loading measured at Selkirk[3] (tonnes)	Mean annual loading measured at Selkirk in Lake Winnipeg (tonnes)[3]	Comments
Total Phosphorous	71	4,905	5,838	Maximum potential increase is <1.4% of the mean annual P loading at Selkirk and <1.2% in Lake Winnipeg
Total Nitrogen	33	32,765	63,207	Potential increase is <0.1% of the mean annual N loading at Selkirk and <0.05% in Lake Winnipeg

Notes:
1. "Worst-case" assumes all herbicides used in a year are released into the Red River.
2. Source: Dickerson *pers. comm.* 2004
3. Source: Bourne *et al.* 2002

The available information suggests that mercury concentrations in the Red River upstream and downstream of the Existing Floodway are below detectable limits of the analysis performed. While it is likely that atmospheric mercury is being deposited on the Existing Floodway, the rate at which the Floodway wetlands are mobilizing this mercury, and in particular, the bio-active water soluable methyl mercury (MeHg) form, to the downstream aquatic systems is uncertain. Grigal (2002) notes that "*wetlands are a site of MeHg production and their presence increases with water residence time: both increase MeHg flux;*" this supports the observations of Waldren *et al* (2000), at the Sudbury River, (eastern Massachusetts) "*net production of MeHg was 15 times greater in the wetland reach.*" The Project's modifications to the Low Flow Channel will reduce wetland occurrence and should decrease water retention time in the channel. Therefore, while current MeHg production in the Existing Floodway Channel is uncertain, the Project is likely to result in a reduction in any MeHg production.

Effects of the operations-inactive phase of the Project are expected to be not significant.

6.3.3.3 Operation - Active

Reduced flooding of industry within Winnipeg due to the Project has a potential benefit to downstream water quality. **It is not anticipated that surface water quality will be altered during operation of the Expanded Floodway Channel compared to the situation that occurs during operation of the Existing Floodway Channel.**

6.3.4 Residual Effects and Significance

A summary of the key Project effects, mitigation measures and assessments of effects, as well as the residual effects of the Project on surface water quality are shown in Table 6.3-8. **The Project will have no significant residual effects on surface water quality.**

6.3.5 Monitoring and Follow-up

Potential changes in surface water quality will be monitored during construction, as a component of the monitoring plans outlined in the EPP. Concentrations of herbicides, nutrients, and TSS in surface water will be monitored upstream and downstream of the Floodway Outlet on the Red River. If significant surface water quality is detected and are found to be the result of Floodway construction, appropriate additional mitigation measures will be implemented.

6.4 AQUATIC HABITAT

For the purpose of this environmental impact assessment, aquatic habitat refers to bottom substrate (gravel, silt, sand, etc.) and aquatic macrophytes (vegetation): both are key components that influence the presence and abundance of aquatic life. Surface water quality, another key component of the aquatic habitat that affects aquatic life, is discussed in Section 6.3. Water flows and velocities and how these physical water characteristics may affect aquatic life as a result of the Project are discussed, where applicable, in Sections 6.5 to 6.7.

6.4.1 Approach and Methodology

6.4.1.1 Effects Assessment

Aquatic habitat information used to assess effects of the Project was acquired from previous studies of the Assiniboine and Red Rivers and from focused field studies designed to address information deficiencies, particularly with respect to aquatic habitat characteristics of the Floodway Channel, the Red River adjacent to the Floodway Inlet Control Structure and Outlet Structure, and the West Dyke drainage ditches (Table 6.2-1 and Appendix 6D).

Field studies designed to characterize aquatic habitat in the local study area are summarized in Table 6.2-1 and details are provided in Appendix 6D.

Table 6.3-8
Summary of Residual Effects and Significance on Surface Water Quality Effects

DESCRIPTION OF EFFECT	MITIGATION	RESIDUAL EFFECTS AND SIGNIFICANCE[(a)]
CONSTRUCTION		
The "worst-case" scenario and unlikely sediment increase in the Floodway Channel is expected to result in an increase in the sediment concentration in the Red River at Lockport of up to 140 mg/L during a 1 in 20 year rainstorm or an increase of up to 140 mg/L during a 1 in 50 year flood event. The total suspended solids concentration is expected to exceed the stipulated MSQSOG objectives during these unlikely events; however, the anticipated TSS increases are still within the range of concentrations historically experienced during flood events.	Potential effects on surface water quality due to erosion and sedimentation will be mitigated through the use of appropriate best management practices as specified in the Environmental Protection Plan. A sediment and erosion control plan will be developed in order to mitigate erosion and sedimentation effects associated with the construction phase. The current design has a budget of $6,200,000 or 6-7% of the Channel Project cost for erosion control.	With the implementation of the measures specified in the sediment and erosion control plan, any residual effects on erosion and sedimentation are expected to be minor and **not significant**.
Potential for surface water contamination due to oil and fuel leaks/spills.	The Environmental Protection Plan will specify both the appropriate procedures to follow to prevent lubricant oil and fuel leaks and spills and the procedures to follow in the event that an lubricant oil or fuel leak or spill does occur.	Residual effects associated with potential leaks and spills of lubricant oil and fuel will be minor and **not significant**.
In a "worst-case" scenario where all the nutrients used in the revegetation plan during one year were washed into the Floodway and then entered the Red River, there could be a detectable change in nutrient concentrations downstream of the Floodway Outlet (i.e., at Lockport). The anticipated change would be an increase in total nitrogen concentrations of 0.1 mg/L and an increase in total phosphorous concentrations of 0.2 mg/L. The expected "worst-case" scenario loading of nitrogen and phosphorous to the Red River would be less than 1.5% of the mean annual loading of nutrients to the Red River at Selkirk.	The revegetation plan will specify the appropriate application rates and application procedures that will be used to minimize loss of nutrients. Furthermore, the monitoring plan will include monitoring of surface water quality.	Residual effects of nutrient input into the Floodway and the Red River are expected to be minimal. Any residual effect is expected to be minor and **not significant**.
Herbicide (2,4-D amine, glyphosate) use along the Floodway is part of the revegetation program. Under a "worst-case" scenario where all of the herbicides used in one year enter the Floodway and the Red River at the Floodway Outlet, there could be a detectable increase in herbicide concentrations downstream of the	The revegetation plan will specify the appropriate procedures for application of herbicides. Furthermore, the monitoring plan will include monitoring of surface water quality.	Residual effects are expected to be minor and **not significant**.

DESCRIPTION OF EFFECT	MITIGATION	RESIDUAL EFFECTS AND SIGNIFICANCE[(a)]
Floodway Outlet. However, the calculated increase in 2,4-D amine and glyphosate is well below the minimum surface water quality guidelines.		
OPERATION – INACTIVE		
The deposition of materials from the use of recreational vehicles when the Floodway is inactive has the potential to affect surface water quality. It is unlikely that present use of recreational vehicles on the Floodway is affecting surface water quality.	It is assumed development of future recreational opportunities will include management of effects on surface water quality.	Residual effects are expected to be minor, short-term, local and **not significant**.
The Project is expected to reduce any MeHg production that is currently occurring in the Existing Floodway.	This effect is expected to be minor and beneficial.	This effect is expected to be positive and minor, and therefore, is **not significant**.
OPERATION – ACTIVE		
The active operation of the Floodway has a potential benefit on downstream water quality.	No mitigation required.	Effect is positive and **not significant**.

Notes:

[a] Preliminary assessment of effects after implementation of proposed preliminary mitigation measure

Methodologies utilized were generally observational in nature and resulted in virtually no effects on the aquatic environment. Fish studies primarily utilized observational and live capture techniques, although limited lethal gill netting was also performed. Non-invasive techniques for aquatic habitat mapping, using GPS-linked SONAR and videography, were undertaken to characterize bottom and shoreline habitat in the Red River. Bottom substrate sampling in the Red River was conducted using a Ponar grab sampler at a number of sampling sites, thereby limiting the amount of disruption to the Red River bottom substrate in the vicinity of the Floodway Outlet Structure.

6.4.1.2 Sources of Effect

The majority of Project effects to the aquatic habitat are expected to occur within the Floodway Channel and the local area of the Red River immediately downstream of the Outlet Structure as a result of physical works during construction. Changes to the aquatic habitat will result from Floodway Channel excavation, Low Flow Channel reconstruction, and construction activities associated with the Floodway Outlet Structure and shoreline protection measures downstream in the Red River. Additionally, intermittent aquatic habitat in the form of ditch and drainage channels adjacent to the West Dyke could be temporarily disturbed as a result of West Dyke modification and extension construction activities.

Effects to aquatic habitat as a result of the Project could affect aquatic life, including fish, where present. As defined by the *Fisheries Act*, the Floodway Channel is a 'fishery[2]' and is considered to be 'fish habitat[3]'.

[2] ""fishery" includes the area, locality, place or station in or on which a pound, seine, net, weir or other fishing appliance is used, set, placed or located, and the area, tract or stretch of water in or from which fish may be taken by the said pound, seine, net, weir or other fishing appliance, and also the pound, seine, net, weir, or other fishing appliance used in connection therewith;"

However, as discussed in Section 6.6.2, it has been determined that the Floodway is not good year-round fish habitat: Section 6.6.2 describes the quality of fish habitat presently existing in the Floodway Channel. It is recognized that some activities related to the expansion of the Floodway may result in a 'Harmful Alteration, Disruption or Destruction' (HADD) of fish habitat in areas of the Red River where construction activities and in-stream shoreline stabilization (e.g., riprap) will take place. The Department of Fisheries and Oceans Canada (DFO) generally requires that there be a "no net loss" of fish habitat. Sections 6.6.3 and 6.7.3 describe the potential Project effects to fish habitat and the mitigation strategy designed to ensure that there would be 'no net loss' of fish habitat as a result of the Project.

6.4.2 Existing Environment

As indicated in Section 6.4.1.2, Project effects to aquatic habitat are expected to be limited to the Floodway Channel, site-specific areas of the Red River and within ditches and drainage channels adjacent to the West Dyke. Therefore, the following existing aquatic habitat description in Sections 6.4.2.1 to 6.4.2.3 will focus primarily on those areas potentially affected by the Project.

6.4.2.1 Floodway Channel

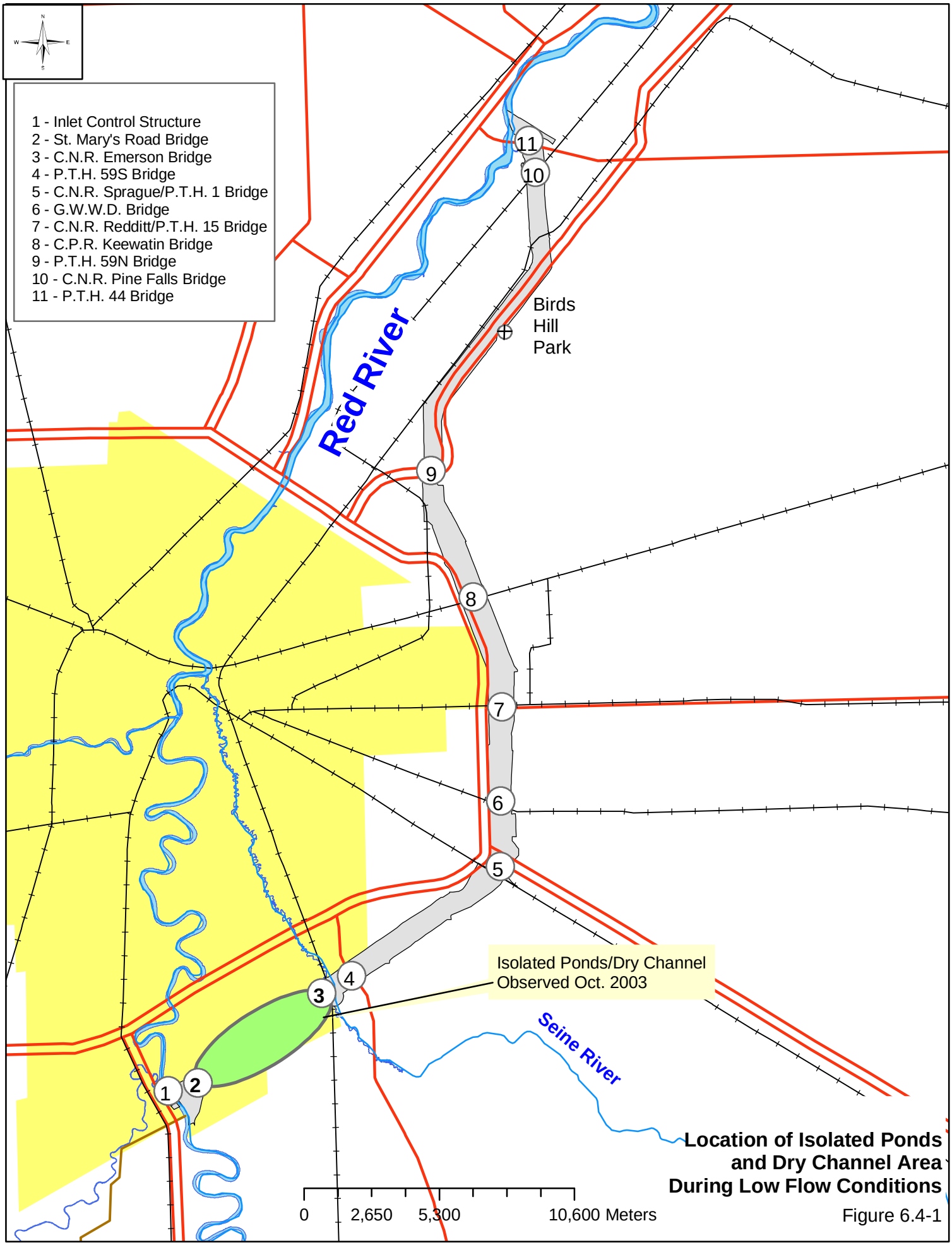
The existing aquatic environment of the Red River Floodway varies seasonally and is primarily influenced by the frequency and volume of water input from land drainage sources (Section 4.9), overflow from the Seine River Syphon Overflow Structures (Section 4.8), groundwater seepage and diverted water from the Red River during Floodway Inlet Control Structure operation.

When the Floodway Inlet Control Structure is not diverting Red River water into the Floodway, the aquatic habitat within the Existing Floodway Channel is generally limited to the Low Flow Channel, which typically varies in width from 4 to 20 metres. Water depth in the Low flow Channel typically ranges from 0.3 to 2 metres under Operation-inactive conditions (Appendix 6E). Under some Operation-inactive conditions, isolated ponds and dry channel areas occur along the southern-most reach of the Floodway between the CPR-Emerson Bridge and the St. Mary' s Bridge crossings (Figure 6.4-1).

During winter, the entire length of the Floodway Low Flow Channel does not freeze to the bottom, probably due to continuous groundwater seepage through the base of the Low Flow Channel. Field studies conducted on February 3 and 4, 2004, indicated that up to 26 distinct areas of open water or water under thin ice occur along the length of the Floodway Low Flow Channel between the area where the Seine River Syphon overflow intersects the Floodway (approximately 7 km downstream of the south end of the Floodway) to the Shkolny Drain area (approximately 7 km upstream of the Floodway Outlet Structure; Appendix 6D). Although the Floodway Low Flow Channel does not freeze completely during winter, fish kills do occur over the winter, indicating that the Floodway is not good year-round fish habitat (Appendix 6D; Section 6.5.2).

Bottom substrate along the majority of the Floodway Low Flow Channel consists of silt/clay, with gravel and cobble substrate becoming more frequent in the northern third of the Low Flow Channel. Bottom

[3] ""fish habitat" means spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes;"



Location of Isolated Ponds and Dry Channel Area During Low Flow Conditions

Figure 6.4-1

substrate is primarily gravel and cobble within the northern 5 km reach up to the Floodway Outlet Structure at Lockport (Appendix 6D).

Hydraulic gates in the existing two Floodway Outlet culverts in the late 1980s have been operated according to an agreement[4] between Manitoba Conservation and Ducks Unlimited (DU). This was an attempt to enhance **waterfowl** habitat along the northern-most reach of the Floodway Channel by creating an impoundment in the Floodway Channel within the approximately 10 km reach upstream of the Floodway Outlet Structure to the Dunning Crossing area. This may also have created some additional limited aquatic habitat between the Floodway Outlet and Dunning Crossing reach (greater wetted area and water depth within the Low Flow Channel in that reach). From 1990 to 2003, the gates have been closed in May/June when spring diversion runoff from the Red River has subsided to create a temporary reservoir, then opened at approximately mid-September each year to allow water to drain from the Floodway into the Red River. Due to the aging mechanics of the hydraulic gates (and costs associated with maintenance and operation), and the limited value of the waterfowl habitat, created between the Floodway Outlet and Dunning Crossing, this agreement was terminated April 26, 2004 by the Minister of Water Stewardship (Hays, *pers. comm.* 2004a).

The short channel section (approximately 100 metres in length) leading from the Floodway Outlet Structure downstream to the Red River consists primarily of gravel, boulder and cobble bottom substrate. The flow of water occurring within that short channel area varies between seasons, and is typically reduced to shallow (<0.05 m depth) braided streams under low flow conditions during late summer/fall. However, when the Floodway is in use during spring flood conditions, this channel area passes water exiting the Floodway Channel over and through (via culverts) the Floodway Outlet Structure; the water within this short channel section then becomes several metres deep, flowing at one to two metres per second within an area approximately the width of the Outlet Structure.

6.4.2.2 Red River

Periodic discharges of floodwaters from the Floodway Channel to the Red River may have influenced the bottom substrate of the Red River in the immediate vicinity of the Floodway Outlet Structure. Bottom substrate in the Red River in the area adjacent to the Floodway Outlet is primarily hard sand; areas upstream to the Lockport Dam (less than 1 km) and 2 km downstream of the Floodway Outlet consist primarily of cobble and gravel bottom substrate with some sand (Appendix 6D). This general area is immediately downstream of the Lockport Dam, which is considered to be one of Manitoba's most valuable recreational fisheries.

6.4.2.3 West Dyke Area

The extent of aquatic habitat associated with the West Dyke and potentially affected by the Project (Section 6.4.3) is considerably less than that of the Floodway and Red River. Drainage ditches parallel either side of the existing West Dyke and the proposed extended West Dyke Right-of-way (ROW). Ditches and drainage channels adjacent to the West Dyke receive water primarily from land drainage and, under high spring flows, from the La Salle River, which is a tributary of the Red River. In addition to

[4] Manitoba Department of Natural Resources Floodway Project DU File 557-0521. Agreement made April 3, 1990 in pursuance of "*The Water Resources Administration Act*".

ditches paralleling the existing and proposed extension of the West Dyke ROW, eight land drainage ditches intersect the existing and proposed extension of the West Dyke:

- the La Salle Drain;
- the proposed Glenlea Drain;
- an unnamed gated drain;
- the Domain Drain;
- the Manness Drain;
- the Bolen Drain;
- an unnamed drain (does not pass through the West Dyke); and
- the Condor Drain (does not pass through the West Dyke).

These drains generally operate year-round, as they intermittently collect spring melt-water and rain event runoff from all intersecting ditches and field drains (Pantel *pers. comm.* 2004). During summer months, these drains typically dry up, although there may be some low-lying areas in which shallow ponding (typically <0.3 m deep) may occur (Pantel *pers. comm.* 2004). Aquatic habitat within the drainage ditches consists primarily of a clay/mud substrate supporting aquatic sedges, cattails and flooded grasses (Appendix 6E). The aquatic habitat within several of these main drains are known to intermittently support fish (Appendix 6D), which are likely accessing the drains via the La Salle River during spring high water events (Section 6.6.2).

6.4.3 Effects and Mitigation

Effects to the **aquatic habitat** during Project construction are anticipated to be primarily restricted to the Floodway Channel, with some site-specific effects in the Red River and to drainage channels and ditches adjacent to the West Dyke.

The potential significance of the described effects to aquatic habitat is evaluated with respect to the lower trophic levels, invertebrates and fish/clam utilization of these areas in Sections 6.5 and 6.7.

6.4.3.1 Pre-construction

A temporary plywood weir, placed in the Low Flow Channel during the late winter of 2003/2004 by study team hydraulic specialists, was the only pre-construction activity that potentially affected aquatic habitat. This temporary structure was discussed with Federal and Provincial regulators and installed, operated and removed as per guidance received. **No adverse effects of this temporary structure were anticipated**.

6.4.3.2 Construction

<u>West Dyke</u>

The extension and modification of the existing West Dyke will result in the disruption of aquatic habitat in a number of existing drains and ditches running adjacent to the length of the existing and proposed expanded West Dyke ROW (Section 6.4.2.3). Drains and ditches will be re-established adjacent to the newly constructed West Dyke ROW. Additionally, some modifications to currently existing drainage

channels connecting the ditches running parallel to the West Dyke will occur (Section 4.5.6.3). To contain sediment run-off into drainage channels in the vicinity of the West Dyke ROW during construction, appropriate sediment control mitigation measures (e.g., sediment screens) will be implemented (Section 4.5.6.3). Vegetation in drainage ditches and channels that will be disturbed during construction is expected to be re-established during the next few growing seasons following construction.

While results of field surveys conducted during spring 2004 indicated that fish occur within drainage channels intersecting the West Dyke (Appendix 6D), it is anticipated that this observed fish presence will be temporary in nature as the drains and ditches empty, and eventually dry out during late summer/fall.

It is not anticipated that construction effects will be cumulative with any other activities in the area.

After the implementation of mitigation measures, effects of construction on the aquatic habitat adjacent to the expanded and modified West Dyke are expected to be neutral to adverse, small, short-term, site-specific, local and not significant.

Floodway Inlet Control Structure

Construction of the Project will not substantially alter the aquatic characteristics of the Floodway Inlet Control Structure.

Riprap will be deposited along the Red River in the vicinity of the Floodway Inlet Control Structure. The deposition of riprap at the Inlet Control Structure is anticipated to be above typical Red River water levels, and as such, **is not anticipated to affect aquatic habitat**.

Floodway Channel

During each stage (year) of the Project's excavation activities, some aquatic habitat within the Floodway Channel will be physically disrupted due to activities related to:

- re-contouring of the Low Flow Channel; and
- placement of riprap in erosion-prone areas within the Low Flow Channel.

The addition of riprap to selected areas of the Floodway Low Flow Channel susceptible to erosion is expected to alter an approximate 30 to 35 km length of the total bottom substrate area of the 48 km-long Floodway Low Flow Channel.

Additionally, aquatic habitat in the Floodway Low Flow Channel will be altered during construction by the potential introduction of increased suspended sediment due to run-off from newly exposed/excavated areas of the Floodway.

After disturbance and natural revegetation, new macrophyte communities are usually altered compared to the original community, with a greater prevalence of species that are resistant to disturbance (Nichols

1975; Cooke 1980). One of the fastest colonizers are aquatic plants of the genus **Potamogeton**, which are likely to be a prevalent species in the waters of the Red River and Seine River. There may be large amounts of **propagules** in these rivers that could recolonize the Floodway Low Flow Channel.

It is likely that some recolonization of macrophytes in the Low Flow Channel will occur three to five years after construction. This estimate will depend on the rate of sedimentation as sediment must be deposited within riprap crevices to provide a substrate suitable for macrophyte colonization, and on the rate of introduction of propagules from the Seine River and Red River.

The effects of construction activities on the aquatic environment are expected to be temporary and will be mitigated by minimizing the amount of in-stream excavation necessary to accommodate any Low Flow Channel re-contouring and erosion control activities (e.g., riprap deposition). Additionally, a revegetation program along the Floodway that will be implemented immediately following each annual phase of construction will minimize sediment run-off into the Low Flow Channel.

After the implementation of mitigation measures, effects of construction on the aquatic habitat in the Floodway Channel are expected to be small, short-term and site-specific, negative, and not significant.

Floodway Outlet Structure

Construction of the Outlet Structure will not displace any existing aquatic habitat, but may result in a larger area of intermittent aquatic habitat between the Outlet and the Red River similar to the aquatic habitat that currently exists in that area.

Construction-related effects of the Outlet Control Structure are anticipated to be site-specific, small and neutral to positive in nature, and not significant.

Red River

Within the Red River, disruptions to the aquatic habitat resulting from Project construction are expected to be associated with:

- modifications to the east river bank associated with the Floodway Outlet Structure extension;
- deposition of riprap and other erosion control measures at selected erosion-prone sites along the west bank of the Red River in the vicinity of the Floodway Outlet Structure and a distance approximately 1.2 km downstream (north) of the Existing Floodway Outlet Structure (Section 4.4); and
- increased suspended sediment resulting from riverbank modifications.

Erosion control measures such as riprap and vegetative methods will be implemented along 1.2 km of Red River shoreline in the vicinity of the Floodway Outlet Structure (Section 4.4.5). The deposition of riprap and other erosion control measures along the west shoreline of the Red River, downstream of the

Outlet Structure, are anticipated to result in the existing aquatic habitat being buried. However, re-establishment of some aquatic vegetation is expected 3 to 5 years following riprap deposition.

Increased suspended sediment expected as a result of these construction activities along the Red River will be mitigated (Chapter 5.0). The proportional increase in suspended sediment and potential effect on water quality in the Red River are discussed in Chapter 5.0. In summary, the proportional increase in suspended sediment, and eventual deposition of sediment to the Red River, is expected to be within the range of natural variability, even under a worst-case scenario where the Floodway must be operated during Floodway excavation activities (Chapter 5.0).

The construction-related suspended sediment discharges, while anticipated to remain within the range of baseline variability on the Red River, could act in a cumulative fashion with other activities, like dredging or shoreline stabilization, to result in potential exceedances of natural variability. No such activities are known to be planned during the Project construction period. Should these other activities proceed during Floodway construction, more aggressive sediment control may be necessary to ensure suspended sediment levels remain within the range of natural variability.

After the implementation of mitigation measures, effects of construction on the aquatic habitat in the Red River are expected to be negative, small, short-term, site-specific, local and not significant.

6.4.3.3 Operation - Inactive

Vegetation within drainage ditches and channels adjacent to the West Dyke ROW, is expected to become re-established during the next growing season following construction. No other effects to the drainage ditches along the West Dyke are anticipated when the Expanded Floodway is present, but not in use. Aquatic habitat within the Floodway Low Flow Channel (under operation-inactive conditions), the Red River and in drainage ditches along the expanded West Dyke is expected to be similar to the current pre-Floodway Expansion condition, with the exception of changes due to the addition of riprap and the re-contouring of the bottom of the Floodway Channel and along shoreline areas of the Red River, in the vicinity of the Floodway Outlet Structure in selected areas where erosion is known to be a concern.

As indicated in Section 6.4.3.2, existing aquatic habitat will be altered in areas in the Low Flow Channel and Red River shoreline where riprap will be deposited.

The potential Project-related effects on aquatic habitat involve the modification of the Low Flow Channel and the modifications to the Red River downstream of the Outlet Structure. These changes occur during construction and persist into the future. These Project-related aquatic habitat changes could be cumulative with other potential effects on aquatic habitat, such as ongoing shoreline stabilization and related infrastructure activities. The current and future magnitude of these activities is uncertain, but assuming compliance to DFO's "no net loss" of habitat policy, these activities are not likely to result in any significant adverse effects.

The effects of the operation-inactive Expanded Floodway on the aquatic habitat are expected to be neutral and similar to the Existing Floodway. The modified habitat in the Low Flow Channel of the

Expanded Floodway and along the Red River is a long-term, site-specific and, small change to the local aquatic habitat.

6.4.3.4 Operation - Active

West Dyke

Operation of the Expanded Floodway during a flood event is not expected to alter aquatic habitat in drainage ditches adjacent to the West Dyke beyond effects that occur during operation of the Existing Floodway.

The active operation of the Project is not anticipated to result in any effects to aquatic habitat on the West Dyke.

Floodway Inlet Control Structure

The Floodway Inlet Control Structure will continue to operate under current rules (Section 4.4). When the Floodway Inlet Control Structure gates are raised, Red River flow to the Floodway Channel. Operation may effect fish habitat under existing conditions, particularly with respect to fish movements (discussed further in Section 6.6 and in Supplemental Documentation). It is assumed that when the Floodway Inlet Control Structure gates are raised, fish passage upstream in the Red River is temporarily blocked under existing conditions and will not change as a result of the Project regime of the Floodway Inlet Control Structure.

Should the operations of the Floodway Inlet Control Structure be altered (as a component of a future activity, like summer operations), it is possible that fish habitat availability may change as a result of the alteration of the timing or frequency of fish movements in the Red River. This effect is explored further in Supplemental Documentation.

This potential to change the Floodway Inlet Control Structure operation, exists within the Existing Floodway; as a result, there is no potential for the Project to have a cumulative effect on fish movement.

The Project Inlet Control Structure under active operation conditions is not anticipated to have an effect on aquatic habitat.

Floodway Channel

Operation of the Expanded Floodway will result in marginally less flooded land adjacent to the Red River upstream of the Floodway Inlet Control Structure (Section 5.3). This will result in less temporary flooding over previously dry-land areas, including land areas expected to be flooded and contained by the West Dyke. This effect is potentially beneficial to fish, since fish are often stranded on land or in isolated pond areas after floodwaters recede (such as in drainage ditches and channels adjacent to the West Dyke), but is expected to be minor in magnitude.

With the expansion of the Floodway Channel, the following aspects of aquatic habitat within the Channel will be altered when the Floodway is in use:

- total wetted area within the Floodway Channel will be marginally increased (for small flood events only) due to the expanded width of the Channel base; and
- the majority of willows in the Floodway Channel will be removed during construction and ongoing maintenance programs.

Effects to the aquatic habitat in the Floodway will be temporary since the Floodway is typically only operated for a few weeks during emergency flood events. After the threat of flood has passed and the Inlet Control Structure gates are lowered again, water levels/flows in the Floodway revert to pre-operation conditions within a relatively short period.

During the time the Floodway is in operation, the aquatic habitat within the Floodway Channel may also experience some alterations due to the introduction of woody debris or foreign material (e.g., various forms of refuse that may wash into the Floodway from the Red River and adjacent flooded land areas).

The Project's operation-related impacts to the aquatic environment are not expected to change substantially from the existing operational condition with one exception: it is anticipated that overland Flooding along the Red River upstream of the Floodway Inlet will be reduced as a result of the expanded capacity of the Floodway Channel. With a widened Floodway Channel, floodwaters flowing through the channel will be distributed over a wider area and will result in an increased wetted area during flood events. As with the current Floodway operation situation, floodwater levels in the Floodway decrease to 'inactive' levels within a few days of the Floodway Inlet Control Structure gates being lowered back down after the threat of flood is over.

The effects of Expanded Floodway operation on the aquatic habitat in the Floodway Channel are expected to be neutral, long-term and site-specific.

Red River

The effects of expanded Floodway operation on the aquatic habitat in the Red River are expected to be neutral.

6.4.4 Residual Effects and Significance

The Project's effects to the aquatic habitat are summarized in Table 6.4-1 and assessed further in Sections 6.5 and 6.6 with respect to potential ecosystem implications. Approximately 30-35 km of soft-bottomed aquatic habitat with intermittent ponding in the Low Flow Channel will be replaced by a similar area of hard-bottomed aquatic habitat with no ponding. Similarly, up to 1.2 km of aquatic shoreline habitat in the Red River could be modified as a result of Outlet construction and shoreline stabilization/erosion control measures.

No significant adverse impacts are anticipated to the aquatic habitat.

6.4.5 Monitoring and Follow-Up

The projected potential revegetation of some of the riprapped areas in three to five years should be confirmed and the pattern of revegetation characterized to help direct future riprap-related shoreline stabilization projects.

Table 6.4-1
Summary of Residual Effects and Significance on Aquatic Habitat

DESCRIPTION OF EFFECT	MITIGATION	RESIDUAL EFFECTS AND SIGNIFICANCE
CONSTRUCTION - EXCAVATION ACTIVITIES		
West Dyke suspended sediment in drains and ditches	Sediment control measures	Small, site-specific local, short-term, neutral to negative effect **Not significant**
Alteration of erosion-prone bottom substrate and physical disruption of aquatic vegetation communities/substrates at excavation sites along the length of Low Flow Channel	None: Aquatic vegetation is expected to re-establish naturally to the extent feasible given the change in bottom substrate of the majority of the Floodway Low Flow Channel from silt/clay to riprap.	Small, short-term, site-specific negative effect on Red River. **Not significant**
Red River shoreline to be armoured with riprap	Riprap and physical disruption of the Red River shoreline will be very limited.	Large, short-term effect on Floodway aquatic habitat. Since the habitat is poor, the effect is **not significant**
Die-off of some aquatic vegetation in the downstream vicinity of excavation activities due to excessive sediment coating	Appropriate sediment control measures will be used within the Floodway Channel in the immediate vicinity of each excavation site to minimize the increased sediment distribution along the channel.	Small, short-term, site-specific negative effect **Not significant**
Outlet structure expansion increasing intermittent habitat between Outlet and Red River	None	Small, site-specific, long-term, positive effect **Not significant**
OPERATION-INACTIVE		
Low Flow Channel and Red River habitat alteration	None	Small, site-specific, long-term positive effect **Not significant**
OPERATION-ACTIVE		
Physical disruption of some aquatic habitat	None: This is an existing affect of the Existing Floodway during operation. High flow events are a natural occurrence in stream environments. Therefore, aquatic vegetation is expected to recover after disruption due to high flows.	No substantive change from existing conditions **Not significant**

6.5 LOWER TROPHIC LEVELS AND AQUATIC INVERTEBRATES

For the purpose of this assessment, **lower trophic levels** of aquatic life refer to phytoplankton, free-floating/attached algae and zooplankton. **Aquatic invertebrates** refer to aquatic arthropods/insects and benthic invertebrates. Shellfish and crustaceans, which are defined by the federal *Fisheries Act* as 'fish', are excluded and discussed further in Section 6.6.

6.5.1 Approach and Methodology

6.5.1.1 Effects Assessment

The evaluation of potential effects on the lower trophic levels and invertebrates associated with the Project was based upon the anticipated changes to the surface water quality (Chapter 5 and Section 6.3) and the anticipated physical alteration of aquatic substrates and habitats associated with the Project's physical works (Section 6.4).

The aquatic lower trophic and invertebrate community found within the Existing Floodway Channel is the product of an artificial habitat created by the original excavation of the Floodway in the late 1960s. This artificial habitat is subject to substantial environmental variability, particularly with respect to water levels and flows due to unpredictable diversion of Red River waters (primarily in the spring and early summer periods); intermittent discharges (primarily from rain-storm events) from the Seine River; and other overland drains during the spring, summer and fall months. It is anticipated that this environmental variability will be reflected in the aquatic lower trophic and invertebrate community dynamics and will impair the ability to describe this ecosystem's function.

This dynamic ecosystem variability was also noted in a review of historic aquatic lower trophic level and invertebrate surveys conducted on the Red and Assiniboine Rivers (see Appendix 6E, Section 6.5.2). These studies demonstrate that the aquatic lower trophic and invertebrate community is highly variable and difficult to characterize or to predict.

6.5.1.2 Sources of Effect

Tye Project's effect on the aquatic lower trophic and invertebrate communities is anticipated to be a result of the Project's physical works during construction. This is anticipated to be related to habitat level changes as a result of Floodway Channel excavation, Low Flow Channel reconstruction, aquatic habitat alteration associated with the Outlet Structure and shoreline protection measures downstream in the Red River.

6.5.2 Existing Environment

Over 200 species of plankton occur in the Red River (Appendix 6C), and are generally grouped as either zooplankton or phytoplankton. Zooplankton are generally animal-like, whereas phytoplankton are plant-like. Phytoplankton are typically referred to as algae.

Six main types of algae occur in the Red River: Blue-green algae (Cyanobacteria)[5], green algae (Chlorophyta), diatoms (Bacillariophyta), euglena (Euglenophyta), silicoflagellates (Chrysophyta), and Crypotophyta (Tetr*ES* 2001). A 1999 study conducted by Tetr*ES* Consultants Inc. reported that by volume, the Red River's algae populations consist of ~48% green algae, ~42% diatoms, ~8% blue-green algae, and ~2% Cryptophyta. All other algae and zooplankton make up less than 1% of the volume of plankton in the Red River. The above percentages are based on measurements taken through the summer and fall of 1999 (Tetr*ES* 2001).

Each species of algae has a period of accelerated growth or "bloom" season in which the population booms, then dwindles as another species increases. Algae species ratios and total amounts of algae are dependent on light penetration, temperature, pH and water chemistry. Therefore, total algae varies seasonally and annually. Any point sample may produce very different ratios and species compositions depending on temporal and physical variables at the time of sampling.

The benthic invertebrate community in the Red River is diverse, with species representing six Phyla: Annelida (segmented worms), Arthropoda (insects and crustaceans), Mollusca (bivalves [clams and mussels: discussed in Section 6.6] and snails), Nematoda (round worms), Cnidaria, and Platyhelminthes (flatworms). Within these phyla, approximately 50 families have been identified to historically occur within the Red River. Attempts have been made to identify seasonal invertebrate population trends and relationships to substrate types, but large variation in the sampling data has precluded any generalizations regarding invertebrate populations in the Red River for any given location, substrate type or season (Appendix 6-F).

Lower trophic levels and aquatic invertebrate sampling has not occurred in the Floodway Channel or ditches and drainage channels associated with the West Dyke. Given the above-noted observed variability in the benthic invertebrate communities of the Red River, it is anticipated that the lower trophic levels and invertebrate community in the Floodway Channel will also be highly variable, especially given the intermittent inundation of both floodwaters and elevated water levels from rainfall runoff events (i.e., discharge from drains and the Seine River Syphon overflow). As with the Red River, it is unlikely that a sampling program would yield sufficient information to support a predictive model regarding lower trophic level and/or invertebrate community dynamics. The lower trophic level and invertebrate community dynamics are therefore anticipated to be highly variable.

6.5.3 Effects and Mitigation

Project construction effects on lower trophic levels of aquatic life (i.e., phytoplankton, free-floating/attached algae and zooplankton) and other aquatic invertebrates in the Floodway Channel and Red River are anticipated to be related to effects of the initial excavation-related construction activities and to subsequent potential increased suspended sediments arising from construction related runoff and riprap deposition. The anticipated effect of the Project construction due to the inherent intra- and inter-

[5] While it is common practice to include blue-green algae in algae counts, this species is in the Kingdom Monera, which includes all bacteria, while all the other algae mentioned are from the Kingdom Protista.

annual variability of the communities involved can not be defined. It is likely, however, that this effect will be small, and site specific in nature.

6.5.3.1 Pre-Construction

No EIS specific field studies were conducted with respect to characterization of the aquatic lower trophic or invertebrate communities; therefore no resulting effects on these environmental components occurred. No other Pre-construction activities that could affect these communities occurred. **Pre-construction activities were not anticipated to have any effects**.

6.5.3.2 Construction

6.5.3.2.1 Lower Trophic Levels (phytoplankton, algae and zooplankton)

West Dyke

Site preparation and construction activities associated with the West Dyke primarily occur in association with the agriculturally dominated terrestrial communities in the local area. Some sediment discharge to local area drains and ditches, and potentially into intermittent and permanent aquatic communities, is possible. This discharge is anticipated to be well within the range of existing discharges associated with the extensively cultivated agricultural lands of the area. Potential effects on the lower trophic community associated with these potential changes in water quality are generally anticipated to be limited to the Project site and to be controlled with the application of Best Management Practices, and the EPP which will outline standard sediment and erosion control protocols.

Impacts to lower trophic communities are anticipated to be neutral to adverse, small, short-term and limited to the Project site.

Floodway Inlet Control Structure

Anticipated activities will occur above the typical Red River shoreline; therefore no alterations of aquatic lower trophic communities are anticipated.

Project construction activities associated with the Floodway Inlet Control Structure are not anticipated to have any effect on lower trophic levels.

Floodway Channel

Lower trophic levels of aquatic life may be affected by increased suspended sediment during Project construction. Affected lower trophic levels of aquatic life are expected to repopulate during the seasons following each construction phase, and given the limited retention within the Floodway Channel, should reflect the upstream source (Red and Seine Rivers and drains) community dynamics.

The aquatic lower trophic community in the Floodway Channel is generally composed of the relatively permanent wetted area of the lowflow channel downstream of the Seine River Syphon overflow. It is anticipated that much of this biotic community will be disrupted by the reconstruction of the lowflow channel and the subsequent riprapping of this area to prevent future scouring and erosion.

Much of this community, however, is free floating and is influenced by the source waters from the Red River, Seine River and area drains. The changes to the Low Flow Channel substrate should not affect these species (Death 2003).

It is anticipated that the effect to the lower trophic levels during construction in the Floodway Channel will be small, short-term, and restricted to the Project site.

Floodway Outlet Structure

The Floodway Outlet Control Structure construction is not anticipated to have any effect on the lower trophic levels.

Red River

Potential construction effects on the Red River lower trophic community are anticipated to be related to potential changes to the surface water quality, as evaluated in Section 6.3. Other activities in the region could affect lower trophic level community dynamics if water quality is altered. If these activities occur during the Project construction, cumulative effects are possible. In particular, activities that could affect suspended sediment, could have compounding effects on lower trophic levels, should the combined effort result in sediment levels that exceed natural variation. This scenario is not likely to occur, and with appropriate mitigation, sediment levels should be able to be kept within natural variation.

The use of nutrients to assist the re-establishment of vegetation after construction is discussed in Section 6.3. Changes in nutrient levels in the Red River will not be significant; therefore subsequent changes in the phytoplankton community will be small, short-term and not significant.

It is anticipated that any construction-related effects to the lower trophic community oin the Red River, will be within the range of baseline variability and no adverse effects on the community will occur.

6.5.3.2.2 Aquatic Invertebrates

The effects of construction on other aquatic invertebrates in the Floodway, Red River and drainage ditches/channels adjacent to the West Dyke are expected to be negative, small, short-term (within West Dyke drainage ditches/channels) and site-specific. It is not likely that any long-term changes that occur as a result of the altered Low Flow Channel substrate will be adverse.

West Dyke

Aquatic invertebrate communities that exist in the drainage ditches and channels adjacent to the West Dyke are expected to be disrupted during the construction stages of the expansion and modification of the West Dyke. Use of appropriate sediment control mitigation measures (e.g., sediment screens) will minimize sediment input into drainage channels that occur adjacent to the West Dyke, thereby minimizing potential harm to aquatic invertebrates due to increased suspended sediment loads.

It is anticipated that the Project could have a small, site-specific, short-term effect on West Dyke aquatic invertebrate communities.

Floodway Inlet Control Structure

Project construction is not anticipated to result in any changes to aquatic invertebrate community dynamics at the Inlet Control Structure.

Floodway Channel and Crossings

The recontouring of the Low Flow Channel and related deposition of riprap in erosion-prone areas, and the increased suspended sediment related to construction activities within and adjacent to the Floodway Channel are the primary sources of potential construction effects to aquatic invertebrates. Aquatic invertebrate populations, particularly soft-substrate dwelling benthic invertebrates, will be disrupted during riprap placement activities. There is expected to be a shift in the soft-substrate dwelling invertebrate community to one that is composed more of a mixture of hard-substrate and soft-substrate dwelling invertebrate communities.

Project construction is anticipated to have a moderate, site-specific, long-term effect on the aquatic invertebrate community of the Low Flow Channel. The nature of this effect is unlikely to be adverse.

Floodway Outlet Structure

The construction of the Floodway Outlet Structure will disrupt the existing aquatic invertebrate communities, particularly between the outlet downstream to the Red River. The widening of this area as a result of the Project (i.e., expanded Outlet Structure) is anticipated to result in the re-establishment of this community over a larger area.

Project construction effects on aquatic invertebrates in the vicinity of the Floodway Outlet Structure are anticipated to be site-specific, small, and long-term. The nature of this effect is unlikely to be adverse.

Red River

Within the Red River where riprap will be deposited, a site-specific shift in invertebrate communities is expected. However, the time required for the re-establishment of invertebrate communities in the Red River is expected to be less than for the Floodway Channel due to the higher natural suspended sediment load in the Red River (that would be deposited within riprap crevices) and the greater opportunity for invertebrate re-colonization from adjacent unaffected areas in the Red River.

The Project erosion control measures (primarily riprap) proposed for the banks of the Red River downstream of the Floodway Outlet Structure are anticipated to result in the disruption of up to 1.3 km of benthic-based lower trophic community. It is predicted that a modified lower trophic community will colonize the harder riprap substrate.

The overall Project construction effects to aquatic invertebrates in the Red River are anticipated to be small, local and long-term. The effect may be either adverse or positive, but given it's small and local nature, it is unlikely to be significant.

6.5.3.3 Operation - Inactive

Aquatic invertebrate populations are expected to recover from the disruption resulting from construction activities (i.e., riprap deposition and increased suspended sediments) following the construction phase when the Expanded Floodway is inactive. During the post-construction period, soft clay/silt bottom substrate is expected to be deposited or re-established within riprap cervices. This will occur after the Expanded Floodway is operated, thereby allowing increased sediment loads to be transported and deposited into the Floodway Channel. The aquatic invertebrate community within the Floodway Low Flow Channel where riprap will be deposited is expected to shift towards a combination of hard substrate and soft substrate-dwelling invertebrate communities (in contrast to the mostly soft substrate-dwelling community of the Existing Floodway Low Flow Channel).

As indicated in Section 6.4.3.2, aquatic vegetation (which many aquatic invertebrates require) is expected to re-establish itself in a foundation created by any natural deposition of in-stream sediments into the riprap. At least one year of Floodway operation will be required to provide some sediment deposition within riprap crevices to allow aquatic vegetation to become re-established in the Floodway Lowflow Channel.

The habitat-based effects described as a result of construction activities are anticipated to persist in the long term during "operations-inactive". The inherent instability of the lower trophic levels and invertebrate communities associated with the Existing Floodway are also expected to continue. **The Project is anticipated to result in an effect on these communities, The effect may be either adverse or positive, but given its small and local nature, it is unlikely to be significant**.

The dynamic nature inherent to the Floodway Channel's invertebrate community will not be altered by the Project. **The effect may be either adverse or positive, but given its small and local nature, it is unlikely to be significant**.

Ongoing and future aquatic invertebrate habitat modifications associated with shoreline stabilization on the Red and Assiniboine Rivers could cause a cumulative effect with the Project, particularly with respect to the portion of the Red River downstream of the Floodway Outlet that will be riprapped. **The effect may be either adverse or positive, but given its small and local nature, it is unlikely to be significant**.

6.5.3.4 Operative - Active

Aquatic Invertebrate communities and lower trophic level communities in the Red River and Expanded Floodway Channel are not expected to change during the active operation of the Expanded Floodway compared to the Existing Floodway. **Therefore, no Project Operation-active effects to those communities are anticipated.**

6.5.4 Residual Effects and Significance

The construction of the Project is anticipated to result in changes to the aquatic lower trophic and invertebrate communities (as summarized in Table 6.5-1) primarily as a result of habitat changes. Potential effects to the aquatic lower trophic communities are associated with construction-related activities and are anticipated to be within the range of natural variability. Potential Project effect on the aquatic invertebrate community will be long-term due to the fundamental changes in aquatic habitat from riprapping activities. While it is uncertain whether these changes will be positive or adverse, it is not likely that significant adverse impacts to the area's invertebrate communities will result.

The Project is not anticipated to have any significant adverse effects to lower trophic level and aquatic invertebrate communities.

6.5.5 Monitoring and Follow-Up

The demonstrated high variability in the area's aquatic lower trophic and invertebrate communities is anticipated to impair any monitoring program's ability to distinguish Project–related effects from the natural state. It is unlikely that monitoring will yield useful information to further define the Project's effects.

Table 6.5-1
Summary of Residual Effects and Signifance on Lower Trophic Levels and Aquatic Invertebrates

DESCRIPTION OF EFFECT	MITIGATION	RESIDUAL EFFECTS AND SIGNIFICANCE[(a)]
CONSTRUCTION		
Lower Trophic Levels (phytoplankton, algae and zooplankton)		
There is the potential for increased sediment particulates to be harmful to some lower trophic levels.	None: Populations of lower trophic levels are expected to repopulate the aquatic environment shortly after disturbance from increased suspended sediment due to construction activities.	Small, short-term, site-specific to local, negative effect **Not Significant**
Riprap substrate will provide increased habitat for attached algae, thereby increasing attached algae presence in the Floodway. No measurable effect is expected regarding the effect of riprap deposition to other lower trophic organisms.	None	Moderate, long-term, site-specific positive effect to attached algae, but neutral effect to other lower trophic level organisms **Overall: Not Significant**
Other Aquatic Invertebrates (e.g., aquatic insects/benthic invertebrates)		
Disruption of some aquatic invertebrate habitat and death of some aquatic invertebrates is expected at excavation sites.	None	Small to moderate, short-term, site-specific to local negative effect **Not Significant**
There is potential for increased sediment particulates to be harmful to aquatic invertebrates.	Appropriate sediment control measures will be implemented to minimize increased sediment transfer downstream	Small, short-term, site-specific negative effect **Not Significant**
Alteration of bottom substrate at erosion-prone areas of the Floodway will result in a site-specific change in the benthic invertebrate community.	None	Small, long-term, site-specific neutral effect **Not Significant**
Alteration of bottom substrate of the Red River downstream of the Outlet Structure.	None	Small, long-term, site-specific neutral effect **Not Significant**
OPERATION (INACTIVE)		
Lower Trophic Levels (phytoplankton, algae and zooplankton)		
None expected.		
Other Aquatic Invertebrates (e.g., aquatic insects/benthic invertebrates)		
None expected.		
OPERATION (ACTIVE)		
Lower Trophic Levels (phytoplankton, algae and zooplankton)		
No overall measurable effect expected.		
Other Aquatic Invertebrates (e.g., aquatic insects/benthic invertebrates)		
There is the potential for some aquatic invertebrates to be moved into (and out of) the Floodway Channel and be displaced by high velocity/flow waters during Floodway operation. This is an existing effect of Floodway operations that is not	None	**No substantive change from existing conditions**

DESCRIPTION OF EFFECT	MITIGATION	RESIDUAL EFFECTS AND SIGNIFICANCE[(a)]
expected to change as a result of the expansion of the Floodway Channel.		
There is the potential for the introduction of increased numbers of predatory species (e.g., fish, other invertebrates) that feed on aquatic invertebrates in the Floodway Channel	None	**No substantive change from existing conditions**

6.6 FISH AND CLAM POPULATIONS

6.6.1 Approach and Methodology

6.6.1.1 Effects Assessment

The environmental assessment of the Project's effect on fish and clam populations was primarily based on the results of historical and field studies of local fish and clam populations and was applied to the anticipated alteration of fish and clam habitat as described in Section 6.4. The general assessment approach is described in Chapter 2.

6.6.1.2 Sources of Effect

The primary source of potential effects of the Project on fish and clam populations are the anticipated alteration of habitat (as discussed in Section 6.4) and the potential effects on fish movement dynamics.

6.6.2 Existing Environment

Historical records indicate the Red River is home to 57 native species of fish, and 9 introduced species, for a total of 66 fish species, of which 18 species are commonly caught by anglers in the Red River (Stewart 2004; Stewart and Watkinson 2004; Appendices 6C and 6E).

The most commonly caught species depend on the type of gear used (i.e., angling, gillnets, hoopnets, electrofishing), the location, and the time of year, and include: goldeye, channel catfish, white sucker, sauger, carp, freshwater drum, golden redhorse, silver redhorse, shorthead redhorse, Mooneye, Northern Pike, Quillback, Stonecat, Rock Bass, Walleye, Bigmouth Buffalo, Black Crappie, brown bullhead, black bullhead, burbot, lake cisco and Silver chubb (Remnant *et al.* 2000).

Approximately 32 species of freshwater clams and mussels (bivalves) occur or potentially occur in the Red River, of which 23 species are considered common. Bivalve species include 12 in the Family Unionida and 20 in the Family Sphaeridae (Appendices 6C and 6E). No threatened or **endangered** species occur in the area disrupted by the Project.

Fish and clam species **diversity** and population sizes are generally linked to the available habitat. Suitable habitat differs for each fish species or community and is dependent on physical features such as stream gradient, substrate type, vegetation cover, water depth and velocity; the chemical composition of

the water; and the existing invertebrate community. However, historical surveys have produced such variable results that no statistically significant conclusions can be drawn to estimate fish populations reliably in the Red River (Appendix 6F).

Aquatic fish and clam field studies at the Floodway Inlet Control Structure included the following activities:

- helicopter overflight and photography, September, 2003;
- site visits and photography and limited flow/velocity measurement and estimation in September to December, (2003), and February, April and May, (2004);
- attempted deployment of acoustic tags on Red River fish species in October/November, 2003; and
- deployment of the DIDSON acoustic dual frequency sonar camera[6] at the Floodway Inlet Control Structure in late April/May 2004.

The results of the field surveys are provided in Appendix 6D and provide support for the assessment. In particular, the fall fish community surveys of the Low Flow Channel confirmed its utilization as a habitat for at least eight species of fish. Subsequent surveys conducted in mid-winter found evidence of substantive winter-kill of the Low Flow Channel fish community. Details are provided in Appendix 6D.

An underwater sonar imaging camera was utilized to verify and characterize fish movement through the Existing Floodway Inlet Control Structure. While the existing structure may be an impairment to fish movement during some river flow conditions, i.e., during inactive operations (the characteristics of the existing environment will be explored further in Supplemental Documentation), the Project will not alter this characteristic of the existing environment. It is not anticipated that the Project will change the operation of the Inlet Control Structure; any change in the use of this structure could have ecosystem effects on fish movements, and potentially on fish populations. The sonar camera investigations conducted in April/May 2004 are currently being analyzed and results will be provided in Supplemental Documentation, which will provide further details on fish movement through the Inlet Control Structure.

6.6.3 Effects and Mitigation

As indicated in Section 6.2.4, effects to the aquatic habitat (and therefore fish movements and populations) during Project construction are anticipated to be limited to the Floodway Channel with some site-specific effects in the Red River, particularly along the east shoreline at the Floodway Outlet expansion site. Project construction an operation effects to fish movements and populations are summarized in Table 6.6-1.

6.6.3.1 Pre-Construction

The methodologies utilized were primarily observational in nature and resulted in virtually no effects on the environment. For the Floodway Channel and crossings, aquatic community surveys conducted in the

[6] The DIDSON acoustic camera provided video-quality underwater images of fish presence and movements and is described in more detail in Supplemental Documentation.

spring 2004 were primarily observational in nature, although some live capture methods (i.e., seining) were incorporated. Any incidental post-release fish mortality that may have occurred is anticipated to be limited and would not result in a significant adverse effect on the aquatic community. The attempted deployment of acoustic tags in the late fall of 2003 may have resulted in some mortality of the fish captured. Live capture methods were also utilized to evaluate the Low Flow Channel fish communities and may have resulted in some post-release mortality. This potential mortality was limited and does not present a significant adverse effect.

For the Red River, live capture techniques were utilized to provide site-specific information and to supplement the historic dataset regarding fish populations in the area. It is not anticipated that any pre-construction activities had a substantive effect on fish or clam populations. Population field studies utilized non-evasive observational techniques (aerial and land-based habitat surveys, water-quality data, direct observation and live-capture/release methods and conventional/dual frequency imaging sonar) to characterize fish utilization and movements. The mid-winter installation of a plywood weir in the Low Flow Channel associated with the groundwater studies is not expected to have had a substantive effect on fish habitat and a minimal effect on fish movements.

Project pre-construction effects to fish and clams are anticipated to be very small, site-specific, short-term and neutral to adverse in nature.

6.6.3.2 Construction

Project construction effects to fish movements and populations are summarized in Table 6.6-1.

Table 6.6-1
Potential Effects of Construction on Fish and Clam Populations

DESCRIPTION OF EFFECT	MITIGATION	RESIDUAL EFFECTS
CONSTRUCTION		
Walleye[(b)]		
Physical disruption and sediment contamination of some potential and known spawning habitat/sites along cobble/gravel shoreline of the Red River and potential for increased sediment particulates to be harmful to walleye, particularly the eggs and fry (walleye spawning period: April – late May)	Excavation activities will be limited to as small an area as possible along the cobble/gravel shoreline of the Red River	Small, short-term, site-specific negative effect
Disruption of a limited amount of potential **foraging** habitat along/adjacent to the Red River shoreline.	None: alternate foraging habitat occurs in surrounding habitat not affected by construction activities	Small, short-term, site-specific negative effect
Red River: alteration of a limited extent of silt/clay shoreline as a result of riprap deposition	A fish habitat compensation plan will be developed to satisfy the Department of Fisheries and Ocean's requirements for no net loss of fish habitat	No significant effect after fish habitat compensation
Channel Catfish [(b)]		
Disruption of a limited amount of channel catfish habitat due to excavation activities along/adjacent to shorelines.	None: alternate channel catfish habitat occurs in surrounding habitat not affected by construction activities	Small, short-term, site-specific negative effect
Potential for increased sediment particulates to be harmful to channel catfish, particularly the eggs and fry (spawning period = late June to early July)	Sediment screens will be placed immediately downstream of excavation sites to minimize increased sediment transfer downstream	Small, short-term, site-specific negative effect

DESCRIPTION OF EFFECT	MITIGATION	RESIDUAL EFFECTS
Red River: alteration of a limited extent of silt/clay shoreline is not expected to measurably affect channel catfish populations	A fish habitat compensation plan will be developed to satisfy the Department of Fisheries and Ocean's requirements for no net loss of fish habitat	No significant effect after fish habitat compensation
Northern Pike		
Disruption of some northern pike habitat due to excavation activities along/adjacent to shorelines.	None: alternate northern pike habitat occurs in surrounding habitat not affected by construction activities	Small, short-term, site-specific negative effect Not Significant
Potential for increased sediment particulates to be harmful to northern pike, particularly the eggs and fry (spawning: April – May)	Sediment screens will be placed immediately downstream of excavation sites to minimize increased sediment transfer downstream	Small, short-term, site-specific negative effect
Red River: alteration of a limited extent of silt/clay shoreline is not expected to measurably affect Northern pike populations	A fish habitat compensation plan will be developed to satisfy the Department of Fisheries and Ocean's requirements for no net loss of fish habitat	No significant effect after fish habitat compensation
Small Forage/Bait Fish		
Disruption of some small forage/bait fish habitat due to excavation activities along/adjacent to shorelines.	None: alternate small forage/bait habitat occurs in surrounding habitat not affected by construction activities	Small, short-term, site-specific negative effect
Potential for increased sediment particulates to be harmful to small forage/bait fish, particularly the eggs and fry	Sediment screens will be placed immediately downstream of excavation sites to minimize increased sediment transfer downstream	Small, short-term, site-specific negative effect
Red River: alteration of a limited extent of silt/clay shoreline is not expected to measurably affect small fish populations	A fish habitat compensation plan will be developed to satisfy the Department of Fisheries and Ocean's requirements for "no net loss" of fish habitat	No significant effect after fish habitat compensation

[a] Assessment of effects after implementation of proposed mitigation measures

[b] Occurs within the Red River and its tributaries, and may occur within the Floodway Channel

[c] Included in the *Fisheries Act* definition of "fish"

[d] Fingernail clam shells were observed along the gravel shoreline of the Floodway Channel near the outlet area in late September, 2003. During May 2004, after the operation of the Floodway, fingernail clams and giant floater mussels (live and shells) were observed within 1 km of the Floodway Outlet in the Low Flow Channel and along the Low Flow Channel shoreline (shells only)

West Dyke

It is not anticipated that the Project construction activities will have a direct effect on fish populations along the West Dyke. Some indirect effects may be associated with disruption of drainage channels in the area, but substantial changes in fish and clam populations are not anticipated.

Construction-related impacts to fish and clams in drainage channels and ditches adjacent to the West Dyke are anticipated to be neutral, site-specific and local, and short-term.

Floodway Inlet Control Structure

While the Existing Floodway Inlet Control Structure may be affecting fish movements in the Red River (to be further explored in supplemental documentation), the proposed Project-related construction changes to the Floodway Inlet Control Structure are not anticipated to alter fish/clam habitats (as discussed in Section 6.4) or fish populations. **No Project-related construction effects on fish and clam populations are anticipated**.

Floodway Channel

The fish and clam populations of the Floodway Channel are anticipated to be variable and dynamic in response to the intermittent changes in water levels and ongoing introduction of fish and clams from upstream sources. The Project's construction activity is anticipated to have a direct effect on the fish and clam habitat of the Floodway Channel, and in particular, the more permanently wetted area in and near the Low Flow Channel, as discussed further in Section 6.4.

The field studies have demonstrated that the Low Flow Channel is used by a number of fish species, and likely a number of clam species (Appendix 6D). The field studies also observed substantive winter kill of fish communities during the winter of 2003/2004 (Appendix 6E). Given the highly variable water levels in the Low Flow Channel (due to intermittent Floodway use and summer rainstorm events) and the observed winter kill of fish population, this channel is poor fish habitat and potentially a population sink.

The Project-related habitat alterations (described in Section 5.5, Figure 5.5-5) are anticipated to result in a general replacement of the current series of scoured soft-bottom ponds with a continuous grade, riprap or harder-bottomed, channel. While it is anticipated that the resident fish community in the Low Flow Channel will reflect the changes in habitat that occur during construction, these habitat alterations should also discourage fish from remaining in the Channel for extended periods of time and result in enhanced fish movements downstream to the Red River. This should result in a reduction in the magnitude or frequency of winter fish kills in the Low Flow Channel. The construction activity may also result in some short-term, localized disruption of fish and clam populations related to specific activities like dewatering (i.e., for bridge foundations) or erosion/sedimentation control.

Upon completion of the construction activity, it is anticipated that the revegetated Floodway Channel characteristics will be similar to the existing situation and that the modified Low Flow Channel, while supporting an altered fish community, will reduce the harmful effects related to existing winter fish kills.

The Project will therefore result in a potentially altered fish community, as a reflection of the altered habitat, but this alteration is anticipated to have no harmful effects, and may reduce the harmful effect of the existing Low Flow Channel configuration. The Project's proposed Channel construction activity is therefore not anticipated to result in a harmful alteration, disruption or destruction of fish habitat, as reflected by the effects on the fish communities that are anticipated to use that habitat.

It is anticipated that the effects of Project construction on the fish communities of the Floodway Channel will be site-specific and short-term. In the case of specific construction activities, a small adverse effect on local fish communities in site-specific locations of the Floodway Low Flow Channel may occur. In the case of the Low Flow Channel as a whole, the effect is anticipated to be neutral, reflecting a balance between the potentially altered fish community and the reduction in the potential for harmful winter kill occurrences.

No significant adverse effects on fish and clam populations are anticipated with respect to Floodway Channel and crossing construction.

Floodway Outlet Structure

The expansion of the Floodway Outlet Structure should result in a small increased area of potential fish/clam habitat downstream to the Red River. The structure itself, once constructed, is not anticipated to affect fish habitat. Fish passage from the Floodway Low Flow Channel to the Red River is anticipated to be similar to the existing structure.

The fish/clam population effects of the Floodway Outlet Structure construction are anticipated to be neutral to small, site-specific, short-term and be positive in nature once construction is completed.

Red River

Fish and clam populations in the area downstream of the Floodway Outlet Structure in the Red River may be influenced by two identified factors: suspended sediment discharge from the Low Flow Channel and bank stabilization/erosion protection measures on the Red River. The magnitude of these factors is described in Chapter 5. The effect of these habitat changes on the fish and clam populations is unpredictable, primarily due to a lack of correlation between fish habitat use and substrate type in the historical dataset (Appendix 6F).

Chapter 5 and Section 6.3 note that anticipated changes to water quality, and sediment levels in particular, are not anticipated to be distinguishable from the Red River's background variation. It is assumed that the existing fish and clam community is adapted to this background variation, and will be unaffected by any changes to water quality as a result of the Project.
The direct habitat alteration resulting from the proposed erosion protection and bank stabilization measures could result in an altered fish community, and the loss of any local clam beds (particularly if measures involve riprapping or vegetation-based shoreline stabilization methods are used). Utilizing the existing dataset, the nature of the potential alteration of the fish community cannot be predicted, since the historical studies suggest that there are no statistically-significant differences in Red River fish community dynamics between soft and hard-bottomed substrates (Appendix 6F).

The available fish community studies suggest that the effect on fish populations will be neutral since the historic dataset does not indicate that fish community dynamics are primarily driven by substrate type on the Red River. However, clam communities in the area will be reduced, since the clams will not be able to utilize the hard riprapped substrates for burrowing during their winter dormancy. This aspect of the Project may represent a harmful alteration of habitat, and may require application of fish habitat compensation methods to achieve "no net loss" of habitat, in order to comply with federal goals and objectives.

Approximately 1.2 km of Red River shoreline could be disrupted by erosion control and shoreline stabilization activities. The detailed design of these activities is not available, and will require further refinement before construction. The degree of fish habitat compensation to balance any harmful effects

will depend upon the shoreline stabilization methods selected. This issue will need to be expounded in supplemental documentation, once the final design is available, to ensure adequate application of "no net loss" principles.

With the application of mitigation measures (i.e., "no net loss" habitat compensation) no adverse effects on fish/clam populations are likely from construction of the Project.

6.6.3.3 Operation – Inactive

West Dyke

A revegetated West Dyke will have no further effect on fish or clam communities. **No effects on fish or clam populations are anticipated**.

Floodway Inlet Control Structure

The Floodway Inlet Control Structure modifications are not anticipated to alter the fish passage currently associated with this feature of the Existing Floodway. **No Project effects on fish or clam populations are anticipated**.

Floodway Channel and Outlet Structure

The Channel and Outlet Structure will function similarly to the existing structures, with the exception of an anticipated reduced frequency of fish stranding and winter fish kill in the Floodway Low Flow Channel. The broader base of the Floodway may also increase the potential wetted area during rainstorm-triggered overflows from the Seine River Syphon overflow structure and area drains. While this is anticipated to be an important source for the replenishment of fish/clam populations in the Floodway Channel, the Project is not anticipated to result in any substantive changes to these populations.

No Project-related effects to fish/clam populations are anticipated.

There will be a small change in fish habitat as a result of the Project (Section 6.4.3); however, this local effect is not anticipated to result in any substantial effects on fish populations in the Red River. The potential effect on clam populations will be site-specific, but given the abundance of soft substrates in the Red River, it is not likely to be significant.

With the application of "no net loss" fish habitat compensation, no adverse effects are anticipated.

Red River

Construction-initiated changes in the fish and clam community the Red River downstream of the Floodway Outlet Structure will persist over time. Mitigative measures to ensure "no net loss" will also persist, so no net effects are anticipated.

The Project's alteration of fish/clam habitat in the Red River may act in a cumulative fashion with any other in-river activity, like shoreline stabilization or infrastructure activities. With the application of the "no net loss" principle, any cumulative effects should not be adverse.

Project operations-inactive are anticipated to be neutral to small, and site-specific to local in nature.

6.6.3.4 Operation – Active

Project Operation-Active effects fish movements and populations are summarized in Table 6.6-2.

Table 6.6-2
Potential Effects of Operations-Active on Fish and Clam Populations

DESCRIPTION OF EFFECT	MITIGATION	RESIDUAL EFFECTS
OPERATION (ACTIVE)		
Walleye[b]		
Potential introduction of Walleye into the Floodway Channel (considered sub optimal habitat) during Floodway operation is an existing effect of Floodway operations that is not expected to change as a result of the expansion of the Floodway Channel.	Although fish will be diverted into the Expanded Floodway as they are under existing operation conditions, alterations to the Floodway Low Flow Channel (removal of deeper water pockets/traps) and Outlet Structure (efficient culvert placement) are expected to reduce the incidence of fish stranding in the Floodway.	No change from Existing Condition.
Channel Catfish [b]		
Potential introduction of channel catfish into the Floodway Channel (considered sub optimal habitat) during Floodway operation is an existing effect of Floodway operations that is not expected to change as a result of the expansion of the Floodway Channel.	Although fish will be diverted into the Expanded Floodway as they are under existing operation conditions, alterations to the Floodway Low Flow Channel (removal of deeper water pockets/traps) and Outlet Structure (efficient culvert placement) are expected to reduce the incidence of fish stranding in the Floodway.	No change from Existing Condition.
Northern Pike		
Potential introduction of Northern pike into the Floodway Channel (considered sub optimal habitat) during Floodway operation is an existing effect of Floodway operations that is not expected to change as a result of the expansion of the Floodway Channel.	Although fish will be diverted into the Expanded Floodway as they are under existing operation conditions, alterations to the Floodway Low Flow Channel (removal of deeper water pockets/traps) and Outlet Structure (efficient culvert placement) are expected to reduce the incidence of fish stranding in the Floodway.	No change from Existing Condition.
Small Forage/Bait Fish		
Potential introduction of small forage/bait fish into the Floodway Channel (considered sub optimal habitat) during Floodway operation is an existing effect of Floodway operations that is not expected to change as a result of the expansion of the Floodway Channel.	Although fish will be diverted into the Expanded Floodway as they are under existing operation conditions, alterations to the Floodway Low Flow Channel (removal of deeper water pockets/traps) and Outlet Structure (efficient culvert placement) are expected to reduce the incidence of fish stranding in the Floodway.	No change from Existing Condition.

[a] Assessment of effects after implementation of proposed mitigation measures

[b] Occurs within the Red River and its tributaries, and may occur within the Floodway Channel

[c] Included in the *Fisheries Act* definition of "fish"

[d] Fingernail clam shells were observed along the gravel shoreline of the Floodway Channel near the outlet area in late September, 2003. During May 2004, after the operation of the Floodway, fingernail clams and giant floater mussels (live and shells) were observed within 1 km of the Floodway Outlet in the Low Flow Channel and along the Low Flow Channel shoreline (shells only)

West Dyke

No Project-related alterations to fish and clam populations are anticipated during Floodway operations-active.

Floodway Inlet Control Structure

Project-related modifications to the Floodway Inlet Control Structure are not anticipated to alter fish/clam habitat movements or populations. **No Project-related effects are anticipated**.

The Project may have a cumulative effect on fish and clam populations, primarily as a result of habitat modifications as assessed in Section 6.4.3.5.

There is the potential for a change in operations, i.e., more frequent summer operations of the Floodway Inlet Control Structure (which could hypothetically start in 2009 once construction is completed). The Floodway Channel is expected to experience an increased wetted area more frequently, on average, over what occurs under the present operating regime. The intermittently flooded terrestrial habitat may be used by some fish and clam species, but no substantive ecosystem changes are anticipated.

Modifications to the summer operations of the Floodway Inlet Control Structure Operations could affect fish movements in the Red River. These potential operational changes will involve utilization of the Floodway to control small flood events (i.e., summer operation to control high summer flows). These potential operational changes, however, do not require an Expanded Floodway and are independent of the Project. If these operation changes are implemented, there would be similar ecological effects on fish populations regardless of whether the Project proceeded or not.

Changes in the Existing Floodway operating rules could have substantive ecosystem level effects as a result of impaired fish movement through the Floodway Inlet Control Structure and will require careful evaluation. Manitoba has indicated that increased summer operation will be considered (except under emergency conditions), but only after construction of the Project is completed and MFEA has committed to undertaking the appropriate fisheries studies, together with the regulatory agencies, to better understand the effects of summer operations. This issue with respect to fish movements, is explored further in supplemental documentation.

Floodway Channel and Outlet Structure

Regarding downstream movements of fish in the Red River during Floodway operation, the Floodway Channel has the potential to act as a diversion channel when the Floodway Inlet Control Structure is in use: fish diverted from the Red River into the Floodway have the opportunity to exit the Floodway and re-enter the Red River approximately 47 km downstream at Lockport by passing over the Outlet structure (during Floodway operation conditions) or through the two Outlet Structure culverts. This is similar to the Existing Floodway, **so no supplemental cumulative effects are anticipated**.

Red River

The Project is anticipated to have no further effect on Red River fish and clam populations, other than that already assessed as a component of construction. Operational utilization of the Expanded Floodway is anticipated to affect fish and clam populations in the Red River to a similar degree as the Existing Floodway.

The cumulative aquatic habitat effects discussed in Section 6.4.3.5 may also result in minor changes to regional fish and clam populations. Historical studies conducted on the Red and Assiniboine Rivers, however, do not suggest that substrate is a primary factor affecting aquatic community dynamics. Cumulative effects on the fish and clam populations are therefore uncertain, but not likely to be significant.

In summary, effects of Expanded Floodway operation on fish and clam populations in the Red River are expected to be positive (in terms of minimizing over-land flooding), short-term and local.

6.6.4 Residual Effects and Significance

Residual effects on fish and clam populations are summarized in Table 6.6-3. With the application of the regulatory "no net loss" policy regarding fish and clam habitat, it is anticipated that minimal residual effects on fish and clam populations will occur.

The Project is not anticipated to have any significant adverse effects on fish and clam populations.

Table 6.6-3
Summary of Residual Effects and Significance on Fish and Clam Populations

DESCRIPTION OF EFFECT	MITIGATION	RESIDUAL EFFECTS AND SIGNIFICANCE[a]
Other Fish		
Disruption of some fish habitat due to excavation activities along/adjacent to shorelines.	None: alternate fish habitat occurs in surrounding habitat not affected by construction activities.	Small, short-term, site-specific negative effect Not Significant
Potential for increased sediment particulates to be harmful to fish, particularly the eggs and fry	Sediment screens will be placed immediately downstream of excavation sites to minimize increased sediment transfer downstream.	Small, short-term, site-specific negative effect Not Significant
Red River: alteration of a limited extent of silt/clay shoreline is not expected to measurably affect other fish populations	A fish habitat compensation plan will be developed to satisfy the Department of Fisheries and Ocean's requirements for no net loss of fish habitat.	No significant effect after fish habitat compensation
Clams/Mussels[c]		
Disruption of some clam/mussels habitat and death of some clams/mussels that may occur at the excavation sites [d] due to excavation activities along/adjacent to shorelines.	None.	Small to moderate, short-term, site-specific to local negative effect Not Significant
Red River: alteration of a limited extent of silt/clay shoreline is not expected to measurably affect clam/mussel and snail populations	A fish habitat compensation plan will be developed to satisfy the Department of Fisheries and Ocean's requirements for no net loss of fish habitat (clams and molluscs are considered 'fish' under the *Fisheries Act*).	No significant effect after fish habitat compensation

[a] Assessment of effects after implementation of proposed preliminary mitigation measure

[b] Occurs within the Red River and its tributaries, and may occur within the Floodway Channel

[c] Included in the *Fisheries Act* definition of "fish"

[d] Fingernail clam shells were observed along the gravel shoreline of the Floodway Channel near the outlet area in late September, 2003. During May 2004, after the operation of the Floodway, fingernail clams and giant floater mussels (live and shells) were observed within 1 km of the Floodway Outlet in the Low Flow Channel and along the Low Flow Channel shoreline (shells only)

6.6.5 Monitoring and Follow-Up

Key monitoring concerning sediment levels in Floodway discharges during construction, as discussed in Chapter 5, and appropriate adaptive management of erosion to ensure avoidance of ecosystem effects on fish and clam populations will need to be implemented.

Potential changes to Floodway Operations (i.e., increased frequency of summer operations) will require careful consideration of potential effects on fish and clam populations in the region, particularly with respect to fish movement upstream through the Inlet Control Structure during both inactive and active operations.

Supplemental documentation will provide the results of the April/May 2004 DIDSON acoustic camera investigations of fish movements through the Existing Floodway Inlet Control Structure and the potential implications of any operational changes.

Manitoba has indicated that increased summer operations is independent of the Project and will be considered only after construction of the Project is completed and MFEA has committed to undertaking the appropriate fisheries studies, together with the regulatory agencies, to better understand the effects of summer operations. This issue is explored further in supplemental documentation.

Supplemental documentation will also detail the proposed shoreline stabilization and erosion control approaches adopted for the Red River (downstream of the Floodway Outlet) after detailed design is completed, the projected adverse effects, and the proposed fish habitat compensation plans to achieve "no net loss". The fish habitat compensation plan supplemental document should also incorporate aspects of the evolving detailed design, such as construction scheduling away from potentially sensitive months of the year and other mitigative actions.

6.7 AQUATIC SPECIES AT RISK

No Federal or Provincial species listed as Endangered or Threatened (i.e., populations and habitat that are protected) are anticipated to occur in the area affected by the Project. Four fish species of special concern (as listed by **SARA**) may occur in the Red River, but are not anticipated to be affected by the Project. Therefore, no effects to the listed aquatic biota in the effected Ecodistricts are anticipated.

No adverse effects on aquatic species at risk are anticipated.