



# Manitoba Floodway Authority

**Red River Floodway Expansion Project  
2009 Construction Surface Water Monitoring Report  
.9905246 NM8  
FINAL REV 0  
March 2010**

**Prepared By**

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**Approved By**

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Principal

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March 30, 2010

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ATTENTION: Ms. Leanne Shewchuk  
Manager of Environmental Services

Re: Red River Floodway Expansion Project  
2009 Construction Surface Water Monitoring Report  
Memo Reference: .9905246 NM8  
Final Report – March 2010

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Dear Ms. Shewchuk:

Please find enclosed twenty (20) paper copies and one (1) electronic copy of the Final Report for the 2009 Construction Surface Water Monitoring of the Red River Floodway Expansion. An electronic copy of each individual Final Monthly Monitoring Report from January to December 2009 is also provided, as supporting documents for the MFA web page.

This annual construction report describes the analysis results for samples collected from the Red River, Floodway Channel and the drains flowing into the Floodway and along the West Dyke during the 2009 construction time period. The data includes the monthly and event-based (Level I) monitoring.

We sincerely appreciate the opportunity to provide ongoing services on this project. If you have any questions regarding this report please contact Ms. Katie Sinclair, or the undersigned.

Yours truly,



Dave MacMillan, P. Eng.  
Principal

KS/dbm/mlb  
Enclosure

## EXECUTIVE SUMMARY

The Red River Floodway Expansion Project Screening Report prepared for Infrastructure Canada concluded that the effects of the project on surface water quality are not likely to be significant provided that the mitigation measures proposed are followed and that a monitoring and follow-up plan for surface water quality is submitted by the Manitoba Floodway Authority. A baseline surface water quality monitoring program was undertaken in the spring – summer of 2005, prior to the start of construction of the Floodway Expansion Project. Additionally a winter baseflow program was conducted in 2005 prior to construction, to monitor the groundwater discharge into the Floodway Channel when there was no surface water contribution. The data obtained during the baseline monitoring program forms the basis for comparison to this 2009 construction monitoring report and all future construction monitoring reports that will be compiled at the end of each construction year. Comparison of the 2009 construction monitoring to baseline data allows the effects of construction to be compared to the applicable compliance criteria and to predictions made in modelling effects.

The surface water quality monitoring program for the 2009 construction year was conducted from January to December 2009 in conjunction with the on-going construction activities. This 2009 construction report outlines the analysis results for samples collected from the Red River at the Inlet and Outlet, 11 locations along the Floodway Channel including the upstream and downstream ends of the construction and revegetation zones, 11 of the outfall drains flowing into the Floodway and 2 drains along the West Dyke. The 2009 construction monitoring data is summarized and compared to the data presented in the baseline surface water monitoring report.

There were twelve (12) monthly monitoring events, with one conducted each month following precipitation events, near the end of the month if a substantial precipitation event had not yet occurred or at the flood peak during the spring Red River flood condition. There were ten (10) Level I event-based monitoring events conducted between May and August, 2009 in response to precipitation levels greater than 10 mm.

On-going construction contracts for the Floodway at the start of January 2009 consisted of Channel Contracts; C-6C (Stn 33+670 – 35+060 west side), C-8B (Stn 40+900 – 50+430 east side), CE1 (Outlet Control Structure), CE2 (Erosion Protection at Red River), I2 (Inlet Control Structure) and I6 (Supply of Hydraulic Cylinders); Bridge Contracts for CPR Keewatin Bridge (T14; Stn 30+220) and CPR Emerson Bridge (T15; Stn 11+200); and West Dyke Contracts for W12 (Stn 19+300 – 23+500), W22 (Stn 19+300 – 23+500), W23 (Stn 33+300 – 35+600), W24 (Stn 35+600 – 23+500), W25 (Stn 2+500 – 4+500) and W26 (Stn 7+600 – 9+950).

Numerous Contracts were also started in 2009 and included T16 (Culvert replacement; Prairie Grove Road over Seine River) and W27 (West Dyke; Stn 23+900 – 25+000) in January; Contract W28 (West Dyke; Stn 40+300 – 43+100) in June; Contracts W19 (West Dyke; Stn 14+600; Glenlea Drain), W29 (West Dyke; Stn 43+100 – 45+380), T17 (PTH Hwy 44 Bridge; Stn 48+050,) and T18 (PTH Hwy 15 Bridge; Stn 25+700,) in July; Contracts S1 (Seine River Syphon), and ED1 (East Dyke; Stn 4+000 – 5 +300 Floodway Channel Stn Extents) in September; Contract W21 (West Dyke; Stn 37+360 – 40+300) in October and Contract W20 (West Dyke; Stn 33+300 – 37+050) in November.

Contracts Completed in 2009 included C6C, C8b, T14, T15, T16, CE1, CE2, ED1, W12, W20, W21, W22, W23, W24, W25, W26, W27, W28, and W29. Details of the construction contracts and activities that occurred during each month are summarized in each of the individual monthly monitoring reports, NM8.1 – January to NM8.12 – December, 2009.

Construction monitoring data for the key water quality parameters of interest, identified and discussed in the baseline surface water monitoring report, were compared to the baseline data under spring flood, non-flood/unfrozen and non-flood/frozen conditions. These parameters included total suspended solids, nutrients (total phosphorus, ammonia, nitrate plus nitrite and potassium), specific conductance, major ions (sodium and chloride), and *E.Coli* for bacterial concerns.

Benzene, toluene, ethylbenzene and xylenes (BTEX) and hydrocarbon fractions F1 to F4 were also analyzed when samples could be collected at the upstream and downstream of construction locations during each monthly monitoring. The April monthly monitoring (spring melt) laboratory analysis also included phenoxy acid herbicide screen (2,4-D, bromoxynil, dicamba, MCPA and picloram), AMPA and glyphosate, at the upstream and downstream of revegetation locations.

Results of the 10 Level I event-based monitoring events conducted between May and August have typically indicated very small changes in TSS concentration in the Red River during the 2009 construction year. The largest increase was on July 31, 2009, which resulted in a change of 0.28 mg/L or 4.29%. This increase in TSS concentration was within the CCME criteria of an allowable increase of 25 mg/L. Nearly all the other Level I event-based monitoring measured a change of less than 1.0% and over half of these were a decrease in TSS concentration, therefore, no Level II event-based monitoring was required during the 2009 construction year.

Several of the key water quality parameter concentrations, in particular specific conductivity, ammonia, potassium, sodium, chloride and *E.Coli* varied spatially throughout the Floodway Channel for a given monthly monitoring during the unfrozen and frozen non-flood conditions. Additionally they could vary temporally (with time) between the monthly monitoring events, at any given sample location.

During the spring flood condition in 2009, concentrations of most parameters measured in the Floodway Channel were typically below the spring flood baseline values, with the exception of *E.Coli* concentrations, which were measured throughout the Floodway Channel at concentrations at or above the spring baseline values. Within the Red River, the concentrations of these parameters were typically higher upstream of the Outlet when compared to sample locations downstream of the Outlet indicating that the input from the Floodway was not having a significant affect on the concentrations of these parameters in the Red River.

Within the non-flood unfrozen condition in 2009, concentrations of most parameters measured in the Floodway Channel were generally within the summer baseline concentrations. During June, several of the parameters including total phosphorus, ammonia, nitrate + nitrite-N, potassium and *E.Coli* concentrations were above summer baseline values; however, this was attributed to higher concentrations of these parameters entering the Floodway Channel via drains from run-off by agricultural fields. *E.Coli* concentrations were typically below or within baseline criteria, however, concentrations were elevated above criteria in the Floodway Channel for July and September. There were no construction activities occurring in the Floodway Channel that would release bacteria into the construction area, therefore the elevated

concentrations are likely due to runoff from off-site. Iron concentrations were typically elevated above the CCME criteria, however these elevated concentrations are not a concern as elevated concentrations above CCME criteria were noted during baseline sampling in 2005. With the exception of samples collected in June, for many of the parameters measured with elevated concentrations within the Floodway Channel, the concentrations downstream of construction within the channel were typically lower than background conditions in the Red River. Therefore, the elevated concentrations in the Floodway Channel would have no effect on concentrations in the Red River or result in dilution if anything.

During the non-flood unfrozen condition monthly monitoring events, parameter concentrations measured in the Red River downstream of the Outlet were typically similar to the background concentrations upstream of the Outlet, ranging from slightly lower to slightly higher, although elevated concentrations downstream were measured for TSS, ammonia, total phosphorus, nitrate + nitrite-N, and *E.Coli* concentrations. The TSS concentration increases measured in the Red River downstream of the Outlet were all less than the CCME criteria of an allowable increase of 25 mg/L and therefore are within criteria. The TSS concentrations were likely the result of natural variation, as concentrations at the Outlet were lower than concentrations in the Red River and would have resulted in dilution if anything. As no nutrients were added during the 2009 construction season, the elevated concentrations of ammonia, total phosphorus and nitrate + nitrite-N were not related to construction activities. Elevated concentrations of *E.Coli* downstream of the Outlet compared to background concentration upstream of the Outlet were measured during May, September, October and November, however; were not attributed to construction activities, nor were they a concern as concentrations were typically within the range measured during baseline monitoring.

Concentrations of most parameters measured in the Floodway Channel were within the winter baseline concentrations (or the summer baseline if there was no winter baseline) with the exception of a few locations sampled in February where the concentration of several parameters (specific conductance, ammonia, sodium, chloride, and *E.Coli*) were elevated above baseline criteria. The elevations of parameter concentrations in February were likely influenced by a rain event carrying nutrients and road salts in the surface water run-off entering the Floodway Channel from agricultural drains and storm sewers. A few exceedances were recorded for concentrations of ammonia and *E.Coli* in January, however; the elevated concentrations of ammonia were not attributed to construction activities as no seeding would have occurred during the winter months and no nutrients were applied during the 2009 construction season. Further, the elevated ammonia concentrations did not result in an exceedance of the CCME un-ionized ammonia criteria. The elevated concentrations of *E.Coli* were not attributed to construction, as there were no construction activities that would release bacteria into the construction area. Further, there is no basis for an evaluation of *E.Coli*, as there are no applicable CCME criteria.

Parameter concentrations measured in the Red River downstream of the Outlet during the non-flood frozen condition were typically similar to or lower than the background concentrations upstream of the Outlet ranging from slightly lower to slightly higher. However, concentrations on the Red River approximately 2 km downstream of the Outlet resulted in elevated concentrations for several parameters (TSS, total phosphorus, chloride and *E.Coli*) compared to the background concentrations upstream of the Outlet. These elevations are likely due to natural variation as the Red River is ice-covered and the concentrations in the Floodway Channel at the Outlet are lower than the concentrations in the Red River. Concentrations of ammonia measured in the Red River downstream of the Outlet were elevated above the background

concentration upstream of the Outlet, however, none of the ammonia concentrations in the Red River exceeded the CCME criteria for unionized ammonia. During the majority of the monthly monitoring events the concentrations at the downstream of construction location were lower than the background concentration upstream of the Outlet, and therefore would have resulted in dilution if anything.

Concentrations of most parameters measured in the Manness and Domain Drains along the West Dyke were elevated above the baseline concentrations during the monthly monitoring events that samples could be collected. Parameters that were within the baseline criteria included TSS and ammonia. All other parameters had at least one concentration elevated above baseline criteria for either the Manness or Domain Drains. Although construction activities were occurring adjacent to the Manness Drain in June and July 2009, the work consisted of rip rap application that was completed in August 2009. There were no construction activities that were occurring immediately adjacent to the Domain Drain in 2009, therefore elevated concentrations in the Manness and Domain Drains in 2009 were likely the result of natural variation.

Based on the results of the 2009 Construction monitoring events, recommendations and refinements for the ongoing monitoring should include the following;

- The 2010 Surface Water Sampling Program should consist of Event-based monitoring focusing on contract specific construction monitoring and assessing the surface water quality as it relates to potential groundwater impacts. In addition to conducting the Level I and II Rain and Spill Event-based monitoring as previously conducted, Event-based monitoring during 2010 should also be conducted in response to elevated water levels in the floodway channel when there is the greatest potential for surface water to affect the groundwater quality (Floodway Flow). This Floodway Flow Event-based monitoring should be conducted when the water level in the Floodway overtops the Low Flow Channel either from elevated Red River water levels (spring or summer flooding) or prolonged precipitation events.
- The Event-based monitoring should replace the regular Monthly monitoring, however, during the unfrozen conditions, typically from April to October, if there is no event-based monitoring triggered during a month then at a minimum samples should be collected in the Floodway Channel upstream and downstream of the overall construction area.
- To assess contract specific effects during the Event-based monitoring new sample locations should be established in the La Salle River upstream and downstream of where the new Glenlea Drain discharges and in the Seine River upstream and downstream of the new culvert on Prairie Grove road. Additionally, during the Level I Event-based monitoring samples should be collected from the Floodway Channel upstream and downstream of each contract area. Whereas, the sample locations in the Manness and Domain Drains adjacent the West Dyke are no longer required during 2010 as the construction activities in the vicinity of these locations was completed in 2009.
- The rain Event-based monitoring in 2010 should continue to follow the protocol used in 2009 with the additional sample locations noted above to identify contract specific effects. To assess potential effects of surface water on groundwater quality, samples collected during the rain Event-based monitoring should also be submitted for laboratory analysis of pH and

conductivity. This revised protocol should be reviewed again during the 2010 monitoring program and revised if required as construction contracts near completion.

- With the introduction of the Nutrient Management Regulation (62/2008) no fertilizers have been applied to the Floodway Channel slopes since 2008. Therefore fewer nutrient parameters should be submitted for laboratory analysis and less frequently than previously.
- The reporting protocol for the 2010 surface water monitoring program should continue to follow the slight modifications made in 2008 to flag potential increases in TSS concentrations more rapidly. This included completing a Level I event-based worksheet for each of the monitoring events to provide an indication as to whether the sediment concentration in the Floodway will have a potential impact on the Red River downstream of the Floodway Outlet. If the worksheet indicates no potential impact then the results would be reported in the monthly monitoring report, whereas, if a potential impact is identified then MFA would be notified immediately and the laboratory would be contacted to request the TSS analysis results as soon as possible. Appropriate measures would then be developed with MFA based on the TSS laboratory results.

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## 1.0 INTRODUCTION

### 1.1 INTRODUCTION

The Environmental Impact Statement (EIS) prepared by TetrES Consultants Inc./Intergroup Consultants Ltd.<sup>(1)</sup> presented the assessment of potential effects on surface water quality resulting from the Floodway Expansion Project (Project). The EIS identified potential effects related to sedimentation associated with Project construction and the use of fertilizers (containing phosphorus, nitrogen and potassium), herbicides (glyphosate and 2,4-D amine) or spills of chemicals during Project construction or maintenance.

The EIS stated that potential effects on surface water quality would be mitigated through the use of appropriate construction management practices that would be specified in the Construction Phase Environmental Protection Plans (CPEPP) developed for each construction site. Additionally, as a component of the monitoring plans for the CPEPP, potential changes in surface water quality would be monitored during construction. Further, in the Red River Floodway Expansion Project Screening Report prepared for Infrastructure Canada <sup>(2)</sup> the responsible authorities concluded that the effects of the project on surface water quality are not likely to be significant provided that the mitigation measures proposed are followed and that a monitoring and follow-up plan for surface water quality is submitted by the Manitoba Floodway Authority (MFA).

A baseline surface water quality monitoring program <sup>(3)</sup> was undertaken in the spring – summer of 2005, prior to the start of construction of the Floodway Expansion Project. It consisted of sampling during early spring (April), the peak spring flow period (April), summer emergency operation (June) and during typical summer monthly (May to August) flow conditions. Additionally a winter baseflow program <sup>(4)</sup> was conducted in 2005 prior to construction, to monitor the groundwater discharge into the Floodway Channel when there was no surface water contribution. During the baseflow program, samples were collected on March 2, 2005 and these water quality results are considered representative of winter baseline data.

The data obtained during the baseline monitoring program forms the basis for comparison to this 2009 construction monitoring report and all future construction monitoring reports that will be compiled at the end of each construction year. Comparison of the 2009 monthly construction

monitoring data (January to December) collected during typical monthly flow conditions, to baseline data will allow the effects of construction to be compared to the applicable compliance criteria and to predictions made in modelling effects. As well, the effectiveness of proposed mitigation measures will be assessed.

## 1.2 SCOPE OF WORK

The scope of work for the 2009 construction Surface Water Monitoring program conducted by KGS Group included the following:

- Collect **monthly** surface water quality data for the Red River, Floodway Channel, Drains that flow into the Floodway Channel and Drains that cross the West Dyke, preferably following a precipitation event or at the flood peak during Red River flood conditions;
- Collect **event-based** surface water quality data for compliance monitoring of applicable parameters (TSS, nutrients, herbicides or hydrocarbons) from the Floodway Channel upstream and downstream of the overall construction area, the Red River downstream of the Outlet and any additional required locations following precipitation events greater than 10 mm or a spill; and
- Provide an assessment of surface water quality comparing results of construction monthly and event-based compliance monitoring to baseline water quality and summarize in a 2009 construction monitoring report in order to;
  - compare predictions made in modelling effects
  - to assess the effectiveness of proposed mitigation measures and adapt if necessary
  - adapt the construction monitoring program in response to data and changes in mitigation measures

## 2.0 METHODOLOGY

### 2.1 OVERVIEW

The field investigation program for the 2009 construction year was conducted from January to December 2009 in conjunction with the on-going construction activities. There were twelve (12) monthly monitoring events, with one conducted each month following precipitation events, near the end of the month if a substantial precipitation event had not yet occurred or at the peak flood during the spring Red River flood condition. There were ten (10) Level I event-based monitoring events conducted between May and August, 2009 in response to precipitation levels greater than 10 mm. No Level II event-based monitoring was required during the 2009 construction year as the results of the Level I event-based monitoring indicated that the potential increase in sediment concentration in the Red River was within the Provincial Guidelines. No spill event-based monitoring was required because the spills that occurred during 2009 were typically small, contained and cleaned up with no potential run-off to the Floodway Channel.

The methodology used for the field program conducted by KGS Group followed the general methodology outlined in the Surface Water Monitoring – 2009 Sampling Program (Appendix A) that incorporated modifications made following the 2005 baseline and 2005 through 2008 construction monitoring programs. Deviations and changes from the general methodology used during the 2009 construction monitoring are described below.

### 2.2 SAMPLING LOCATIONS

The sample locations for the 2009 construction monitoring program are outlined on Figure NM8-1 and Figure NM8-2, listed in table NM8-1 and described as follows;

**Red River at Inlet** – Upstream of the Floodway Channel along the west shore of the river, with the exception of the Spring flood conditions in April, the 3 replicate samples (S-01, S-02 and S-03) were not sampled during the remainder of the 2009 monitoring program because there was no river water entering into the Floodway Channel at the Inlet during the monthly monitoring events.

**Red River at Outlet** – Upstream of the Floodway Outlet along the east shore (S-34) and downstream of the Outlet at 4 locations along the east shore at 0.5, 1, 2 and 3 kilometers (S-30, S-31, S-32 and S-33, respectively) were sampled during each of the twelve (12) monthly monitoring events. S-31 and S-34 were also sampled during each of the ten (10) Level I event-based monitoring events. These 5 river locations were sampled from the shore for safety reasons, except during the months of January to March and December at which time the river was covered by at least 6 inches of ice that had to be augured through to collect the samples.

**Floodway Channel** – The Floodway Channel downstream of the Inlet (S-04) was only sampled during the flood conditions in April; however, was not sampled during the remainder of the 2009 monitoring program because there was no river water entering into the Floodway Channel at the Inlet during any of the other monthly monitoring events. There are a total of 6 other locations in the Floodway Channel that included; downstream of the Grande Pointe Diversion drop structure (S-13), downstream of the North Bibeau Drain drop structure (S-14) and at the four weir locations; Keewatin Weir (S-21), Springfield Weir (S-23), Dunning Weir (S-25) and PTH# 44 Weir (S-28). Each of these locations was sampled during all twelve (12) of the monthly monitoring events with a few exceptions. Location S-13 was not sampled during the January monthly monitoring and S-28 was not sampled during the January, February, or March monthly monitoring because the water was frozen to the bottom of the channel.

**Outfall Sources** – During the non-flood frozen condition from January to March, and December all 11 outfalls that drain into the Floodway Channel were not sampled because the frozen condition prevented any water from flowing into the Floodway Channel.

The Seine River Syphon Overflow (S-05) was not sampled in October because of construction activities occurring at the drain or in November due to lack of flow. During the flood unfrozen condition in April and the non-flood unfrozen condition from May to November the Deacon Reservoir Drain (S-08) was not sampled, as there was no flow at this location. Both the North Bibeau Drain Drop Structure (S-10) and Country Villa Estates Drain (S-11) were not sampled in September, October or November, as there was no flow. Kildare Trunk-Transcona Storm Sewer Outlet (S-12) was not sampled during the 2009 construction monitoring program as this location was inundated with water from April through September, and had no flow in October and November. Ashfield Drain Drop Structure (S-27) was not sampled in September, as there was

no flow. The remaining five locations (S-06, S-07, S-09, S-22 and S-26) were sampled during each monthly monitoring event between April and November.

**West Dyke Drains** – During the non-flood frozen condition from January to March, and December the Manness (S-35) and Domain (S-36) were not sampled as the samples were frozen to the bottom of the channel.

The Manness and Domain Drains were both sampled along the West Dyke during the April monthly monitoring that coincided with the spring melt and during the months of May, August, October and November. The Manness Drain was not sampled during April or May as the site was inaccessible due to construction activities and the Domain Drain was not sampled in September, as there was no flow. An upstream location of the Manness Drain was also sampled in April, May, August, September, October and November.

**Floodway Channel Construction Areas** – In addition to the sample locations shown in figures NM8-1 and NM8-2, samples were also collected from the Floodway Channel upstream and downstream of construction activities (CON U/S and CON D/S, respectively) and upstream and downstream of re-vegetation activities (VEG U/S and VEG D/S, respectively). These sample locations were based on the construction contracts, the extent of the contracts along the Floodway Channel and the construction activities that occurred for each month as summarized in each of the monthly monitoring reports, NM8.1 – January to NM8.12 – December.

For the 2009 monitoring program the upstream end of construction was designated at Station 11+000, located approximately 200 m upstream of the construction activities in the Channel at the CPR Emerson Bridge Contract (T12, Station 11+200). Samples were not collected from the upstream of construction location during January through March and in December (frozen condition). The upstream of construction location was also sampled during each of the ten (10) Level I event-based monitoring events.

The location downstream of construction that was previously established at Station 50+500 during August 2007 was moved to Station 50+900 (downstream of the outlet structure) at the beginning of 2009 in order to measure any potential effects associated with construction

activities at the Outlet structure. Samples were collected from this location for all of the monthly monitoring and Level I event-based monitoring events during 2009.

Seeding during the 2009 construction year began at the CNR Redditt Bridge contract (T11) in March with most of the seeding conducted during October and November at the CPR Emerson (T15), PTH Hwy 15 (T18), CPR Keewatin (T14) and PTH Hwy 44 (T17) bridges. Seeding during 2009 at the remaining Floodway Channel contracts was completed in July and August at C-6C, C-8B and the Outlet Structure (CE1). With the introduction of the Nutrient Management Regulation (62/2008) no fertilizers have been applied when seeding the Floodway Channel slopes since 2008. Regardless, there is potential for runoff of fertilizer because of snowmelt and rain from areas seeded previously during 2008. This included the area from the CPR Emerson bridge contract to the end of the Floodway Channel with contracts C-8A and C-8B. Therefore, the sample locations upstream and downstream of the revegetation zone were the same locations used for upstream and downstream of construction discussed above. No sample was collected in the Floodway Channel upstream of the revegetation zone during the January to March and December monthly monitoring because the water was frozen to the bottom on the Floodway Channel.

## 2.3 SAMPLING PROTOCOL

**Sample Frequency** – The monthly monitoring events were conducted once per month from January to December, typically following a precipitation event. Ten (10) Level I event-based monitoring events were conducted between May and August in response to precipitation events greater than 10 mm as outlined in Appendix A.

**Sampling Protocol** – The protocol followed the U.S. Environmental Protection Agency (EPA), Office of Water Quality (November, 1997, EPA 841-B-97-003) Monitoring Water Quality, Chapter 5 Water Quality Conditions <sup>(5)</sup> as outlined in Appendix A.

**Field Measurements** – pH, temperature, conductivity, turbidity and water depth were obtained during each of the twelve monthly monitoring and ten Level I event-based monitoring events, as outlined in Appendix A.

**Laboratory Analysis** – The analysis package at all of the locations sampled during each of the monthly monitoring events included the following;

- Routine extractable (iron, manganese, fluoride, pH, total dissolved solids, sulphate, nitrate + nitrite-N, calcium, potassium magnesium, sodium, hardness, conductivity, chloride, total alkalinity, bicarbonate, carbonate and hydroxide)
- Total suspended solids (TSS) and turbidity
- Ammonia
- Ortho phosphorus, total phosphorus, total dissolved phosphorus
- Dissolved organic carbon (DOC), total organic carbon (TOC)
- Total Kjeldahl nitrogen (TKN)
- Total coliform and *E.Coli* by m-Coli Blue Membrane Filtration method

In addition to the above, at the upstream and downstream of construction locations, included in the analysis of the monthly monitoring samples, benzene, toluene, ethylbenzene and xylenes (BTEX) and hydrocarbon fractions F1 to F4 were also analyzed. During the April monthly monitoring (spring melt) laboratory analysis also included phenoxy acid herbicide screen (2,4-D, bromoxynil, dicamba, MCPA and picloram), AMPA and glyphosate, at the upstream and downstream of re-vegetation locations.

As part of the Level I event-based monitoring, laboratory analysis of TSS and nutrients (pH, nitrate+nitrite-N, ammonia, Total Kjeldahl Nitrogen, ortho-phosphorus and total dissolved phosphorus) was conducted for the samples collected in the Floodway Channel upstream and downstream of construction and on the Red River upstream (S-34) and downstream (S-31) of the Outlet. No laboratory analysis of herbicides (phenoxy acid herbicide screen, AMPA and glyphosate) was required during the event-based monitoring as there were no herbicides applied during the 2009 construction year.

**Quality Assurance/Quality Control Program** – Quality Assurance and Quality Control (QA/QC) methods have been adopted to ensure that all samples are representative of the site. In the field, quality was assured by using experienced field staff trained to follow the U.S. EPA sampling protocol and ensuring that all sampling equipment was sterilized and/or rinsed with the sampling media a minimum of three times to eliminate cross contamination of samples. Disposable latex gloves were used for every sample retrieved. Samples were placed into EPA approved sample containers provided by the laboratory and stored in cooler chests at 4°C for

transport to ALS Laboratory Group, a Canadian Association for Laboratory Accreditation Inc. (CALA) certified laboratory for detailed analyses.

Implementation of one field duplicate sample per monthly monitoring event and laboratory quality control including; calibration verification standards, continuing calibration verification, certified reference material, matrix spikes, laboratory control samples, duplicates and method blanks, were also used to assure that the laboratory analyses of samples collected in the field were representative of conditions encountered in the investigation. The QA/QC program for the 2009 construction sampling included the following:

- Record keeping for all aspects of sample handling and analysis, including the description of methods/standards used to analyse samples, proper records of sampling and sample handling (chain of custody), analytical result records, and QC sample records.
- Field QC duplicated samples and laboratory QC including calibration verification standards, continuing calibration verification, certified reference material, matrix spikes, laboratory control samples, duplicates and method blanks.

## **2.4 FLOW CALCULATIONS**

Estimates of the flow in the Red River, Floodway Channel, and agricultural drains that flow into the Channel are helpful for interpreting and comparing construction test results. Additionally, flow estimates are necessary to calculate approximate mass balances for the chemical analysis results to interpret the results in particular during event-based compliance monitoring.

The estimate of flow in the Red River was based on information provided in Manitoba Water Stewardship's weekly flow reports for the Red River near Selkirk (Appendix B) <sup>(6)</sup>. Estimates of the flow in the Floodway Channel and in each of the agricultural drains that flow into the channel were based on the recorded water levels at each location. Water levels were recorded using staff gauges installed at each of the sampling locations. The flow was then estimated using a relationship between flow and water level (rating curve), which was developed by KGS Group at each location. The rating curves developed for the agricultural drain drop structures were based on the physical characteristics of the drop structure and approach channel. Rating curves developed for the in-channel locations were based on the physical characteristics of the Floodway Channel.

### 3.0 RESULTS

#### 3.1 HYDROLOGICAL CONDITIONS

##### *Monthly Monitoring*

The monthly monitoring events were generally conducted following a substantial precipitation event during the month or near the end of the month if a substantial precipitation event had not yet occurred. Full details of the hydrological conditions for each monthly monitoring are provided in each of the monthly monitoring reports, NM8.1 – January to NM8.12 – December. Details of precipitation recorded by Environment Canada at the Winnipeg International Airport, Manitoba <sup>(7)</sup> are provided in the Daily Data Report for January to December, 2009 in Appendix C. The precipitation levels during each of the monthly monitoring events and the percentage of the monthly precipitation total are summarized in the following table;

**Summary of Precipitation Levels during the 2009 Monthly Monitoring**

| Sample Date         | Amount of Precipitation (mm) for the Monitoring Event | Percent of Monthly Total | Monthly Total Precipitation (mm) | Historical Average Monthly Total Precipitation (mm) <sup>(8)</sup> |
|---------------------|---|--------------------------|----------------------------------|--|
| January 27-29       | 0.5   | 3%                       | 16.5                             | 19.7   |
| February 19 & 20    | 0.0   | 0%                       | 41.5                             | 14.9   |
| March 4 & 5         | 2.0   | 4%                       | 54.0                             | 21.5   |
| April 20            | 1.5   | 4%                       | 34.0                             | 31.9   |
| May 26              | 12.5  | 20%                      | 63.5                             | 58.8   |
| June 29             | 1.0   | 1.6%                     | 61.5                             | 89.5   |
| July 15             | 45.5  | 40%                      | 114.5                            | 70.6   |
| August 25           | 6.0   | 11%                      | 56.0                             | 75.1   |
| September 29        | 0.0   | 0%                       | 22.5                             | 52.3   |
| October 28          | 4.0   | 11%                      | 39.5                             | 36.0   |
| November 23         | 0.0   | 0%                       | 1.5                              | 25.0   |
| December 16 & 17    | 0.5   | 3%                       | 16.0                             | 18.5   |
| <b>Annual Total</b> |   |                          | 521.0                            | 513.8  |

As evident by the table above, while 2009 had a relatively average overall amount of precipitation with an annual total precipitation of 521.0 mm compared to the historical average of 513.8 the conditions varied from month to month. June, August, September, and November all

had total monthly precipitation amounts substantially lower than the historical average monthly precipitation. In comparison, February, March, and July had substantially higher monthly precipitation amounts compared to the historical average monthly precipitations.

### ***Event-Based Monitoring***

The Level I event-based monitoring events were conducted between May and August, 2009 following precipitation events of 10 mm or greater. The amount and duration of each precipitation event and the year storm categorization (based on the Atmospheric Environment Service, Rainfall Intensity – Duration Frequency (Rainfall IDF) Values for the Winnipeg International Airport <sup>(9)</sup>) which triggered each of the Level I event-based monitoring events are summarized in the following table;

**Summary of Precipitation Levels during the 2009 Event-Based Monitoring**

| <b>Sample Date</b> | <b>Amount of Precipitation (mm) for the Monitoring Event <sup>1</sup></b> | <b>Approximate Duration (hours)</b> | <b>Year Storm <sup>(9)</sup></b> |
|--------------------|---|-------------------------------------|----------------------------------|
| May 26             | 6.6 – 14.5  | 3.5                                 | <2                               |
| June 9             | 10.4 – 14.4   | 3.0                                 | <2                               |
| June 27            | 8.4 – 85.1  | 22.0                                | <2 - <5                          |
| July 9             | 22.8 – 55.1   | 12.0                                | <2 - <5                          |
| July 15            | 16.8 – 37.1   | 9.5                                 | <2                               |
| July 30            | 6.5 – 26.7  | 4.0                                 | <2                               |
| July 31            | 9.8 – 34.3  | 6.0                                 | <2                               |
| August 15          | 10.0 – 25.0   | 12.0                                | <2                               |
| August 21          | 0.5 – 16.0  | 13.0                                | <2                               |
| August 25          | 0.4 – 11.7  | 6.0                                 | <2                               |

1 - Amount of precipitation measured varied between the different weather stations.

### **3.2 WATER QUALITY**

The field chemistry and turbidity measured in the surface water at each location during the monthly and event-based monitoring events are listed in Table NM8-1. The general water quality results for all of the analyzed parameters collected at each location during the monthly and event-based monitoring events are summarized in Table NM8-2. The petroleum hydrocarbons and bacteria results for samples collected during the monthly monitoring and the

herbicides collected during the April monthly (spring melt run-off) are summarized in Table NM8-3, Table NM8-4 and Table NM8-5 respectively. Existing CCME Surface Water Quality Guideline values are given for any parameters that have established objectives.

Construction monitoring data for the key water quality parameters of interest, identified and discussed in the baseline surface water monitoring report, were compared to the baseline data under spring flood, non-flood/unfrozen and non-flood/frozen conditions. These parameters included total suspended solids, nutrients (total phosphorus, ammonia, nitrate plus nitrite and potassium), specific conductance, major ions (sodium and chloride), and *E.Coli* for bacterial concerns (Figures NM8-3 to NM8-34).

During April 2009, the Red River experienced flood conditions and, as such, there was water entering the Floodway Channel. Red River water began naturally flowing into the Floodway Channel on March 25 when the water levels rose above an elevation of 750 feet (228.6 m). The Floodway gates were put into operation on April 8 and remained in operation until the end of the month. The flood water levels crested on April 18 at an elevation of 766.75 feet. The samples analysed in April 2009 were compared to the samples collected during the flood conditions on April 12, 2005 during the baseline monitoring from the Red River, Floodway Channel, Drains that flow into the Floodway Channel, and Drains that cross the West Dyke.

During the May to November 2009 construction monitoring there was no Red River water entering the Floodway Channel, therefore, these monthly monitoring events represent the non-flood/unfrozen condition. As a result the range of baseline conditions for comparison shown on the figures for the Channel are represented by the minimum and maximum concentrations observed during the summer baseline monitoring when there was no Red River water diverted. This included data from the May 10, June 13 and August 19, 2005 baseline monthly events. For the upstream end of the Floodway Channel where there was insufficient baseline data to provide a range of baseline conditions, the range was extrapolated using the data immediately downstream and following the observed trends. The Floodway Channel summer baseline conditions are representative of surface water run-off from precipitation events and therefore are comparable to the non-flood/unfrozen condition. The baseline conditions used for comparison for the drains flowing into the Floodway Channel and for the Red River at the Outlet are from the corresponding sample events as above. In addition, for the Red River at the Outlet the baseline

conditions from the emergency summer operation and the July monthly event are used for comparison because these dates represent the range of Red River flow conditions that could occur in any given year during construction.

During the January to March, and December 2009 construction monitoring there was no Red River water entering the Floodway Channel, therefore, these monthly monitoring events represent the non-flood/frozen condition. The Floodway Channel summer baseline conditions as discussed above are representative of surface water run-off from precipitation events and, therefore, for some parameters are not comparable to the frozen conditions. Under frozen conditions the surface water is primarily from groundwater discharge into the Channel, referred to as baseflow. As a result in addition to the summer baseline conditions, for applicable parameters, the monthly monitoring values during the non-flood/frozen condition are also compared to the winter baseline results from the baseflow monitoring conducted at the Floodway Channel weir locations in March 2005 <sup>(4)</sup>.

### **3.2.1 Total Suspended Solids**

#### ***Monthly Monitoring***

The comparison of TSS concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood condition, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-3, NM8-4, and NM8-5, respectively.

A major increase in total suspended solids (TSS) concentration was measured in the Floodway Channel downstream of construction (196 mg/L; Stn 50+900) compared to upstream of construction (80 mg/L; Stn 11+000; Figure NM8-3) during the spring flood conditions. These concentration increases were not attributed to construction as the concentration of these parameters in the Floodway Channel were generally lower than baseline Floodway concentrations, except for the location downstream of the North Bibeau Drain (292 mg/L). Additionally, the concentrations of these parameters in the Floodway Channel were generally similar to or lower than the Red River and would have resulted in dilution and not increases. The TSS concentration measured in the Floodway Channel at the Outlet (196 mg/L) was similar to

the concentrations in the Red River. As such no increase in was measured in the Red River downstream of the Outlet (144 to 198 mg/L) compared to upstream of the Outlet (208 mg/L).

The TSS concentrations measured in the Floodway Channel were generally within or lower than the baseline concentrations during the monthly monitoring representing the non-flood/unfrozen condition, except during May and June (Figure NM8-4). The sample locations with elevated TSS concentrations included P.T.H #44 Weir (S-28) in May and the Dunning Weir (S-25), upstream of construction (CON U/S) location, and downstream of construction (CON D/S) location in June. However, during both of these months, all other TSS concentrations in the Floodway Channel were below the summer baseline conditions. There was a slight increase of TSS concentrations in May at the downstream of construction location (36 mg/L) compared to upstream of construction location (34 mg/L); however, the increase was well within the CCME criteria of an allowable increase of 25 mg/L. In June, the TSS concentration at the downstream of construction location (Stn 50+900; 78 mg/L) was well below the concentration at the upstream of construction location (Stn 11+000; 118 mg/L; Table NM8-2). In both May and June a major increase in TSS concentration was measured in the Red River approximately 2 km (S-32; 290 mg/L and 358 mg/L, respectively) and 3 km (S-33; 382 mg/L and 562 mg/L, respectively) downstream of the Outlet compared to the background concentration upstream of the Outlet (S-34; 200 mg/L and 466 mg/L, respectively). However, in both months, the samples 0.5 km (S-30) and 1 km (S-31) downstream of the Outlet had concentrations that were lower than the background concentration upstream of the Outlet. Additionally, in both May and June, the mass balance calculations indicated that the input from the Floodway Channel would result in a dilution of the TSS concentration in the Red River and was within the CCME criteria.

The TSS concentrations measured in the Floodway Channel were lower than the baseline concentrations during the monthly monitoring representing the non-flood/frozen condition (Figure NM8-5). During January, the Red River samples downstream of the outlet (S-30 to S32) had increases in TSS concentration compared to the background concentration upstream of the Outlet (S-34). In January, the samples collected at stations S-30, S-31 and S-32 had TSS concentrations of 240 mg/L, 72 mg/L and 820 mg/L, respectively, compared to the background concentration upstream of the Outlet (9 mg/L). In December the sample collected at the sample location 2 km downstream of the Outlet (S-32) had a TSS concentration of 596 mg/L compared to the background concentration upstream of the Outlet (11 mg/L). The elevated TSS

concentrations in the Red River were not likely due to construction activities within the Floodway Channel because all TSS concentrations in the Floodway Channel were significantly lower than the Red River concentrations and were below summer baseline criteria. In particular the TSS concentrations measured in the Floodway Channel at the downstream of construction location (Stn 50+900; January (<5 mg/L); December (<5 mg/L)) were lower than the values in the Red River compared to January (9 to 820 mg/L) and December (10 to 596 mg/L). Elevated TSS concentrations in the Red River are likely due to the natural variation in the Red River. The mass balance calculations for each of the monthly non-flood/frozen monitoring reports (NM8.1 - NM8.3 and NM8.12) indicated that the input from the Floodway Channel would have resulted in a dilution of the TSS concentration in the Red River and were within the CCME criteria.

The TSS concentrations measured in the Red River at the Floodway Outlet during 2009 were compared to the 10<sup>th</sup> and 90<sup>th</sup> percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. The TSS concentrations measured each month during 2009 were within the 10<sup>th</sup> to 90<sup>th</sup> percentile range in April, July through to September, and November (Figure NM8-6). In January the TSS concentrations at sample locations S-30 to S-32 in the Red River (72 to 820 mg/L) were much higher than the historical 90<sup>th</sup> percentile (19 mg/L) and the background concentration upstream of the Outlet (S-34; 9 mg/L). The TSS concentrations entering the Red River from the Floodway Channel would have resulted in a dilution during January as the concentrations in the Floodway Channel were lower and therefore, it is unlikely that the increased TSS is a result of construction activities occurring in the Floodway Channel. During February, although the TSS concentrations were elevated above the 10<sup>th</sup> and 90<sup>th</sup> percentile range the TSS concentration downstream of the Outlet (S30 - S33; 16-130 mg/L) were lower than the background concentration upstream of the Outlet (S-34; 200 mg/L). In March, the TSS concentrations measured in the Red River downstream of the Outlet were typically lower (25 to 43 mg/L) than the background concentration upstream of the Outlet (200 mg/L), with the exception of 2 km downstream of the Outlet that resulted in a minor elevation (S-32; 210 mg/L). In May the TSS concentration in the Red River 2 km (S-32; 290 mg/L) and 3 km downstream of the Outlet (S-33; 382 mg/L) were above the 90<sup>th</sup> percentile for the month (277 mg/L) and the background concentration upstream of the Outlet (S-34; 200 mg/L). In June, the concentration of TSS in the Red River at 2 km and 3 km downstream of the Outlet ((S-32; 358 mg/L) and (S-33; 562 mg/L), respectively), as well as the background concentration upstream of the Outlet (S-

34; 466 mg/L) were higher than the 90<sup>th</sup> percentile for the month (176 mg/L). Both May and June monthly samples were collected during or after periods of heavy precipitation. Therefore, the elevated TSS concentrations in the Red River may be associated with the higher than normal average monthly precipitation and in particular the 2-year to 2- to 5-year storm event as discussed above. Although October had concentrations elevated above the 10<sup>th</sup> and 90<sup>th</sup> percentile, the TSS concentrations downstream of the Outlet (35 to 49 mg/L) were below the background concentration upstream of the Outlet (60 mg/L). Lastly, in December the concentration of TSS at a single sample location 2 km downstream of the Outlet (S-32; 596 mg/L) was elevated above the 90<sup>th</sup> percentile for December (23 mg/L) and the background concentration upstream of the Outlet (S-34; 11 mg/L). In January, February, March, May, June, October and December the concentrations of TSS above the 90<sup>th</sup> percentile is likely a result of natural variation in the river and not related to construction, as all the mass balance worksheets for 2009 resulted in sediment loads in the Red River from the Floodway Channel below the CCME criteria of 25 mg/L.

The TSS concentrations measured in the Manness and Domain Drains along the West Dyke ranged from <5 to 31 mg/L and 5 to 86 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). These concentrations were within or below the baseline range of concentrations measured in the Manness and Domain Drains (11 to 300 mg/L and <5 to 100 mg/L, respectively) during the previous sampling conducted prior to the start of construction.

### ***Event-Based Monitoring***

Results of the 10 Level I event-based monitoring events conducted between May and August indicated very small changes in TSS concentration in the Red River during the 2009 construction year (Table NM8-6). The Level I event-based worksheet and the follow-up lab results fax for each rain event are provided with the monthly monitoring reports, MN8.1 – January to NM8.12 December.

During the Level I event-based monitoring, the only measurable increases in TSS concentration in the Red River were following the July 9 (1.4% increase), July 15 (0.3% increase) and July 31 (4.29% increase) monitoring events, with nearly all the other events resulting in a negligible (<1.0%) decrease. The July 9 rainfall (23 to 55 mm in 12 hours) ranged from less than a 2-year

storm to close to a 5-year storm based on the Atmospheric Environment Service, Rainfall Intensity – Duration Frequency (Rainfall IDF) Values for the Winnipeg International Airport <sup>(9)</sup>. The July 15 rainfall (17 to 37 mm in 10 hours) also ranged from less than a 2-year storm to close to a 5-year storm, with the July 31 rainfall (10 to 34 mm over 6 hours) being close to a 2-year storm. The mass balance calculations indicated that an estimated increase in the TSS concentration of 2.72 mg/L or 3.45% for July 9, 0.48 mg/L or 0.85 % for July 15, and –0.16 mg/L or –0.41% for July 31 which would result in the Red River from the Floodway Channel inputs. Likewise the mass balance using the flows provided by MWS and the laboratory TSS concentrations indicated an approximate increase in the TSS concentration of 1.48 mg/L or 1.42% for July 9, 0.12 mg/L or 0.24% for July 15 and 0.28 mg/L or 4.29% for July 31, 2009 (Table NM8-6). These increases in TSS concentrations are within the CCME criteria of an allowable increase of 25 mg/L based on the background concentration being <250 mg/L (clear flow). Nearly all the other Level I event-based monitoring events measured a change of less than 1.0% and resulted in a decrease in TSS concentration.

A review of the estimated and actual change in Red River sediment concentration measured during the Level I event-based monitoring is provided in Table NM8-6. This review indicates that the values estimated using the mass balancing based on field measurements of turbidity and water flows, and the site-specific relationships between TSS and field turbidity are comparable to the actual increases calculated from laboratory TSS analysis and reported flows. The review also clearly demonstrates that a TSS increase exceeding the CCME criteria of an allowable 10% or 25 mg/L is very unlikely for precipitation events less than 10 mm.

### **3.2.2 Specific Conductance**

The comparison of specific conductance values between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-7, NM8-8 and NM8-9, respectively.

Specific conductance concentrations measured in the Floodway Channel were below the baseline values at all stations during the monthly monitoring representing the spring flood condition (Figure NM8-7). Likewise, specific conductance concentrations measured in the Red

River at all locations were also below baseline criteria, however; specific conductance concentrations measured in the Red River downstream of the Outlet (309  $\mu\text{S}/\text{cm}$  to 320  $\mu\text{S}/\text{cm}$ ) resulted in minor elevations compared to the background concentration upstream of the Outlet 307 ( $\mu\text{S}/\text{cm}$ ). However, these concentrations are likely due to the natural variation of the Red River.

Specific conductance concentrations measured in the Floodway Channel during the monthly monitoring representing the non-flood/unfrozen condition were all within or below the range of summer baseline criteria (Figure NM8-8). Typically all specific conductance concentrations measured in the Red River were below summer baseline criteria except during the months of October and November. The Red River specific conductance concentrations in October were slightly elevated above baseline criteria, however; concentrations downstream of the Outlet (899 to 938  $\mu\text{S}/\text{cm}$ ) were lower than the background concentration upstream of the Outlet (964  $\mu\text{S}/\text{cm}$ ). These elevated concentrations in the Red River are not likely due to construction activities in the Floodway Channel as the specific conductance concentration at the Outlet was 686  $\mu\text{S}/\text{cm}$  and would have resulted in dilution. Although the Red River specific conductance concentrations in November were also slightly elevated above baseline criteria, the concentrations downstream of the Outlet (894 to 970  $\mu\text{S}/\text{cm}$ ) were lower than the background concentration upstream of the Outlet (1020  $\mu\text{S}/\text{cm}$ ). These elevated concentrations in the Red River are also not likely due to construction activities in the Floodway Channel as the specific conductance concentration at the Outlet was 415  $\mu\text{S}/\text{cm}$  and would have resulted in dilution.

The specific conductance concentrations measured in the Floodway Channel were generally within or below the range of winter baseline values (1150 to 1730  $\mu\text{S}/\text{cm}$ ) during the monthly monitoring representing the non-flood/frozen condition, with the exception of February (Figure NM8-8). During the February monthly monitoring event, the Dunning Weir (S-25; 1890  $\mu\text{S}/\text{cm}$ ) and downstream of construction (Stn 50+900; 2040  $\mu\text{S}/\text{cm}$ ) locations were elevated above the winter baseline criteria. Although the specific conductance concentration at the Floodway Channel Outlet was higher than the values in the Red River, this may have resulted in a negligible change in the Red River at one sample location located 1 km downstream of the Outlet (1040  $\mu\text{S}/\text{cm}$ ) compared to the background concentration upstream of the Outlet (1020  $\mu\text{S}/\text{cm}$ ). Groundwater infiltration during the frozen months typically results in elevated specific conductance values in the Floodway Channel compared to non-frozen conditions when there is

a greater proportion of surface water contribution from the drains and precipitation, therefore; the elevated specific conductance concentrations in the Floodway Channel are likely due to groundwater infiltration. Also, the elevations of parameter concentrations in February may have been due to a rain event carrying nutrients and road salts in the surface water run-off entering the Floodway Channel from agricultural drains and storm sewers.

The specific conductance measured in the Manness and Domain Drains along the West Dyke ranged from 219 to 3320  $\mu\text{S}/\text{cm}$  and 141 to 1180  $\mu\text{S}/\text{cm}$ , respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). The values measured in the Manness Drain were within the baseline range (177 to 1680  $\mu\text{S}/\text{cm}$ ), except during September, October and November where specific conductance concentrations ranged between 2010 to 3320  $\mu\text{S}/\text{cm}$ . The elevated specific conductance levels were not a result of construction because the activities in the vicinity of the Manness Drain prior to September consisted of rip rap application that was completed in August 2009 and August resulted in a specific conductance concentration of 831  $\mu\text{S}/\text{cm}$ , which was within the baseline criteria. The majority of values measured in the Domain Drain were within the baseline range (108 to 503  $\mu\text{S}/\text{cm}$ ), except for the elevated concentrations during May, July, October and November, which ranged between 537 to 1180  $\mu\text{S}/\text{cm}$ . These elevated specific conductance concentrations were not a result of construction as there were no construction activities in the immediate vicinity of the Domain Drain in 2009.

### **3.2.3 Total Phosphorus**

#### ***Monthly Monitoring***

The comparison of total phosphorus concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-10, NM8-11 and NM8-12, respectively.

The total phosphorus concentrations measured in the Floodway Channel and Red River during the monthly monitoring representing the spring flood were below the spring flood baseline values (Figure NM8-10).

The total phosphorus concentrations measured in the Floodway Channel during the monthly monitoring representing the non-flood/unfrozen condition were generally lower than the summer baseline criteria, except during June and July (Figure NM8-11). Although the concentrations of total phosphorus were much higher in June, the concentration measured downstream of construction (Station 50+900; 0.563 mg/L) was below the background concentration upstream of construction (Station 11+000; 0.590). The elevated total phosphorus concentration in June at the Spring Hill Weir (S-23; 1.260 mg/L) may be due to natural variation as discharge into the Floodway Channel from the Cooks Creek Drain outlet structure, which had an elevated total phosphorus concentration (1.670 mg/L) did not elevate concentrations at the Keewatin Weir location (0.277 mg/L). Additionally, the samples collected in June from the Red River downstream of the Outlet (0.515 mg/L to 0.646 mg/L) resulted in concentrations that were lower than the background concentration upstream of the Outlet (0.711 mg/L). In July, one sampling location was elevated above the summer baseline criteria and included the Dunning Weir (S-25; 0.594 mg/L). The total phosphorus concentration in July measured downstream of construction (Station 50+900; 0.264 mg/L) was also moderately elevated above the upstream of construction location (Station 11+000; 0.212 mg/L), however; both concentrations were within the summer baseline criteria. Additionally, in July the total phosphorus concentrations measured in the Red River were moderately elevated downstream of the Outlet (0.284 mg/L to 0.340 mg/L) compared to the background concentration upstream of the Outlet (0.305 mg/L). The elevated total phosphorus in the Floodway Channel is not related to construction because no nutrients were applied in 2009; instead they may be in response to elevated total phosphorus concentrations flowing into the floodway from the agricultural drains. The elevated total phosphorus concentrations in the Red River downstream of the Outlet compared to the background concentration upstream of the Outlet were likely due to natural variation as the majority of the locations were within the summer baseline criteria and the concentrations downstream of construction are similar to or lower than the concentrations in the Red River upstream of the Outlet.

The total phosphorus concentrations measured in the Floodway Channel were within or lower than the baseline concentrations during the monthly monitoring representing the non-flood/frozen condition with the exception of the downstream of Grande Pointe Drain (S-13; 0.935 mg/L) location in February (Figure NM8-12). This elevated concentration was not a result of construction as there were no construction activities at the upstream end of the Floodway

Channel that would contribute to total phosphorus concentrations. Additionally, the concentration in the Floodway Channel was lower than the concentrations in the Red River such that there was no observed increase in Red River concentrations downstream of the Outlet. In January the range of total phosphorus concentrations in the Red River downstream of the Outlet (0.336 mg/L to 0.995 mg/L) were higher compared to the background condition upstream of the Outlet (0.266 mg/L). However, the elevated concentrations in the Red River are not likely the result of construction activities in the Floodway Channel as the concentration at the Outlet was 0.065 mg/L and would have resulted in dilution.

The total phosphorus concentration measured in the Red River at the Floodway Outlet during 2009 were compared to the 10<sup>th</sup> and 90<sup>th</sup> percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of records available from 1970 to 2003. The total phosphorus concentrations measured each month during 2009, except for January, March and June monthly events were within the 10<sup>th</sup> and 90<sup>th</sup> percentile ranges (Figure NM8-13). Although one of the Red River samples collected downstream of the Outlet in March (S-32; 0.608 mg/L) and all of the downstream samples collected in June (0.515 mg/L to 0.646 mg/L) resulted in total phosphorus concentrations higher than the 90<sup>th</sup> percentile for their respective months (0.519 mg/L and 0.448 mg/L, respectively), none of the downstream concentrations were elevated above the background concentration upstream of the Outlet (0.638 mg/L (March); 0.711 (June), respectively). In January, the total phosphorus concentration measured at two locations downstream of the Outlet (S30; 0.591 mg/L and S32; 0.995 mg/L) were elevated above the historical January 90<sup>th</sup> percentile (0.515 mg/L). These elevated total phosphorus concentrations above historical concentrations in the Red River may be associated with nutrients from adjacent agricultural fields as no nutrients were applied to the Floodway Channel slopes in 2009.

The total phosphorus concentrations measured in the Manness and Domain Drains along the West Dyke ranged from 0.047 to 0.460 mg/L and 0.087 to 0.789 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). The values measured in the Manness Drain were lower than the baseline range (0.329 to 0.710 mg/L). The values measured in the Domain Drain were generally lower than the baseline range (0.238 to 0.723 mg/L), except for the slightly elevated concentration measured during the June (0.789 mg/L) monthly monitoring. This elevated total phosphorus concentration above baseline may be

associated with the higher TSS concentration measured during June and a not a result of construction activities as there were no activities in the immediate vicinity of the drain in 2009.

### ***Event-Based Monitoring***

Total phosphorus was analyzed during 3 of the 10 event-based monitoring events conducted in 2009, however all Level I event-based monitoring events were in conjunction with a monthly monitoring event and therefore were analyzed as part of the routine analysis. Therefore analyses of these results are described above in the discussion for non-flood/unfrozen conditions. There were no nutrients applied on the slopes of the Floodway Channel during the 2009 year, therefore only TSS was analyzed for all Level I event-based events that were not completed in conjunction with the monthly monitoring event.

### **3.2.4 Ammonia (NH<sub>3</sub>)**

The water quality guidelines for ammonia vary depending on the temperature and pH concentrations of the water. For the 2009 construction monitoring program, the pH ranged from 7.29 to 8.73, which was within the CCME criteria for the protection of freshwater aquatic life (6.5 to 9.0; Table NM8-2). For the 2009 construction monitoring program the temperature ranged from 0°C to 23.3°C. The soluble ammonia (NH<sub>3</sub>) values reported by the laboratory were converted by KGS Group into un-ionized ammonia values based on a pH temperature relationship (Table NM8-2). The un-ionized ammonia represents all the forms of ammonia in the water, with the exception of the ammonium ion (NH<sub>4</sub>). The corresponding un-ionized ammonia CCME criteria for the protection of freshwater aquatic life is 0.019 mg/L.

### ***Monthly Monitoring***

The comparison of ammonia concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-14, NM8-15 and NM8-16, respectively.

The ammonia concentration measured in the Floodway Channel downstream of construction (Station 50+900; 0.091 mg/L) had a minor elevation compared to upstream of construction

(Station 11+000; 0.089 mg/L) during the spring flood condition (Figure NM8-14). However, the concentrations in the Floodway Channel were all below the spring flood baseline concentrations. Additionally, the ammonia concentrations in the Red River downstream of the Outlet (0.092 to 0.118 mg/L) were lower compared to the background concentration upstream of the Outlet (0.158 mg/L). The concentrations in the Red River were also below the baseline concentrations and resulted in un-ionized ammonia concentrations below the CCME criteria.

The ammonia concentrations measured in the Floodway Channel were generally below the range of summer baseline concentrations during the monthly monitoring representing the non-flood/unfrozen condition, with the exception of June and July (Figure NM8-15). In June the ammonia concentrations measured in the Floodway Channel locations downstream of the North Bibeau Drain (S-14; 0.737 mg/L), Spring Hill Weir (S-23; 0.304 mg/L), Dunning Weir (S-25; 0.366 mg/L), PTH Hwy 44 Weir (S-28; 0.405 mg/L) and at the downstream of construction location (Station 50+900; 0.478 mg/L) were elevated above the summer baseline criteria. These measured concentrations were more than twice the upper summer baseline range. However, of these elevated ammonia concentrations in the Floodway Channel only the ammonia concentration measured at the downstream of the North Bibeau Drain (0.031 mg/L), Spring Hill Weir (0.026 mg/L), and PTH #44 Weir (Duplicate; 0.021 mg/L) resulted in un-ionized ammonia concentrations exceeding the CCME criteria of 0.019 mg/L. These elevated concentrations and exceedance of the CCME criteria during June may be in response to elevated ammonia concentrations flowing into the Floodway Channel from the North Bibeau Drain (0.887 mg/L) and the Springfield Road Drain Drop Structure (0.332 mg/L). These drains flow into the Floodway Channel from agricultural fields in the surrounding areas. As no nutrients were applied during the 2009 season, the elevated ammonia concentrations in the Floodway Channel were not attributed to construction activities. A major increase in ammonia concentration was measured in the Red River approximately 0.5 km (S-30; 0.294 mg/L) downstream of the Outlet compared to the background concentration upstream of the Outlet (0.021 mg/L), however; all other Red River concentrations were below the background concentration upstream of the Outlet and below summer baseline concentrations. Additionally, none of the ammonia concentrations resulted in unionized ammonia exceeding the CCME criteria.

The ammonia concentrations measured in the Floodway Channel were typically within or below the range of winter baseline concentrations, with a few exceptions, during the monthly

monitoring representing the non-flood/frozen condition (Figure NM8-16). The ammonia concentrations measured in the Floodway Channel at the Keewatin Weir (1.310 mg/L), Spring Hill Weir (1.600 mg/L), Dunning Weir (0.826 mg/L) and downstream of construction (Station 50+900; 0.305 mg/L) locations in January, and the Dunning Weir (0.666 mg/L) and downstream of construction (0.597 mg/L) locations in February were above the upper range for the winter baseline criteria. The elevated concentrations of ammonia in January were not attributed to construction activities as no seeding would have occurred during the winter months and no nutrients were applied during the 2009 construction season. The elevated concentrations in February, though not attributed to 2009 construction activities, may have been the result of nutrient run-off from the February 9<sup>th</sup> rain flowing over areas that were fertilized in November 2008 at the downstream end of the Floodway. Concentrations measured in the Red River downstream of the Outlet in January through March (ranges of 0.947 to 1.190 mg/L, 0.581 to 0.792 mg/L, and 0.443 to 0.712 mg/L, respectively) were higher than the background concentrations upstream of the Outlet (0.902 mg/L, 0.581 mg/L, 0.065 mg/L, respectively). There were no exceedances downstream of the Outlet compared to upstream for the Outlet for the month of December. Additionally, no ammonia concentrations measured in the Red River exceeded the CCME criteria for unionized ammonia.

The ammonia concentrations measured in the Red River at the Floodway Outlet during 2009 were compared to the 10<sup>th</sup> to 90<sup>th</sup> percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. All of the ammonia concentrations measured each month during 2009 were within or lower than the 10<sup>th</sup> to 90<sup>th</sup> percentile ranges (Figure NM8-17).

The ammonia concentrations measured in the Manness and Domain Drains along the West Dyke ranged from <0.050 to 0.253 mg/L and <0.050 to 0.303 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). These concentrations were within the baseline range of concentrations measured in the Manness and Domain Drains (0.050 to 1.57 mg/L and 0.070 to 2.03 mg/L, respectively). Additionally, all of the measured ammonia concentrations resulted in un-ionized ammonia concentrations below the CCME criteria.

### ***Event-Based Monitoring***

Ammonia was analyzed during 3 of the 10 event-based monitoring events conducted in 2009, however all Level I event-based monitoring events were in conjunction with a monthly monitoring event and therefore were analyzed as part of the routine analysis. Therefore analyses of these results are described above in the discussion for non-flood/unfrozen conditions. There were no nutrients applied on the slopes of the Floodway Channel during the 2009 year, therefore only TSS was analyzed for all Level I event-based events that were not completed in conjunction with the monthly monitoring event.

### **3.2.5 Nitrate + Nitrite-N**

#### ***Monthly Monitoring***

The comparison of nitrate + nitrite-N concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-18, NM8-19 and NM8-20, respectively.

The nitrate + nitrite-N concentrations measured in the Floodway Channel downstream of construction (Station 50+900; 0.422 mg/L) were moderately elevated compared to the upstream of construction location (Station 11+000; 0.268 mg/L) during the spring flood condition. However, the concentrations in the Floodway Channel were all below the spring flood baseline conditions. The elevated concentrations were not attributed to construction as no fertilizers were applied in the construction area. Further, the concentrations of nitrate + nitrite-N in the Red River downstream of the Outlet (0.376 mg/L to 0.423 mg/L) were lower compared to the background concentration in the Red River upstream of the Outlet (0.461 mg/L; Figure NM8-18), and were well below the spring flood baseline concentrations.

The nitrate + nitrite-N concentrations measured in the Floodway Channel in June were all elevated above the range of the summer baseline criteria (Figure NM8-19). During the remaining months that represent the non-flood/unfrozen condition, the nitrate + nitrite-N concentrations measured were typically within the range of the summer baseline values with the exception of the Keewatin Weir in May (S-21; 0.989 mg/L), downstream of North Bibeau Drain

in July (S-14; 1.100 mg/L) and downstream of Grande Pointe Drain in August (S-13; 0.766 mg/L). However, the nitrate + nitrite-N concentrations measured during these three months were within the range of summer baseline concentrations in the Floodway Channel at the Outlet and they were similar or lower than the concentrations in the Red River, except for June. When comparing the downstream of the Outlet locations on the Red River to the background concentration upstream of the Outlet, there were minor increases of nitrate + nitrite-N concentrations measured in July and October, and moderate increases in June. The elevated nitrate + nitrite-N concentrations in the Floodway Channel and subsequently in the Red River, are likely the result of elevated nitrate + nitrite-N concentrations in several of the drains flowing into the Floodway Channel from agricultural fields in the surrounding area and not due to construction activities as no nutrients have been applied in 2009.

The nitrate + nitrite-N concentrations were not compared to winter baseline concentrations as there are none available, however, the concentrations measured in the Floodway Channel were typically within the range of summer baseline concentrations during the monthly monitoring representing the non-flood/frozen condition (Figure NM8-20). Exceptions included the sample collected from downstream of Grande Pointe Drain (S-13; 0.923 mg/L) and the downstream of construction (Station 50+900; 0.4380 mg/L) locations in February. As well, the concentrations at the Keewatin and Springhill Weir locations (<1 mg/L) appear to be elevated above baseline concentrations in December; however this is due to laboratory error as the lab used a higher detection limit of 1 mg/L instead of the previous detection limit of 0.005 mg/L. There was no seeding with fertilizer application during the winter months that would contribute to the elevated nitrate + nitrite-N concentrations. As previously noted, the increased nutrient levels in February could be attributed to run-off from the February 9<sup>th</sup> rain event flowing over the areas that were fertilized in November 2008. The concentrations of nitrate + nitrite-N sampled from the Red River downstream of the Outlet in January through March and in December were similar or lower than the background conditions sampled upstream. Further, with the exception of the sample collected in February, the concentrations measured at the downstream of construction location (Station 50+900) in the remaining months representing the non-flood/frozen condition were lower than the concentrations measured in the Red River.

The nitrate + nitrite-N concentrations measured in the Red River at the Floodway Outlet during 2009 were compared to the 10<sup>th</sup> to 90<sup>th</sup> percentile range of monthly historical data collected

once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. The nitrate + nitrite-N concentrations measured during half of the 2009 monthly monitoring were within or below the 10<sup>th</sup> to 90<sup>th</sup> percentile ranges (Figure NM8-21). During the January, February, June, October, November, and December monthly monitoring events, the nitrate + nitrite-N concentrations in the Red River both upstream and downstream of the Outlet were higher than their respective historical 90<sup>th</sup> percentiles. The elevated nitrate + nitrite-N concentrations above historical concentrations are not a result of construction however, as the concentrations downstream of the Outlet were very similar or lower compared to the background concentrations upstream of the Outlet, with the exception of moderate elevations in January, June and October. The moderate concentration increases measured in January and October (1.020 mg/L to 1.170 mg/L and 0.817 mg/L to 1.100 mg/L, respectively) compared to the background concentrations upstream of the Outlet (1.030 mg/L and 0.951 mg/L, respectively) were not likely due to construction activities within the Floodway Channel because the nitrate + nitrite-N concentrations within the Floodway were lower than the Red River concentrations. The higher than normal precipitation in June and subsequent run-off that would have occurred may have contributed to the extent of the increased concentrations measured in the Red River samples during this month.

The nitrate + nitrite-N concentrations measured in the Manness and Domain Drains along the West Dyke ranged from <0.005 to 5.310 mg/L and 0.033 to 7.410 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). These concentrations were generally within the baseline range of concentrations measured in the Manness and Domain Drains (0.040 to 4.650 mg/L and 0.010 to 3.910 mg/L, respectively) except for the concentration at the Manness Drain during May (5.310 mg/L) and Domain Drain during June (7.41 mg/L). The elevated concentration at the Manness Drain may be due to the wet conditions after the spring flood and the drainage of agricultural fields. The elevated concentration at the Domain Drain may be associated with the higher TSS concentration measured during June and a not a result of construction activities as there were no activities in the immediate vicinity of the drain in 2009.

### ***Event-Based Monitoring***

Nitrate + nitrite-N was analyzed during 3 of the 10 event-based monitoring events conducted in 2009, however all Level I event-based monitoring events were in conjunction with a monthly

monitoring event and therefore were analyzed as part of the routine analysis. Therefore analyses of these results are described above in the discussion for non-flood/unfrozen conditions. There were no nutrients applied on the slopes of the Floodway Channel during the 2009 year, therefore only TSS was analyzed for all Level I event-based events that were not completed in conjunction with the monthly monitoring event.

### 3.2.6 Potassium

The comparison of potassium concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-22, NM8-23, and NM8-24, respectively.

All of the potassium concentrations measured in the Floodway Channel during the spring flood condition were at or below the spring flood baseline values. The potassium value measured in the Floodway Channel downstream of construction (Station 50+900; 8.45 mg/L) was slightly elevated compared to the background potassium value upstream of construction (8.18 mg/L; Station 11+000; Figure NM8-22). However, the potassium concentrations measured in the Floodway Channel were all within the spring flood baseline concentrations. Additionally, the potassium concentrations measured in the Floodway Channel were lower than the concentrations in the Red River and would have resulted in dilution, however; minor concentrations increases were observed in the Red River downstream of the Outlet (8.84 to 9.10 mg/L) compared to upstream of the Outlet (8.79 mg/L). All Red River concentrations were within spring flood baseline criteria.

With the exception of the June monthly monitoring event and several locations in May, July and August, the potassium concentrations measured in the Floodway Channel during the monthly monitoring representing the non-flood/unfrozen condition were generally lower or within the range of summer baseline criteria (Figure NM8-23). The more notable exception included the upstream of construction station, which was elevated above the site-specific baseline value for all months (5.59 mg/L to 7.87mg/L), however; was below the overall summer baseline value, except for May and August. As well, the concentration of potassium in the Floodway Channel downstream of Grande Pointe Drain (S-13) was elevated above the site-specific baseline value

from May through August (5.56 mg/L to 7.30 mg/L), however was below the overall summer baseline concentration. The concentration of potassium in the Floodway Channel was elevated above the summer baseline conditions for several locations, which included the Keewatin Weir in May (8.17 mg/L), the Spring Hill Weir in July (13.10 mg/L) and the upstream of construction location in May and August (7.63 mg/L and 7.87 mg/L, respectively). Additionally, potassium concentrations in May and August at PTH Hwy 44 Weir (7.19 mg/L and 6.89 mg/L, respectively) and the downstream of construction location (Station 50+900; 7.18 mg/L and 6.88 mg/L, respectively) were slightly elevated above the site specific summer baseline values, however; were below the overall baseline value. With the exception of June, the concentration of potassium for all months at the upstream of construction location was slightly elevated compared to the downstream of construction location, therefore; the increased potassium concentrations are not likely due to construction activities within the Floodway Channel. Further, the concentrations at the downstream of construction location (Station 50+900) were lower than the background concentration upstream of the Outlet on the Red River. Additionally, the Red River samples downstream of the Outlet had concentrations of potassium that were either less than the background conditions upstream or had negligible increases, and all of the samples were within the baseline range.

The potassium concentrations were not compared to winter baseline concentrations as there are none available, however, the concentrations measured in the Floodway Channel were typically within the range of summer baseline concentrations during the monthly monitoring representing the non-flood/frozen condition, with the exception of February (Figure NM8-24). Additionally, the concentrations of potassium in the Floodway Channel in January, March, and December were lower at the downstream of construction (Station 50+900) location and did not contribute to the elevated potassium concentrations in the Red River downstream of the Outlet compared to the background concentration upstream of the Outlet. Several of the potassium concentrations measured in February were well above the upper range of the summer baseline and included the Spring Hill Weir (S-23; 10.1 mg/L), Dunning Weir (S-25; 13.3 mg/L) and downstream of construction (Station 50+900; 13.2 mg/L) locations. The elevated potassium concentration at the downstream of construction location in February may have resulted in the minor concentration increase measured in the Red River 1 km downstream of the Outlet (8.86 mg/L) compared to the background concentration upstream of the Outlet (8.43 mg/L). However,

all of the Red River potassium concentrations for the remaining months had concentrations downstream of the Outlet below the background concentration upstream of the Outlet.

The potassium concentrations measured in the Red River at the Floodway Outlet during 2009 were compared to the 10<sup>th</sup> to 90<sup>th</sup> percentile range of monthly historical data collected once a month by Manitoba Water Stewardship from the Red River at Selkirk for the period of record available from 1970 to 2003. The potassium concentrations measured 1 km downstream of the Outlet during February and upstream of the Outlet during October were higher than the 90<sup>th</sup> percentile, whereas all other months during 2009 were within or lower than the 10<sup>th</sup> to 90<sup>th</sup> percentile ranges (Figure NM8-25). The slight increase in concentration of potassium at the station 1 km downstream of the Outlet was negligible and was likely the result of natural variation in the Red River and not related to construction as the remaining downstream samples were below the background concentrations for potassium.

The potassium concentrations measured in the Manness and Domain Drains along the West Dyke ranged from 11.30 to 20 mg/L and 8.05 to 23 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). These concentrations were generally within the baseline range of concentrations measured in the Manness and Domain Drains (8.4 to 17.8 mg/L and 7.99 to 18.9 mg/L, respectively) except for the concentration at the Manness Drain during September (20 mg/L) and Domain Drain during November (23 mg/L). The elevated concentrations at the Manness and Domain Drains may be associated with the elevated specific conductivity concentrations measured during September, however, there were no construction activities during September that would cause an increased potassium concentration.

### **3.2.7 Sodium**

The comparison of sodium concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-26, and NM8-27, and NM8-28.

All of the sodium concentrations measured in the Floodway Channel in April were below the spring flood baseline concentrations (Figure NM8-26). There was a slight increase between concentrations at the upstream and downstream of construction locations; however, as all of the samples were below the baseline and, the increase was not likely related to construction activities. Additionally, all Red River concentrations downstream of the Outlet (8.16 to 8.62 mg/L) were lower than the sodium concentration upstream of the Outlet (8.81 mg/L).

The sodium concentrations measured in the Floodway Channel during the monthly monitoring representing the non-flood/unfrozen condition were within the range of summer baseline values (Figure NM8-27). The concentrations of sodium at the downstream of construction location (Station 50+900) were lower than the background conditions upstream of the Outlet on the Red River and therefore would have resulted in dilution for all months. However, all Red River concentrations during October were elevated above the summer baseline concentrations, but it was unlikely due to construction activities in the Floodway Channel as all Floodway Channel concentrations were below baseline. Additionally, all the months when compared to the non-flood/unfrozen baseline conditions, generally had lower concentrations of sodium at the downstream Red River locations compared to the background concentration upstream of the Outlet.

The sodium concentrations measured in the Floodway Channel were within or below the range of the winter baseline values (70.5 to 165 mg/L) during the monthly monitoring representing the non-flood/frozen condition with the exception of three sample locations in February (Figure NM8-28). In February several locations were elevated above the winter baseline concentrations and included the Spring Hill Weir (S-23; 170 mg/L), Dunning Weir (S-25; 215 mg/L) and the downstream of construction location (Station 50+900; 247 mg/L). There were no construction activities in February that would contribute to the elevated sodium concentrations, however; the elevated concentrations may be a result of the above freezing temperatures during February 9<sup>th</sup> through 11<sup>th</sup> and in conjunction with a heavy rainfall of 26.5 mm that occurred on February 9<sup>th</sup>. This may have resulted in road salts being flushed into the Floodway Channel via the Transcona Storm Sewer that were not diluted with typical spring melt water. The elevated sodium concentrations from the Floodway Outlet may have resulted in a minor concentration increase measured in the Red River 1 km downstream of the Outlet (66.4 mg/L) compared to the background concentration upstream of the Outlet (61.4 mg/L). However, all other Red River

concentrations in February were lower than the background concentration upstream of the Outlet. In January, there was also a moderate increase in the sodium concentrations in the Red River downstream of the Outlet (59.5 to 70.3 mg/L) compared to the background concentration upstream of the Outlet (56.7 mg/L). The elevated concentrations in January were not likely due to construction activities within the Floodway Channel because the sodium concentrations measured in the Floodway Channel at the Outlet (67.2 mg/L) and all other channel locations (62.4 to 81.4 mg/L) were similar compared to the Red River concentrations. Additionally, as stated above, all Floodway Channel locations were below the winter baseline values. The minor sodium concentration in the Red River has no basis for evaluation, as there is no established CCME sodium criterion for the protection of freshwater aquatic life.

The sodium concentrations measured in the Manness and Domain Drains along the West Dyke ranged from 5.50 to 166 mg/L and 2.31 to 36.8 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). The concentrations measured in the Manness and Domain Drains were generally elevated above baseline criteria 4.79 to 76 mg/L and 2.36 to 18.2 mg/L, respectively. Elevated sodium concentrations also coincide with elevated specific conductance concentrations, however, there were no construction activities occurring adjacent to the either of the drain locations that would release sodium concentrations into the drain locations during 2009.

### **3.2.8 Chloride**

The comparison of chloride concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-29, NM8-30, and NM8-31.

The chloride concentration measured downstream of construction (15.5 mg/L) was slightly elevated above the upstream of construction location (12.6 mg/L; Figure NM8-29). However, all chloride concentrations in the Floodway Channel were below spring flood baseline data. Additionally, all Red River concentrations downstream of the Outlet (13.6 to 13.9 mg/L) were lower than the Chloride concentrations upstream of the Outlet (14.2 mg/L).

The chloride concentrations measured in the Floodway Channel during the monthly monitoring representing the non-flood/unfrozen condition were within the range of summer baseline criteria (Figure NM8-30). The concentration of chloride measured downstream of construction (Station 50+900) was slightly elevated in June, August, September, October and November (13.1 mg/L, 18.5 mg/L, 25.9 mg/L, 25.8 mg/L, 25.9 mg/L, respectively) compared to the background condition upstream of construction (Station 11+000; 12.7 mg/L, 17.6 mg/L, 21.3 mg/L, 23.7 mg/L, 23.4 mg/L, respectively). Although these minor concentration increases were observed in the Floodway Channel, the concentration at the Outlet was lower than the background condition upstream of the Outlet on the Red River and therefore; the chloride concentrations did not increase concentrations downstream of the Outlet in the Red River compared to the background conditions upstream of the Outlet.

The chloride concentrations measured in the Floodway Channel downstream of construction and at the other Floodway Channel locations were all within or below the range of winter baseline values (60 to 205 mg/L) during the monthly monitoring representing the non-flood/frozen condition with the exception of three stations in February (Figure NM8-31). In February the Spring Hill Weir (S-23; 256 mg/L), Dunning Weir (S-25; 368 mg/L), and the downstream of construction location (Station 50+900; 415 mg/L) resulted in concentrations above the upper range for the winter baseline criteria. There were no construction activities that would contribute to the elevated chloride concentrations, however, as discussed earlier in reference to sodium concentrations, the elevated concentrations of chloride may be in part a result of the above freezing temperatures and rain event in early February which may have resulted in road salts being flushed into the Floodway Channel by the Transcona Storm Sewer. The elevated chloride concentrations from the Floodway Outlet may have resulted in the minor concentration increase measured in the Red River 2 km downstream of the Outlet (65 mg/L) compared to the background concentration upstream of the Outlet (63 mg/L) in February. During the months of January, March and December there were slight elevations in chloride concentrations in the Red River downstream of the Outlet compared to the background condition upstream of the Outlet, however; as noted, all of the samples collected during these months were well within or below the winter baseline values. The minor chloride concentration increase in the Red River during February has no basis for evaluation, as there is no established CCME chloride criterion for the protection of freshwater aquatic life.

The chloride concentrations measured in the Manness and Domain Drains along the West Dyke ranged from 16.7 to 760 mg/L and 9.1 to 122 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). The concentrations measured in the Manness and Domain Drains were elevated above baseline criteria 15 to 380 mg/L and 10 to 71 mg/L, respectively, for both drain locations. Elevated chloride concentrations also coincide with elevated specific conductance concentrations, however, there were no construction activities occurring adjacent to the either of the drain locations that would release chloride concentrations into the drains during 2009.

### **3.2.9 Iron**

During the 2009 construction monitoring there were several occurrences of iron concentrations above the CCME criteria for the protection of freshwater aquatic life (0.30 mg/L; Table NM8-2), similar to what was observed during baseline and 2005 through 2008 construction monitoring. Iron concentrations are likely influenced, in part, by the presence of high levels of suspended sediment in the samples, which contributes to the iron when the samples are acidified for analysis.

During the spring flood condition, the concentration of iron measured in the Floodway Channel was elevated above the CCME criteria at all sample locations. Further, the downstream of construction location (Station 50+900; 1.99 mg/L) was elevated above the background condition sampled upstream of construction (Station 11+000; 1.53 mg/L). Additionally, the concentration of iron in the Red River samples collected 500 m, 2 km, and 3 km downstream of the Outlet (3.06 mg/L, 3.17 mg/L, and 3.21 mg/L) were elevated above the background concentration collected upstream of the Outlet (2.77 mg/L; Table NM8-2). Concentrations of iron above the CCME criteria were also measured in most of the drains entering the Floodway. The elevated concentrations of iron are neither attributed to construction nor are they of concern, as concentrations ranging from 0.32 to 3.34 mg/L were measured during the baseline sampling for the spring flood condition.

The iron concentrations measured in the Floodway Channel varied monthly during the monitoring representing the non-flood/unfrozen condition (Table NM8-2). There were exceedances of the CCME criteria during a majority of the months representing non-

flood/unfrozen condition at every station in the Floodway Channel. The average elevated iron concentration in the Floodway Channel generally was 0.41 mg/L, which was similar to the exceedances measured during the baseline monitoring (0.31 to 0.81 mg/L); however, there were a few considerable exceedances as high as of 2.20 mg/L. In June, July and November the concentrations of iron at the downstream of construction location (1.86 mg/L, 0.383 mg/L, and 0.326 mg/L, respectively) were elevated compared to the concentration at the upstream of construction location (0.971 mg/L, 0.119 mg/L, and 0.326 mg/L, respectively). These elevated concentrations are within the range of concentrations measured during the baseline monitoring in the Red River (0.31 to 1.56 mg/L).

The iron concentrations measured in the Floodway Channel were generally below the CCME criteria during the monthly monitoring representing the non-flood/frozen condition (Table NM8-2). However, elevated iron concentrations above the CCME criteria were typically measured at a couple of locations in the Floodway Channel during each month (0.32 to 0.53 mg/L). These elevated iron concentrations are again, reflective of similar exceedances measured in the Floodway Channel (0.31 to 0.81 mg/L) during baseline monitoring. There were no elevated iron concentrations above the CCME criteria measured at the downstream of construction (Station 50+900) location compared to the upstream of construction (Station 11+000) location for any of the months representing the non-flood/frozen condition.

The iron concentrations measured in the Manness and Domain Drains along the West Dyke ranged from 0.038 to 1.970 mg/L and 0.222 to 3.780 mg/L, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). These iron concentrations typically exceeded the CCME criteria (0.30 mg/L), except for those measured in the Manness Drain during May, August, October and November and the Domain Drain during October. These elevated concentrations, also exceeded the baseline range of concentrations measured in the Manness and Domain Drains (0.21 to 0.93 mg/L and 0.15 to 1.06 mg/L, respectively). There were no construction activities in the immediate vicinity of the drains during 2009 that would release iron into the drains; therefore it is likely due to natural variation.

### 3.2.10 Petroleum Hydrocarbons

The concentration of petroleum hydrocarbons analyzed (Benzene, Toluene, Ethyl-benzene, Xylenes (-o,-m,-p), and hydrocarbon fractions F1 to F4) were below detection limits in the Floodway Channel downstream of the construction area during each of the monthly monitoring events (Table NM8-3). The concentrations of petroleum hydrocarbons were below detection limits in the Floodway Channel upstream of construction when samples could be collected during the April (spring melt), May June, July, August, September, October and November monthly monitoring. Although there was no water upstream of the construction area to sample as a background condition during January, February, March or December the concentration of petroleum hydrocarbons analyzed downstream of construction were below detection limits, therefore petroleum hydrocarbons were not considered an issue during the monthly monitoring in 2009.

### 3.2.11 Bacterial

The comparison of *E.Coli* concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the monthly construction monitoring events for the spring flood, non-flood/unfrozen and non-flood/frozen conditions are shown on Figures NM8-32, MM8-33, and NM8-34, respectively. The laboratory analysis method used for Total Coliform and *E.Coli* testing was the M-coli Blue membrane filtration analysis method, which has an upper detection limit of 1500 to 2000 CFU/100 mL. Samples in which the bacteria exceed the upper limit of 2000 CFU/100 mL are identified as overgrown.

*E.Coli* concentrations measured in the Floodway channel were very similar to the baseline values during the monthly monitoring representing the flood condition (Figure NM8-32; Table 8-4). However, moderate concentration increases in *E.Coli* were measured downstream of construction (Station 50+900; 30 CFU/100 mL) compared to upstream of construction (Station 11+000; 10 CFU/100 mL). The slightly elevated concentrations of *E.Coli* in the Floodway Channel included downstream of Grande Point Drain (S-13; 30 CFU/100mL), downstream of North Bibeau Drain (S-14; 30 CFU/100mL), and Spring Hill Weir (S-23; 40 CFU/100mL) and were not attributed to construction as there were no construction activities that would release

bacteria into the Floodway Channel. Additionally, slightly elevated concentrations in the Floodway Channel did not result in increased *E.Coli* concentrations downstream of the Outlet (<10 to 40 CFU/100 mL) compared to upstream of the Outlet (150 CFU/100 mL).

The *E.Coli* concentrations measured in the Floodway Channel varied from month to month, during the monthly monitoring representing the non-flood/unfrozen condition (Figure NM8-33). The *E.Coli* concentrations were generally within the range of the summer baseline values with the exception of June, July and August that had exceedances at site-specific sample locations, however were within the overall summer baseline criteria. During the month of September, the majority of sample locations were elevated above site-specific summer baseline criteria, however; all locations were within the overall baseline range, except for at the Dunning Weir (S-25; 870 CFU/100 mL). *E.Coli* concentrations in the Floodway Channel at the downstream of construction location (Station 50+900) were elevated when compared to the upstream of construction location (Station 11+000) in May, July, August, September and October. Further, in May, September and October there were elevated concentrations of *E.Coli* in the Red River at several sample locations downstream of the Outlet when compared to the background concentration upstream of the Outlet. However; there were no construction activities occurring in the Floodway Channel that would have resulted in the release of bacteria into the construction area; therefore the elevated concentrations are likely due to runoff from off-site.

The *E.Coli* concentrations were not compared to winter baseline concentrations as there were none available, however, the concentrations measured in the Floodway Channel were generally below the detection limit of 10 CFU/100mL or within the summer baseline concentrations (16 to 630 CFU/100 mL) during the monthly monitoring representing the non-flood/frozen condition, with a few exceptions (Figure NM8-34). During January the concentrations measured in the Floodway Channel at the Keewatin weir, Spring Hill weir, and Dunning Weir locations were all overgrown. Additionally, the concentration measured at the Dunning Weir (560 CFU/100 mL) in February was also elevated above the summer baseline range. Further, in February, March, and December there were elevations in the concentrations of *E.Coli* on the Red River at several of the sample locations downstream of the Outlet when compared to the background concentration upstream of the Outlet. The elevated *E.Coli* concentrations, however, were not attributed to construction, as there were no construction activities in the Floodway Channel that would release bacteria into the construction area.

The *E.Coli* concentrations measured in the Manness and Domain Drains along the West Dyke ranged from <10 to 110 CFU/100 mL and <10 to 660 CFU/100 mL, respectively, during the monthly monitoring in which samples could be collected (Table NM8-2). These concentrations were typically within the baseline range of concentrations measured in the Manness and Domain Drains (11 CFU/100 mL to overgrown and <10 to 650 CFU/100 mL, respectively), except for the sample obtained from the Domain Drain in July (660 mg/L). There were no construction activities occurring immediately adjacent to the Domain Drain in 2009, therefore, the elevated concentration is likely due to natural variation.

### **3.2.12 Herbicides**

The concentration of herbicides analyzed (2,4-D, AMPA, Bromoxynil, Dicamba, Glyphosate, MCPA and Picloram) were below the laboratory analysis detection limits for the samples collected in the Floodway Channel both upstream and downstream of the revegetation area during the spring melt represented by the April monthly monitoring (Table NM8-5). There were no herbicides applied during the 2009 construction year and therefore no other herbicide monitoring was conducted beyond the spring melt condition which was sampled to assess the run-off from agricultural fields. Based on these results herbicides were not a concern during the 2009 construction year.

## 4.0 SUMMARY AND CONCLUSIONS

1. The 2009 construction surface water quality monitoring program was conducted from January to December 2009 in conjunction with the on-going construction activities that occurred from Station 11+200 to 50+500. This consisted of;
  - a. All the Channel contracts, except C-1, C-2, C3a, C3b, C3c, C4, C5, C6a, C6b, C7a, C7b, and C8a, that were completed prior to 2009;
  - b. Bridge contracts for CNR Redditt (T11), CPR Keewatin (T14), CPR Emerson (T15), P.T.H Hwy 44 Bridge (T17) and P.T.H. Hwy 15 Bridge (T18);
  - c. Culvert replacement at Prairie Grove Road over the Seine River (T16)
  - d. The erosion protection on the Red River (CE2)
  - e. The Inlet and Outlet structures;
  - f. The East Dyke earthwork contract (ED1) and;
  - g. The West Dyke earthworks contracts (W12, W19, W20, W21, W22, W23, W24, W25, W26, W27, W28, W29).
2. Samples were collected from the Red River at the Inlet and Outlet, at 11 locations along the Floodway Channel including the upstream and downstream ends of the construction and revegetation zones, at 11 of the outfall drains flowing into the Floodway and at 2 drains along the West Dyke, when there was a sufficient amount of water to collect a sample.
3. At each sampling location, field data was obtained (conductivity, pH, temperature, EC and turbidity) and water samples were submitted to an accredited laboratory for testing (including inorganic parameters, turbidity, TSS and bacteria). Benzene, toluene, ethylbenzene and xylenes (BTEX) and hydrocarbon fractions F1 to F4 were also analyzed when samples could be collected at the upstream and downstream of construction locations. During the April (spring melt) monitoring laboratory analysis also included phenoxy acid herbicide screen (2,4-D, bromoxynil, dicamba, MCPA and picloram), AMPA and glyphosate, at the upstream and downstream of revegetation locations. These results were compared to the floodway baseline surface water data, based on sampling in April to August, 2005 and applicable CCME criteria.
4. There were twelve (12) monthly monitoring events, with one conducted each month following precipitation events, near the end of the month if a substantial precipitation event had not yet occurred, or at the peak flood during Red River Flood conditions. There were ten (10) Level I event-based monitoring events conducted between May and August, 2009 in response to precipitation levels greater than 10 mm.
5. Results of the 10 Level I event-based monitoring events conducted between May and August have typically indicated very small changes in TSS concentration in the Red River during the 2009 construction year. The largest increase was on July 31, which resulted in a change of 0.28 mg/L or 4.29%. This increase in TSS concentration was within the CCME criteria of an allowable increase of 25 mg/L. Nearly all the other Level I event-based monitoring measured a change of less than 1.0% and over half of these were a decrease in TSS concentration, therefore, no Level II event-based monitoring was required during the 2009 construction year.

6. During the spring flood condition in 2009, concentrations of most parameters measured in the Floodway Channel were typically below the spring flood baseline values, with the exception of *E.Coli* concentrations, which were measured throughout the Floodway Channel at concentrations at or above the spring baseline values. Within the Red River, the concentrations of these parameters were typically higher upstream of the Outlet when compared to sample locations downstream of the Outlet indicating that the input from the Floodway was not having a significant affect on the concentrations of these parameters in the Red River.
7. Within the non-flood unfrozen condition in 2009, concentrations of most parameters measured in the Floodway Channel were generally within the summer baseline concentrations. During June, several of the parameters including total phosphorus, ammonia, nitrate + nitrite-N, potassium and *E.Coli* concentrations were above summer baseline values; however, this was attributed to higher concentrations of these parameters entering the Floodway Channel via drains from run-off by agricultural fields. *E.Coli* concentrations were typically below or within baseline criteria, however, concentrations were elevated above criteria in the Floodway Channel for July and September. There were no construction activities occurring in the Floodway Channel that would release bacteria into the construction area, therefore the elevated concentrations are likely due to runoff from off-site. Iron concentrations were typically elevated above the CCME criteria, however these elevated concentrations are not a concern as elevated concentrations above CCME criteria were noted during baseline sampling in 2005. With the exception of samples collected in June, for many of the parameters measured with elevated concentrations within the Floodway Channel, the concentrations downstream of construction within the channel were typically lower than background conditions in the Red River. Therefore, the elevated concentrations in the Floodway Channel would have no effect on concentrations in the Red River or result in dilution if anything.
8. During the non-flood unfrozen condition monthly monitoring events, parameter concentrations measured in the Red River downstream of the Outlet were typically similar to the background concentrations upstream of the Outlet, ranging from slightly lower to slightly higher, although elevated concentrations downstream were measured for TSS, ammonia, total phosphorus, nitrate + nitrite-N, and *E.Coli* concentrations. The TSS concentration increases measured in the Red River downstream of the Outlet were all less than the CCME criteria of an allowable increase of 25 mg/L and therefore are within criteria. The TSS concentrations were likely the result of natural variation, as concentrations at the Outlet were lower than concentrations in the Red River and would have resulted in dilution if anything. As no nutrients were added during the 2009 construction season, the elevated concentrations of ammonia, total phosphorus and nitrate + nitrite-N were not related to construction activities. Elevated concentrations of *E.Coli* downstream of the Outlet compared to background concentration upstream of the Outlet were measured during May, September, October and November, however; were not attributed to construction activities, nor were they a concern as concentrations were typically within the range measured during baseline monitoring.
9. Concentrations of most parameters measured in the Floodway Channel were within the winter baseline concentrations (or the summer baseline if there was no winter baseline) with the exception of a few locations sampled in February where the concentration of several parameters (specific conductance, ammonia, sodium, chloride, and *E.Coli*) were

elevated above baseline criteria. The elevations of parameter concentrations in February were likely influenced by a rain event carrying nutrients and road salts in the surface water run-off entering the Floodway Channel from agricultural drains and storm sewers. A few exceedances were recorded for concentrations of ammonia and *E.Coli* in January, however; the elevated concentrations of ammonia were not attributed to construction activities as no seeding would have occurred during the winter months and no nutrients were applied during the 2009 construction season. Further, the elevated ammonia concentrations did not result in an exceedance of the CCME un-ionized ammonia criteria. The elevated concentrations of *E.Coli* were not attributed to construction, as there were no construction activities that would release bacteria into the construction area. Further, there is no basis for an evaluation of *E.Coli*, as there are no applicable CCME criteria.

10. Parameter concentrations measured in the Red River downstream of the Outlet during the non-flood frozen condition were typically similar to or lower than the background concentrations upstream of the Outlet ranging from slightly lower to slightly higher. However, concentrations on the Red River approximately 2 km downstream of the Outlet resulted in elevated concentrations for several parameters (TSS, total phosphorus, chloride and *E.Coli*) compared to the background concentrations upstream of the Outlet. These elevations are likely due to natural variation as the Red River is ice-covered and the concentrations in the Floodway Channel at the Outlet are lower than the concentrations in the Red River. Concentrations of ammonia measured in the Red River downstream of the Outlet were elevated above the background concentration upstream of the Outlet, however, none of the ammonia concentrations in the Red River exceeded the CCME criteria for unionized ammonia. During the majority of the monthly monitoring events the concentrations at the downstream of construction location were lower than the background concentration upstream of the Outlet, and therefore would have resulted in dilution if anything.
11. Concentrations of most parameters measured in the Manness and Domain Drains along the West Dyke were elevated above the baseline concentrations during the monthly monitoring events that samples could be collected. Parameters that were within the baseline criteria included TSS and ammonia. All other parameters had at least one concentration elevated above baseline criteria for either the Manness or Domain Drains. Although construction activities were occurring adjacent to the Manness Drain in June and July 2009, the work consisted of rip rap application that was completed in August 2009. There were no construction activities that were occurring immediately adjacent to the Domain Drain in 2009, therefore elevated concentrations in the Manness and Domain Drains in 2009 were likely the result of natural variation.

## 5.0 RECOMMENDATIONS

Based on the results of the 2009 Construction monitoring events, recommendations and refinements for the ongoing monitoring should include the following;

- The 2010 Surface Water Sampling Program should consist of Event-based monitoring focusing on contract specific construction monitoring and assessing the surface water quality as it relates to potential groundwater impacts. In addition to conducting the Level I and II Rain and Spill Event-based monitoring as previously conducted, Event-based monitoring during 2010 should also be conducted in response to elevated water levels in the floodway channel when there is the greatest potential for surface water to affect the groundwater quality (Floodway Flow). This Floodway Flow Event-based monitoring should be conducted when the water level in the Floodway overtops the Low Flow Channel either from elevated Red River water levels (spring or summer flooding) or prolonged precipitation events.
- The Event-based monitoring should replace the regular Monthly monitoring, however, during the unfrozen conditions, typically from April to October, if there is no event-based monitoring triggered during a month then at a minimum samples should be collected in the Floodway Channel upstream and downstream of the overall construction area.
- To assess contract specific effects during the Event-based monitoring new sample locations should be established in the La Salle River upstream and downstream of where the new Glenlea Drain discharges and in the Seine River upstream and downstream of the new culvert on Prairie Grove road. Additionally, during the Level I Event-based monitoring samples should be collected from the Floodway Channel upstream and downstream of each contract area. Whereas, the sample locations in the Manness and Domain Drains adjacent the West Dyke are no longer required during 2010 as the construction activities in the vicinity of these locations was completed in 2009.
- The rain Event-based monitoring in 2010 should continue to follow the protocol used in 2009 with the additional sample locations noted above to identify contract specific effects. To assess potential effects of surface water on groundwater quality, samples collected during the rain Event-based monitoring should also be submitted for laboratory analysis of pH and conductivity. This revised protocol should be reviewed again during the 2010 monitoring program and revised if required as construction contracts near completion.
- With the introduction of the Nutrient Management Regulation (62/2008) no fertilizers have been applied to the Floodway Channel slopes since 2008. Therefore fewer nutrient parameters should be submitted for laboratory analysis and less frequently than previously.
- The reporting protocol for the 2010 surface water monitoring program should continue to follow the slight modifications made in 2008 to flag potential increases in TSS concentrations more rapidly. This included completing a Level I event-based worksheet for each of the monitoring events to provide an indication as to whether the sediment concentration in the Floodway will have a potential impact on the Red River downstream of the Floodway Outlet. If the worksheet indicates no potential impact then the results would be

reported in the monthly monitoring report, whereas, if a potential impact is identified then MFA would be notified immediately and the laboratory would be contacted to request the TSS analysis results as soon as possible. Appropriate measures would then be developed with MFA based on the TSS laboratory results.

## 6.0 REFERENCES

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## TABLES

## FIGURES

## APPENDICES

**APPENDIX A**  
**SURFACE WATER MONITORING – 2009 SAMPLING PROGRAM**

## **APPENDIX B**

### **MANITOBA WATER STEWARDSHIP, WEEKLY RIVER FLOW REPORT RED RIVER NEAR SELKIRK**

**APPENDIX C**

**ENVIRONMENT CANADA  
WINNIPEG INT'L A, MANITOBA – DAILY DATA REPORTS  
JANUARY - DECEMBER 2009**