Manitoba Floodway Authority

Red River Floodway Expansion Project
2010 Construction Surface Water Monitoring Report
.9905246 NM9

FINAL REV A

March 2011

Prepared By

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File No. 05-1100-01.19.06.03

Manitoba Floodway Authority
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ATTENTION: Ms. Leanne Shewchuk
Manager of Environmental Services

RE: Red River Floodway Expansion Project
2010 Construction Surface Water Monitoring Report
Memo Reference: .9905246 NM9
Final Report – March 2011

Dear Ms. Shewchuk:

Please find enclosed twenty (20) paper copies and one (1) electronic copy of the Final Report for the 2010 Construction Surface Water Monitoring of the Red River Floodway Expansion. An electronic copy of each individual Final Monthly Monitoring Report from April to October 2010 has been previously provided, as supporting documents for the MFA web page.

This annual construction report describes the analysis results for samples collected from the Red River, the Floodway Channel, the drains flowing into the Floodway Channel, the La Salle River at the Glenlea Drain and the Seine River at the Prairie Grove Road Culvert locations during the 2010 construction time period. The data includes the Event-based monitoring 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), as well as following potential erosion causing precipitation (Rain) or reported spills (Spill).

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

Yours truly,

Original Signed By: Dave B. MacMillan

Dave MacMillan, P. Eng.
Principal

SM/dbm/sp
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 2010 construction monitoring report. Comparison of the 2010 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.

Construction Surface Water monitoring conducted from 2005 to 2009 has confirmed that the effects of the project on surface water quality have not been significant with the mitigation measures that have been implemented. The large earth moving contracts for the Floodway Channel were mostly completed prior to 2009 and are now predominately covered by an established vegetation cover that will minimize erosion concerns. Additionally, with the introduction of the Nutrient Management Regulation (62/2008), no fertilizers have been applied to the Floodway Channel slopes since 2008. Likewise, pesticides have not been applied as part of the project since first tested on a small site in 2005. Finally, the majority of the construction activities are now complete, with the exception of the remaining bridge work and minor channel work. Therefore, the 2010 Surface Water Sampling Program consisted of Event-based monitoring focusing on contract specific construction monitoring and assessing the surface water quality for key parameters of interest as it relates to potential groundwater impacts.

The surface water quality monitoring program for the 2010 construction year was conducted from April to October 2010 in conjunction with the on-going construction activities. This 2010 construction report outlines the analysis results for samples collected from the Red River at the Inlet and Outlet, 9 locations along the Floodway Channel including the upstream and downstream ends of the construction zones, 11 of the outfall drains flowing into the Floodway, 2 locations in the Seine River, and 2 locations in the La Salle River. The 2010 construction monitoring data is summarized and compared to the data presented in the baseline surface water monitoring report.

Floodway Flow event-based monitoring took place during the crest of both spring and summer flood events in April and June, respectively, with monitoring also completed pre and post-crest during the spring flood event. There were fifteen (15) Level I Rain event-based monitoring events conducted between April and October, 2010, in response to precipitation levels greater than 10 mm.

Contracts that were substantially completed in 2009 but required minor work during 2010 to address deficiencies included Channel Contracts ED1 (East Dyke; Stn 4+000 – 5+300) and CE1 (Outlet Control Structure) and Bridge Contracts for CPR Keewatin Bridge (T14; Stn 30+220) and CPR Emerson Bridge (T15; Stn 11+200). Similarly, the previously completed Channel Contracts C7A (Stn 35+100 – 40+590) and C8B (Stn 40+900 – 50+430) had additional

work added to the contract in 2010. With the exception of outstanding deficiencies for CE1 all of this work was completed in 2010.

On-going construction contracts for the Floodway at the start of January 2010 consisted of Channel Contracts I2 (Inlet Control Structure) and S1 (Seine River Syphon); Bridge Contracts for P.T.H Hwy 44 Bridge (T17; Stn 48+050), and P.T.H. Hwy 15 Bridge (T18; Stn 25+700); and West Dyke Contracts for W19 (Stn 14+600) and W21 (Stn 37+300 – 40+300). These contracts were all substantially completed by the end of 2010 with the exception of some minor site clean-up or seeding or activities to address deficiencies, which will be completed in 2011.

Several new contracts were started in 2010, including C11 (Gap Enhancement; Stn 5+000 – 9+000) and GD1 (Groundwater Springs Remediation and LFC Riprap) in February; W29 (West Dyke Drainage Repairs) in April; T20 (PTH 15 and 101 Paving; Stn 25+700) and W30 (West Dyke Gravel Contract; Stn 30+500 – 37+500) in June; T19 (Pedestrian Bridge) and C13 (Channel Clean-up and Repair) in August; ED2 (Inlet Erosion Control) in September; and C12 (Bridge Pier Protection) in December. Details of the construction contracts and activities that occurred during each month are summarized in each of the individual monthly summary reports, NM9.4 – April to NM9.10 – October. Most of the work on these new contracts was completed during 2010, with the exception of some on-going work for T19, T20, C12, ED2 and GD1.

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 and summer flood 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 during the Floodway Flow event-based monitoring. Whereas, total suspended solids and specific conductance were the only parameters of interest measured during the Level I Rain event-based monitoring.

Benzene, toluene, ethylbenzene and xylenes (BTEX) and hydrocarbon fractions F1 to F4 were also analyzed when samples were collected at the upstream and downstream of construction locations during each of the Floodway Flow and Level I Rain event-based monitoring. The laboratory analysis during each of the Floodway Flow event-based monitoring also included phenoxy acid herbicide screen (2,4-D, bromoxynil, dicamba, MCPA and picloram), AMPA, and glyphosate at the upstream and downstream of construction locations.

During the spring flood monitoring in 2010, concentrations of most parameters measured in the Floodway Channel were typically below the spring flood baseline values, with the exception of specific conductance, nitrate+nitrite-N, and potassium concentrations. Within the Red River, the concentrations of specific conductance and nitrate+nitrite-N 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. Potassium concentrations downstream of the Outlet were very slightly higher than those upstream of the Outlet.

During the summer flood monitoring in 2010, concentrations of most parameters measured in the Floodway Channel were typically below the summer flood baseline values, with the exception of specific conductance, sodium, chloride, and ammonia concentrations. 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 having a neutral or dilution effect on the concentrations of these parameters in the Red River.

During the spring and summer flood monitoring in 2010, concentrations of most parameters measured in the Seine River upstream and downstream of the Prairie Grove Road Culvert were typically lower compared to the background concentration in the Seine River. A few exceptions included elevated concentrations of specific conductance, potassium, sodium, chloride and bacteria measured during the summer flood monitoring. There were no construction activities that would contribute to these concentration increases.

Results of the 15 Level I Rain event-based monitoring events conducted between April and October indicated that TSS concentrations in the Floodway Channel were often higher than the background concentration at the location upstream of the construction. However, these increases along the Floodway Channel were not a concern because the TSS concentrations in the Red River were higher than the corresponding concentrations in the water discharging from the Floodway Channel. Therefore, the mass balances show that there were no increases in TSS concentrations in the Red River downstream of the Outlet following any of the rain events in 2010. Because there were no increases in TSS concentrations, no Level II Rain event-based monitoring was required during the 2010 construction year.

It is recommended that the Construction Surface Water Monitoring program for the floodway expansion be discontinued, as of December 2010, and replaced by a Post-Construction Activities Surface Water Sampling Program as part of the Groundwater Monitoring Program. The Post-Construction Activities Surface Water Sampling Program will focus on surface water quality sampling needed to compliment groundwater quality assessments. This recommendation is based on the following:

- Nearly all of the Floodway Expansion Project work is now completed except minor site clean-up or seeding or activities to address deficiencies, which will be completed in 2011.

- The large earth moving contracts for the Floodway Channel were mostly completed prior to 2009 and are now predominately covered by and established vegetation cover that will minimize erosion concerns.

- With the introduction of the Nutrient Management Regulation (62/2008) no fertilizers have been applied to the Floodway Channel slopes since 2008 and therefore nutrient impacts from the project is no longer a concern.

- Herbicides have not been applied as part of the Floodway Expansion Project since 2005, as noted in Section 3.2.12, and therefore herbicide impacts from the project are also no longer a concern.

TABLE OF CONTENTS

PAGE

EXECUTIVE SUMMARY I

1.0 INTRODUCTION 1
1.1 INTRODUCTION 1
1.2 SCOPE OF WORK 2

2.0 METHODOLOGY 4
2.1 OVERVIEW 4
2.2 SAMPLING LOCATIONS 4
2.3 SAMPLING PROTOCOL 6
2.4 FLOW CALCULATIONS 8

3.0 RESULTS 9
3.1 HYDROLOGICAL CONDITIONS 9
3.2 WATER QUALITY 10
3.2.1 Total Suspended Solids 12
3.2.2 Specific Conductance 14
3.2.3 Total Phosphorus 16
3.2.4 Ammonia (NH3) 17
3.2.5 Nitrate + Nitrite-N 19
3.2.6 Potassium 20
3.2.7 Sodium 21
3.2.8 Chloride 23
3.2.9 Iron 24
3.2.10 Petroleum Hydrocarbons 26
3.2.11 Bacteria 26
3.2.12 Herbicides 28

4.0 SUMMARY AND CONCLUSIONS 29

5.0 RECOMMENDATIONS 31

6.0 REFERENCES 32

TABLES
FIGURES
APPENDICES

LIST OF TABLES

NM9-1 Field Surface Water Chemistry
NM9-2 General Water Quality
NM9-3 Petroleum Hydrocarbons in Surface Water
NM9-4 Bacteria in Surface Water
NM9-5 Herbicides in Surface Water
NM9-6 Rain Event-Based TSS Monitoring Review

LIST OF FIGURES

NM9-1 Floodway Channel Sample Locations
NM9-2 West Dyke Sample Locations
NM9-3 Total Suspended Solids – Spring Flood Condition
NM9-4 Total Suspended Solids – Summer Flood Condition
NM9-5 Specific Conductance – Spring Flood Condition
NM9-6 Specific Conductance – Summer Flood Condition
NM9-7 Total Phosphorus – Spring Flood Condition
NM9-8 Total Phosphorus – Summer Flood Condition
NM9-9 Ammonia – Spring Flood Condition
NM9-10 Ammonia – Summer Flood Condition
NM9-11 Nitrate + Nitrite–N – Spring Flood Condition
NM9-12 Nitrate + Nitrite–N – Summer Flood Condition
NM9-13 Potassium – Spring Flood Condition
NM9-14 Potassium – Summer Flood Condition
NM9-15 Sodium – Spring Flood Condition
NM9-16 Sodium – Summer Flood Condition
NM9-17 Chloride – Spring Flood Condition
NM9-18 Chloride – Summer Flood Condition
NM9-19 E.Coli – Spring Flood Condition
NM9-20 E.Coli – Summer Flood Condition

LIST OF APPENDICES

Appendix A Surface Water Monitoring – 2010 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, April – October 2010

1.0 INTRODUCTION

1.1 INTRODUCTION

The Environmental Impact Statement (EIS) prepared by TetrES Consultants Inc./Intergroup Consultants Ltd.[1] 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 [2] 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).

Construction Surface Water monitoring conducted from 2005 to 2009 has confirmed that the effects of the project on surface water quality have not been significant with the mitigation measures that have been implemented. The large earth moving contracts for the Floodway Channel were mostly completed prior to 2009 and are now predominately covered by an established vegetation cover that will minimize erosion concerns. Additionally, with the introduction of the Nutrient Management Regulation (62/2008), no fertilizers have been applied to the Floodway Channel slopes since 2008. Likewise, pesticides have not been applied as part of the project since first tested on a small site in 2005. Finally, the majority of the construction activities are now complete, with the exception of the remaining bridge work and minor channel work. Therefore, the 2010 Surface Water Sampling Program consisted of Event-based

monitoring focusing on contract specific construction monitoring and assessing the surface water quality for key parameters of interest as it relates to potential groundwater impacts.

A baseline surface water quality monitoring program [(3)] 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 [(4)] 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 2010 construction monitoring report and all future construction monitoring reports that will be compiled at the end of each construction year. Comparison of the 2010 monthly construction monitoring data (April to October) 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 2010 construction Surface Water Monitoring program conducted by KGS Group included the following:

- Collect **Floodway Flow Event-based** surface water quality data for parameters of interest from the Red River, La Salle River, Seine River, Floodway Channel and Drains that flow into the Floodway Channel at times when the water level in the Floodway overtops the Low Flow Channel either from elevated Red River water levels (spring and summer flooding) or prolonged precipitation events;

- Collect **Rain Event-based** surface water quality data for parameters of interest (TSS, pH and conductivity) from the Floodway Channel, La Salle River and Seine River upstream and downstream of each construction area, the Red River upstream and downstream of the Outlet and any additional required locations following precipitation events greater than 10 mm;

- Collect **Spill Event-based** surface water quality data for compliance monitoring of applicable parameters (herbicides or hydrocarbons) from the Floodway Channel upstream and downstream of the spill area, the Red River upstream and downstream of the Outlet and any additional required locations following a reported spill; and

- Provide an assessment of surface water quality comparing results of construction event-based monitoring to baseline water quality and summarized in an 2010 construction monitoring report in order to:

    - compare predictions made in modelling effects;
    - assess the effectiveness of proposed mitigation measures and adapt, if necessary; and
    - 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 2010 construction year was conducted from April to October 2010 in conjunction with the on-going construction activities. Floodway Flow event-based monitoring took place during the crest of both spring and summer flood events in April and June, respectively, with monitoring also completed pre and post-crest during the spring flood event. There were fifteen (15) Level I Rain event-based monitoring events conducted between April and October, 2010, in response to precipitation levels greater than 10 mm. No Level II Rain event-based monitoring was required during the 2010 construction year, as the results of the Level I Rain 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, as the spills that occurred during 2010 were typically small and were 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 – 2010 Sampling Program (Appendix A) that incorporated modifications made following the 2005 baseline and 2005 through 2009 construction monitoring programs. Deviations and changes from the general methodology used during the 2010 construction monitoring are described below.

2.2 SAMPLING LOCATIONS

The sample locations for the 2010 construction monitoring program are outlined on Figure NM9–1 and Figure NM9–2, listed in table NM9-1, and described as follows:

Red River at Inlet – Upstream of the Floodway Channel along the west shore of the river, the 3 replicate samples (S-01, S-02 and S-03), were only sampled during the Spring Flood in April and Summer Flood in June as proposed with no deviations from the 2010 Sampling Program.

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 all sampled during both Spring Flood and Summer Flood events, whereas only S-31 and S-34 were sampled during the fifteen (15) Level I Rain event-based monitoring events as proposed with no deviations from the 2010 Sampling Program.

Floodway Channel – The Floodway Channel downstream of the Inlet (S-04a) was not sampled during six (6) of the fifteen (15) Level I Rain event-based monitoring as there was no flow at this location. There were 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). These sample locations were all sampled as proposed with no other deviations from the 2010 Sampling Program.

Outfall Sources – During the Spring and Summer Flood events the Deacon Reservoir Drain (S-08) and the Kildare Trunk-Transcona Storm Sewer Outlet (S-12) were not sampled because the sample locations were dry and inundated, respectively. Likewise, during the Spring Flood event the Seine River Syphon Overflow (S-05) was not sampled as there was no water diverting into the Floodway Channel. The remaining eight locations (S-06, S-07, S-09, S-10, S-11, S-22, S-26 and S-27) were all sampled as proposed with no other deviations from the 2010 Sampling Program.

Seine River – Sample locations located in the Seine River immediately upstream (S-15) and downstream (S-16) of the newly installed culvert at the Prairie Road crossing were sampled during the Spring Flood and Summer Flood events and during all fifteen (15) of the Level I Rain event-based monitoring events as proposed with no deviations from the 2010 Sampling Program.

La Salle River – Sample locations located in the La Salle River 50 m upstream (S-37) and 50 m downstream (S-38) of the construction activities at the Glenlea Drain Outlet were not sampled during the Spring Flood and Summer Flood events and six (6) of the fifteen (15) Level I Rain event-based monitoring. Samples were not collected at these two locations as there was no water in the Glenlea drain discharging to the river at these times.

Floodway Channel Construction Areas **–** Samples were collected from the Floodway Channel upstream and downstream of the overall construction activities (CON U/S and CON D/S, respectively) as proposed, however, CON U/S was not sampled during six (6) of the fifteen (15) Level I Rain event-based monitoring as there was no flow at this location. 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, NM9.4 – April to NM9.10 – October.

The location upstream of construction (CON U/S) that was previously established at Station 11+000 during 2008 was moved to Station 5+500 before sampling began in 2010 to be upstream of any potential effects associated with Contract C-11. The location downstream of construction (CON D/S) that was previously established downstream of the Outlet structure at Station 50+900 during 2009 was maintained in order to measure any potential effects associated with previous construction activities at the Outlet structure.

Minimal seeding was conducted during the 2010 construction year, mostly in association with bridge replacement activities along the Floodway. However, with the introduction of the Nutrient Management Regulation (62/2008), no fertilizers have been applied to the Floodway Channel slopes since 2008.

2.3 SAMPLING PROTOCOL

Sample Frequency **–** The 2010 construction monitoring program included nineteen (19) monitoring events between April and October. Four Floodway Flow event-based monitoring events were conducted including the Spring flood with the pre- and post-crest monitoring in April and the Summer flood in June. Fifteen (15) Level I Rain event-based monitoring events were conducted between April and October 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 [(5)] as outlined in Appendix A.

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

Laboratory Analysis – The parameters submitted for laboratory analysis were consistent with previous years and varied between each event-based monitoring, as outlined in Appendix A. As previously noted key parameters of interest were selected to assess the surface water quality as it relates to potential groundwater impacts, and included a combination of the following:

- **General Chemistry** – turbidity, pH, conductivity, total alkalinity, bicarbonate, carbonate, hydroxide, hardness, chloride, fluoride, sulphate, nitrate-nitrite, calcium, magnesium, potassium, sodium, iron, manganese, total dissolved solids;
- **Total Suspended Solids** (TSS);
- **Nutrients** – ammonia, total phosphorus, total Kjeldahl nitrogen (TKN);
- **Bacterial** – total coliform and *E.Coli* by m-Coli Blue Membrane Filtration method;
- **Hydrocarbons** – fractions F1 to F4 and benzene, toluene, ethylbenzene and xylenes (BTEX); and
- **Pesticides** – phenoxy acid herbicide screen (2,4-D, bromoxynil, dicamba, MCPA, picloram), AMPA, and glyphosate.

There were no deviations from the 2010 sampling protocol with the exception that an incorrect chain of custody was submitted for the samples taken during the Level I Rain event on October 26th which, unfortunately, resulted in no analysis of TSS for these samples.

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. Quality assurance included independent quality checks of field and laboratory data completed by an experienced person. 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.

Laboratory quality control, including calibration verification standards, continuing calibration verification, certified reference material, matrix spikes, laboratory control samples, duplicates, and method blanks, were used to assure that the laboratory analyses of samples collected in

the field were representative of conditions encountered in the investigation. Additionally, one field duplicate sample was collected per Floodway Flow event-based monitoring at the flood crest. The QA/QC program for the 2010 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) [(6)]. 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

During the Spring Flood the Red River water level upstream of the Floodway reached a stage of El. 228.80 m (750.66 feet) on March 24, 2010 and water began to naturally flow over the entrance plug (El. 750 ft.) into the floodway, although the control gates were not in operation. The gates were put into operation on March 28 and operated until April 22, 2010. The Spring Flood water levels crested on April 7 at an elevation of 231.46 m (759.39 feet) with a flow of 1,903 m^3/s (67,200 cfs) in the Red River and 449 m^3/s (15,850 cfs) diverted into the Floodway Channel.

During the Summer Flood the gates of the Floodway Inlet control structure were again put into operation on May 30 and operated until June 16, 2010. The flood water levels crested on June 4 at an elevation of 231.1 m (758.24 ft) with a flow of 1,230 m^3/s (43,450 cfs) in the Red River and 345 m^3/s (12,200 cfs) diverted into the Floodway Channel.

The Level I Rain event-based monitoring events were conducted between April and October, 2010, following precipitation events of 10 mm or greater. The rain events were typically less than a 2 year storm, however the monitoring conducted on May 30 was in response to a rain event that was up to a 50 year storm. Additional rain events greater than a 2 year storm included the monitoring on July 14 and August 13 that were completed in response to rain events that were up to a 5 to 10 year storm and the monitoring on September 10 in response to a rain event up to a 2 to 5 year storm. Details of precipitation recorded by Environment Canada at the Winnipeg International Airport, Manitoba [(7)] are provided in the Daily Data Report for April to October, 2010 in Appendix C. 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 [(8)]) which triggered each of the Rain event-based monitoring events are summarized in the following table:

Summary of Precipitation Levels During the 2010 Event-Based Monitoring

Sample Date	Amount of Precipitation (mm) for the Monitoring Event *	Approximate Duration (hours)	Year Storm (8)
April 30	12.4 – 18.0	7.0	<2
May 5	11.2 – 30.0	21.0	<2
May 25	4.6 – 20.0	7.0	<2
May 30	11.4 – 82.0	10.0	<2 to ~50
June 19	15.8 – 18.6	24.0	<2
June 27	5.2 – 28.4	2.0	<2
July 14	23.7 – 63.8	7.5	<2 to 5-10
August 13	4.6 – 56.9	4.5	<2 to 5-10
August 16	0.8 – 17.2	11.0	<2
August 31	20.4 – 38.2	15.0	<2
September 2	18.0 – 38.1	13.5	<2
September 10	24.0 – 48.4	10.0	<2 to 2-5
September 24	13.4 – 26.0	17.0	<2
October 26	17.6 – 26.4	16.0	<2
October 27	17.9 – 24.4	18.0	<2

* - 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 Floodway Flow and Level I Rain event-based monitoring events are listed in Table NM9–1. The general water quality results for all of the analyzed parameters collected at each location during the event-based monitoring are summarized in Table NM9–2. The petroleum hydrocarbons and bacteria results for samples collected during the event-based monitoring and the herbicides collected during the April flood crest event are summarized in Table NM9–3, Table NM9–4, and Table NM9–5, respectively. Existing CCME Surface Water Quality Guideline values are given for any parameters that have established criteria.

Construction monitoring data for the key water quality parameters of interest, identified and discussed in the Baseline Surface Water Monitoring Report and to assess the surface water quality as it relates to potential groundwater impacts, was compared to the baseline data under spring flood, non-flood/unfrozen, and summer emergency operation 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 for the Floodway Flow spring and summer flood events (Figures NM9-3 to NM9-20). For the Level I Rain event-based monitoring, only three parameters were analyzed: total suspended solids, pH, and specific conductance, as no nutrients have been applied to the Floodway slopes since 2008.

During April 2010 the Red River experienced spring flood conditions and, as such, there was water entering the Floodway Channel. The samples analyzed in April 2010 were compared to the baseline monitoring samples collected during the spring flood conditions on April 12, 2005, from the Red River, Floodway Channel, and drains that flow into the Floodway Channel.

During June 2010 the Red River again experienced flood conditions (summer flood) with water entering the Floodway Channel and the floodway gates operated. The samples analyzed during June 2010 were compared to the summer emergency operation period of the baseline monitoring on June 24 and July 18, 2005. The summer flood baseline monitoring data was also used as the basis for comparison to the Level I Rain event-based monitoring during June 2010.

During the construction monitoring conducted in May and from July to October 2010 there was no Red River water entering the Floodway Channel; therefore, the Level I Rain event-based monitoring is represented by the non-flood/unfrozen condition. As a result, the range of baseline conditions for comparison 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 of this area and following the observed trends. The Floodway Channel summer baseline conditions are representative of surface water run-off from precipitation events and are, therefore, comparable to the non-flood/unfrozen condition. The baseline conditions used for comparison 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 flood 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.

3.2.1 Total Suspended Solids

Floodway Flow Event-based

The comparison of TSS concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the Floodway Flow Event-based monitoring events for the spring and summer flood conditions are shown on Figures NM9–3 and NM9–4, respectively.

An increase in total suspended solids (TSS) concentration was measured in the Floodway Channel downstream of construction (176 mg/L) compared to upstream of construction (150 mg/L) during the spring flood crest in April, 2010 (Figure NM9–3). Similarly an increase in TSS concentration was measured in the Floodway Channel downstream of construction (251 mg/L) during the pre-crest monitoring and at the Dunning Weir location (282 mg/L) during the post-crest monitoring compared to the background concentrations upstream of construction (195 mg/L and 217 mg/L, respectively). Regardless of these concentration increases, the TSS concentrations in the Floodway Channel were generally within or lower than the range spring flood baseline concentrations (Figure NM9–3). Additionally, the TSS concentrations in the Floodway Channel were similar to or lower than that of the Red River and would have resulted in dilution rather than increases in concentration in the river itself. The TSS concentration measured in the Floodway Channel at the Outlet (176 mg/L) during the flood crest was lower than the concentration in the Red River upstream of the Outlet (214 mg/L); thus, no increase was measured in the Red River downstream of the Outlet (176 to 198 mg/L). The mass balance calculations indicated that an approximate dilution in the TSS concentration of 4 mg/L (approximately 2%) would result in the Red River from the Floodway Channel inputs; these values are within CCME criteria.

An increase in total suspended solids (TSS) concentration was again measured in the Floodway Channel downstream of construction (39 mg/L) compared to upstream of construction (17 mg/L) during the summer flood event in June, 2010. Regardless of this concentration increase, the

TSS concentrations in the Floodway Channel were generally within or lower than summer flood baseline concentrations. Additionally, the TSS concentrations in the Floodway Channel were generally similar to or lower than those of the Red River and would have resulted in dilution rather than increases in concentration in the river. The TSS concentration measured in the Floodway Channel at the Outlet (39 mg/L) was lower than the concentration in the Red River upstream of the Outlet (55 mg/L); thus, no increase was measured in the Red River downstream of the Outlet (41 to 51 mg/L). The mass balance calculations indicated that an approximate dilution in the TSS concentration of 3 mg/L (approximately 5%) would result in the Red River from the Floodway Channel inputs, indicating that these values are within CCME criteria.

TSS concentrations were not measured in the LaSalle River during the spring and summer flood events as there was no water discharging from the Glenlea Drain. The TSS concentrations measured in the Seine River upstream and downstream of the Prairie Grove Road Culvert (19 mg/L and 16 mg/L, respectively) were lower than the background concentration in the Seine River (23 mg/L) during the spring flood event. Lower TSS concentrations in the Seine River near the culvert were again measured relative to background concentrations during the summer flood.

Rain Event-based

Results of the 15 Level I Rain event-based monitoring events conducted between April and October indicated that TSS concentrations in the Floodway Channel were sometimes higher than the background concentration at the location upstream of the construction (Table NM9-2). However, these increases along the Floodway Channel were not a concern because the TSS concentrations in the Red River (66 to 432 mg/L) were higher than the corresponding concentrations in the water discharging from the Floodway Channel (25 to 164 mg/L) during the 2010 construction year (Table NM9-6). Therefore, the mass balances show that there were no increases in TSS concentrations in the Red River downstream of the Outlet following any of the rain events in 2010.

A review of the estimated and actual change in Red River sediment concentration measured during the Rain event-based monitoring is provided in Table NM9-6. This review indicates that

the estimated dilutions (0.04% to 6.78%) in TSS concentration 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 dilutions (0.04% to 3.35%) calculated from laboratory TSS analysis and reported flows. The review also demonstrates that as the Floodway Channel is mostly revegetated a TSS increase exceeding the CCME criteria of an allowable 10% or 25 mg/L is very unlikely even during larger precipitation events. The Rain event-based worksheet and the follow-up lab results fax for each rain event are provided with the monthly monitoring reports, MN9.4 – April to NM9.10 - October.

During the Level I Rain event-based monitoring, the TSS concentrations measured in the LaSalle River and in the Seine River downstream of the construction areas were typically similar or lower than the background concentrations with a few exceptions (Table NM9-6). During the May 30 Level I Rain event-based monitoring, the TSS concentrations in the Seine River downstream of the Prairie Road crossing (S-16, 238 mg/L) and in the LaSalle River downstream of the Glenlea drain (S-38; 714 mg/L) were higher than the background concentrations (169 mg/L and 446 mg/L, respectively). These TSS concentrations exceeding the CCME criteria of an allowable 10% or 25 mg/L occurred during a rain that was approaching a 1:50 year event. A similar elevated TSS concentration, exceeding the CCME criteria, occurred on the Seine River during the July 14 Level I Rain event-based monitoring that was conducted following a rain up to a 5 to 10 year event. However, no further exceedances were measure in the Seine River during the larger rain events that occurred in August and September, suggesting that the vegetation has now established sufficiently to control erosion.

3.2.2 Specific Conductance

Floodway Flow Event-based

Specific conductance was analyzed, as previously noted, to assess the surface water quality as it relates to potential groundwater impacts in particular to identify if surface water is infiltrating or if groundwater is discharging. 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 Floodway Flow Event-based monitoring for the spring and summer flood conditions are shown on Figures NM9–5, and NM9–6, respectively.

The specific conductance values measured at several locations in the Floodway Channel during the spring flood event (crest and post-crest) were slightly higher than the spring flood baseline values measured in 2005 (392 to 426 µS/cm; Figure NM9–5). The specific conductance measured in the Floodway Channel increased slightly from the pre-crest, to the crest and subsequently to the post-crest monitoring. This indicated that the composition of the flood waters continued to increase in solute concentrations after the crest, as the initial snow melt contribution decreased and the baseflow groundwater discharge contribution increased. The elevated values measured are not likely due to construction activities in the Floodway Channel, as the location downstream of construction had lower specific conductance values during the pre-crest, crest and post-crest flood (367 µS/cm, 417 µS/cm and 566 µS/cm, respectively) compared to the respective background values at the upstream of construction location (327 µS/cm, 434 µS/cm and 582 µS/cm). Additionally, the specific conductance concentration measured during the spring flood crest in the Floodway Channel at the Outlet (417 µS/cm) was similar to the concentrations in the Red River. As such, no increase was measured in the Red River downstream of the Outlet (417 to 419 µS/cm) compared to the background concentration upstream of the Outlet (429 µS/cm).

The specific conductance values measured at several of the locations in the Floodway Channel during the summer flood event (585 to 664 µS/cm) were also slightly higher than the corresponding summer flood baseline values (197 to 619 µS/cm; Figure NM9–6). Again, the elevated values are not likely due to construction activities in the Floodway Channel as the downstream of construction location (632 µS/cm) had a specific conductance below the upstream of construction location (660 µS/cm). The specific conductance measured in the Floodway Channel at the Outlet (632 µS/cm) was similar to the values measured in the Red River; as such, no increase was measured in the Red River downstream of the Outlet (613 to 622 µS/cm) compared to the background value upstream of the Outlet (622 µS/cm).

The specific conductance measured in the Seine River upstream and downstream of the Prairie Grove Road Culvert (565 µS/cm and 576 µS/cm, respectively) were similar compared to the background value in the Seine River (568 µS/cm) during the spring flood event. Whereas the specific conductance values in the Seine River near the culvert (490 µS/cm and 540 µS/cm) were higher relative to background value (478 µS/cm) during the summer flood.

Rain Event-based

Specific conductance measured in the Floodway Channel during the Level I Rain event-based monitoring were all within or below the range of summer baseline values with one exception. The sample at Keewatin Weir (1020 µS/cm) was elevated above the summer baseline values (454 to 944 µS/cm) during the August 31 Level I Rain event-based monitoring. However, this elevated specific conductance did not affect the Red River, as the value measured in the Red River downstream of the Outlet (798 µS/cm) was lower than the background specific conductance in the Red River upstream of the Outlet (838 µS/cm).

During the Level I Rain event-based monitoring, the specific conductance measured in the LaSalle River and in the Seine River in the locations downstream of construction varied from being higher to lower compared to the background locations although they had a similar range of values (Table NM9-6). The background specific conductance in the Seine River ranged from 284 to 772 µS/cm while the range upstream of the Prairie Road crossing ranged from 284 to 701 µS/cm and downstream of the crossing ranged from 329 to 760 µS/cm. Likewise the background specific conductance in the LaSalle River upstream of the Glenlea drain ranged from 182 to 731 µS/cm while downstream of the drain ranged from 140 to 687 µS/cm.

3.2.3 Total Phosphorus

Floodway Flow Event-based

Fertilizers have not been applied to the slopes of the Floodway Channel since 2008, as previously noted, however, total phosphorus was analyzed to assess the surface water quality as it relates to potential groundwater impacts. 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 Floodway Flow Event-based spring and summer flood monitoring events of 2010 are shown on Figures NM9–7 and NM9–8, respectively.

The total phosphorus concentrations measured in the Floodway Channel and Red River during the Floodway Flow Event-based monitoring representing the spring flood (crest) were below the spring flood baseline values (Figure NM9-7). Additionally the total phosphorus concentrations in

the Floodway Channel (0.295 to 0.412 mg/L) were lower than the concentration in the Red River upstream of the Outlet (0.432 mg/L) and therefore no increase was measured in the Red River downstream of the Outlet (0.348 to 0.407 mg/L).

The total phosphorus concentration measured in the Floodway Channel downstream of construction (0.334 mg/L) was moderately elevated compared to upstream of construction (0.297 mg/L) during the summer flood event. However, all concentrations in the Floodway Channel were within or below summer flood baseline values (Figure NM9-8). Additionally the total phosphorus concentration discharging from the Floodway Channel (0.334 mg/L) was lower than the concentration in the Red River upstream of the Outlet (0.394 mg/L). As such no increase was measured in the Red River downstream of the Outlet (0.319 to 0.346 mg/L).

The total phosphorus concentrations measured in the Seine River upstream and downstream of the Prairie Grove Road Culvert (0.147 mg/L and 0.138 mg/L, respectively) were slightly lower compared to the background concentration in the Seine River (0.151 mg/L) during the spring flood event. Lower total phosphorus concentrations in the Seine River near the culvert were again measured relative to background concentrations during the summer flood.

3.2.4 Ammonia (NH3)

Floodway Flow Event-based

Fertilizers have not been applied to the slopes of the Floodway Channel since 2008, as previously noted; however, ammonia was analyzed to assess the surface water quality as it relates to potential groundwater impacts.

The water quality guidelines for ammonia vary depending on the temperature and pH concentrations of the water. For the Floodway Flow Event-based spring and summer flood monitoring events of 2010, the pH ranged from 7.00 to 8.76, which was within the CCME criteria for the protection of freshwater aquatic life (6.5 to 9.0; Table NM9-2). The temperature range during the Floodway Flow Event-based monitoring was from 3.7°C to 18.6°C. The soluble ammonia (NH_3) values reported by the laboratory were converted by KGS Group into un-ionized

ammonia values based on a pH temperature relationship (Table NM9-2). The un-ionized ammonia represents all the forms of ammonia in the water, with the exception of the ammonium ion (NH_4). The corresponding un-ionized ammonia CCME criterion for the protection of freshwater aquatic life is 0.019 mg/L.

The comparison of ammonia concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the Floodway Flow Event-based spring and summer flood monitoring events of 2010 are shown on Figures NM9–9 and NM9–10, respectively.

A moderate ammonia concentration increase was measured in the Floodway Channel downstream of construction (0.090 mg/L) compared to the background concentration upstream of construction (0.055 mg/L) during the spring flood (crest) event monitoring. However, the ammonia concentrations in the Floodway Channel were all below the spring flood baseline concentrations (Figure NM9–9) and result in un-ionized ammonia below the CCME criterion (Table NM9-2). Additionally the ammonia concentration discharging from the Floodway Channel (0.090 mg/L) was lower than the concentration in the Red River upstream of the Outlet (0.144 mg/L). As such no increase was measured in the Red River downstream of the Outlet (0.065 to 0.088 mg/L). All of the ammonia concentrations measured in the Red River were below spring flood baseline concentrations and resulted in un-ionized ammonia concentrations below the CCME criterion.

The ammonia concentration measured in the Floodway Channel downstream of the Grand Pointe drain (0.149 mg/L) during the summer flood event, was elevated above the summer flood baseline values (0.04 to 0.13 mg/L). However; samples from locations further downstream and downstream of construction had ammonia concentrations below the laboratory detection limits (<0.050 mg/L) which was the same for the location upstream of construction. The measureable ammonia concentration resulted in an un-ionized ammonia concentration below the CCME criterion. The ammonia concentrations measured in the Red River downstream of the Outlet (<0.050 to 0.051 mg/L) were lower compared to the background concentration upstream of the Outlet (0.078 mg/L) and were within the range of baseline concentrations. All of the ammonia concentrations measured in the Red River resulted in un-ionized ammonia concentrations below the CCME criterion.

The ammonia concentrations measured in the Seine River upstream and downstream of the Prairie Grove Road Culvert (0.059 mg/L and 0.055 mg/L, respectively) were slightly lower compared to the background concentration in the Seine River (0.072 mg/L) during the spring flood event. The ammonia concentrations in the Seine River near the culvert were below laboratory detection limits (<0.050 mg/L) during the summer flood, which was again lower relative to background concentration (0.081 mg/L).

3.2.5 Nitrate + Nitrite-N

Floodway Flow Event-based

Fertilizers have not been applied to the slopes of the Floodway Channel since 2008, as previously noted; however, nitrate + nitrite-N was analyzed to assess the surface water quality as it relates to potential groundwater impacts. 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 Floodway Flow Event-based spring and summer flood monitoring events of 2010 are shown on Figures NM9–11 and NM9–12, respectively.

The nitrate + nitrite-N concentrations measured at most locations in the Floodway Channel and in the Red River were slightly elevated above spring flood baseline values during the spring flood crest monitoring (Figure NM9–11). A negligible increase in nitrate + nitrite-N concentration was measured in the Floodway Channel downstream of construction (1.74 mg/L) compared to upstream of construction (1.69 mg/L) during the flood crest. Similarly a slight increase in nitrate + nitrite-N concentration was measured in the Floodway Channel downstream of construction (1.14 mg/L) during the post-crest monitoring compared to the background concentration upstream of construction (1.02 mg/L). Whereas there was no increase measured in the Floodway Channel downstream of construction during the pre-crest monitoring. The nitrate + nitrite-N concentrations measured in the Floodway Channel decreased slightly from the pre-crest, to the crest and subsequently to the post-crest monitoring, such that the concentrations during the post-crest monitoring were within or lower than the spring baseline concentrations. Although nitrate + nitrite-N concentrations in the Floodway Channel were above the baseline during the flood crest the concentration discharging from the Floodway Channel (1.74 mg/L)

was similar to the concentrations measured in the Red River. As such, no increase was measured in the Red River downstream of the Outlet (1.66 to 1.69 mg/L) compared to the background nitrate + nitrite-N concentration upstream of the Outlet (1.74 mg/L).

A moderate concentration increase in nitrate + nitrite-N was measured in the Floodway Channel downstream of construction (0.778 mg/L) compared to background concentration upstream of construction (0.619 mg/L) during the summer flood event. However, the concentrations in the Floodway Channel were all within or below the summer flood baseline range (Figure NM9-12). Additionally the nitrate + nitrite-N concentration discharging from the Floodway Channel (0.778 mg/L) was lower than the concentration in the Red River upstream of the Outlet (0.827 mg/L). As such no increase was measured in the Red River downstream of the Outlet (0.721 to 0.759 mg/L).

The nitrate + nitrite-N concentrations measured in the Seine River upstream and downstream of the Prairie Grove Road Culvert (0.300 mg/L and 0.284 mg/L, respectively) were slightly lower compared to the background concentration in the Seine River (0.311 mg/L) during the spring flood event. Lower nitrate + nitrite-N concentrations in the Seine River near the culvert were again measured relative to background concentrations during the summer flood.

3.2.6 Potassium

Floodway Flow Event-based

Fertilizers have not been applied to the slopes of the Floodway Channel since 2008, as previously noted; however, potassium was analyzed to assess the surface water quality as it relates to potential groundwater impacts. The comparison of potassium concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the Floodway Flow Event-based spring and summer flood monitoring events of 2010 are shown on Figures NM9–13 and NM9–14, respectively.

The potassium concentrations measured at several locations in the Floodway Channel were slightly elevated above spring flood baseline values during the spring flood crest monitoring (Figure NM9–13). Similarly the potassium concentrations in the Floodway Channel measured

during the post-crest were slightly elevated above spring flood baseline, whereas concentrations measured during the pre-crest monitoring were within the baseline concentrations. During the crest and post-crest monitoring a minor increase in the potassium concentration was measured downstream of construction (9.53 mg/L and 9.32 mg/L) compared to the background concentration upstream of construction (9.03 mg/L and 9.08 mg/L). Regardless of the increase and elevated potassium concentrations in the Floodway Channel the potassium concentration at the Outlet (9.53 mg/L) during the flood crest was very similar to the concentration in the Red River upstream of the Outlet (9.55 mg/L). As such, there was very little change in the concentrations measured in the Red River downstream of the Outlet (9.34 to 9.57 mg/L) compared to the background concentration upstream of the Outlet (9.55 mg/L).

A negligible concentration increase in potassium was measured in the Floodway Channel downstream of construction (6.13 mg/L) compared to background concentration upstream of construction (6.04 mg/L) during the summer flood event. However, the concentrations in the Floodway Channel were all below the summer flood baseline range (Figure NM9-14). Additionally the potassium concentration discharging from the Floodway Channel (6.13 mg/L) was lower than the concentration in the Red River upstream of the Outlet (6.61 mg/L). As such the concentrations in the Red River downstream of the Outlet ranged from lower to similar (5.91 to 6.62 mg/L).

The potassium concentration measured in the Seine River upstream and downstream of the Prairie Grove Road Culvert (7.88 mg/L and 7.95 mg/L, respectively) were similar compared to the background concentration in the Seine River (7.92 mg/L) during the spring flood event. Whereas there was a negligible to minor increase in potassium concentrations in the Seine River near the culvert (4.43 mg/L and 4.59 mg/L) relative to the background concentration (4.37 mg/L) during the summer flood.

3.2.7 Sodium

Floodway Flow Event-based

Similar to specific conductance, sodium was analyzed to assess the surface water quality as it relates to potential groundwater impacts in particular to identify if surface water is infiltrating or if

groundwater is discharging. The comparison of sodium concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the Floodway Flow Event-based spring and summer flood monitoring events of 2010 are shown on Figures NM9–15 and NM9-16, respectively.

The sodium concentrations measured in the Floodway Channel and Red River during the Floodway Flow Event-based monitoring representing the spring flood crest were similar to the spring flood baseline values (Figure NM9-15). The sodium concentrations measured in the Floodway Channel increased from the pre-crest, to the crest and subsequently to the post-crest monitoring, such that the concentrations during the post-crest monitoring were higher than the spring baseline concentrations. However, the concentrations in the Floodway Channel downstream of construction were lower or similar to the background concentrations upstream of construction during all three spring flood monitoring events. Additionally, all Floodway Channel sodium concentrations (14.7 to 16.1 mg/L) measured during the spring flood crest were lower than the concentration in the Red River upstream of the Outlet (16.5 mg/L) and therefore no increase was measured in the Red River downstream of the Outlet (15.1 to 15.4 mg/L).

The sodium concentrations measured in the Floodway Channel (19.7 to 27.0 mg/L) during the summer flood monitoring were elevated above the summer flood baseline values (Figure NM9-16). However, this is reflective of the higher sodium concentrations measured in the Red River upstream of the Floodway Inlet (29.1 to 31.4 mg/L) which was diverting into the Floodway. The sodium concentration measured in the Floodway Channel at the downstream of construction location (25.4 mg/L) was lower than that of the background concentration upstream of construction (31.5 mg/L). Additionally, the sodium concentration measured in the Floodway Channel at the Outlet (25.4 mg/L) was lower than the concentration in the Red River upstream of the Outlet (25.8 mg/L). As such, no increase was measured in the Red River downstream of the Outlet (22.8 to 24.9 mg/L) compared to the background concentration upstream of the Outlet.

The sodium concentration measured in the Seine River at the Prairie Grove Road Culvert ranged from lower upstream of the culvert (18.1 mg/L) to higher downstream of the culvert (20.9 mg/L) compared to the background concentration in the Seine River (18.8 mg/L) during the spring flood event. Whereas there was a major increase in sodium concentrations in the

Seine River near the culvert (13.1 mg/L and 19.1 mg/L) relative to the background concentration (11.5 mg/L) during the summer flood. There were no construction activities that would account for this elevated sodium concentration.

3.2.8 Chloride

Floodway Flow Event-based

Similar to specific conductance, sodium was analyzed to assess the surface water quality as it relates to potential groundwater impacts in particular to identify if surface water is infiltrating or if groundwater is discharging. The comparison of chloride concentrations between baseline conditions and from samples collected for the Red River, Floodway Channel and drain sample locations during the Floodway Flow Event-based spring and summer flood monitoring events of 2010 are shown on Figures NM9–17 and NM9-18, respectively.

The chloride concentrations measured in the Floodway Channel and Red River during the Floodway Flow Event-based monitoring representing the spring flood crest were similar to or lower than the spring flood baseline values (Figure NM9-17). The chloride concentrations measured in the Floodway Channel during the pre-crest and post-crest monitoring were slightly higher, however still within the spring flood baseline values. Additionally, the concentrations in the Floodway Channel downstream of construction were lower or similar to the background concentrations upstream of construction during all three spring flood monitoring events. The chloride concentration measured in the Floodway Channel at the Outlet (15.8 mg/L) was lower than the concentration in the Red River upstream of the Outlet (16.5 mg/L). As such, no increase was measured in the Red River downstream of the Outlet (15.7 to 16.2 mg/L) compared to the background concentration upstream of the Outlet.

The chloride values measured in the Floodway Channel (22.5 to 29.7 mg/L) during the summer flood monitoring were elevated above the summer flood baseline values (Figure NM9-18). Additionally, the chloride concentration measured in the Floodway Channel at the downstream of construction location (28.4 mg/L) was moderately elevated above the background concentration upstream of construction (24.9 mg/L). Regardless of the downstream concentration increase and being above baseline conditions the chloride concentration in the

Floodway Channel at the Outlet (28.4 mg/L) was lower than the concentration in the Red River upstream of the Outlet (28.8 mg/L). As such, no increases were measured in the Red River downstream of the Outlet (27.0 mg/L to 28.0 mg/L) compared to the background concentration upstream of the Outlet.

The chloride concentration measured in the Seine River at the Prairie Grove Road Culvert ranged from lower upstream of the culvert (31.0 mg/L) to higher downstream of the culvert (34.5 mg/L) compared to the background concentration in the Seine River (31..4 mg/L) during the spring flood event. Whereas there was a major increase in chloride concentrations in the Seine River near the culvert (18.4 mg/L and 26.4 mg/L) relative to the background concentration (15.8 mg/L) during the summer flood. This is similar to what was observed for the sodium concentrations but again there were no construction activities that would account for this elevated chloride concentration.

3.2.9 Iron

Floodway Flow Event-based

During the 2010 construction monitoring there were many occurrences of iron concentrations above the CCME criterion for the protection of freshwater aquatic life (0.30 mg/L; Table NM9–2), similar to what was observed during baseline and 2005 through 2009 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.

The concentrations of iron measured at all locations in the Floodway Channel and the Red River were elevated above the CCME criterion during the Floodway Flow Event-based monitoring representing the spring flood crest. Likewise, the iron concentrations measured at all of the Floodway Channel locations were elevated above the CCME criterion during the pre-crest and post-crest monitoring. The iron concentration measured at the downstream of construction location (2.09 mg/L) was elevated above the background condition sampled upstream of construction (1.89 mg/L). The elevated concentration was however lower than the concentration in the Red River upstream of the Outlet (2.54 mg/L); therefore the concentrations of iron in the Red River downstream of the Outlet (2.04 to 2.30 mg/L) were lower than the background

concentration collected upstream of the Outlet. The elevated concentrations of iron are neither attributed to construction nor are they of concern, as concentrations exceeding the CCME criterion, 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 during the summer flood event ranged from 0.05 to 0.47 mg/L, with the concentrations from the Keewatin weir location to the Outlet (0.31 to 0.47 mg/L) exceeding the CCME criterion (0.3 mg/L). Iron concentrations were also above CCME criterion from several outfall sources and for most of the Red River samples. The iron concentration measured at the downstream of construction location (0.33 mg/L) was elevated above the background condition sampled upstream of construction (0.05 mg/L). The elevated concentration was however lower than the concentration in the Red River upstream of the Outlet (0.37 mg/L); therefore the concentrations of iron in the Red River downstream of the Outlet (.032 to 0.34 mg/L) were lower than the background concentration collected upstream of the Outlet. As noted above the elevated concentrations of iron are neither attributed to construction nor are they of concern, as concentrations exceeding the CCME criterion, ranging from 0.33 to 0.81 mg/L, were measured during the baseline sampling for the summer flood condition.

The iron concentrations measured in the Seine River upstream and downstream of the Prairie Grove Road Culvert (0.64 mg/L and 0.51 mg/L, respectively) were slightly lower compared to the background concentration in the Seine River (0.74 mg/L) during the spring flood event. Whereas there was a negligible to minor increase in potassium concentrations in the Seine River near the culvert (0.23 mg/L and 0.28 mg/L) relative to the background concentration (0.23 mg/L) during the summer flood. All the concentrations measured in the Seine River exceeded the CCME criterion during the spring flood, whereas they were below the CCME criterion during the summer flood.

3.2.10 Petroleum Hydrocarbons

Floodway Flow Event-based

Hydrocarbons were analyzed, as in previous years, to identify if there were any potential impacts to surface water from spills that occurred during construction activities. The concentrations 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 at the locations upstream and downstream of the construction area during both the spring flood crest and summer flood monitoring (Table NM9–3).

Rain Event-based

The concentrations of petroleum hydrocarbons were again below detection limits in the Floodway Channel at the locations upstream and downstream of the construction area during each of the Level I Rain Event-based monitoring, with one exception. During the October 27 Level I Rain event-based monitoring benzene was detected in the Floodway Channel at both the upstream and downstream of construction locations (0.91 µg/L and 0.91 µg/L) and F1 hydrocarbons were detected upstream of construction (1510 µg/L). Since the hydrocarbons detected were measured in the background water upstream of construction they are not a result of construction activities. Additionally, as the benzene concentration measured is well below the CCME criterion (370 µg/L) hydrocarbons were not considered to be a concern during the 2010 construction monitoring program.

3.2.11 Bacteria

Floodway Flow Event-based

While there are no specific construction activities that would release bacteria into the Floodway Channel bacteria was analyzed to assess the surface water quality as it relates to potential groundwater impacts in particular to identify if bacteria is affecting drinking water quality. 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 Floodway Flow

Event-based spring and summer flood monitoring events of 2010 are shown on Figures NM9–19 and NM9-20, 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.

Most samples collected for analysis of *E.Coli* in the Floodway and in the Red River during the Floodway Flow Event-based monitoring representing the spring flood crest and pre-crest were below the laboratory detection limit of 10 CFU/100 mL. Low concentrations of *E. Coli* were detected in the Floodway Channel (10 to 30 CFU/100 mL) during the post-crest spring flood monitoring. All of the *E.Coli* concentrations measured were within or below the spring flood baseline values (Figure NM9–19).

Moderate concentration increases of *E.Coli* were measured in the Floodway Channel downstream of construction (150 CFU/100 mL) and at most of the Floodway Channel sample locations compared to upstream of construction (10 CFU/100 mL) during the summer flood monitoring. These elevated concentrations of *E.Coli* measured in the Floodway Channel (20 to 480 CFU/100 mL) are within the summer flood baseline values (40 to 1030 CFU/100 mL). Additionally, the increase in concentrations within the Floodway Channel did not result in increased *E.Coli* concentrations in the Red River downstream of the Outlet (110 to 260 CFU/100 mL) compared to the background concentration in the Red River upstream of the Outlet (500 CFU/100 mL). The elevated *E.Coli* concentrations found during the summer flood event 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* concentration measured in the Seine River upstream and downstream of the Prairie Grove Road Culvert were below laboratory detection limits of 10 CFU/100 mL while the background concentration in the Seine River was very low (10 CFU/100 mL) during the spring flood event. The *E.Coli* concentration measured in the Seine River at the Prairie Grove Road Culvert ranged from lower upstream of the culvert (90 CFU/100 mL) to higher downstream of the culvert (180 CFU/100 mL) compared to the background concentration in the Seine River (120 CFU/100 mL) during the summer flood event.

3.2.12 Herbicides

Floodway Flow Event-based

Herbicides have not been applied as part of the Floodway Expansion Project since 2005 as previously noted. Therefore, only samples collected during peak flood events are analyzed for herbicides to identify if there is run-off from agricultural fields that may be affecting water quality in the Floodway Channel to assess potential impacts to groundwater.

AMPA and glyphosate were both detected in the Floodway Channel during the Floodway Flow Event-based monitoring representing the spring flood crest. There was no increase in the concentration of AMPA in the Floodway Channel at the location downstream of construction (1.02 µg/L) compared to the background concentration upstream of construction (1.07 µg/L). While there was a moderate increase in the concentration of glyphosate in the Floodway Channel at the location downstream of construction (1.25 µg/L) compared to the background concentration upstream of construction (1.12 µg/L) these concentrations were well below the CCME criteria (65 µg/L). Therefore these herbicide concentrations measured in the Floodway Channel were not considered to be a concern.

In addition to AMPA and glyphosate, and MCPA were also detected in the Floodway Channel during the Floodway Flow Event-based monitoring representing the summer flood crest. There were negligible to moderate increases in the concentration of 2,4-D, AMPA, glyphosate and MCPA in the Floodway Channel at the location downstream of construction (0.11 µg/L, 0.29 µg/L, 1.62 µg/L and 0.20 µg/L, respectively) compared to the background concentrations upstream of construction (<0.10 µg/L, 0.28 µg/L, 1.52 µg/L and 0.17 µg/L, respectively). However, these herbicide concentrations were all well below the applicable CCME criteria.

4.0 SUMMARY AND CONCLUSIONS

1. The 2010 construction surface water quality monitoring program was conducted from April to October 2010 in conjunction with construction activities that occurred from Station 4+000 to 50+500. This consisted of contracts that were substantially completed in 2009, but required minor work during 2010 to address deficiencies, on-going construction contracts that started prior to 2010 and new contracts started in 2010. These included the following:

   a. Channel Contracts C7A (Stn 35+100 – 40+590), C8B (Stn 40+900 – 50+430), C11 (Gap Enhancement; Stn 5+000 – 9+000), C12 (Bridge Pier Protection), C13 (Channel Clean-up and Repair), ED1 (East Dyke; Stn 4+000 – 5+300), ED2 (Inlet Erosion Control), S1 (Seine River Syphon), and GD1 (Groundwater Springs Remediation and LFC Riprap);
   b. Bridge contracts for CPR Keewatin (T14), CPR Emerson (T15), P.T.H Hwy 44 Bridge (T17), P.T.H. Hwy 15 Bridge (T18), T19 (Pedestrian Bridge), T20 (PTH 15 and 101 Paving; Stn 25+700)
   c. The Inlet (I2) and Outlet (CE1) control structures; and
   d. The West Dyke earthworks contracts W19 (Stn 14+600), W21 (Stn 37+300 – 40+300), W29 (West Dyke Drainage Repairs) and W30 (West Dyke Gravel Contract; Stn 30+500 – 37+500).

2. Samples were collected from the Red River at the Inlet and Outlet, at 9 locations along the Floodway Channel, including the upstream and downstream ends of the construction zones, at 8 of the outfall drains flowing into the Floodway, and at 2 locations each on the Seine and La Salle Rivers, when there was a sufficient amount of water to collect a sample.

3. At each sampling location, field data was obtained (conductivity, pH, temperature 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 were collected at the upstream and downstream of construction locations. During the spring and summer flood peak monitoring, laboratory analysis also included screening for phenoxy acid herbicides (2,4-D, bromoxynil, dicamba, MCPA and picloram), AMPA, and glyphosate at the upstream and downstream of construction 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. Floodway Flow event-based monitoring took place during the crest of both spring and summer flood events in April and June, respectively, with monitoring also completed pre and post-crest during the spring flood event. There were fifteen (15) Level I Rain event-based monitoring events conducted between April and October, 2010, in response to precipitation levels greater than 10 mm.

5. During the spring flood monitoring in 2010, concentrations of most parameters measured in the Floodway Channel were typically below the spring flood baseline values, with the exception of specific conductance, nitrate+nitrite-N, and potassium concentrations. Within the Red River, the concentrations of specific conductance and nitrate+nitrite-N

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. Potassium concentrations downstream of the Outlet were very slightly higher than those upstream of the Outlet.

6. During the summer flood monitoring in 2010, concentrations of most parameters measured in the Floodway Channel were typically below the summer flood baseline values, with the exception of specific conductance, sodium, chloride, and ammonia concentrations. 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 having a neutral or dilution effect on the concentrations of these parameters in the Red River.

7. During the spring and summer flood monitoring in 2010, concentrations of most parameters measured in the Seine River upstream and downstream of the Prairie Grove Road Culvert were typically lower compared to the background concentration in the Seine River. A few exceptions included elevated concentrations of specific conductance, potassium, sodium, chloride and bacteria measured during the summer flood monitoring. There were no construction activities that would contribute to these concentration increases.

8. Results of the 15 Level I Rain event-based monitoring events conducted between April and October indicated that TSS concentrations in the Floodway Channel were often higher than the background concentration at the location upstream of the construction. However, these increases along the Floodway Channel were not a concern because the TSS concentrations in the Red River were higher than the corresponding concentrations in the water discharging from the Floodway Channel. Therefore, the mass balances show that there were no increases in TSS concentrations in the Red River downstream of the Outlet following any of the rain events in 2010. Because there were no TSS concentration increases no Level II Rain event-based monitoring was required during the 2010 construction year.

5.0 RECOMMENDATIONS

It is recommended that the Construction Surface Water Monitoring program for the floodway expansion be discontinued, as of December 2010, and replaced by a Post-Construction Activities Surface Water Sampling Program as part of the Groundwater Monitoring Program. The Post-Construction Activities Surface Water Sampling Program focus on surface water quality sampling needed to compliment groundwater quality assessments. This recommendation is based on the following:

- Nearly all of the Floodway Expansion Project work is now completed (including vegetation) except minor site clean-up or activities to address deficiencies, which will be completed in 2011.

- The large earth moving contracts for the Floodway Channel were mostly completed prior to 2009 and are now predominately covered by an established vegetation cover that will minimize erosion concerns.

- With the introduction of the Nutrient Management Regulation (62/2008) no fertilizers have been applied to the Floodway Channel slopes since 2008 and therefore nutrient impacts from the project is no longer a concern.

- Herbicides have not been applied as part of the Floodway Expansion Project since 2005, as noted in Section 3.2.12, and therefore herbicide impacts from the project are also no longer a concern.

6.0 REFERENCES

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TABLES

TABLE NM9-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
Floodway Flow Event - Spring Flood (crest)							
CON U/S	Floodway Channel - Station 5+500	7-Apr-10	6.07	474	7.2	129.7	
CON D/S	Floodway Channel - Station 50+900	7-Apr-10	7.22	424	8.5	147.1	
S-01	Red River - Upstream of Inlet	7-Apr-10	6.04	459	8.2	137.2	
S-02	Red River - Upstream of Inlet (replicate of 1)	7-Apr-10	5.56	484	6.1	137.1	
S-03	Red River - Upstream of Inlet (replicate of 1)	7-Apr-10	5.27	483	5.6	139.6	
S-04a	Floodway Channel - U/S of Seine River Syphon	7-Apr-10	6.55	486	6.5	128.9	
S-05	Seine River Syphon Overflow	7-Apr-10	-	-	-	-	CNM - No Water Diverting
S-05 U/S	- Upstream of Perimeter Ditches	7-Apr-10	6.32	622	4.3	34.1	
S-06	Grande Pointe Diversion Drop Structure	7-Apr-10	7.77	610	5.4	42.4	
S-07	Centreline Drop Structure	7-Apr-10	8.44	578	7.7	14.6	
S-08	Deacon Reservoir Drain	7-Apr-10	-	-	-	-	CNM - Dry
S-09	Cooks Creek Diversion Drop Structure	7-Apr-10	8.54	558	9.9	46.2	
S-09 U/S	- Upstream of Perimeter Ditches	7-Apr-10	7.01	557	7.5	39.4	
S-10	North Bibeau Drain Drop Structure	7-Apr-10	8.71	586	9.5	1.1	
S-10 U/S	- Upstream of Perimeter Ditches	7-Apr-10	7.62	509	6.5	1.2	
S-11	Country Villa Estates Drain	7-Apr-10	7.40	759	12.6	1.1	
S-12	Kildare Trunk-Transcona Storm Sewer Outlet	7-Apr-10	-	-	-	-	CNM - Inundated
S-13	Floodway Channel - D/S of Grande Pointe Drain	7-Apr-10	7.64	511	7.2	93.7	
S-14	Floodway Channel - D/S of North Bibeau Drain	7-Apr-10	7.86	482	7.8	203.3	
S-15	Seine River U/S of Prairie Grove Road Culvert	7-Apr-10	6.06	643	4.2	26.9	
S-16	Seine River D/S of Prairie Grove Road Culvert	7-Apr-10	6.79	643	3.7	24.5	
S-21	Floodway Channel - Keewatin Weir	7-Apr-10	7.62	439	8.9	143.6	
S-22	Springfield Road Drain Drop Structure	7-Apr-10	7.43	707	11.1	1.4	
S-23	Floodway Channel - Spring Hill Weir	7-Apr-10	7.47	439	8.8	158.0	
S-25	Floodway Channel - Dunning Weir	7-Apr-10	7.31	438	8.4	134.2	
S-26	Skholny Drain Drop Structure	7-Apr-10	7.40	657	7.6	5.2	
S-27	Ashfield Drain Drop Structure	7-Apr-10	7.48	607	9.4	13.6	
S-27 U/S	- Upstream of Perimeter Ditches	7-Apr-10	7.37	610	5.9	0.7	
S-28	Floodway Channel - PTH #44 Weir	7-Apr-10	7.10	436	8.3	160.8	
S-30	Red River - Downstream of Outlet (500 m)	7-Apr-10	7.10	435	7.6	146.7	
S-31	Red River - Downstream of Outlet (1000 m)	7-Apr-10	7.28	435	7.3	152.1	
S-32	Red River - Downstream of Outlet (2000 m)	7-Apr-10	7.40	437	7.1	151.2	
S-33	Red River - Downstream of Outlet (3000 m)	7-Apr-10	7.73	457	7.3	158.3	
S-34	Red River - Upstream of Outlet	7-Apr-10	7.19	445	7.3	163.1	
S-37	La Salle River - Upstream of Glenlea Drain	7-Apr-10	-	-	-	-	CNM - No Flow in Drain
S-38	La Salle River - Downstream of Glenlea Drain	7-Apr-10	-	-	-	-	CNM - No Flow in Drain
Floodway Flow Event - Spring Flood (pre-crest)							
CON U/S	Floodway Channel - Station 5+500	1-Apr-10	6.83	420	4.5	167.1	
CON D/S	Floodway Channel - Station 50+900	1-Apr-10	7.65	406	5.9	220.2	
S-21	Floodway Channel - Keewatin Weir	1-Apr-10	7.31	457	4.6	183.4	
S-23	Floodway Channel - Spring Hill Weir	1-Apr-10	6.96	400	6.1	153.7	
S-25	Floodway Channel - Dunning Weir	1-Apr-10	7.58	392	6.0	168.2	
Floodway Flow Event - Spring Flood (post-crest)							
CON U/S	Floodway Channel - Station 5+500	15-Apr-10	6.86	630	9.9	135.8	
CON D/S	Floodway Channel - Station 50+900	15-Apr-10	6.80	625	11.3	92.2	
S-21	Floodway Channel - Keewatin Weir	15-Apr-10	7.56	614	10.7	117.6	
S-23	Floodway Channel - Spring Hill Weir	15-Apr-10	7.80	617	10.2	154.8	
S-25	Floodway Channel - Dunning Weir	15-Apr-10	8.00	614	10.0	189.9	

TABLE NM9-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
Floodway Flow Event - Summer Flood (crest)							
CON U/S	Floodway Channel - Station 5+500	9-Jun-10	7.49	717	16.3	30.9	
CON D/S	Floodway Channel - Station 50+900	9-Jun-10	7.81	635	17.4	50.6	
S-01	Red River - Upstream of Inlet	9-Jun-10	7.58	708	18.2	32.3	
S-02	Red River - Upstream of Inlet (replicate of 1)	9-Jun-10	7.52	710	17.9	31.0	
S-03	Red River - Upstream of Inlet (replicate of 1)	9-Jun-10	7.53	715	17.9	31.9	
S-04a	Floodway Channel - U/S of Seine River Syphon	9-Jun-10	7.68	711	16.2	34.9	
S-05	Seine River Syphon Overflow	9-Jun-10	7.62	527	15.9	55.4	
S-05 U/S	- Upstream of Perimeter Ditches	9-Jun-10	7.68	522	15.6	73.0	
S-06	Grande Pointe Diversion Drop Structure	9-Jun-10	7.77	518	15.8	102.4	
S-07	Centreline Drop Structure	9-Jun-10	7.61	492	13.9	63.3	
S-08	Deacon Reservoir Drain	9-Jun-10	-	-	-	-	CNM - Dry
S-09	Cooks Creek Diversion Drop Structure	9-Jun-10	7.73	449	15.4	217.2	
S-09 U/S	- Upstream of Perimeter Ditches	9-Jun-10	7.76	456	15.1	205.4	
S-10	North Bibeau Drain Drop Structure	9-Jun-10	7.59	629	14.1	82.6	
S-10 U/S	- Upstream of Perimeter Ditches	9-Jun-10	7.27	454	14.1	107.5	
S-11	Country Villa Estates Drain	9-Jun-10	7.49	600	15.7	6.5	
S-12	Kildare Trunk-Transcona Storm Sewer Outlet	9-Jun-10	-	-	-	-	CNM - Inundated
S-13	Floodway Channel - D/S of Grande Pointe Drain	9-Jun-10	7.74	661	16.1	57.5	
S-14	Floodway Channel - D/S of North Bibeau Drain	9-Jun-10	7.88	676	16.3	75.9	
S-15	Seine River U/S of Prairie Grove Road Culvert	9-Jun-10	7.61	537	15.8	60.7	
S-16	Seine River D/S of Prairie Grove Road Culvert	9-Jun-10	7.56	633	15.5	51.1	
S-21	Floodway Channel - Keewatin Weir	9-Jun-10	7.88	656	17.7	51.5	
S-22	Springfield Road Drain Drop Structure	9-Jun-10	8.31	646	15.2	6.2	
S-23	Floodway Channel - Spring Hill Weir	9-Jun-10	7.96	589	16.6	109.5	
S-25	Floodway Channel - Dunning Weir	9-Jun-10	7.91	592	16.9	98.1	
S-26	Skholny Drain Drop Structure	9-Jun-10	8.19	526	15.4	11.9	
S-27	Ashfield Drain Drop Structure	9-Jun-10	7.83	645	14.8	13.0	
S-27 U/S	- Upstream of Perimeter Ditches	9-Jun-10	7.67	678	14.4	2.2	
S-28	Floodway Channel - PTH #44 Weir	9-Jun-10	7.87	632	17.4	67.0	
S-30	Red River - Downstream of Outlet (500 m)	9-Jun-10	7.86	607	17.5	62.7	
S-31	Red River - Downstream of Outlet (1000 m)	9-Jun-10	7.85	619	17.8	55.4	
S-32	Red River - Downstream of Outlet (2000 m)	9-Jun-10	7.83	618	17.9	54.5	
S-33	Red River - Downstream of Outlet (3000 m)	9-Jun-10	7.68	627	18.0	51.7	
S-34	Red River - Upstream of Outlet	9-Jun-10	7.79	617	18.6	62.7	
S-37	La Salle River - Upstream of Glenlea Drain	9-Jun-10	-	-	-	-	CNM - No Flow in Drain
S-38	La Salle River - Downstream of Glenlea Drain	9-Jun-10	-	-	-	-	CNM - No Flow in Drain
Level I Rain Event							
CON D/S	Floodway Channel - Station 50+900	30-Apr-10	8.46	761	10.7	45.1	
		5-May-10	8.47	877	9.1	63.5	
		25-May-10	8.18	686	17.9	33.1	
		30-May-10	7.96	412	15.7	136.7	
		19-Jun-10	7.82	804	18.7	44.0	
		27-Jun-10	8.07	376	20.6	49.4	
		14-Jul-10	8.05	559	21.5	164.5	
		13-Aug-10	7.94	597	23.6	93.5	
		16-Aug-10	6.62	673	17.1	41.0	
		31-Aug-10	7.30	675	17.8	52.4	
		2-Sep-10	7.61	386	16.8	82.6	
		10-Sep-10	8.01	415	14.5	110.0	
		24-Sep-10	7.98	580	12.1	53.3	
		26-Oct-10	7.86	718	9.4	36.0	
		27-Oct-10	7.80	585	7.0	86.0	

TABLE NM9-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
CON U/S	Floodway Channel - Station 5+500	30-Apr-10	-	-	-	-	CNM - Dry
		5-May-10	8.18	1002	9.3	22.9	
		25-May-10	-	-	-	-	CNM - Dry
		30-May-10	7.86	638	15.1	56.2	
		19-Jun-10	7.32	860	19.1	50.0	
		27-Jun-10	7.93	725	22.4	6.1	
		14-Jul-10	7.28	415	21.8	160.1	
		13-Aug-10	-	-	-	-	CNM - No Flow
		16-Aug-10	-	-	-	-	CNM - No Flow
		31-Aug-10	-	-	-	-	CNM - No Flow
		2-Sep-10	7.33	496	16.4	15.5	
		10-Sep-10	7.81	579	14.1	23.8	
		24-Sep-10	7.33	491	11.2	12.7	
		26-Oct-10	-	-	-	-	CNM - No Flow
		27-Oct-10	7.72	577	6.5	9.7	
S-04a	Floodway Channel - U/S of Seine River Syphon	30-Apr-10	-	-	-	-	CNM - Dry
		5-May-10	8.27	713	8.1	36.1	
		25-May-10	-	-	-	-	CNM - Dry
		30-May-10	7.94	364	14.7	143.3	
		19-Jun-10	7.58	871	20.5	34.6	
		27-Jun-10	8.45	475	22.0	14.5	
		14-Jul-10	7.61	410	22.0	73.3	
		13-Aug-10	-	-	-	-	CNM - No Flow
		16-Aug-10	-	-	-	-	CNM - No Flow
		31-Aug-10	-	-	-	-	CNM - No Flow
		2-Sep-10	7.46	278	17.7	111.2	
		10-Sep-10	7.78	505	15.1	29.5	
		24-Sep-10	7.64	454	11.6	12.6	
		26-Oct-10	-	-	-	-	CNM - No Flow
		27-Oct-10	7.86	485	7.0	35.3	
S-05 U/S	Seine River Syphon Overflow - Upstream of Perimeter Ditches	30-Apr-10	7.93	504	11.3	23.2	
		5-May-10	8.31	780	9.2	30.2	
		25-May-10	7.80	527	18.0	30.1	
		30-May-10	7.63	341	15.2	193.8	
		19-Jun-10	7.98	717	17.8	53.3	
		27-Jun-10	7.90	402	21.1	63.4	
		14-Jul-10	8.13	518	21.7	68.2	
		13-Aug-10	8.16	469	23.7	73.2	
		16-Aug-10	7.58	565	16.8	34.3	
		31-Aug-10	6.80	444	17.6	57.0	
		2-Sep-10	7.12	285	16.5	76.9	
		10-Sep-10	7.71	545	14.0	71.9	
		24-Sep-10	7.40	488	9.9	45.7	
		26-Oct-10	7.13	801	9.3	40.3	
		27-Oct-10	7.38	574	6.8	28.0	
S-13	Floodway Channel - D/S of Grande Pointe Drain	30-Apr-10	8.30	540	11.0	68.0	
		5-May-10	8.41	716	9.0	41.8	
		25-May-10	8.20	594	19.0	50.9	
		30-May-10	7.79	323	14.4	64.7	
		19-Jun-10	8.02	668	18.5	75.8	
		27-Jun-10	8.14	404	21.5	111.9	
		14-Jul-10	8.14	463	22.2	96.7	
		13-Aug-10	8.35	541	24.6	39.5	
		16-Aug-10	7.68	560	17.1	28.8	
		31-Aug-10	7.01	440	18.2	174.9	
		2-Sep-10	7.40	255	17.2	95.1	
		10-Sep-10	8.04	432	15.0	54.1	
		24-Sep-10	8.01	432	12.4	76.5	
		26-Oct-10	7.34	652	10.3	32.2	
		27-Oct-10	7.88	566	6.2	75.1	

TABLE NM9-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-14	Floodway Channel - D/S of North Bibeau Drain	30-Apr-10	8.64	703	11.7	19.6	
		5-May-10	8.42	808	10.3	81.8	
		25-May-10	8.46	749	18.5	146.8	
		30-May-10	7.88	276	16.3	545.8	
		19-Jun-10	8.10	563	20.3	64.1	
		27-Jun-10	8.08	396	23.7	44.8	
		14-Jul-10	8.02	413	23.3	244.1	
		13-Aug-10	8.34	583	24.1	63.3	
		16-Aug-10	7.96	744	18.5	50.3	
		31-Aug-10	7.40	655	18.3	40.2	
		2-Sep-10	7.50	330	18.6	62.4	
		10-Sep-10	8.03	418	14.9	83.6	
		24-Sep-10	7.87	519	12.6	69.7	
		26-Oct-10	7.52	702	9.7	28.4	
		27-Oct-10	7.75	492	7.0	104.6	
S-15	Seine River U/S of Prairie Grove Road Culvert	30-Apr-10	8.37	507	12.4	21.7	
		5-May-10	8.34	798	9.3	29.3	
		25-May-10	8.04	550	18.6	25.7	
		30-May-10	7.79	304	15.5	282.3	
		19-Jun-10	7.56	741	17.8	44.9	
		27-Jun-10	7.97	405	20.5	60.5	
		14-Jul-10	7.93	412	20.8	322.1	
		13-Aug-10	8.02	486	23.5	62.2	
		16-Aug-10	7.58	586	17.0	24.7	
		31-Aug-10	7.08	427	17.8	76.0	
		2-Sep-10	6.92	323	16.0	65.4	
		10-Sep-10	7.66	461	13.8	75.9	
		24-Sep-10	7.88	482	10.1	50.6	
		26-Oct-10	7.25	694	9.8	30.6	
		27-Oct-10	7.66	493	8.0	43.7	
S-16	Seine River D/S of Prairie Grove Road Culvert	30-Apr-10	8.33	512	12.8	22.7	
		5-May-10	8.30	859	8.7	26.5	
		25-May-10	7.92	586	18.2	25.9	
		30-May-10	7.70	357	15.9	238.5	
		19-Jun-10	7.94	728	17.5	46.1	
		27-Jun-10	7.97	410	21.0	59.7	
		14-Jul-10	7.57	403	20.8	181.5	
		13-Aug-10	7.99	523	23.1	54.4	
		16-Aug-10	7.67	645	17.0	23.2	
		31-Aug-10	6.65	453	17.0	67.0	
		2-Sep-10	6.98	390	16.2	47.9	
		10-Sep-10	7.70	570	13.8	15.8	
		24-Sep-10	7.74	514	10.2	40.4	
		26-Oct-10	6.99	763	9.7	34.0	
		27-Oct-10	7.64	519	7.2	36.5	
S-21	Floodway Channel - Keewatin Weir	30-Apr-10	8.15	679	10.3	49.0	
		5-May-10	8.45	765	9.5	40.2	
		25-May-10	8.24	769	18.5	64.9	
		30-May-10	7.89	457	15.4	57.9	
		19-Jun-10	8.09	755	21.9	61.0	
		27-Jun-10	7.93	407	22.6	24.3	
		14-Jul-10	7.51	395	23.9	105.7	
		13-Aug-10	8.16	696	23.2	63.3	
		16-Aug-10	7.36	750	18.1	42.8	
		31-Aug-10	7.30	1008	17.9	52.6	
		2-Sep-10	7.45	403	17.5	39.9	
		10-Sep-10	8.01	417	15.2	70.7	
		24-Sep-10	8.00	687	12.6	62.0	
		26-Oct-10	7.55	633	10.0	24.5	
		27-Oct-10	7.73	564	6.6	75.1	

TABLE NM9-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-25	Floodway Channel - Dunning Weir	30-Apr-10	8.69	787	12.5	26.0	
		5-May-10	8.47	818	9.6	65.6	
		25-May-10	8.40	690	19.2	70.6	
		30-May-10	8.07	370	15.2	157.8	
		19-Jun-10	8.29	786	19.6	47.2	
		27-Jun-10	8.11	376	20.1	54.3	
		14-Jul-10	8.30	495	21.8	95.7	
		13-Aug-10	8.37	648	24.1	71.1	
		16-Aug-10	7.53	714	17.0	46.4	
		31-Aug-10	6.13	613	17.3	56.2	
		2-Sep-10	7.70	329	17.0	71.7	
		10-Sep-10	8.06	407	15.0	84.7	
		24-Sep-10	8.05	789	12.5	61.6	
		26-Oct-10	7.75	711	9.5	47.5	
		27-Oct-10	7.24	543	7.7	54.4	
S-31	Red River - Downstream of Outlet (1000 m)	30-Apr-10	8.15	839	12.5	102.8	
		5-May-10	8.29	841	11.3	132.2	
		25-May-10	8.19	880	18.9	115.7	
		30-May-10	7.93	429	15.7	229.6	
		19-Jun-10	7.99	800	19.2	76.7	
		27-Jun-10	7.98	393	20.3	115.4	
		14-Jul-10	7.98	710	22.8	223.7	
		13-Aug-10	8.10	818	25.0	162.3	
		16-Aug-10	7.32	798	20.2	88.3	
		31-Aug-10	7.22	806	18.7	56.4	
		2-Sep-10	7.69	443	17.2	108.1	
		10-Sep-10	7.90	505	14.7	101.3	
		24-Sep-10	8.08	687	12.5	100.9	
		26-Oct-10	7.53	880	9.3	96.4	
		27-Oct-10	7.77	669	8.0	79.7	
S-34	Red River - Upstream of Outlet	30-Apr-10	8.22	837	12.4	99.7	
		5-May-10	8.39	853	10.4	123.5	
		25-May-10	8.25	961	19.5	124.7	
		30-May-10	7.92	631	16.5	347.3	
		19-Jun-10	7.43	820	19.5	129.3	
		27-Jun-10	7.95	556	20.6	215.7	
		14-Jul-10	8.04	844	23.5	175.0	
		13-Aug-10	8.11	833	25.2	163.0	
		16-Aug-10	7.39	810	20.9	84.5	
		31-Aug-10	7.74	851	19.4	54.4	
		2-Sep-10	7.88	658	18.1	187.9	
		10-Sep-10	8.09	78.7	16.2	78.3	
		24-Sep-10	7.94	777	13.2	127.8	
		26-Oct-10	7.57	933	9.4	100.5	
		27-Oct-10	7.79	859	8.3	138.7	
S-37	La Salle River - Upstream of Glenlea Drain	30-Apr-10	-	-	-	-	CNM - No Flow in Drain
		5-May-10	8.11	724	9.7	131.1	
		25-May-10	-	-	-	-	CNM - No Flow in Drain
		30-May-10	6.17	197	15.8	612.0	
		19-Jun-10	-	-	-	-	CNM - No Flow in Drain
		27-Jun-10	-	-	-	-	CNM - No Flow in Drain
		14-Jul-10	7.68	662	22.8	73.8	
		13-Aug-10	7.65	408	22.5	238.3	
		16-Aug-10	7.19	296	17.3	70.8	
		31-Aug-10	6.15	380	18.4	157.3	
		2-Sep-10	7.49	406	16.6	138.6	
		10-Sep-10	7.68	370	14.6	88.1	
		24-Sep-10	7.68	344	9.9	201.0	
		26-Oct-10	-	-	-	-	CNM - No Flow
		27-Oct-10	7.99	745	7.1	83.9	

TABLE NM9-1
FIELD SURFACE WATER CHEMISTRY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No.	Location	Date	pH (units)	E.C. (µS/cm)	Temp. (°C)	Turbidity (NTU)	Comments
S-38	La Salle River - Downstream of Glenlea Drain	30-Apr-10	-	-	-	-	CNM - No Flow in Drain
		5-May-10	8.05	768	9.8	129.7	
		25-May-10	-	-	-	-	CNM - No Flow in Drain
		30-May-10	7.80	157	15.1	704.1	
		19-Jun-10	-	-	-	-	CNM - No Flow in Drain
		27-Jun-10	-	-	-	-	CNM - No Flow in Drain
		14-Jul-10	7.73	681	22.5	67.8	
		13-Aug-10	7.89	388	22.3	253.0	
		16-Aug-10	7.07	294	17.3	68.1	
		31-Aug-10	6.87	290	17.3	63.8	
		2-Sep-10	6.96	243	15.0	56.3	
		10-Sep-10	7.67	527	14.1	115.1	
		24-Sep-10	7.26	276	10.0	250.3	
		26-Oct-10	-	-	-	-	CNM - No Flow
		27-Oct-10	7.89	672	6.5	132.6	

Notes:
"-" = No Data
E.C. = Electrical Conductivity
CNM = Could Not Monitor

TABLE NM9-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter [2]																								
		Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	Total Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	Cation Anion Ratio (%) [7]	Cation-Anion Balance (%) [8]
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.003*	-	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*0.001*	*5*	*5*	*0.2*	-	-
CCME [4]																											
Freshwater Aquatic Life		[5]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	[6]	-	-	-
Floodway Flow Event - Spring Flood (crest)																											
CON U/S	7-Apr-10	122	7.85	434	133	162	<0.60	<0.40	196	18.5	0.20	85.7	0.055	0.001	1.690	46.8	19.4	9.03	16.3	**1.9**	0.139	0.387	283	150	1.33	95.7	-2.2
CON D/S	7-Apr-10	**154**	8.06	417	130	159	<0.60	<0.40	194	15.8	0.22	79.7	0.090	0.002	1.740	45.8	19.3	9.53	14.9	**2.1**	0.134	0.366	271	**176**	1.34	98.3	-0.8
S-01	7-Apr-10	118	7.84	434	133	162	<0.60	<0.40	195	16.0	0.21	85.1	0.059	0.001	1.700	46.4	19.3	9.29	15.9	**2.2**	0.151	0.355	279	161	1.28	96.5	-1.8
S-02	7-Apr-10	122	7.87	433	133	162	<0.60	<0.40	197	16.0	0.20	86.2	0.063	0.001	1.720	46.7	19.6	9.12	16.1	**2.1**	0.151	0.378	281	154	1.24	96.9	-1.6
S-03	7-Apr-10	116	7.87	435	133	162	<0.60	<0.40	191	16.0	0.20	86.5	0.072	0.001	1.740	45.4	18.9	8.81	15.6	**1.8**	0.153	0.384	279	158	1.27	93.7	-3.2
S-04a	7-Apr-10	107	7.81	430	132	161	<0.60	<0.40	191	15.9	0.19	84.0	0.059	0.001	1.750	45.5	18.9	9.10	15.7	**1.9**	0.129	0.367	276	136	1.12	95.4	-2.4
S-05 U/S	7-Apr-10	20.8	8.12	568	219	267	<0.60	<0.40	269	31.4	0.18	60.8	0.072	0.001	0.311	56.6	31.0	7.92	18.8	**0.7**	0.050	0.151	339	23	0.99	97.5	-1.3
S-06	7-Apr-10	34.1	8.20	539	222	267	1.90	<0.40	264	25.7	0.17	57.6	0.091	0.002	0.229	55.0	30.7	8.07	14.9	**0.7**	0.042	0.191	326	40	1.25	95.9	-2.1
S-07	7-Apr-10	11.0	8.27	523	222	262	4.26	<0.40	259	17.5	0.22	65.0	<0.050	0.002	0.152	47.2	34.2	8.36	13.4	0.2	0.020	0.157	319	9	1.11	94.6	-2.8
S-09	7-Apr-10	28.4	8.29	505	222	264	3.54	<0.40	250	19.0	0.18	55.6	0.323	0.012	0.059	51.2	29.6	11.2	11.5	**0.8**	0.029	0.515	312	34	1.67	93.9	-3.1
S-09 U/S	7-Apr-10	27.2	8.30	497	224	262	5.50	<0.40	253	17.8	0.19	51.3	0.277	0.009	0.063	52.0	29.9	11.0	11.3	**0.7**	0.028	0.450	308	29	1.61	96.2	-2.0
S-10	7-Apr-10	1.09	8.53	532	173	202	4.65	<0.40	245	21.7	0.19	101	<0.050	0.003	<0.050	40.2	35.1	9.41	18.5	0.0	0.005	0.133	330	<5.0	0.93	96.0	-2.1
S-10 U/S	7-Apr-10	0.91	8.00	452	176	215	<0.60	<0.40	207	20.3	0.19	53.9	<0.050	0.001	<0.050	38.9	26.7	10.7	13.0	0.0	0.002	0.291	269	<5.0	1.02	95.2	-2.5
S-11	7-Apr-10	0.56	8.00	738	197	241	<0.60	<0.40	268	92.9	0.20	55.7	<0.050	0.001	0.199	53.9	32.3	10.6	51.2	0.0	0.001	0.101	416	<5.0	0.79	101.0	0.6
S-13	7-Apr-10	74.8	7.98	461	161	196	<0.60	<0.40	212	19.0	0.20	73.0	0.056	0.001	1.270	48.0	22.3	8.55	15.4	**1.2**	0.082	0.295	289	103	1.14	95.3	-2.4
S-14	7-Apr-10	**218**	7.91	434	139	169	<0.60	<0.40	218	16.6	0.21	82.1	0.073	0.001	1.580	51.2	21.8	9.46	15.9	**2.4**	0.220	0.412	287	**278**	1.42	104.0	2.0
S-15	7-Apr-10	15.5	8.22	565	215	253	4.13	<0.40	262	31.0	0.19	65.6	0.059	0.001	0.300	54.9	30.2	7.88	18.1	**0.6**	0.044	0.147	338	19	1.11	94.8	-2.7
S-16	7-Apr-10	16.4	8.20	576	211	251	2.68	<0.40	264	34.5	0.18	65.4	0.055	0.001	0.284	54.5	31.1	7.95	20.9	**0.5**	0.045	0.138	342	16	1.11	97.3	-1.4
S-21	7-Apr-10	126	7.83	425	132	160	<0.60	<0.40	198	15.9	0.19	83.5	0.060	0.001	1.780	47.4	19.5	9.71	16.1	**2.3**	0.139	0.366	279	156	1.31	99.4	-0.3
S-22	7-Apr-10	1.24	8.76	692	261	290	14.2	<0.40	348	34.3	0.18	101	<0.050	0.006	<0.050	63.4	46.1	8.81	15.4	0.0	0.008	0.089	426	<5.0	0.96	94.5	-2.8
S-23	7-Apr-10	132	7.85	427	137	167	<0.60	<0.40	212	16.2	0.21	81.0	0.061	0.001	1.630	49.9	21.1	9.81	15.8	**2.3**	0.145	0.373	283	169	1.39	103.0	1.5
S-25	7-Apr-10	122	8.13	426	135	164	<0.60	<0.40	187	16.0	0.22	80.6	0.087	0.002	1.670	43.9	18.8	8.91	14.7	**2.0**	0.123	0.332	271	151	1.39	93.1	-3.6
S-26	7-Apr-10	4.07	8.37	622	300	354	5.50	<0.40	337	21.4	0.18	49.7	<0.050	0.002	<0.050	70.1	39.4	4.01	12.4	0.2	0.022	0.043	377	7	0.92	96.7	-1.7
S-27	7-Apr-10	**9.57**	7.28	580	272	332	<0.60	<0.40	323	16.3	0.23	62.2	<0.050	0.000	0.056	60.5	41.7	3.63	9.25	0.2	0.006	0.038	357	12	0.88	96.3	-1.9
S-27 U/S	7-Apr-10	1.04	8.21	583	264	317	2.42	<0.40	321	18.0	0.26	65.5	<0.050	0.001	<0.050	57.2	43.2	3.73	9.58	0.0	0.002	0.033	356	<5.0	1.01	96.7	-1.7
S-28	7-Apr-10	**157**	7.00	416	130	159	<0.60	<0.40	193	15.8	0.22	80.8	0.078	0.000	1.690	45.6	19.3	9.63	15.3	**2.2**	0.139	0.400	272	175	1.37	98.1	-0.9
Field Dup.	7-Apr-10	**170**	8.06	416	131	159	<0.60	<0.40	195	15.8	0.22	79.9	0.072	0.001	1.700	46.4	19.3	9.53	15.4	**1.8**	0.137	0.366	272	**183**	1.61	99.4	-0.3
S-30	7-Apr-10	138	8.05	417	132	161	<0.60	<0.40	198	15.7	0.18	78.7	0.065	0.001	1.660	47.2	19.5	9.57	15.3	**2.1**	0.138	0.348	272	182	1.24	100.0	0.2
S-31	7-Apr-10	159	8.05	417	131	160	<0.60	<0.40	194	15.9	0.21	78.8	0.073	0.001	1.690	45.9	19.3	9.40	15.1	**2.3**	0.139	0.377	271	176	1.28	98.6	-0.7
S-32	7-Apr-10	162	8.04	418	132	161	<0.60	<0.40	198	16.2	0.20	79.7	0.078	0.001	1.680	47.0	19.6	9.57	15.4	**2.0**	0.155	0.393	274	194	1.34	99.8	-0.1
S-33	7-Apr-10	165	8.06	419	133	163	<0.60	<0.40	194	16.1	0.20	80.4	0.088	0.002	1.690	46.0	19.3	9.34	15.2	**1.8**	0.155	0.407	274	198	1.37	97.0	-1.5
S-34	7-Apr-10	178	8.08	429	132	161	<0.60	<0.40	199	16.5	0.21	83.3	0.144	0.003	1.740	46.9	20.0	9.55	16.5	**2.5**	0.203	0.432	280	214	1.62	99.5	-0.3
Floodway Flow Event - Spring Flood (pre-crest)																											
CON U/S	1-Apr-10	168	8.19	372	111	135	<0.60	<0.40	182	20.8	0.19	87.0	-	-	1.97	42.8	18.2	9.02	13.6	**2.8**	0.148	-	266	195	-	93.6	-3.3
CON D/S	1-Apr-10	**230**	8.20	367	111	135	<0.60	<0.40	185	20.9	0.16	88.4	-	-	1.98	44.2	18.2	8.80	12.9	**3.1**	0.174	-	269	**251**	-	93.7	-3.3
S-21	1-Apr-10	**192**	8.19	417	112	136	<0.60	<0.40	184	29.9	0.18	88.6	-	-	2.02	43.6	18.2	8.79	20.3	**2.3**	0.150	-	285	202	-	94.3	-2.9
S-23	1-Apr-10	148	8.25	369	119	145	<0.60	<0.40	181	19.3	0.18	78.2	-	-	1.62	41.0	19.0	8.83	10.9	**2.6**	0.125	-	256	166	-	92.2	-4.1
S-25	1-Apr-10	172	8.23	359	114	139	<0.60	<0.40	178	19.3	0.13	82.0	-	-	1.81	42.1	17.8	8.76	10.9	**2.0**	0.128	-	257	180	-	91.4	-4.5

TABLE NM9-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter [2]																								
		Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	Total Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	Cation Anion Ratio (%) [7]	Cation-Anion Balance (%) [8]
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.003*	-	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*0.001*	*5*	*5*	*0.2*	-	-
CCME [4]																											
Freshwater Aquatic Life		[5]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	[6]	-	-	-
Floodway Flow Event - Spring Flood (post-crest)																											
CON U/S	15-Apr-10	101	8.12	582	164	191	4.51	<0.40	275	20.6	0.22	134	-	-	1.02	62.7	28.7	9.08	25.4	**0.9**	0.151	-	383	217	-	101.0	0.7
CON D/S	15-Apr-10	75.3	8.15	566	157	191	<0.60	<0.40	276	20.2	0.23	133	-	-	1.14	63.0	28.8	9.32	25.3	**0.9**	0.114	-	379	58	-	104.0	2.2
S-21	15-Apr-10	96.3	8.10	572	158	184	4.45	<0.40	276	20.2	0.27	132	-	-	1.11	62.1	29.4	9.36	25.6	**1.0**	0.143	-	378	151	-	105.0	2.2
S-23	15-Apr-10	**139**	8.13	570	162	194	1.70	<0.40	313	20.2	0.25	130	-	-	1.08	71.1	33.0	9.24	24.5	**1.4**	0.180	-	390	239	-	115.0	6.8
S-25	15-Apr-10	**168**	8.16	565	159	189	2.55	<0.40	307	20.1	0.26	130	-	-	1.10	70.4	31.8	9.43	24.9	**1.5**	0.168	-	387	**282**	-	114.0	6.5
Floodway Flow Event - Summer Flood (crest)																											
CON U/S	9-Jun-10	19.1	8.16	660	194	236	<0.60	<0.40	282	24.9	0.26	141	<0.050	0.002	0.619	54.3	35.6	6.04	31.5	0.1	0.046	0.297	412	17	1.07	94.7	-2.7
CON D/S	9-Jun-10	**35.3**	8.28	632	185	225	<0.60	<0.40	285	28.4	0.23	136	<0.050	0.003	0.778	63.1	31.1	6.13	25.4	**0.3**	0.063	0.334	404	39	0.29	94.3	-2.9
S-01	9-Jun-10	22.3	8.10	659	193	236	<0.60	<0.40	301	25.4	0.25	144	<0.050	0.002	0.626	64.9	33.6	6.94	29.1	**0.3**	0.068	0.300	423	22	1.2	97.5	-1.3
S-02	9-Jun-10	21.7	8.10	659	194	236	<0.60	<0.40	294	25.3	0.23	143	<0.050	0.002	0.636	63.3	32.9	6.76	29.1	0.3	0.064	0.296	419	23	1.0	95.9	-2.1
S-03	9-Jun-10	24.2	8.12	660	194	237	<0.60	<0.40	288	25.3	0.27	142	<0.050	0.002	0.622	55.0	36.5	6.12	31.4	0.1	0.056	0.300	415	21	1.1	95.5	-2.3
S-04A	9-Jun-10	**28.0**	8.26	661	192	234	<0.60	<0.40	284	24.9	0.22	140	<0.050	0.003	0.641	55.8	35.2	6.16	30.2	0.1	0.048	0.311	410	29	1.07	95.3	-2.4
S-05	9-Jun-10	39.5	8.13	484	225	275	<0.60	<0.40	238	17.2	0.24	14.0	0.059	0.002	0.145	46.6	29.5	4.39	12	0.2	0.039	0.332	259	30	1.1	102	0.8
S-05 U/S	9-Jun-10	49.5	8.14	478	225	275	<0.60	<0.40	235	15.8	0.19	14.5	0.081	0.003	0.161	46.8	28.8	4.37	11.5	0.2	0.032	0.361	257	55	1.11	101	0.4
S-06	9-Jun-10	45.4	8.23	476	226	276	<0.60	<0.40	237	14.7	0.2	14.6	<0.050	0.003	0.163	47.9	28.5	4.18	10.3	**0.3**	0.056	0.388	256	80	1.27	101	0.3
S-07	9-Jun-10	49.1	8.10	446	187	228	<0.60	<0.40	209	12.7	0.28	44.6	<0.050	0.002	0.340	32.5	31.1	6.77	13.8	**0.4**	0.030	0.987	255	34	1.43	97.9	-1.1
S-09	9-Jun-10	146	8.26	410	215	262	<0.60	<0.40	229	<9.0	0.24	28.8	<0.050	0.003	<0.050	52.0	24.0	2.50	5.48	**0.6**	0.084	0.315	241	183	1.22	99.3	-0.3
S-09 U/S	9-Jun-10	217	8.25	414	216	264	<0.60	<0.40	231	<9.0	0.24	28.9	<0.050	0.003	<0.050	52.4	24.3	2.55	5.69	**0.6**	0.086	0.272	243	226	0.88	99.7	-0.1
S-10	9-Jun-10	61.4	8.00	583	178	218	<0.60	<0.40	270	18.7	0.22	131	<0.050	0.001	0.388	40.0	41.3	9.21	18.6	**0.4**	0.032	0.905	367	35	1.57	93.8	-3.2
S-10 U/S	9-Jun-10	87.0	7.87	415	167	204	<0.60	<0.40	186	16.0	0.19	45.3	<0.050	0.001	0.337	31.6	26.0	10.8	9.97	**0.4**	0.022	1.180	241	39	1.8	92.8	-3.8
S-11	9-Jun-10	5.04	8.15	590	235	287	<0.60	<0.40	246	34.0	0.17	35.9	<0.050	0.002	<0.050	49.4	29.9	5.76	24.8	0.3	0.059	0.319	321	<5.0	0.99	95.8	-2.1
S-13	9-Jun-10	**53.8**	8.14	617	200	244	<0.60	<0.40	271	22.5	0.26	117	0.149	0.006	0.547	55.0	32.6	5.91	24.5	0.2	0.059	0.350	380	**55**	1.21	93.3	-3.5
S-14	9-Jun-10	**86.6**	8.19	632	192	234	<0.60	<0.40	279	23.5	0.23	129	0.056	0.003	0.634	56.2	33.6	6.42	25.9	0.3	0.079	0.430	392	**96**	1.43	94.7	-2.7
S-15	9-Jun-10	42.7	8.20	490	226	276	<0.60	<0.40	241	18.4	0.25	19.0	<0.050	0.002	0.149	46.6	30.3	4.43	13.1	0.2	0.045	0.335	268	37	1.2	101	0.4
S-16	9-Jun-10	42.2	8.17	540	228	278	<0.60	<0.40	254	26.4	0.25	35.4	<0.050	0.002	0.135	46.3	33.6	4.59	19.1	0.3	0.044	0.298	303	40	1.07	99.4	-0.3
S-21	9-Jun-10	**33.0**	8.33	664	190	228	1.90	<0.40	279	29.7	0.2	139	<0.050	0.004	0.678	61.8	30.4	6.21	27	0.3	0.063	0.302	411	**44**	1.05	91.2	-4.6
S-22	9-Jun-10	4.10	8.57	643	273	311	10.7	<0.40	322	26.2	0.21	70.1	<0.050	0.005	<0.050	55.9	44.3	6.17	14.7	0.2	0.016	0.478	381	5	1.22	94.4	-2.9
S-23	9-Jun-10	**90.1**	8.36	585	202	241	2.62	<0.40	264	24.5	0.17	102	<0.050	0.004	0.482	58.3	28.7	5.28	19.7	**0.4**	0.079	0.345	362	**99**	1.07	90.8	-4.8
S-25	9-Jun-10	**77.6**	8.34	592	193	231	2.03	<0.40	269	25.4	0.24	111	<0.050	0.003	0.552	62.3	27.6	6.10	21	**0.5**	0.067	0.318	371	**80**	1.01	93	-3.6
S-26	9-Jun-10	6.17	8.50	625	295	342	8.70	<0.40	319	22.8	0.24	28.3	<0.050	0.004	<0.050	63.6	38.8	2.97	13	0.2	0.017	0.092	346	11	0.87	98.2	-0.9
S-27	9-Jun-10	5.19	8.29	637	279	340	<0.60	<0.40	328	23.8	0.19	55.6	<0.050	0.003	<0.050	57.1	45.0	3.16	13.5	0.2	0.018	0.070	365	14	0.81	97.4	-1.3
S-27 U/S	9-Jun-10	1.30	8.27	668	290	354	<0.60	<0.40	329	26.0	0.23	59.2	<0.050	0.002	<0.050	55.3	46.4	2.44	13.5	0.1	0.016	0.047	377	<5.0	0.88	92.9	-3.7
S-28	9-Jun-10	**46.0**	8.27	632	185	226	<0.60	<0.40	273	28.2	0.23	136	<0.050	0.003	0.772	60.8	29.4	6.11	25.2	**0.3**	0.063	0.351	400	**53**	0.86	90.6	-4.9
Field Dup.	9-Jun-10	**46.1**	8.29	633	185	226	<0.60	<0.40	284	28.6	0.27	139	<0.050	0.003	0.713	65.5	29.2	6.77	24.7	**0.3**	0.061	0.263	408	**54**	0.91	92.6	-6.1
S-30	9-Jun-10	44.1	8.28	613	185	226	<0.60	<0.40	266	27.0	0.22	123	<0.050	0.003	0.723	58.9	28.9	5.91	23.4	**0.3**	0.060	0.319	382	51	0.96	91.5	-4.4
S-31	9-Jun-10	43.2	8.28	619	186	227	<0.60	<0.40	275	27.4	0.25	130	<0.050	0.003	0.721	61.3	29.5	6.08	24.3	**0.3**	0.062	0.341	393	51	0.95	92.2	-4.0
S-32	9-Jun-10	38.6	8.26	622	185	226	<0.60	<0.40	274	28.0	0.18	133	<0.050	0.003	0.735	60.5	29.8	6.07	24.9	**0.3**	0.061	0.337	396	41	0.88	91.6	-4.4
S-33	9-Jun-10	38.4	8.25	622	184	225	<0.60	<0.40	270	27.3	0.24	131	0.051	0.003	0.759	63.4	27.2	6.62	22.8	**0.3**	0.058	0.346	392	50	0.88	90.5	-8.6
S-34	9-Jun-10	46.8	8.25	622	180	220	<0.60	<0.40	262	28.8	0.20	130	0.078	0.005	0.827	57.9	28.5	6.61	25.8	**0.4**	0.090	0.394	389	55	1.01	90.7	-4.9

TABLE NM9-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter [2]																							
		Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	Total Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	Cation Anion Ratio (%) [7]	Cation-Anion Balance (%) [8]
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.003*	-	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*0.001*	*5*	*5*	*0.2*	-	-
CCME [4]																											
Freshwater Aquatic Life		[5]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	[6]	-	-	-
Level I Rain Event																											
CON D/S	30-Apr-10	-	8.30	700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	-	-	-
	5-May-10	-	8.40	773	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**62**	-	-	-
	25-May-10	-	8.34	628	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-
	30-May-10	-	7.95	378	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**97**	-	-	-
	19-Jun-10	-	8.28	727	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-
	27-Jun-10	-	8.17	424	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**36**	-	-	-
	14-Jul-10	-	8.33	505	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**164**	-	-	-
	13-Aug-10	-	8.21	575	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	79	-	-	-
	16-Aug-10	-	8.31	630	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-
	31-Aug-10	-	8.29	668	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42	-	-	-
	2-Sep-10	-	8.05	372	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**73**	-	-	-
	10-Sep-10	-	8.22	408	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**111**	-	-	-
	24-Sep-10	-	8.29	602	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**45**	-	-	-
	26-Oct-10	-	8.55	698	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[9]	-	-	-
	27-Oct-10	-	8.21	574	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**108**	-	-	-
CON U/S	5-May-10	-	8.23	881	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
	30-May-10	-	7.92	600	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	34	-	-	-
	19-Jun-10	-	7.88	779	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45	-	-	-
	27-Jun-10	-	8.19	859	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<5	-	-	-
	14-Jul-10	-	7.92	373	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	103	-	-	-
	2-Sep-10	-	8.00	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-
	10-Sep-10	-	8.05	576	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
	24-Sep-10	-	7.96	507	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	-	-
	27-Oct-10	-	8.08	565	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-
S-04a	5-May-10	-	8.23	631	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22	-	-	-
	30-May-10	-	7.92	383	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**154**	-	-	-
	19-Jun-10	-	7.90	785	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	21	-	-	-
	27-Jun-10	-	8.54	553	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	10	-	-	-
	14-Jul-10	-	7.92	368	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59	-	-	-
	2-Sep-10	-	7.96	279	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**87**	-	-	-
	10-Sep-10	-	8.02	515	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-
	24-Sep-10	-	8.08	468	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-
	27-Oct-10	-	8.05	477	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**38**	-	-	-
S-05 U/S	30-Apr-10	-	8.22	462	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	-	-	-
	5-May-10	-	8.30	693	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-
	25-May-10	-	8.22	490	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-
	30-May-10	-	7.61	317	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	169	-	-	-
	19-Jun-10	-	8.06	650	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	-	-	-
	27-Jun-10	-	8.06	457	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54	-	-	-
	14-Jul-10	-	8.28	468	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	55	-	-	-

TABLE NM9-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter [2]																								
		Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	Total Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	Cation Anion Ratio (%) [7]	Cation-Anion Balance (%) [8]
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.003*	-	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*0.001*	*5*	*5*	*0.2*	-	-
CCME [4]																										
Freshwater Aquatic Life		[5]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	[6]	-	-	-
S-05 U/S	13-Aug-10	-	8.31	464	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	77	-	-	-
	16-Aug-10	-	8.33	531	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-
	31-Aug-10	-	8.07	429	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47	-	-	-
	2-Sep-10	-	7.78	284	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	86	-	-	-
	10-Sep-10	-	8.04	510	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	97	-	-	-
	24-Sep-10	-	7.92	500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-
	26-Oct-10	-	8.54	772	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[9]	-	-	-
	27-Oct-10	-	7.68	560	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-
S-13	30-Apr-10	-	8.20	502	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67	-	-	-
	5-May-10	-	8.37	636	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35	-	-	-
	25-May-10	-	8.31	548	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42	-	-	-
	30-May-10	-	7.66	297	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39	-	-	-
	19-Jun-10	-	8.15	607	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**84**	-	-	-
	27-Jun-10	-	8.22	462	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**124**	-	-	-
	14-Jul-10	-	8.16	430	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	82	-	-	-
	13-Aug-10	-	8.44	506	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	-	-	-
	16-Aug-10	-	8.43	520	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18	-	-	-
	31-Aug-10	-	8.26	428	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	214	-	-	-
	2-Sep-10	-	7.85	258	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**83**	-	-	-
	10-Sep-10	-	8.27	427	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**60**	-	-	-
	24-Sep-10	-	8.11	445	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**77**	-	-	-
	26-Oct-10	-	8.56	599	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[9]	-	-	-
	27-Oct-10	-	8.09	553	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	93	-	-	-
S-14	30-Apr-10	-	8.47	653	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-
	5-May-10	-	8.39	719	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**70.6**	-	-	-
	25-May-10	-	8.51	686	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	165	-	-	-
	30-May-10	-	7.72	244	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**518**	-	-	-
	19-Jun-10	-	8.04	512	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	46	-	-	-
	27-Jun-10	-	8.21	451	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	27	-	-	-
	14-Jul-10	-	8.28	376	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**246**	-	-	-
	13-Aug-10	-	8.49	574	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47	-	-	-
	16-Aug-10	-	8.50	695	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41	-	-	-
	31-Aug-10	-	8.49	647	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	-	-	-
	2-Sep-10	-	7.81	336	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**51**	-	-	-
	10-Sep-10	-	8.19	419	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**100**	-	-	-
	24-Sep-10	-	8.24	533	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**63**	-	-	-
	26-Oct-10	-	8.54	688	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[9]	-	-	-
	27-Oct-10	-	8.16	479	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**131**	-	-	-

TABLE NM9-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter [2]																								
		Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	Total Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	Cation Anion Ratio (%) [7]	Cation-Anion Balance (%) [8]
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.003*	-	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*0.001*	*5*	*5*	*0.2*	-	-
CCME [4]																										
Freshwater Aquatic Life		[5]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	[6]	-	-	-
S-15	30-Apr-10	-	8.24	477	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-
	5-May-10	-	8.31	701	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-
	25-May-10	-	8.24	511	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
	30-May-10	-	7.68	284	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8	-	-	-
	19-Jun-10	-	8.06	658	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44	-	-	-
	27-Jun-10	-	8.04	458	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59	-	-	-
	14-Jul-10	-	8.09	369	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**344**	-	-	-
	13-Aug-10	-	8.21	467	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54	-	-	-
	16-Aug-10	-	8.29	547	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-
	31-Aug-10	-	7.98	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59	-	-	-
	2-Sep-10	-	7.80	312	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	63	-	-	-
	10-Sep-10	-	8.03	454	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	73	-	-	-
	24-Sep-10	-	8.01	493	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	39	-	-	-
	26-Oct-10	-	8.52	675	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[9]	-	-	-
	27-Oct-10	-	7.91	488	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	35	-	-	-
S-16	30-Apr-10	-	8.22	512	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	-	-
	5-May-10	-	8.29	760	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	-	-	-
	25-May-10	-	8.22	549	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19	-	-	-
	30-May-10	-	7.76	329	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**238**	-	-	-
	19-Jun-10	-	8.06	675	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42	-	-	-
	27-Jun-10	-	8.03	472	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	-	-	-
	14-Jul-10	-	8.03	364	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**200**	-	-	-
	13-Aug-10	-	8.13	494	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57	-	-	-
	16-Aug-10	-	8.24	607	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-
	31-Aug-10	-	7.94	461	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	-	-	-
	2-Sep-10	-	7.78	401	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47	-	-	-
	10-Sep-10	-	7.97	559	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	64	-	-	-
	24-Sep-10	-	7.93	537	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28	-	-	-
	26-Oct-10	-	8.53	728	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[9]	-	-	-
	27-Oct-10	-	7.97	512	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	-	-	-
S-21	30-Apr-10	-	7.87	623	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44	-	-	-
	5-May-10	-	8.39	685	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	-	-	-
	25-May-10	-	8.30	708	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	-	-	-
	30-May-10	-	7.81	434	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	30	-	-	-
	19-Jun-10	-	8.11	685	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	-	-	-
	27-Jun-10	-	8.05	461	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	-	-	-
	14-Jul-10	-	8.07	370	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	92	-	-	-

TABLE NM9-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter [2]																								
		Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	Total Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	Cation Anion Ratio (%) [7]	Cation-Anion Balance (%) [8]
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.003*	-	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*0.001*	*5*	*5*	*0.2*	-	-
CCME [4]																											
Freshwater Aquatic Life		[5]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	[6]	-	-	-
S-21	13-Aug-10	-	8.30	668	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	61	-	-	-
	16-Aug-10	-	8.34	705	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	37	-	-	-
	31-Aug-10	-	8.46	1020	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	51	-	-	-
	2-Sep-10	-	7.80	397	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**30**	-	-	-
	10-Sep-10	-	8.20	411	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**50**	-	-	-
	24-Sep-10	-	8.36	713	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**61**	-	-	-
	26-Oct-10	-	8.47	628	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[9]	-	-	-
	27-Oct-10	-	8.18	549	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**91**	-	-	-
S-25	30-Apr-10	-	8.49	754	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	26	-	-	-
	5-May-10	-	8.41	735	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**57.6**	-	-	-
	25-May-10	-	8.47	633	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	71	-	-	-
	30-May-10	-	8.00	338	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**77**	-	-	-
	19-Jun-10	-	8.22	711	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-
	27-Jun-10	-	8.18	425	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**37**	-	-	-
	14-Jul-10	-	8.41	450	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	78	-	-	-
	13-Aug-10	-	8.48	626	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	67	-	-	-
	16-Aug-10	-	8.32	665	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33	-	-	-
	31-Aug-10	-	8.32	612	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	44	-	-	-
	2-Sep-10	-	8.06	325	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**58**	-	-	-
	10-Sep-10	-	8.31	405	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**78.2**	-	-	-
	24-Sep-10	-	8.31	821	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**41**	-	-	-
	26-Oct-10	-	8.55	700	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[9]	-	-	-
	27-Oct-10	-	8.16	527	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**67**	-	-	-
S-31	30-Apr-10	-	8.14	779	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	143	-	-	-
	5-May-10	-	8.28	755	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	193	-	-	-
	25-May-10	-	8.29	805	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	210	-	-	-
	30-May-10	-	7.91	411	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	255	-	-	-
	19-Jun-10	-	8.25	732	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	115	-	-	-
	27-Jun-10	-	8.10	440	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	134	-	-	-
	14-Jul-10	-	8.24	651	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**302**	-	-	-
	13-Aug-10	-	8.33	790	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	247	-	-	-
	16-Aug-10	-	8.30	762	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	117	-	-	-
	31-Aug-10	-	8.35	798	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	54	-	-	-
	2-Sep-10	-	8.04	437	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	84	-	-	-
	10-Sep-10	-	8.22	521	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150	-	-	-
	24-Sep-10	-	8.24	707	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	132	-	-	-
	26-Oct-10	-	8.56	861	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[9]	-	-	-
	27-Oct-10	-	8.23	690	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	113	-	-	-

TABLE NM9-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter [2]																								
		Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	Total Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	Cation Anion Ratio (%) [7]	Cation-Anion Balance (%) [8]
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.003*	*-*	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*0.001*	*5*	*5*	*0.2*	*-*	*-*
CCME [4]																										
Freshwater Aquatic Life		[5]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	[6]	-	-	-
S-34	30-Apr-10	-	8.13	787	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140	-	-	-
	5-May-10	-	8.37	763	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	187	-	-	-
	25-May-10	-	8.32	879	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	360	-	-	-
	30-May-10	-	7.93	590	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	432	-	-	-
	19-Jun-10	-	8.14	745	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	188	-	-	-
	27-Jun-10	-	8.11	637	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	327	-	-	-
	14-Jul-10	-	8.20	775	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	256	-	-	-
	13-Aug-10	-	8.35	814	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	284	-	-	-
	16-Aug-10	-	8.31	781	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	103	-	-	-
	31-Aug-10	-	8.37	838	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66	-	-	-
	2-Sep-10	-	8.14	653	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	220	-	-	-
	10-Sep-10	-	8.33	797	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	131	-	-	-
	24-Sep-10	-	8.25	805	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	195	-	-	-
	26-Oct-10	-	8.60	914	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	[9]	-	-	-
	27-Oct-10	-	8.32	864	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	257	-	-	-
S-37	5-May-10	-	8.12	661	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	162	-	-	-
	30-May-10	-	7.36	182	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	446	-	-	-
	14-Jul-10	-	8.03	608	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	-	-	-
	13-Aug-10	-	7.94	377	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	279	-	-	-
	16-Aug-10	-	7.61	273	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	66	-	-	-
	31-Aug-10	-	7.76	345	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	130	-	-	-
	2-Sep-10	-	7.75	360	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	232	-	-	-
	10-Sep-10	-	7.88	360	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	111	-	-	-
	24-Sep-10	-	7.75	350	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	211	-	-	-
	27-Oct-10	-	8.17	731	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	105	-	-	-

TABLE NM9-2
GENERAL WATER QUALITY
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter [2]																								
		Turbidity (NTU)	pH (units)	E.C. (µS/cm)	Alkalinity as $CaCO_3$	Bicarbonate as HCO_3	Carbonate as CO_3	Hydroxide as OH	Hardness as $CaCO_3$	Chloride - Soluble	Fluoride - Soluble	Sulphate - Soluble	Ammonia (NH_3) - Soluble	Unionized Ammonia [3]	Nitrate+ Nitrite-N Soluble	Calcium	Magnesium	Potassium	Sodium	Iron	Manganese	Total Phosphorus	T.D.S. (Calc.)	T.S.S.	T.K.N.	Cation Anion Ratio (%) [7]	Cation-Anion Balance (%) [8]
Detection Limit		*0.05*	*0.01*	*0.4*	*1*	*2*	*0.6*	*0.4*	*0.2*	*9*	*0.1*	*9*	*0.003*	-	*0.005*	*0.05*	*0.01*	*0.05*	*0.02*	*0.01*	*0.0002*	*0.001*	*5*	*5*	*0.2*	-	-
CCME [4]																											
Freshwater Aquatic Life		[5]	6.5-9.0	-	-	-	-	-	-	-	-	-	-	0.019	-	-	-	-	-	0.3	-	-	-	[6]	-	-	-
S-38	5-May-10	-	8.10	687	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	161	-	-	-
	30-May-10	-	7.70	140	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**714**	-	-	-
	14-Jul-10	-	8.04	625	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	79	-	-	-
	13-Aug-10	-	7.88	369	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	276	-	-	-
	16-Aug-10	-	7.62	277	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	56	-	-	-
	31-Aug-10	-	7.66	277	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50	-	-	-
	2-Sep-10	-	7.66	245	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	47	-	-	-
	10-Sep-10	-	7.83	520	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	114	-	-	-
	24-Sep-10	-	7.75	285	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	203	-	-	-
	27-Oct-10	-	8.15	673	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**140**	-	-	-

Notes:

"-" = No Data

E.C. = Electrical Conductivity
D.O.C. = Dissolved Organic Carbon
T.O.C. = Total Organic Carbon
T.K.N. = Total Kjeldahl Nitrogen
T.D.S. = Total Dissolved Solids
T.S.S. = Total Suspended Solids

1. See Table NM9-1 for sample location descriptions.
2. All values are expressed in milligrams per litre (mg/L) unless indicated otherwise.
3. Guideline for un-ionized ammonia is 0.019 mg/L. Un-ionized ammonia is pH and Temperature dependant. See Factsheet for details.
   Unionized Ammonia = (f) x (Ammonia), f = 1/(10(pKa - pH) + 1), pKa = 0.09018+2729.92/T, where T = Temperature in Kelvins
4. CCME 2007 - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999. Update 7.0 - 2007. Chapter 4 -Aquatic Life

BOLD - Exceedance of Criteria

5. Turbidity Guidelines Narrative (see fact sheet for complete details):
   Clear Flow:
   Maximum increase of 8 NTUs from background levels for a short-term exposure (e.g. 24 hr period).
   Maximum average increase of 2 NTUs from background levels for a longer exposure (e.g. 30 d period).
   High Flow or Turbid Waters:
   Maximum increase of 8 NTUs from background levels at any one time when background levels are between 8 and 80 NTUs.
   Should not increase more than 10% of background levels when background is >80 NTUs.
6. Suspended Sediments Guidelines (see fact sheet for complete details):
   Clear Flow:
   Maximum increase of 25 mg/L from background levels for any short-term exposure (eg. 24 hr period).
   Maximum average increase of 5 mg/L from background levels for longer term exposures (eg. Inputs lasting between 24 hrs and 30 days).
   High Flow:
   Maximum increase of 25 mg/L from background levels at any time when background levels are between 25 and 250 mg/L.
   Should not increase more than 10% of background levels when background is >250 mg/L.
7. Cation Anion ratio = $\frac{\text{sum of meq of Cations}}{}$ X 100 = % sum of meq of Anions
8. Cation Anion balance = $\frac{\text{sum of meq of Cations - sum of meq of Anions}}{}$ X 100 = % sum of meq of Cations + sum of meq Anions

TABLE NM9-3
PETROLEUM HYDROCARBONS IN SURFACE WATER
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter [2]								
		Benzene	Toluene	Ethyl-benzene	Xylenes (-o,-m,-p)	F1 (C_6 - C_{10})	F2 (C_{10} - C_{16})	F3 (C_{16} - C_{34})	F4 (C_{34} - C_{50})	Total Hydrocarbons (C_6 - C_{50})
Detection Limit		*0.5*	*0.5*	*0.5*	*1.5*	*100*	*100*	*250*	*250*	*250*
CCME [3]										
Recreation and Aesthetics		-	-	-	-	-	-	-	-	-
Freshwater Aquatic Life		370 (MAC)	2 (MAC)	90 (MAC)	-	-	-	-	-	-
Floodway Flow Event - Spring Flood (crest)										
CON U/S (Stn 5+500)	7-Apr-10	<0.50	<0.50	<0.50	<1.5	<100	<100	<250	<250	<250
CON D/S (Stn 50+900)	7-Apr-10	<0.50	<0.50	<0.50	<1.5	<100	<100	<250	<250	<250
Floodway Flow Event - Summer Flood (crest)										
CON U/S (Stn 5+500)	9-Jun-10	<0.50	<0.50	<0.50	<1.5	<100	<100	<250	<250	<250
CON D/S (Stn 50+900)	9-Jun-10	<0.50	<0.50	<0.50	<1.5	<100	<100	<250	<250	<250
Level I Rain Event										
CON D/S (Stn 50+900)	30-Apr-10	<0.50	<0.50	<0.50	<1.5	<100	<100	<250	<250	<250
	5-May-10	<0.50	<0.50	<0.50	<1.5	<100	<100	<250	<250	<250
	25-May-10	<0.50	<0.50	<0.50	<1.5	<100	<100	<250	<250	<250
	19-Jun-10	<0.50	<0.50	<0.50	<1.0	<100	<100	<250	<250	<250
	14-Jul-10	<0.50	<1.0	<0.50	<1.5	<100	<250	<250	<250	-
	13-Aug-10	<0.50	<1.0	<0.50	<1.5	<100	<250	<250	<250	<250
	16-Aug-10	<0.50	<1.0	<0.50	<1.5	<100	<250	<250	<250	<250
	2-Sep-10	<0.50	<1.0	<0.50	<1.5	<100	<250	<250	<250	-
	10-Sep-10	<0.50	<1.0	<0.50	<1.5	<100	<100	<250	<250	-
	26-Oct-10	<0.50	<1.0	<0.50	<1.5	<100	<250	<250	<250	-
	27-Oct-10	0.91	<1.0	<0.50	<1.5	<100	<250	<250	<250	-
CON U/S (Stn 5+500)	5-May-10	<0.50	<0.50	<0.50	<1.5	<100	<100	<250	<250	<250
	19-Jun-10	<0.50	<0.50	<0.50	<1.0	<100	<100	<250	<250	<250
	14-Jul-10	<0.50	<1.0	<0.50	<1.5	<100	<250	<250	<250	-
	2-Sep-10	<0.50	<1.0	<0.50	<1.5	<100	<250	<250	<250	-
	10-Sep-10	[4]	[4]	[4]	[4]	[4]	<100	<250	<250	-
	27-Oct-10	0.91	<1.0	<0.50	<1.5	1510	<250	<250	<250	-

Notes:
"-" = No Data

1. See Table NM9-1 for sample location descriptions
2. All concentrations in micrograms per litre (µg/L).
3. CCME 2005 - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines
   Chapter 3 - Canadian Water Quality Guidelines for Recreation and Aesthetics (Update October 2005) - Fact Sheets
   Chapter 4 - Canadian Water Quality Guidelines for the Protection of Aquatic Life (Update October 2005) - Fact Sheets
   MAC - Maximum Acceptable Concentration
4. Parameter not sampled due to lab error.

BOLD - Exceedance of Health Related Criteria (MAC)

TABLE NM9-4
BACTERIA IN SURFACE WATER
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No. [1]	Date	Parameter	
		Total Coliform CFU/100mL	E.Coli CFU/100mL
Detection Limit		*10*	*10*
CCME [2]			
Freshwater Aquatic Life		-	-
Floodway Flow Event - Spring Flood (crest)			
CON U/S	7-Apr-10	50	<10
CON D/S	7-Apr-10	120	<10
S-01	7-Apr-10	90	<10
S-02	7-Apr-10	190	<10
S-03	7-Apr-10	110	<10
S-04a	7-Apr-10	60	<10
S-05 U/S	7-Apr-10	140	<10
S-06	7-Apr-10	80	<10
S-07	7-Apr-10	50	<10
S-09	7-Apr-10	710	570
S-09 U/S	7-Apr-10	790	560
S-10	7-Apr-10	50	<10
S-10 U/S	7-Apr-10	40	<10
S-11	7-Apr-10	10	<10
S-13	7-Apr-10	60	<10
S-14	7-Apr-10	70	10
S-15	7-Apr-10	40	<10
S-16	7-Apr-10	30	<10
S-21	7-Apr-10	140	<10
S-22	7-Apr-10	20	<10
S-23	7-Apr-10	160	20
S-25	7-Apr-10	50	10
S-26	7-Apr-10	10	<10
S-27	7-Apr-10	80	<10
S-27 U/S	7-Apr-10	30	10
S-28	7-Apr-10	70	<10
Field Dup.	7-Apr-10	120	10
S-30	7-Apr-10	90	<10
S-31	7-Apr-10	80	<10
S-32	7-Apr-10	100	<10
S-33	7-Apr-10	60	10
S-34	7-Apr-10	130	<10
Floodway Flow Event - Spring Flood (pre-crest)			
CON U/S	1-Apr-10	160	<10
CON D/S	1-Apr-10	180	<10
S-21	1-Apr-10	260	<10
S-23	1-Apr-10	240	<10
S-25	1-Apr-10	210	<10
Floodway Flow Event - Spring Flood (post-crest)			
CON U/S	15-Apr-10	890	30
CON D/S	15-Apr-10	340	10
S-21	15-Apr-10	720	<10
S-23	15-Apr-10	210	<10
S-25	15-Apr-10	250	10

TABLE NM9-4
BACTERIA IN SURFACE WATER
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample No. (1)	Date	Parameter	
		Total Coliform CFU/100mL	E.Coli CFU/100mL
Detection Limit		*10*	*10*
CCME (2)			
Freshwater Aquatic Life		-	-
Floodway Flow Event - Summer Flood (crest)			
CON U/S	9-Jun-10	1120	10
CON D/S	9-Jun-10	1950	150
S-01	9-Jun-10	1420	20
S-02	9-Jun-10	1430	30
S-03	9-Jun-10	1400	10
S-04a	9-Jun-10	1920	20
S-05	9-Jun-10	OVERGROWN	110
S-05 U/S	9-Jun-10	OVERGROWN	120
S-06	9-Jun-10	OVERGROWN	140
S-07	9-Jun-10	OVERGROWN	90
S-09	9-Jun-10	OVERGROWN	60
S-09 U/S	9-Jun-10	OVERGROWN	70
S-10	9-Jun-10	OVERGROWN	10
S-10 U/S	9-Jun-10	OVERGROWN	40
S-11	9-Jun-10	OVERGROWN	440
S-13	9-Jun-10	1680	250
S-14	9-Jun-10	530	100
S-15	9-Jun-10	OVERGROWN	90
S-16	9-Jun-10	OVERGROWN	180
S-21	9-Jun-10	OVERGROWN	180
S-22	9-Jun-10	OVERGROWN	10
S-23	9-Jun-10	OVERGROWN	170
S-25	9-Jun-10	OVERGROWN	480
S-26	9-Jun-10	710	70
S-27	9-Jun-10	OVERGROWN	40
S-27 U/S	9-Jun-10	1560	60
S-28	9-Jun-10	590	110
Field Dup.	9-Jun-10	950	70
S-30	9-Jun-10	OVERGROWN	110
S-31	9-Jun-10	1460	140
S-32	9-Jun-10	OVERGROWN	260
S-33	9-Jun-10	OVERGROWN	220
S-34	9-Jun-10	OVERGROWN	500

Notes:

"-" = No Data

"OVERGROWN" = Exceeds the upper detection limit of 1500 to 2000 CFU/100 mL.

1. See Table NM9-1 for sample location descriptions.
2. CCME 2007 - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999. Update 7.0 - 2007.
   Chapter 4 -Aquatic Life

BOLD - Exceedance of Criteria

TABLE NM9-5
HERBICIDES IN SURFACE WATER
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Location	Date	Parameter [1]						
		2,4-D	AMPA	Bromoxynil	Dicamba	Glyphosate	MCPA	Picloram
EQL		*0.1*	*0.2*	*0.1*	*0.1*	*0.2*	*0.1*	*0.1*
CCME [2]								
Freshwater Aquatic Life		4	-	5	10	65	2.6	29
Floodway Flow Event - Spring Flood (crest)								
CON U/S (Stn 5+500)	7-Apr-10	<0.1	**1.07**	<0.1	<0.1	**1.12**	<0.1	<0.1
CON D/S (Stn 50+900)	7-Apr-10	<0.1	**1.02**	<0.1	<0.1	**1.25**	<0.1	<0.1
Floodway Flow Event - Summer Flood (crest)								
CON U/S (Stn 5+500)	9-Jun-10	<0.1	**0.28**	<0.1	<0.1	**1.52**	**0.17**	<0.1
CON D/S (Stn 50+900)	9-Jun-10	**0.11**	**0.29**	<0.1	<0.1	**1.62**	**0.2**	<0.1

Notes:

"-" = No Data

EQL = Estimated Quantitation Limit = The lowest level of the parameter that can be quantified with confidence

1. All values are expressed in micrograms per lite (µg/L).
2. CCME 2007 - Canadian Council of Ministers of the Environment. Canadian Environmental Quality Guidelines, 1999. Update 7.0 - 2007. Chapter 4 -Aquatic Life

BOLD	- Parameter Detected
BOLD & Shaded	- Exceedance of Criteria

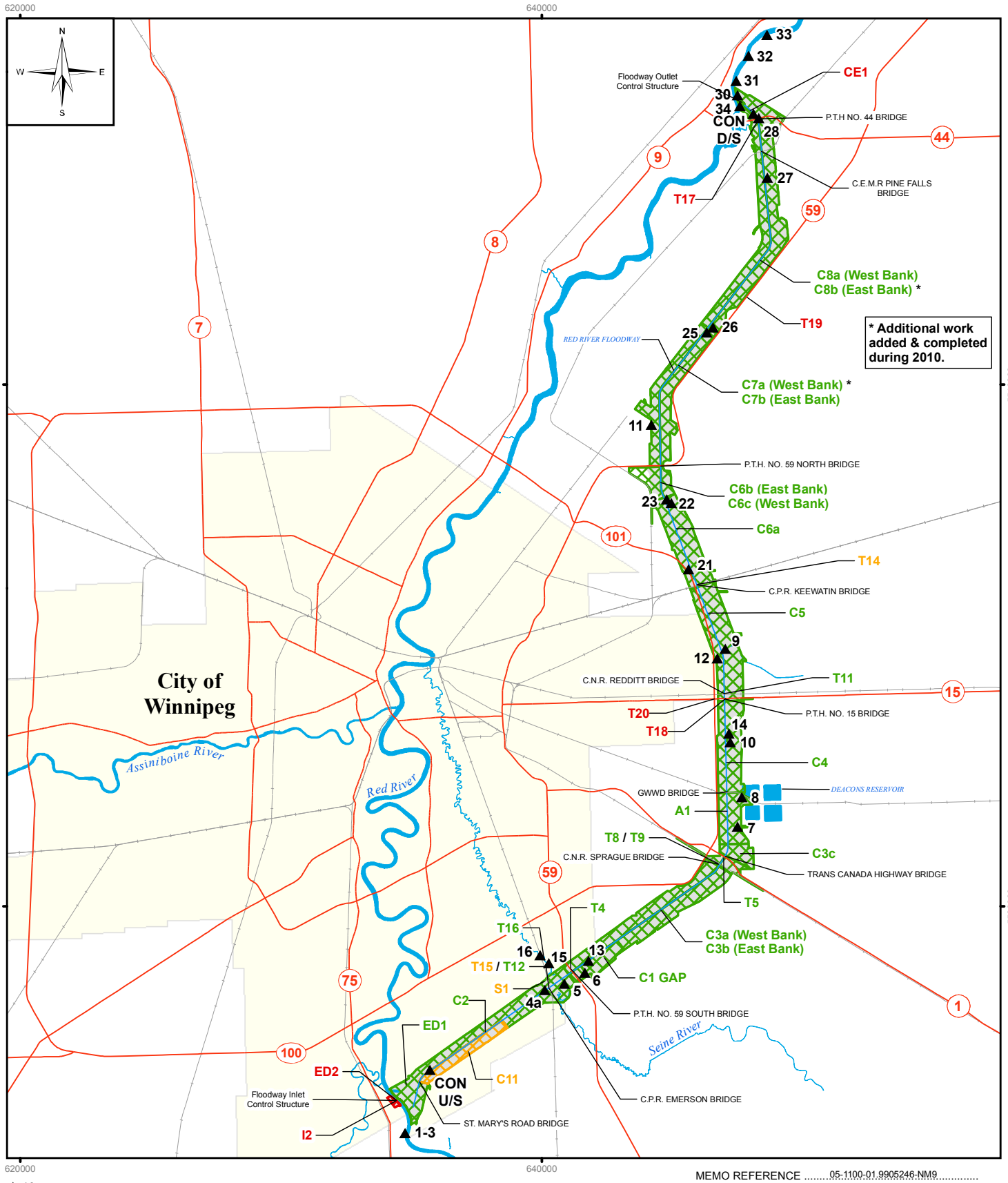
TABLE NM9-6
LEVEL I RAIN EVENT BASED TSS MONITORING REVIEW
RED RIVER FLOODWAY - 2010 SURFACE WATER MONITORING

Sample Date	Amount of Precipitation (mm) for the Monitoring Event [1]	Approximate Duration (hrs)	Year Storm [2]	Estimated							Actual						
				Floodway - Downstream of Construction			Red River - Upstream of Outlet			Change in Red River Sediment Concentration (%)	Floodway - Downstream of Construction			Red River - Upstream of Outlet			Change in Red River Sediment Concentration (%)
				Flow (cms)	TSS (mg/L)	Sediment Load (tonne/day)	Flow (cms)	TSS (mg/L)	Sediment Load (tonne/day)		Flow (cms)	TSS (mg/L)	Sediment Load (tonne/day)	Flow (cms)	TSS (mg/L)	Sediment Load (tonne/day)	
30-Apr-10	12.4 to 18.0	7.0	<2	8.2	37.0	26.2	511.3	118.7	5,243	**-1.09%**	8.2	41	29.0	595.9	140	7,208	**-0.96%**
5-May-10	11.2 to 30.0	21.0	<2	8.6	51.0	37.9	475.0 [3]	147.2	6,041	**-1.16%**	8.6	62	46.1	594.9	187	9,612	**-0.95%**
25-May-10	4.6 to 20.0	7.0	<2	11.0	27.8	26.5	546.1	148.6	7,013	**-2.39%**	11.0	25	23.8	571.4	360	17,773	**-1.76%**
30-May-10	11.4 to 82.0	10.0	<2 to ~50	22.7	163.0	319.0	991.0	415.0	3,540	**-1.36%**	22.7	97	189.8	1043.7	432	38,955	**-1.65%**
19-Jun-10	15.8 to 18.6	24.0	<2	4.8	36.1	14.9	679.6	154.1	9,051	**-0.54%**	4.8	33	13.6	663.4	188	10,776	**-0.59%**
27-Jun-10	5.2 to 28.4	2.0	<2	7.1	40.2	24.7	754.6	257.6	16,792	**-0.78%**	7.1	36	22.1	782.8	327	22,115	**-0.80%**
14-Jul-10	23.7 to 63.8	7.5	<2 to 5-10	2.4	128.1	26.3	550.0	208.8	9,924	**-0.17%**	2.4	164	33.7	519.8	256	11,498	**-0.16%**
13-Aug-10	4.6 to 56.9	4.5	<2 to 5-10	0.2	74.4	1.3	317.8	196.3	5,389	**-0.04%**	0.2	79	1.4	370.1	284	9,082	**-0.04%**
16-Aug-10	0.8 to 17.2	11.0	<2	0.6	33.7	1.9	317.8	101.0	2,772	**-0.13%**	0.6	33	1.7	355.0	103	3,159	**-0.12%**
31-Aug-10	20.4 to 38.2	15.0	<2	0.8	42.6	2.9	279.1	64.5	1,555	**-0.10%**	0.8	42	2.8	483.8	66	2,759	**-0.06%**
2-Sep-10	18.0 to 38.1	13.5	<2	29.0	66.0	165.4	274.1	226.5	5,364	**-6.78%**	29.0	73	182.9	549.3	220	10,442	**-3.35%**
10-Sep-10	24.0 to 48.4	10.0	<2 to 2-5	2.9	87.2	21.6	374.6	93.5	3,024	**-0.05%**	2.9	111	27.4	425.6	131	4,817	**-0.10%**
24-Sep-10	13.4 to 26.0	17.0	<2	1.7	44.1	6.6	690.9	154.2	9,204	**-0.18%**	1.7	45	6.7	710.8	195	11,975	**-0.19%**
26-Oct-10	17.6 to 26.4	16.0	<2	0.9	30.2	2.2	327.5 [3]	120.8	3,419	**-0.20%**	0.9	[4]	N/A	506.5	[4]	N/A	N/A
27-Oct-10	17.9 to 24.4	18.0	<2	5.7	70.1	34.7	425.0 [3]	167.5	6,150	**-0.77%**	5.7	108	53.4	527.9	257	11,722	**-0.62%**

Notes:

1 - Amount of precipitation measured varied between the different weather stations
2 - Year Storm is an approximate calculation based on the Atmospheric Environment Service, Rainfall Intensity - Duration Frequency Values for the Winnipeg Int'l Airport and recorded precipitation at the unofficial rain gauge sites
3 - Flow value obtained from the Environment Canada website instead of Manitoba Water Stewardship weekly flow data
4 - Parameter not tested due to laboratory error
N/A - Not Applicable

FIGURES



▲10 Surface Water Sampling Locations

C0	Completed Prior to 2010		Completed Prior to 2010
C0	Completed During 2010		Completed During 2010
C0	Still Active at End of 2010		Still Active at End of 2010

1:200,000

1 0 1 2 3 4 5

Kilometres

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MEMO REFERENCE ..... 05-1100-01.9905246-NM9 .....

KGS GROUP

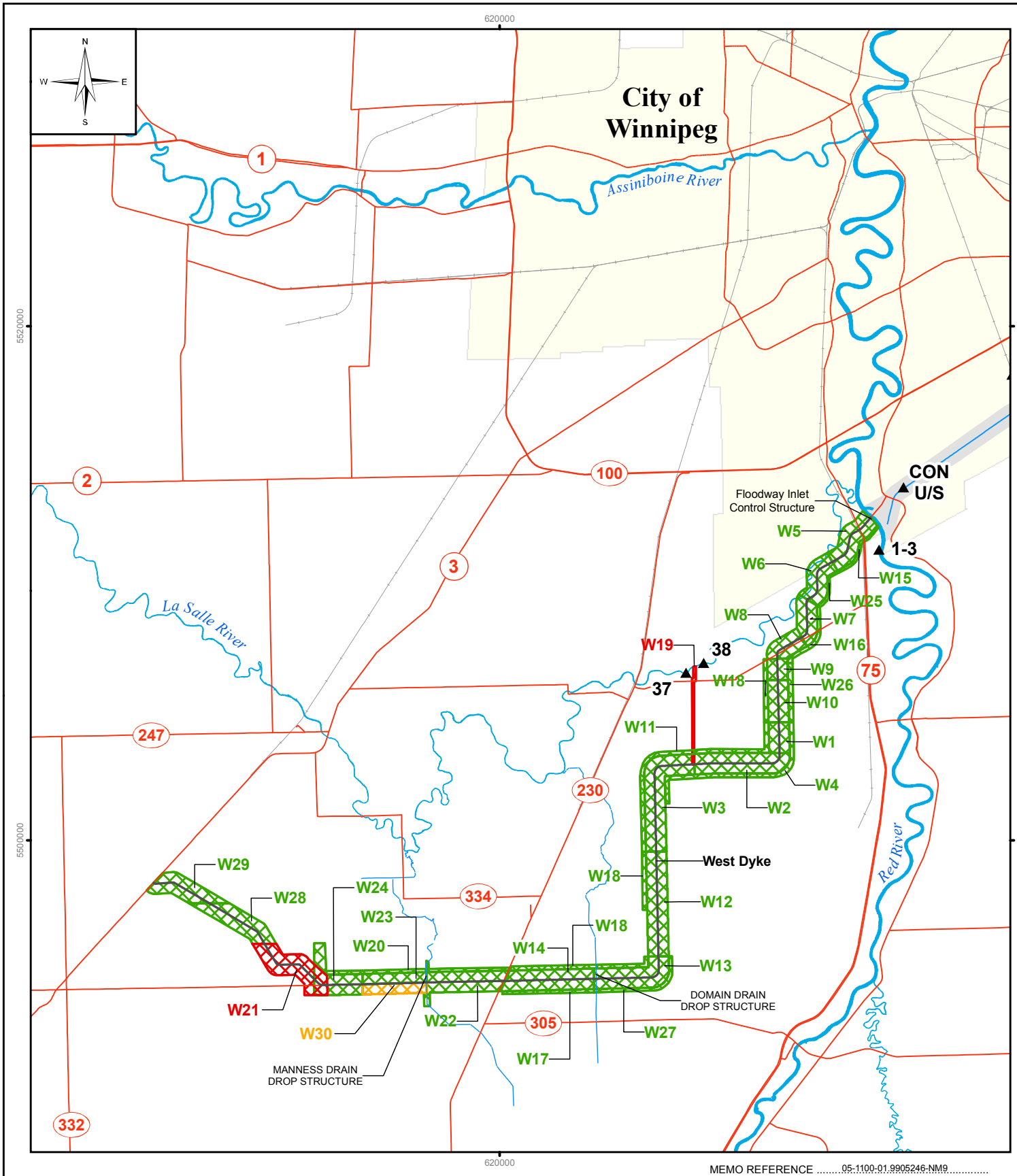
MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

FLOODWAY CHANNEL SAMPLE LOCATIONS

MARCH 2011	FIGURE NM9-1	REV 0



▲37 Surface Water Sampling Locations

C0	Completed Prior to 2010		Completed Prior to 2010
C0	Completed During 2010		Completed During 2010
C0	Still Active at End of 2010		Still Active at End of 2010

1:200,000

1 0 1 2 3 4 5

Kilometres

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MEMO REFERENCE ..... 05-1100-01.9905246-NM9 .....

KGS GROUP

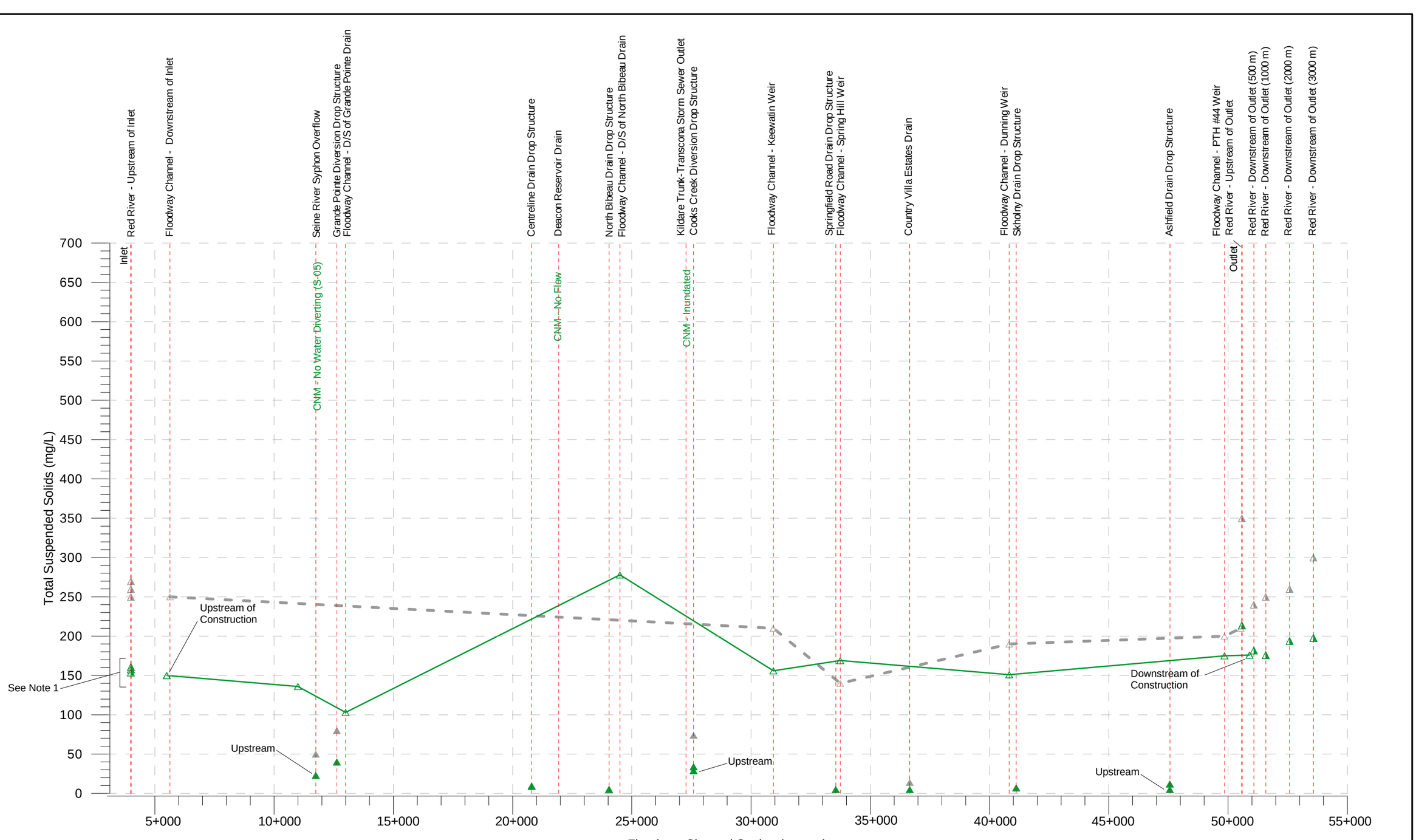
MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

FLOODWAY CHANNEL SAMPLE LOCATIONS

MARCH 2011	FIGURE NM9-2	REV 0



Channel 2005 Spring Flood Baseline Data (12-Apr-05)

Channel 7-Apr-10

Drain 2005 Spring Flood Baseline Data (12-Apr-05)

Drain 7-Apr-10

River 2005 Spring Flood Baseline Data (12-Apr-05)

River 7-Apr-10

Flow in Red River at Lockport on April 7, 2010 was 1940 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE ....05-1100-01-9905246-NM9.....

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

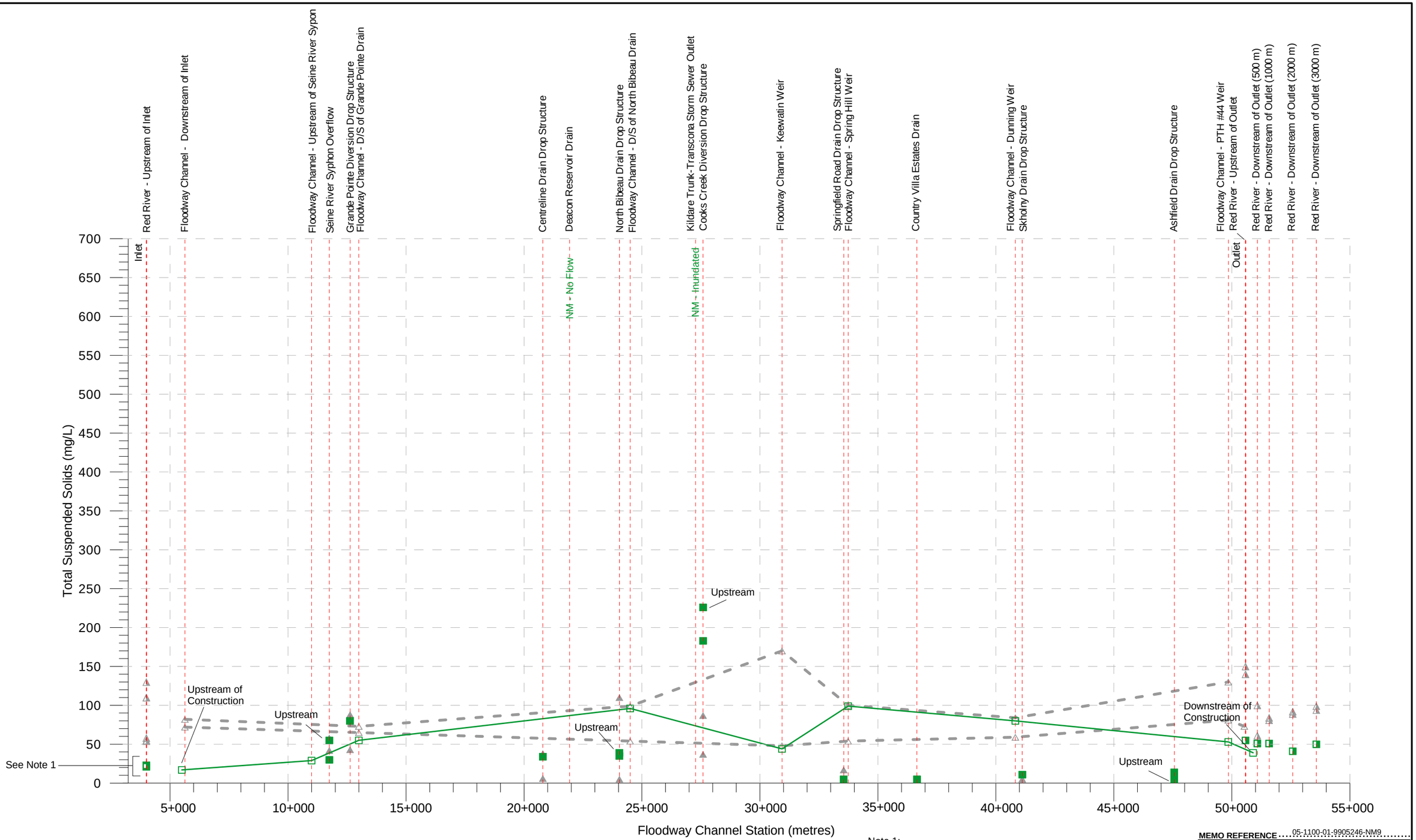
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

TOTAL SUSPENDED SOLIDS
SPRING FLOOD CONDITION

MARCH 2011	FIGURE NM9-3	REV 0

X:\projects\2003\03-1100-01\general\(.19)SiteSurv&Invest\(.06)Environmental\(.03)SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\Figures\FigNM9-3_TSS spring flood



Channel Summer Flood Upper and Lower Range Baseline data (24-Jun-05, 18-Jul-05)
Channel 9-June-10

Drain Summer Flood Baseline
Drain 9-June-10

River Summer Flood Baseline
River 9-June-10

Flow in Red River at Lockport on June 9, 2010 was 1104 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

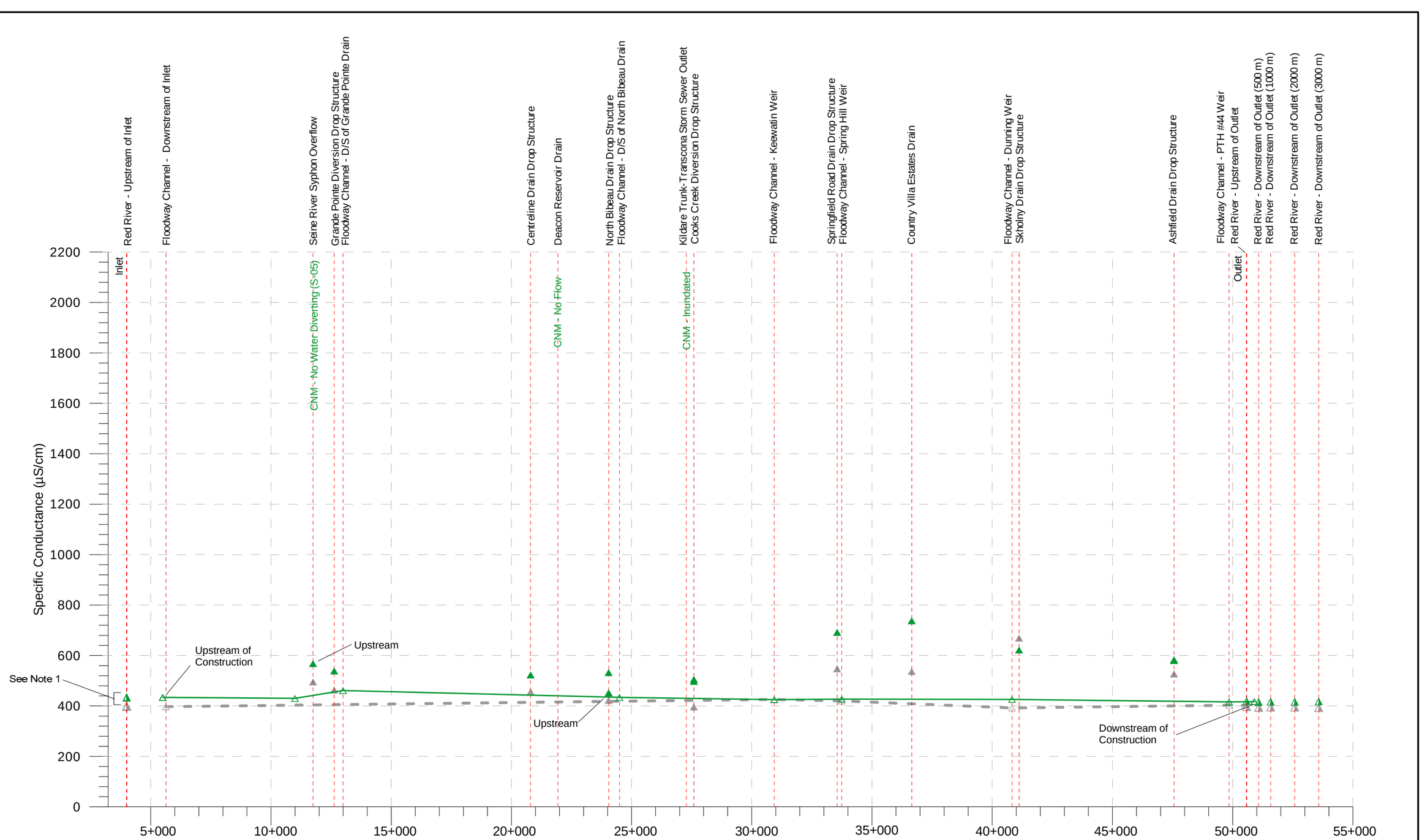
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

TOTAL SUSPENDED SOLIDS
SUMMER FLOOD CONDITION

MARCH 2011	FIGURE NM9-4	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-4_TSS summer flood



Channel 2005 Spring Flood Baseline Data (12-Apr-05)
Channel 7-Apr-10

Drain 2005 Spring Flood Baseline Data (12-Apr-05)
Drain 7-Apr-10

River 2005 Spring Flood Baseline Data (12-Apr-05)
River 7-Apr-10

Flow in Red River at Lockport on on April 7, 2010 was 1940 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE ..... 05-1100-01-9905246-NM9 .....

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

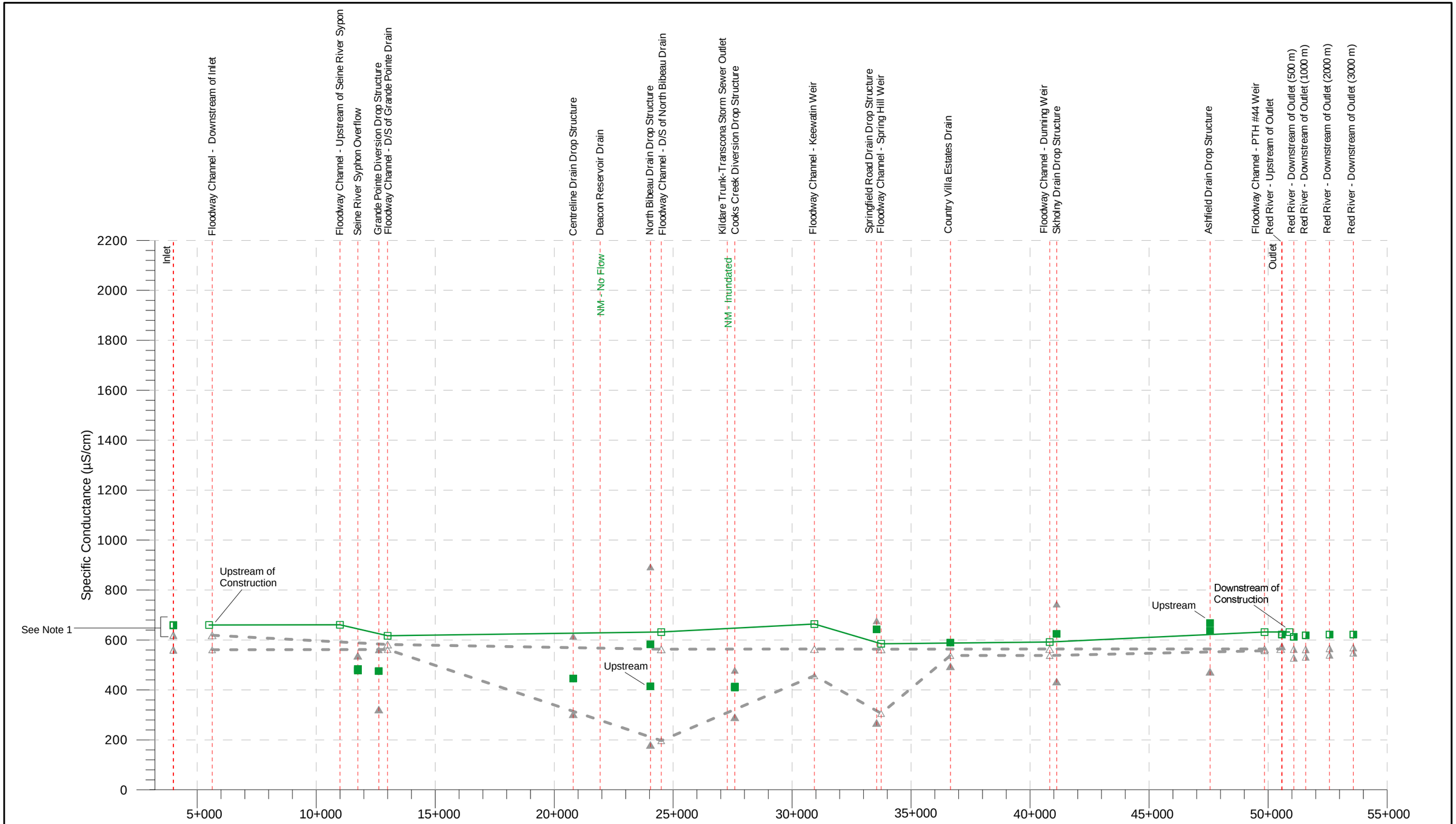
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

SPECIFIC CONDUCTANCE
SPRING FLOOD CONDITION

MARCH 2011	FIGURE NM9-5	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-5_EC spring flood



Flow in Red River at Lockport on June 9,2010 was 1104 m³/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE ... 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

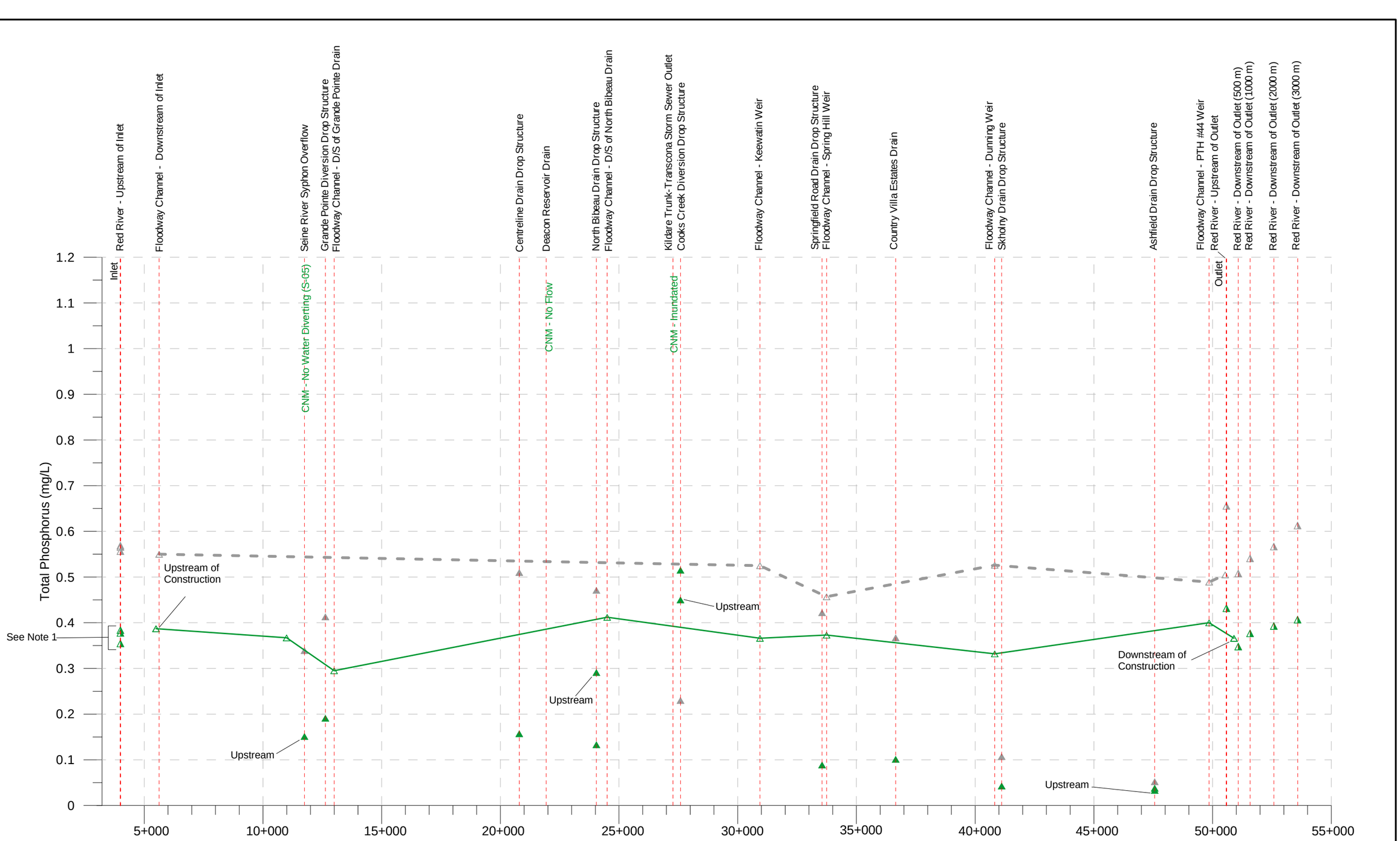
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

SPECIFIC CONDUCTANCE
SUMMER FLOOD CONDITION

MARCH 2011	FIGURE NM9-6	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-6_EC summer flood



Flow in Red River at Lockport on April 7, 2010 was 1940 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

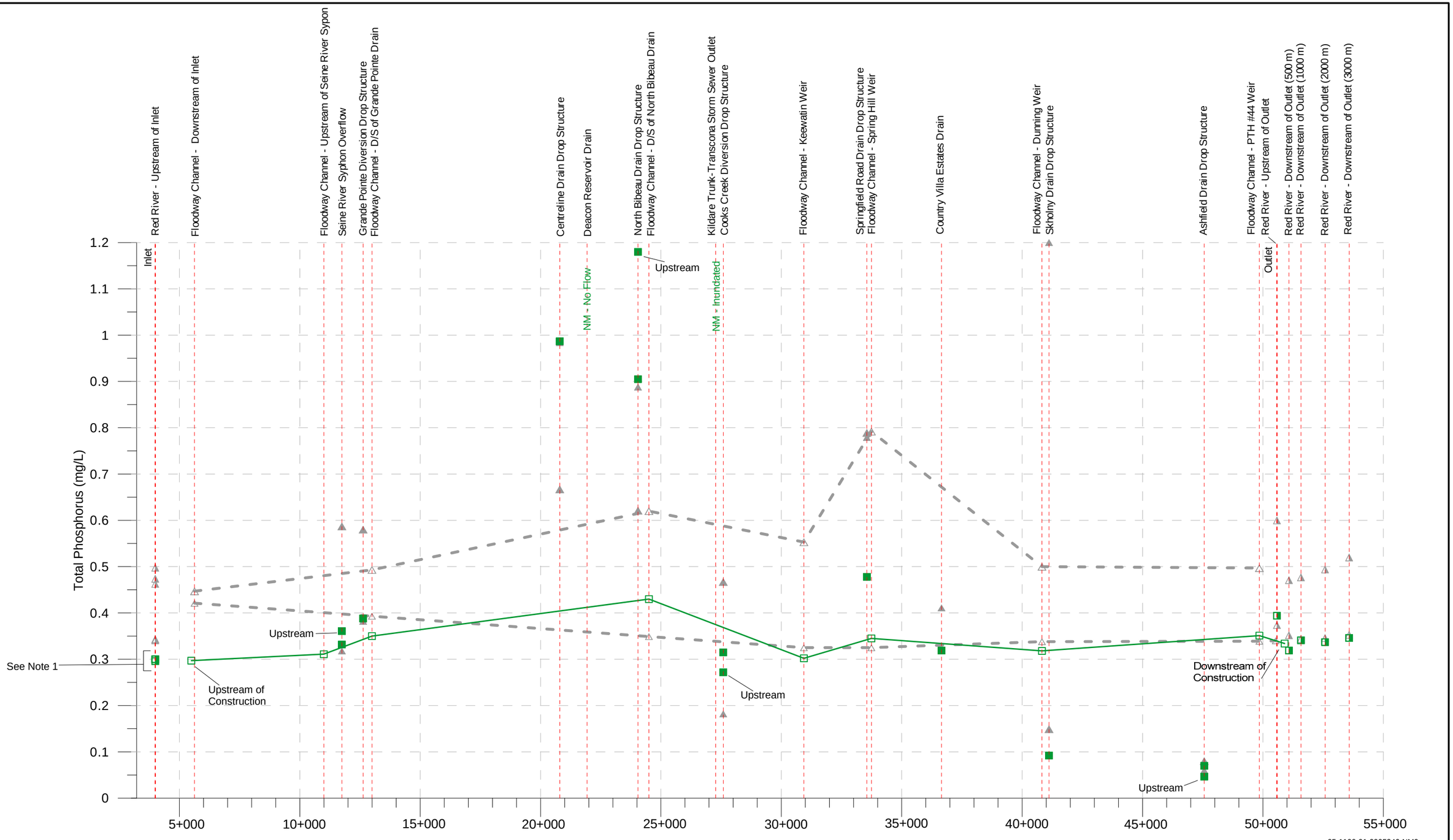
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

TOTAL PHOSPHORUS
SPRING FLOOD CONDITION

MARCH 2011	FIGURE NM9-7	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-7_Phosporus spring flood



Channel Summer Flood Upper and Lower Range Baseline (24-Jun-05, 18-Jul-05)

Channel 9-June-10

Drain Summer Flood Baseline

Drain 9-June-10

River Summer Flood Baseline

River 9-June-10

Flow in Red River at Lockport on June 9, 2010 was 1104 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

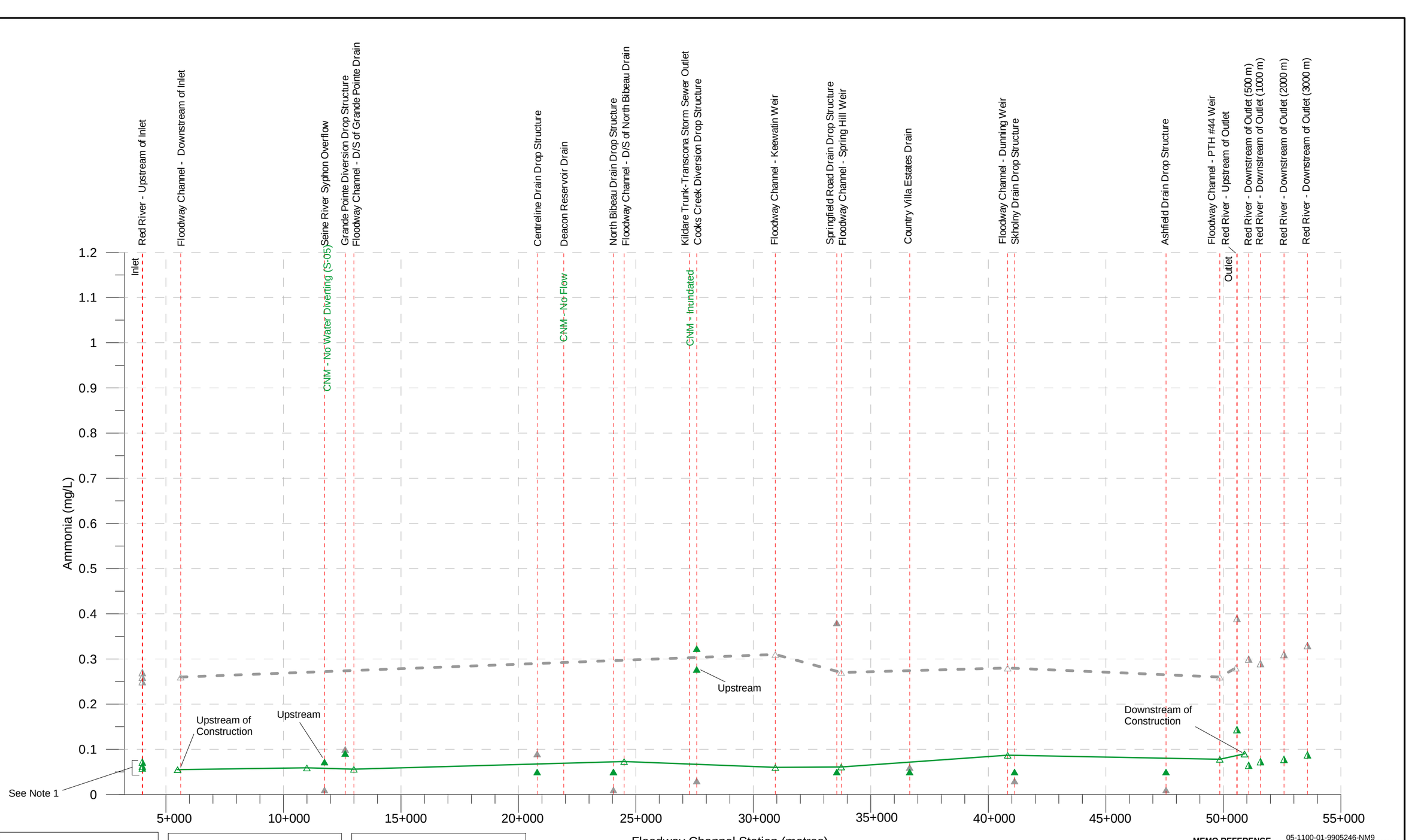
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

TOTAL PHOSPHORUS
SUMMER FLOOD CONDITION

MARCH 2011	FIGURE NM9-8	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-8_Phosporus summer flood



Flow in Red River at Lockport on April 7, 2010 was 1940 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

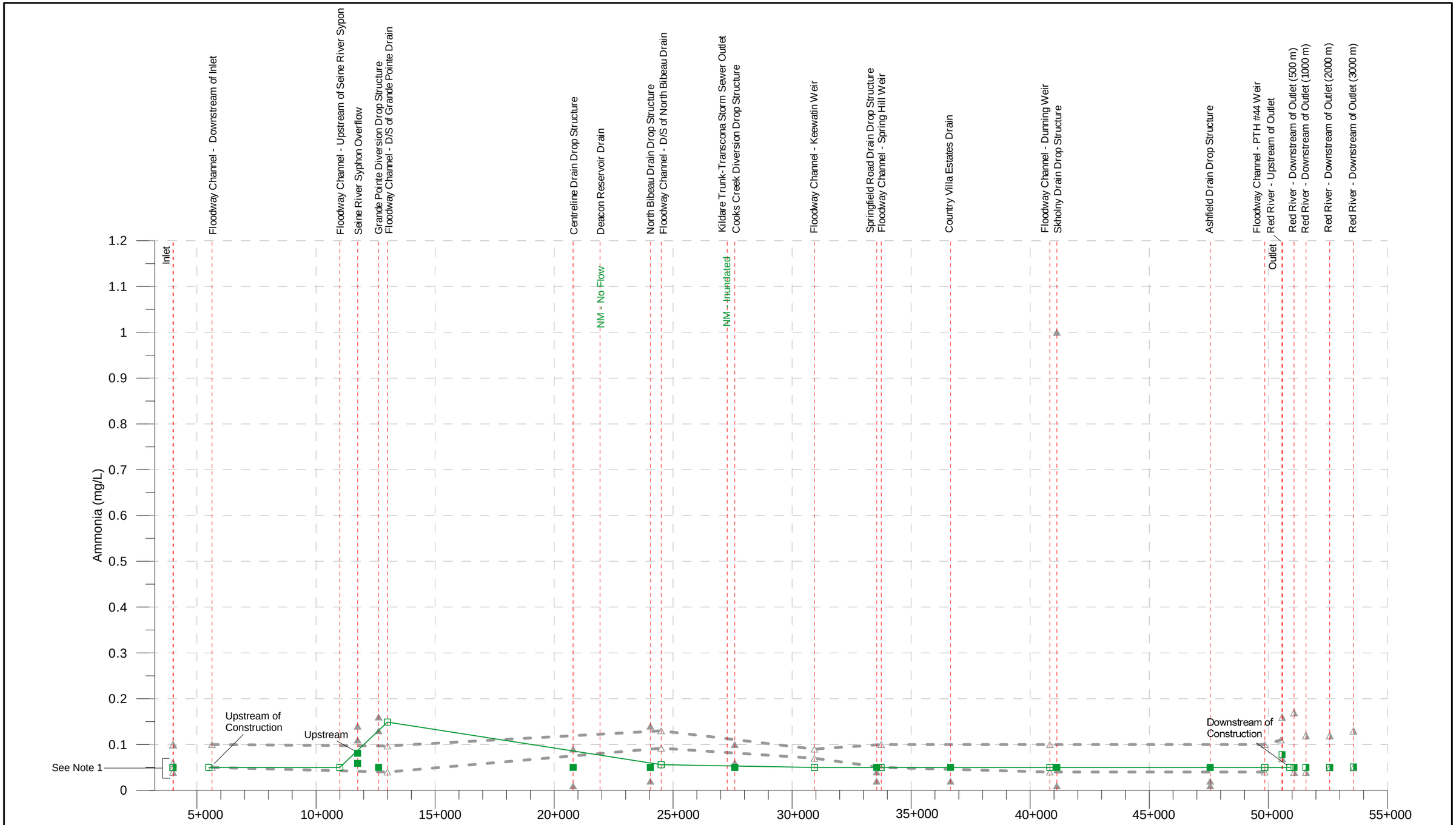
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

AMMONIA
SPRING FLOOD CONDITION

MARCH 2011	FIGURE NM9-9	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-9_Ammonia spring flood



Flow in Red River at Lockport on June 9, 2010 was 1104 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

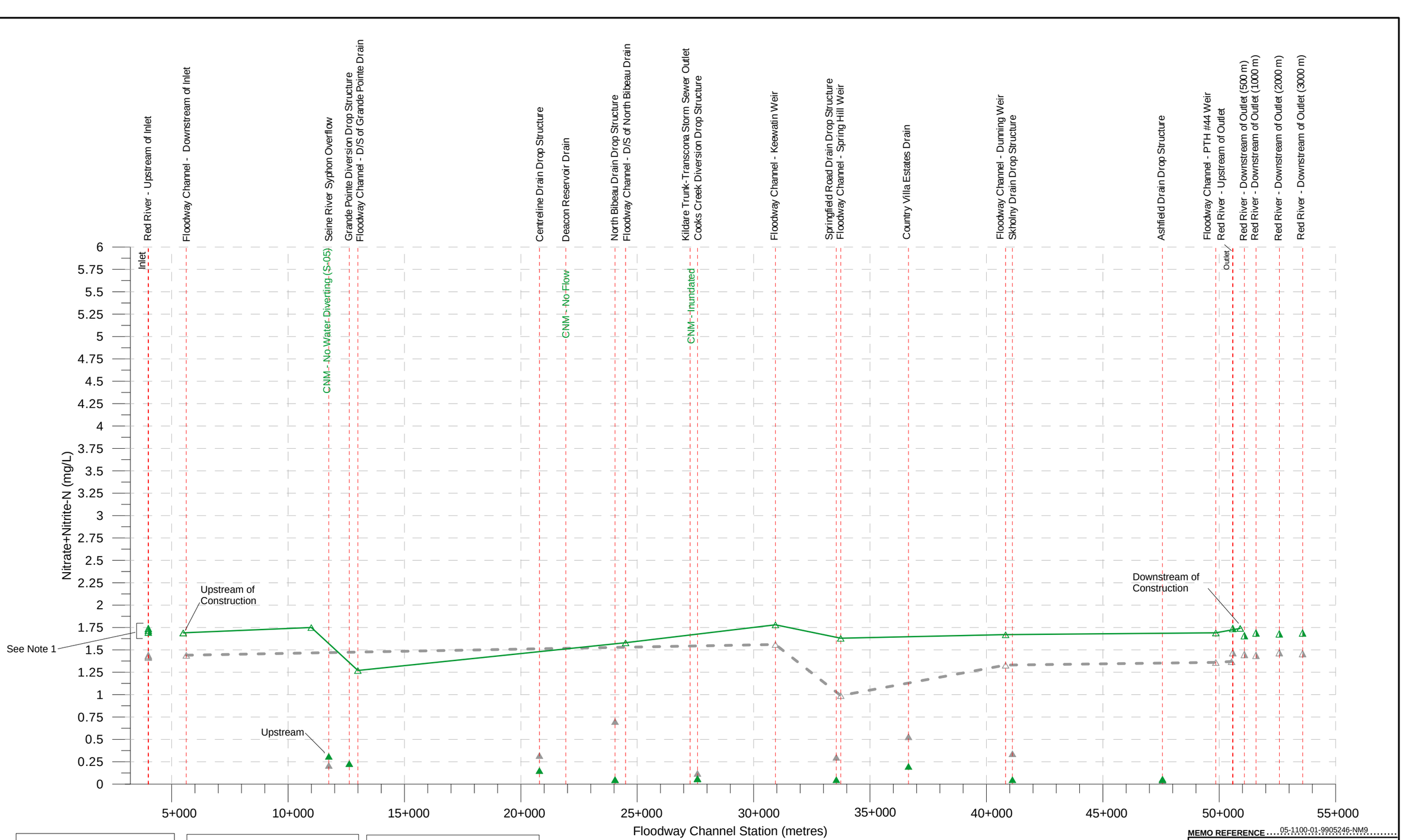
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

AMMONIA
SUMMER FLOOD CONDITION

MARCH 2011	FIGURE NM9-10	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-10_Ammonia summer flood



Flow in Red River at Lockport on April 7, 2010 was 1940 m^3/s

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE....05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

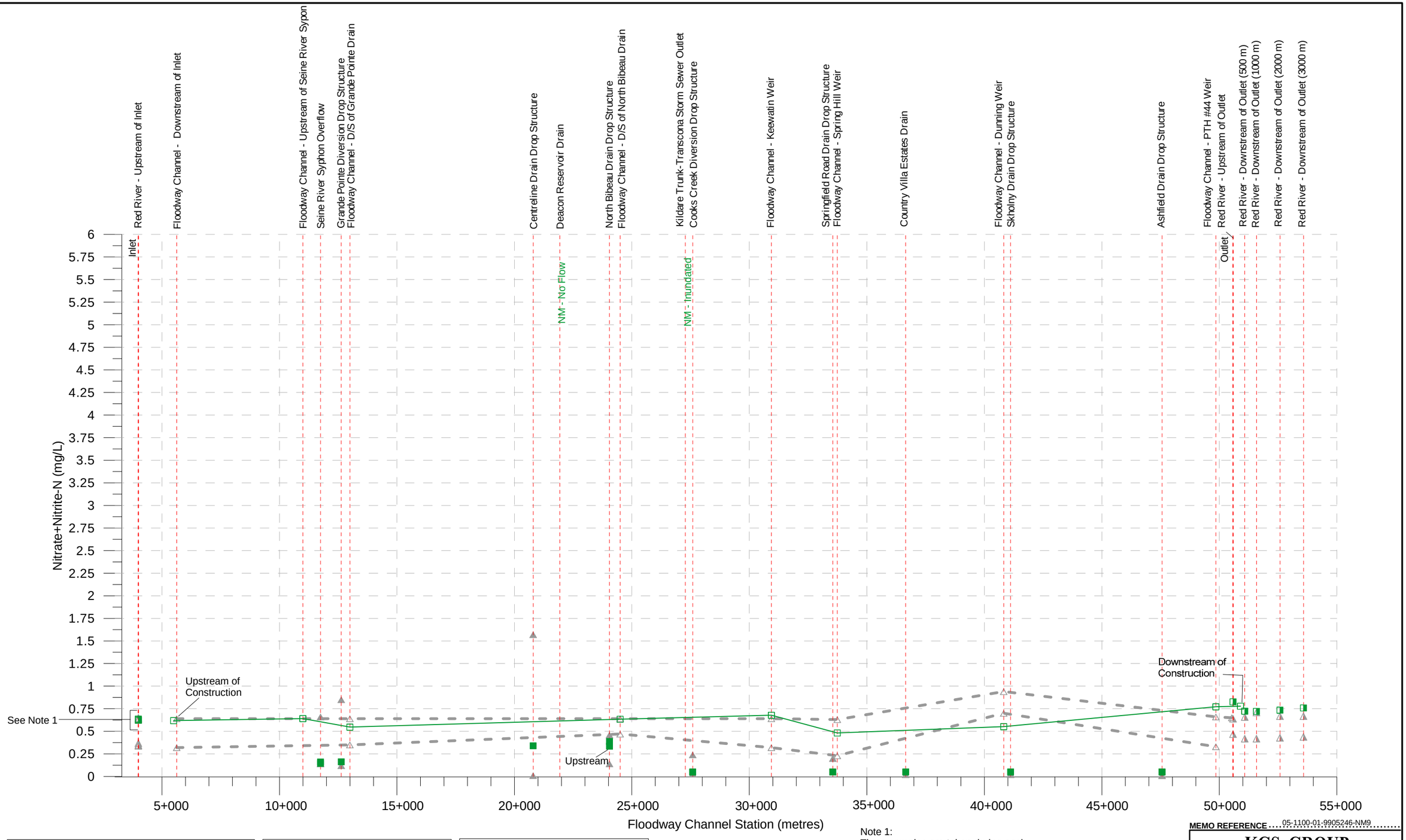
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

NITRATE+NITRITE-N
SPRING FLOOD CONDITION

MARCH 2011	FIGURE NM9-11	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-11_Nitrate+Nitrite spring flood



Flow in Red River at Lockport June 9, 2010 was 1104 m^3/s

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE ....05-1100-01-9905246-NM9.....

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

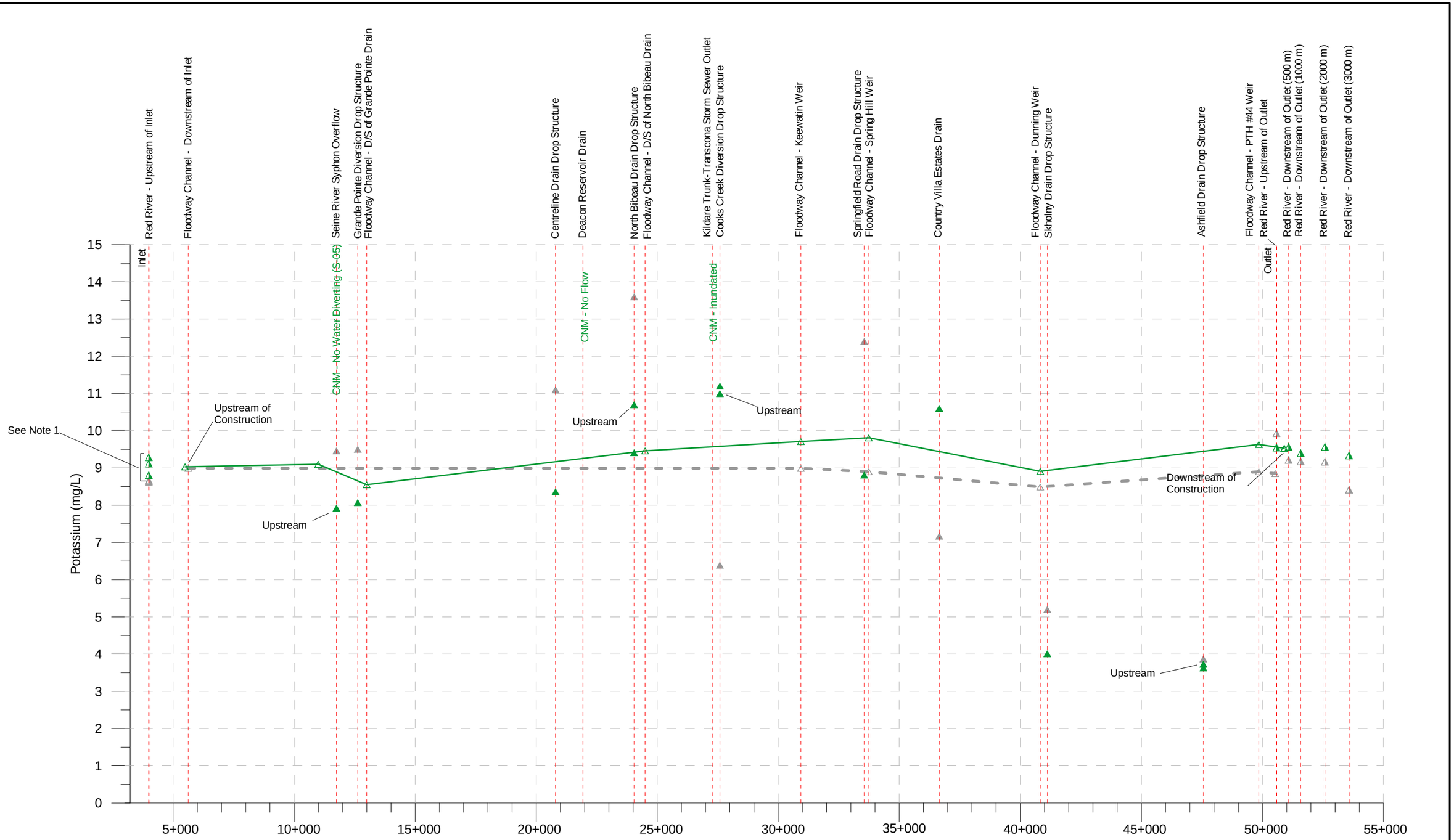
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

NITRATE+NITRITE-N
SUMMER FLOOD CONDITION

MARCH 2011	FIGURE NM9-12	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-12_Nitrate+Nitrite summer flood



Channel 2005 Spring Flood Baseline Data (12-Apr-05)
Channel 7-Apr-10

Drain 2005 Spring Flood Baseline Data (12-Apr-05)
Drain 7-Apr-10

River 2005 Spring Flood Baseline Data (12-Apr-05)
River 7-Apr-10

Flow in Red River at Lockport on April 7, 2010 was 1940 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

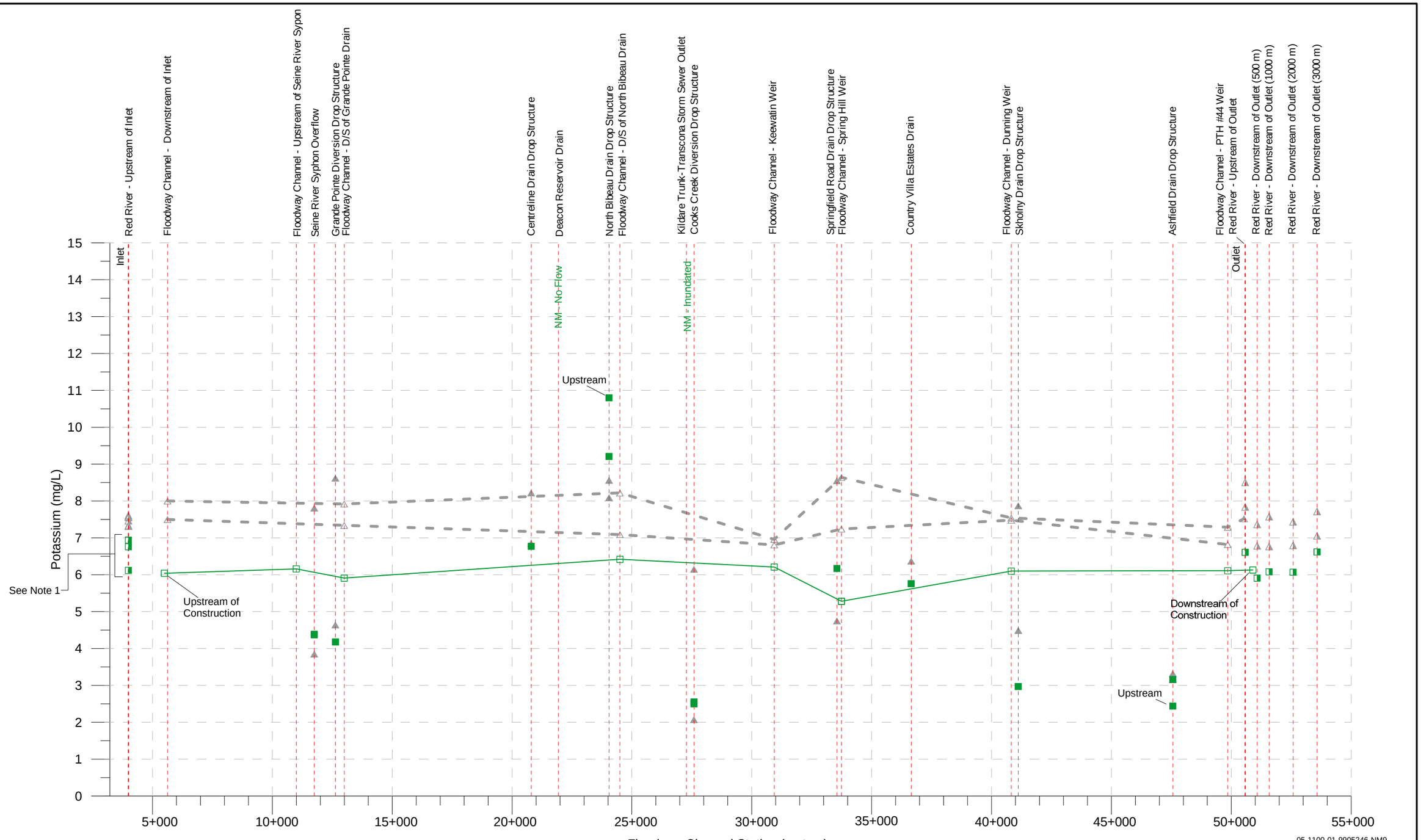
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

POTASSIUM
SPRING FLOOD CONDITION

MARCH 2011	FIGURE NM9-13	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-13_Potassium spring flood



Channel Summer Flood Upper and Lower Range Baseline (24-Jun-05, 18-Jul-05)
Channel 9-June-10

Drain Summer Flood Baseline
Drain 9-June-10

River Summer Flood Baseline
River 9-June-10

Flow in Red River at Lockport on June 9, 2010 was 1104 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

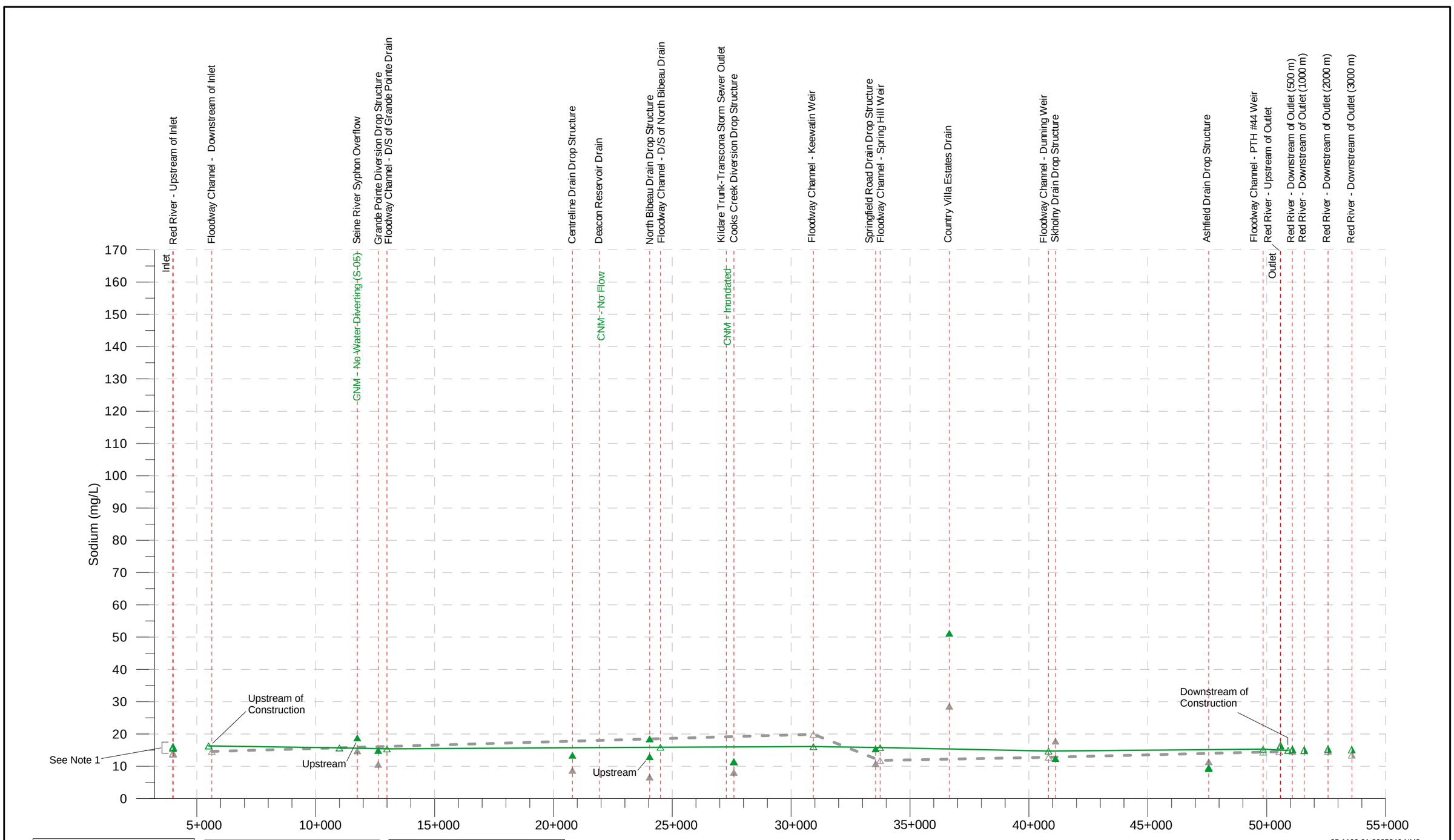
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

POTASSIUM
SUMMER FLOOD CONDITION

MARCH 2011	FIGURE NM9-14	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-14_Potassium summer flood



Flow in Red River at Lockport on April 7, 2010 was 1940 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

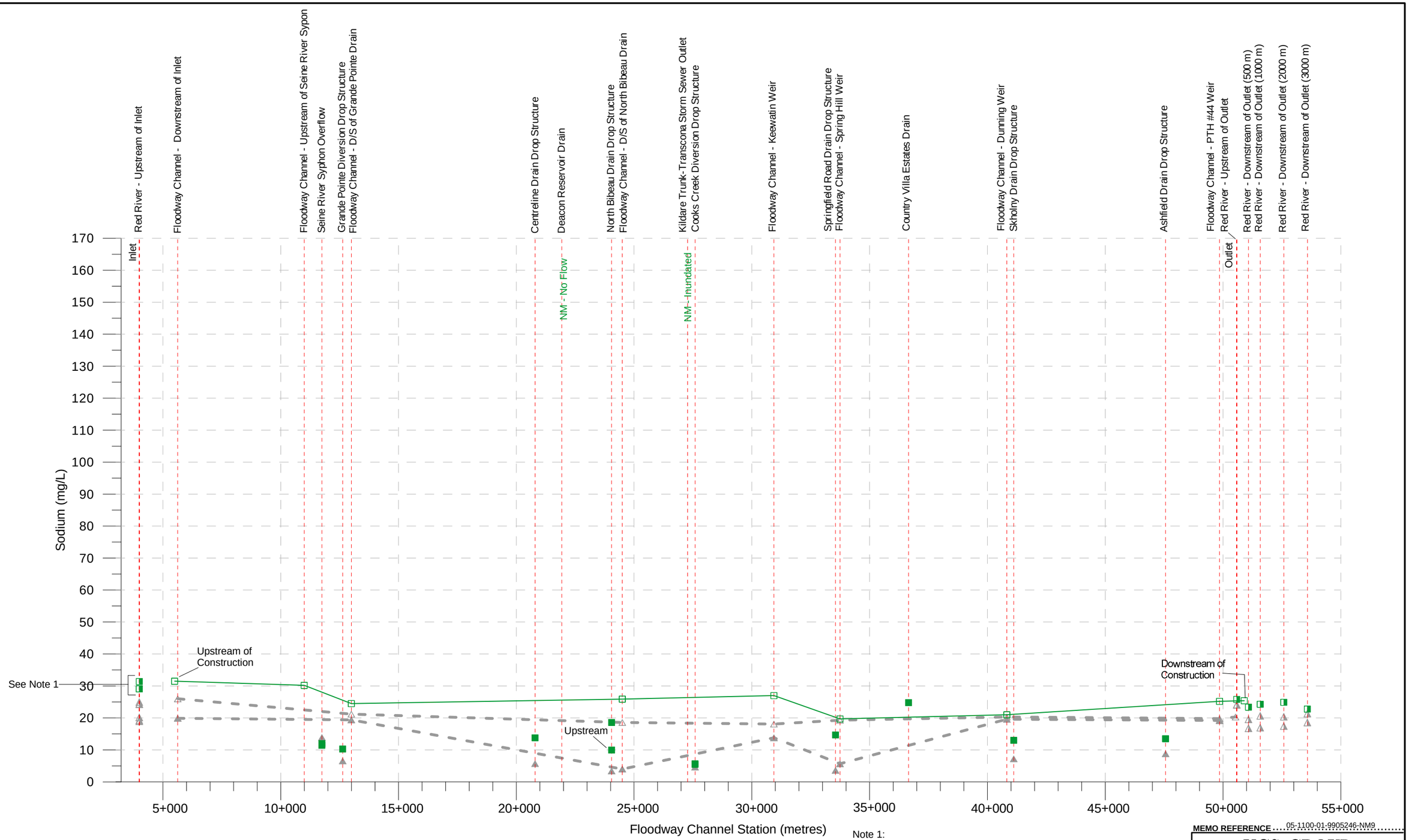
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

SODIUM
SPRING FLOOD CONDITION

MARCH 2011	FIGURE NM9-15	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-15_Sodium spring flood



Channel Summer Flood Upper and Lower Range Baseline (24-Jun-05, 18-Jul-05)
Channel 9-June-10

Drain Summer Flood Baseline
Drain 9-June-10

River Summer Flood Baseline
River 9-June-10

Flow in Red River at Lockport on June 9, 2010 was 1104 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE ... 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

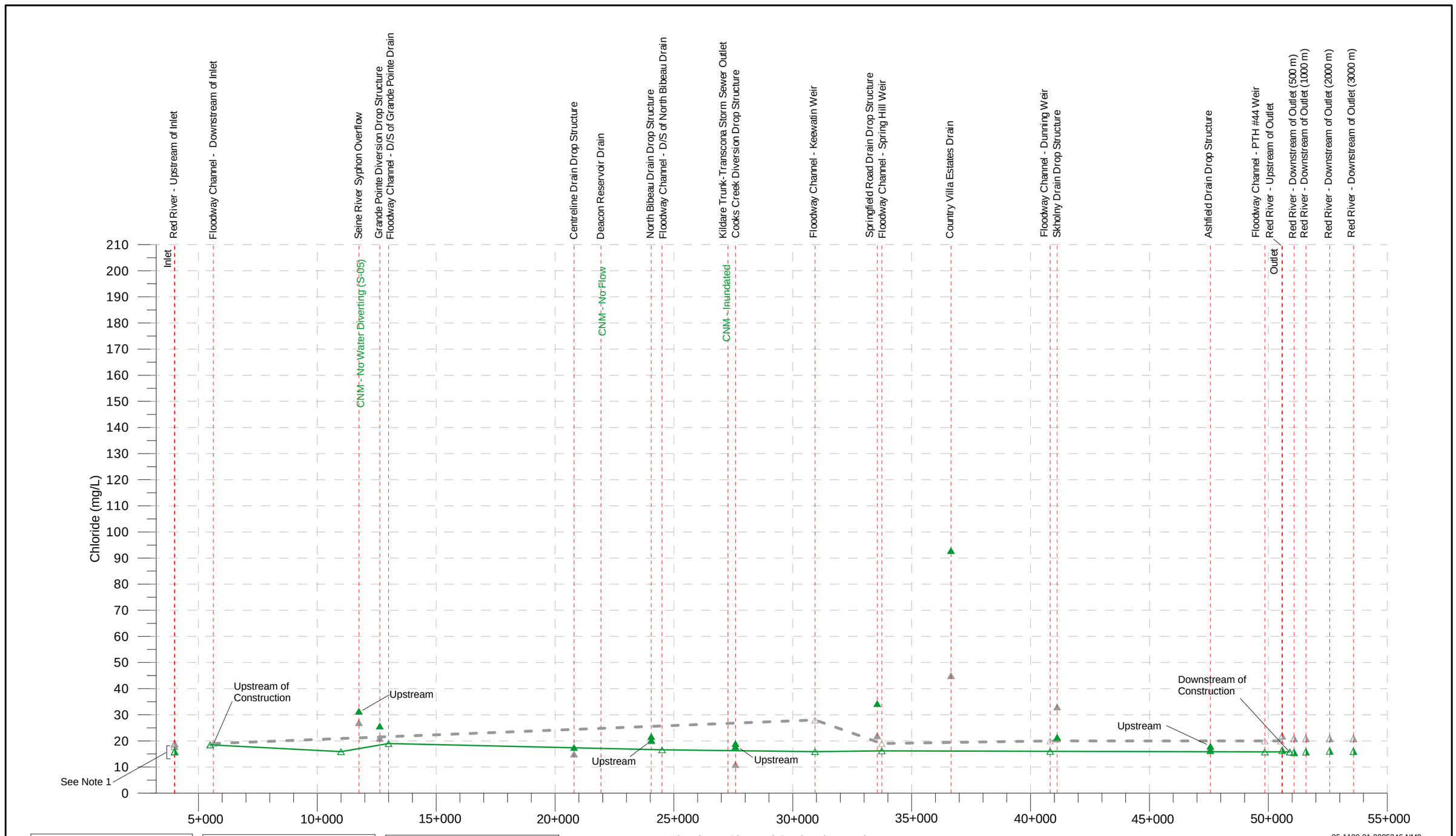
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

SODIUM
SUMMER FLOOD CONDITION

MARCH 2011	FIGURE NM9-16	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-16_Sodium summer flood



Flow in Red River at Lockport on April 7, 2010 was 1940 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

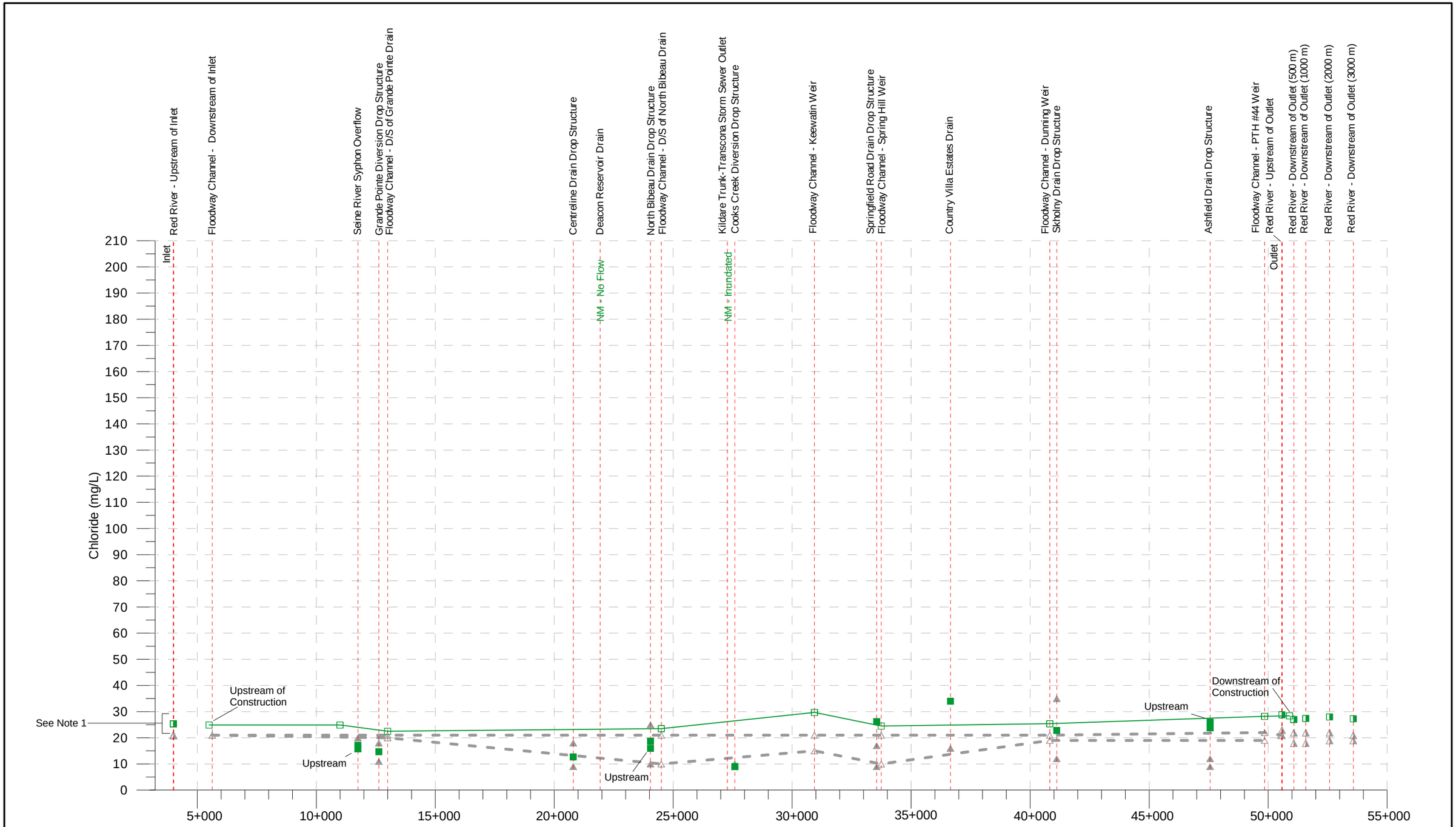
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

CHLORIDE
SPRING FLOOD CONDITION

MARCH 2011	FIGURE NM9-17	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-17_Chloride spring flood



Flow in Red River at Lockport on June 9, 2010 was 1104 m^3/s.

Note 1:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

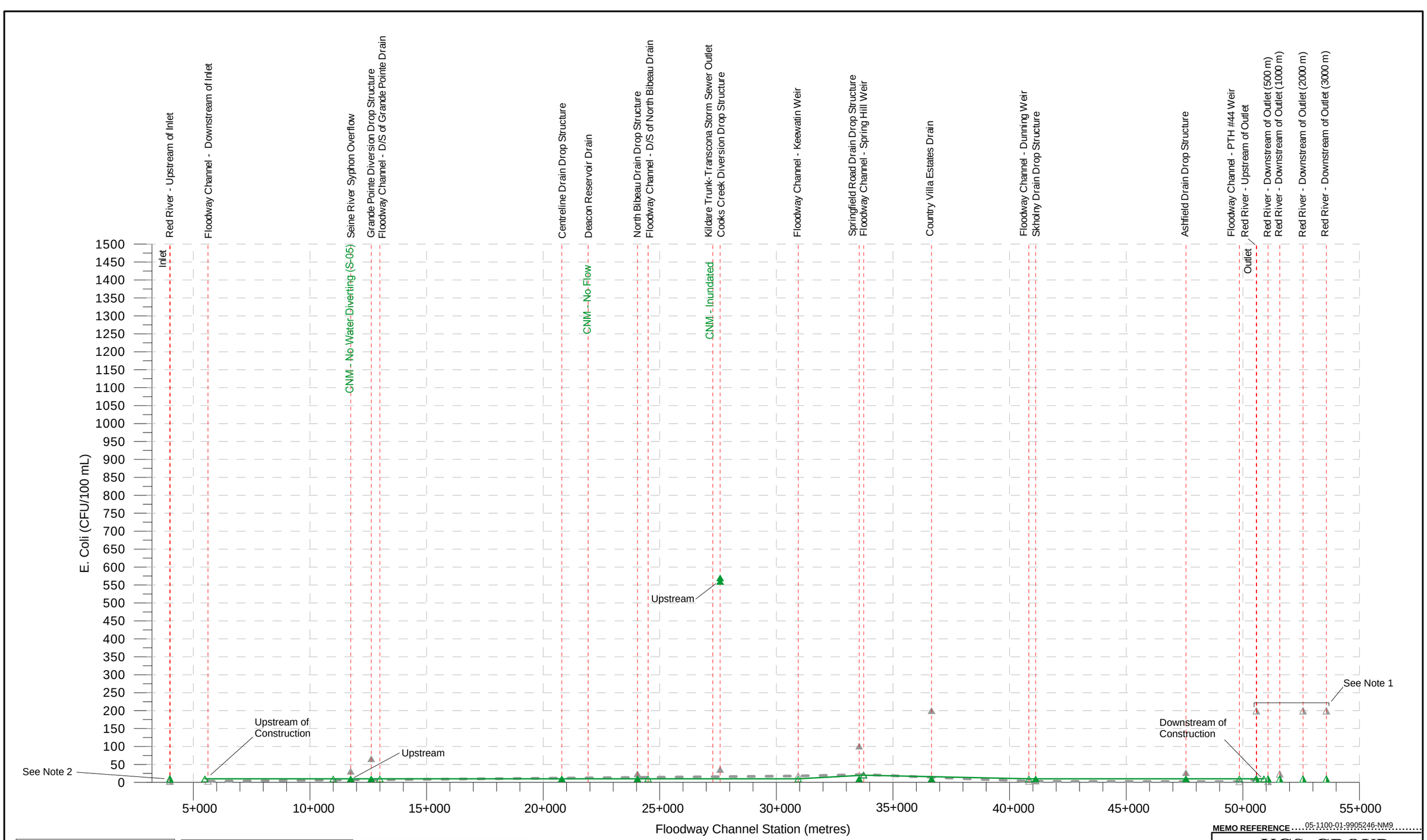
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

CHLORIDE
SUMMER FLOOD CONDITION

MARCH 2011	FIGURE NM9-18	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-18_Chloride summer flood



Channel 2005 Spring Flood Baseline Data (12-Apr-05)
Channel 7-Apr-10

Drain 2005 Spring Flood Baseline Data (12-Apr-05)
Drain 7-Apr-10

River 2005 Spring Flood Baseline Data (12-Apr-05)
River 7-Apr-10

Flow in Red River at Lockport on April 7, 2010 was 1940 m^3/s.

Note 1:
The lab Quanti Tray method used during some baseline monitoring had a maximum detection limit of 200 CFU/100 mL. For all other samples, the EColi by MColi Blue MF method was used.

Note 2:
Three samples are taken during each sample event upstream of the inlet. These samples have returned very similar results.

MEMO REFERENCE 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

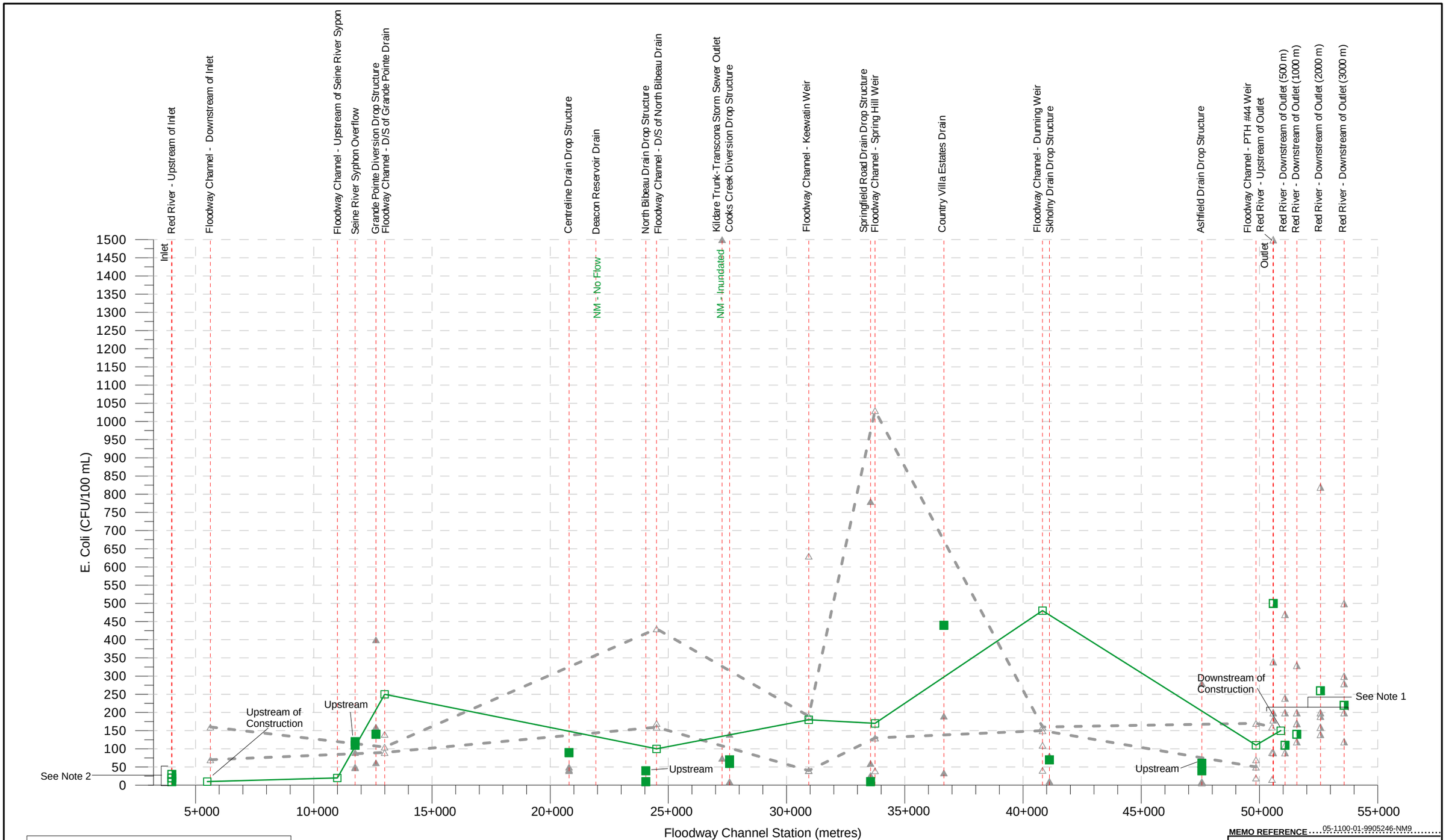
RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

E.COLI
SPRING FLOOD CONDITION

MARCH 2011	FIGURE NM9-19	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-19_EColi spring flood



Channel Summer Baseline Upper and Lower Range (Channel Lower Range Extrapolated from D/S of Grande Pointe to Keewatin Weir)

Channel 9-June-10

Drain Summer Flood Baseline

Drain 9-June-10

River Summer Flood Baseline

River 9-June-10

Flow in Red River at Lockport on: June 9, 2010 was 1104 m^3/s

Note 1:
The lab Quanti Tray method used during some baseline monitoring had a maximum detection limit of 200 CFU/100 mL. For all other samples, the EColi by MColi Blue MF method was used.

Note 2:
Three samples are taken during each sample event upstream of the inlet.These samples have returned very similar results.

MEMO REFERENCE ... 05-1100-01-9905246-NM9

KGS GROUP

MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

E.COLI
SUMMER FLOOD CONDITION

MARCH 2011	FIGURE NM9-20	REV 0

X:\projects\2003\03-1100-01\General\(.19) SiteSurv&Invest\(.06) Environmental\(.03) SW Monitoring\Temp\2010 Construction\Reports\Annual Report Components\FIgures\FigNM9-20_EColi summer flood

APPENDICES

APPENDIX A

SURFACE WATER MONITORING – 2010 SAMPLING PROGRAM

1.0 INTRODUCTION

This report provides details and a description of the sampling events, sampling protocol, data reduction, reporting and summary tables for the 2010 Surface Water Sampling Program prepared by KGS Group.

There are no specific requirements for surface water monitoring specified in the Environment Act Licence for the Floodway Expansion Project; however, the surface water quality monitoring program was initially developed in 2005 as a component of the Environmental Management Plan. This was done to address concerns raised by the local public regarding impacts to groundwater quality, and to address potential effects on surface water quality resulting from the Project as identified in the Environmental Impact Statement (EIS). 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.

Construction Surface Water monitoring conducted from 2005 to 2009 has confirmed that the effects of the project on surface water quality have not been significant with the mitigation measures that have been implemented. Additionally, with the introduction of the Nutrient Management Regulation (62/2008), no fertilizers have been applied to the Floodway Channel slopes since 2008. Likewise, pesticides have not been applied as part of the project since first tested on a small site in 2005. Finally, the majority of the construction activities are now complete, with the exception of the remaining bridge work and minor channel work. Therefore, the 2010 Surface Water Sampling Program will consist of Event-based monitoring focusing on contract specific construction monitoring and assessing the surface water quality as it relates to potential groundwater impacts.

The Event-based monitoring during 2010 will 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), as well as following potential erosion causing precipitation (Rain) or reported spills (Spill). Regular Monthly monitoring will no longer be conducted; 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 will be collected in the

Floodway Channel upstream and downstream of the overall construction area and analyzed for all parameters except pesticides. The scope of work for the 2010 construction Surface Water Monitoring program conducted by KGS Group includes the following:

- Collect **Floodway Flow Event-based** surface water quality data for parameters of interest from the Red River, La Salle River, Seine River, Floodway Channel and Drains that flow into the Floodway Channel at times when the water level in the Floodway overtops the Low Flow Channel either from elevated Red River water levels or prolonged precipitation events;

- Collect **Rain Event-based** surface water quality data for parameters of interest (TSS, pH and conductivity) from the Floodway Channel, La Salle River and Seine River upstream and downstream of each construction area, the Red River upstream and downstream of the Outlet and any additional required locations following precipitation events greater than 10 mm;

- Collect **Spill Event-based** surface water quality data for compliance monitoring of applicable parameters (herbicides or hydrocarbons) from the Floodway Channel upstream and downstream of the spill area, the Red River upstream and downstream of the Outlet and any additional required locations following a reported spill; and

- Provide an assessment of surface water quality comparing results of construction event-based monitoring to baseline water quality and summarized in an 2010 construction monitoring report in order to:

    - compare predictions made in modelling effects;
    - assess the effectiveness of proposed mitigation measures and adapt, if necessary; and
    - adapt the construction monitoring program in response to data and changes in mitigation measures.

2.0 SAMPLING LOCATIONS

The sample locations are similar to those used during the past sampling programs incorporating minor alterations as recommended in the Baseline and 2005 to 2009 Construction Surface Water Monitoring reports. These sample locations are outlined on Figure NM9-1 and Figure NM9-2 and described as follows:

Red River at Inlet

- Upstream of the Floodway channel along the west shore of the river, 3 replicate samples collected consecutively at the same location (S-01) to capture the natural variation within the Red River. During a sampling event when there is no river water entering into the Floodway channel at the inlet, these samples will not be collected.

Red River at Outlet

- Upstream of the Floodway Outlet along the east shore (S-34) and downstream of the Outlet along the east shore at 500, 1000, 2000, and 3000 m (S-30, S-31, S-32 and S-33, respectively).

Floodway Channel

- Floodway Channel downstream of the Inlet (S-04a), downstream of the Grande Pointe Diversion drop structure (S-13), downstream of the North Bibeau Drain drop structure (S-14) and at the four former weir locations within the low flow channel that were used to calculate the channel base flow during the winter: Keewatin Weir (S-21); Springfield Weir (S-23); Dunning Weir (S-25); and PTH# 44 Weir (S-28). Note during a sample event if there is less than 0.1 m water depth in the low flow channel at a sample location, then that location will not be collected during that event.

- Sample locations will also be located in the Floodway Channel, upstream and downstream of the overall construction limits for all contracts (CON U/S and CON D/S). Note that these sample locations will change as work proceeds and the limits of construction change. During a sampling event if there is less than 0.1 m water depth in the low flow channel at a sample location, then that location will not be collected during that event.

Outfall Sources

- At the 11 outfalls immediately upstream of where they drain into the Floodway channel. These include: Seine River Syphon Overflow (S-05); Grande Point Diversion Drop Structure (S-06); Centreline Drain Drop Structure (S-07); Deacon Reservoir Drain (S-08); Cooks Creek Diversion Drop Structure (S-09); North Bibeau Drain Drop Structure (S-10); Country Villa Estates Drain (S-11); Kildare Trunk-Transcona Storm Sewer Outlet (S-12); Springfield Road Drain Drop Structure (S-22); Skholny Drain Drop Structure (S-26); and Ashfield Drain Drop Structure (S-27). The new construction of the Kildare Trunk-Transcona Storm Sewer Outlet (S-12) makes it impractical to obtain a water sample prior to water from the drain mixing with water from the Floodway Channel. Therefore, a mixed sample will be collected at the outlet. During a sampling event if there is low flow or the water is frozen such that no water is entering into the Floodway from any of the above drains, or there is insufficient amounts of water in the drain to collect a sample (< 0.10 m flow depth), then that drain will not be sampled during that event. Additionally, during a sampling event if a drain is within an area of on-going construction activities, to eliminate a potential confounding effect and in order to assess the effects from the perimeter ditches an additional sample will be collected from the drain upstream of the perimeter ditching.

Seine River

- Sample locations will be located in the Seine River immediately upstream (S-15) and downstream (S-16) of the newly installed culvert at the Prairie Grove Road crossing. During a sampling event if there is less than 0.1 m water depth in the Seine River at a sample location, then that location will not be collected during that event.

La Salle River

- Sample locations will be located in the La Salle River, approximately 50 m upstream (S-37) and downstream (S-38) of the construction activities at the Glenlea Drain Outlet. During a sampling event when there is no water draining into the La Salle River from the Glenlea Drain, then these samples will not be collected during that event. The need to sample will be confirmed by calling the on-site supervisor prior to heading out to the area.

The potential maximum number of sample locations, likely only for Floodway Flow Event-based monitoring coinciding with a spring flood, is 36, whereas there are as few as 6 sample locations during the Spill Event-based monitoring. The sample locations used for any given sampling event will depend on the reason for the sampling event as described in Section 5 (Table 1), time of year, flow conditions, and construction progress to date.

3.0 SAMPLING PROTOCOL

As in the previous years sampling programs, the protocol follows the U.S. Environmental Protection Agency (EPA), Office of Water Quality, Monitoring Water Quality, Chapter 5 Water Quality Conditions (November, 1997, EPA 841-B-97-003). Samples are collected by wading into the water source and/or using a 3 metre sample extension rod to sample as close to the centre of the flow as possible. For safety considerations, the Red River samples are collected from the shoreline using the sample extension rod. Samples are collected by dipping a sample collector into the water to a depth of approximately 30 cm, or half the depth if there is less than 60 cm of water, and scooping the sample collector upstream into the water flow. If there is an insufficient depth of water, 10 cm or less, then sampling is not conducted as the bottom would likely be disturbed during sampling and spoil the sample. Before each sample, the collection jar is rinsed a minimum of three times with the sample water to ensure representative readings of the existing surface water conditions.

4.0 PARAMETERS

While sampling during event-based monitoring, field measurements of pH, temperature, conductivity, and turbidity will be obtained. Water depth is also recorded from staff gauges installed at Floodway Channel locations and in the outfalls. Staff gauges are not installed at Kildare Trunk-Transcona Storm Sewer Outlet, Country Villa Estates Drain, or Deacon Reservoir Drain, as it is not feasible to record the depth of water at these drains. No depth of water is recorded for any of the samples collected from the Red River.

The water depth is recorded to estimate the water discharge at each site using rating curves developed for each of the drains and the Floodway Channel at the sample locations. Estimates of the water discharge are necessary to calculate approximate mass balances for the chemical analysis results to interpret the results in particular during rain event-based monitoring. Discharge estimates for the Red River are based on upstream and downstream measurements from Water Survey of Canada Metering Stations.

The analysis package for the sampling events includes various combinations of the following:

- **General Chemistry** – turbidity, pH, conductivity, total alkalinity, bicarbonate, carbonate, hydroxide, hardness, chloride, fluoride, sulphate, nitrate-nitrite, calcium, magnesium, potassium, sodium, iron, manganese, total dissolved solids;
- **Total Suspended Solids** (TSS);
- **Nutrients** – ammonia, total phosphorus, total Kjeldahl nitrogen (TKN);
- **Bacterial** – total coliform and *E.Coli* by m-Coli Blue Membrane Filtration method;
- **Hydrocarbons** – fractions F1 to F4 and benzene, toluene, ethylbenzene and xylenes (BTEX); and
- **Pesticides** – phenoxy acid herbicide screen (2,4-D, bromoxynil, dicamba, MCPA, picloram), AMPA, and glyphosate.

Additional parameters can be added, if required and approved by MFA. The specific laboratory analysis during each monitoring event and at each sampling location are summarized in Table 1 and described in more detail in Section 5.

5.0 EVENT-BASED MONITORING

Floodway Flow Event

The Floodway Flow Event-based monitoring would be conducted in response to elevated water levels in the Floodway Channel that overtop the Low Flow Channel and inundate a portion of the channel base. This regularly occurs during annual spring flooding when the Floodway Inlet Control Structure is put into operation and Red River water is diverted into the Floodway Channel. Diversion of Red River water can also occur during emergency summer operation or when the Red River water levels are elevated and naturally flow over the entrance plug (El. 750 ft.) into the Floodway Channel without operation of the control gates. The Low Flow Channel can also be overtopped without diversion of Red River water during periods of prolonged or intense rain resulting in substantial inflows from the outfall sources (agricultural drains).

The Floodway Flow Event-based monitoring program will be structured so that the level of effort associated with the monitoring (i.e. the number of samples collected and parameters analyzed) is consistent with the level of potential concern. The potential for surface water quality to impact groundwater quality increases when there is more water present in the Floodway Channel and when it is present for a greater length of time. Based on this, the number of samples to be collected and parameters analyzed during the various conditions are as follows:

Spring Flood - In the event of a spring flood, with or without operation of the control gates, samples will be collected at all of the locations outlined in Section 2 during the flood peak. These samples will be analyzed for the full parameter set outlined in Section 4 except the hydrocarbons and pesticides, which will only be analyzed for the samples collected in the Floodway Channel upstream and downstream of the overall construction limits for all contracts.

If the spring flood is projected to result in use of the Floodway Channel for more than two weeks, then consideration will be given to conduct additional sampling near the beginning and end of the operation, based on discussion with the MFA. During these additional monitoring events samples will only be collected from selected Floodway Channel locations. These samples will be analyzed for the full parameter set, excluding the nutrients, hydrocarbons, and pesticides.

Summer Flood – In the event of a summer flood with operation of the control gates, samples will be collected at all of the locations outlined in Section 2, except the Seine River, during the flood peak. These samples will be analyzed for the full parameter set outlined in Section 4 except the hydrocarbons and pesticides, which will only be analyzed for the samples collected in the Floodway Channel upstream and downstream of the overall construction limits for all contracts. In the event of a summer flood *without* operation of the control gates, samples will only be collected from the Red River and Floodway Channel locations and analyzed for the full parameter set, excluding the nutrients, hydrocarbons, and pesticides.

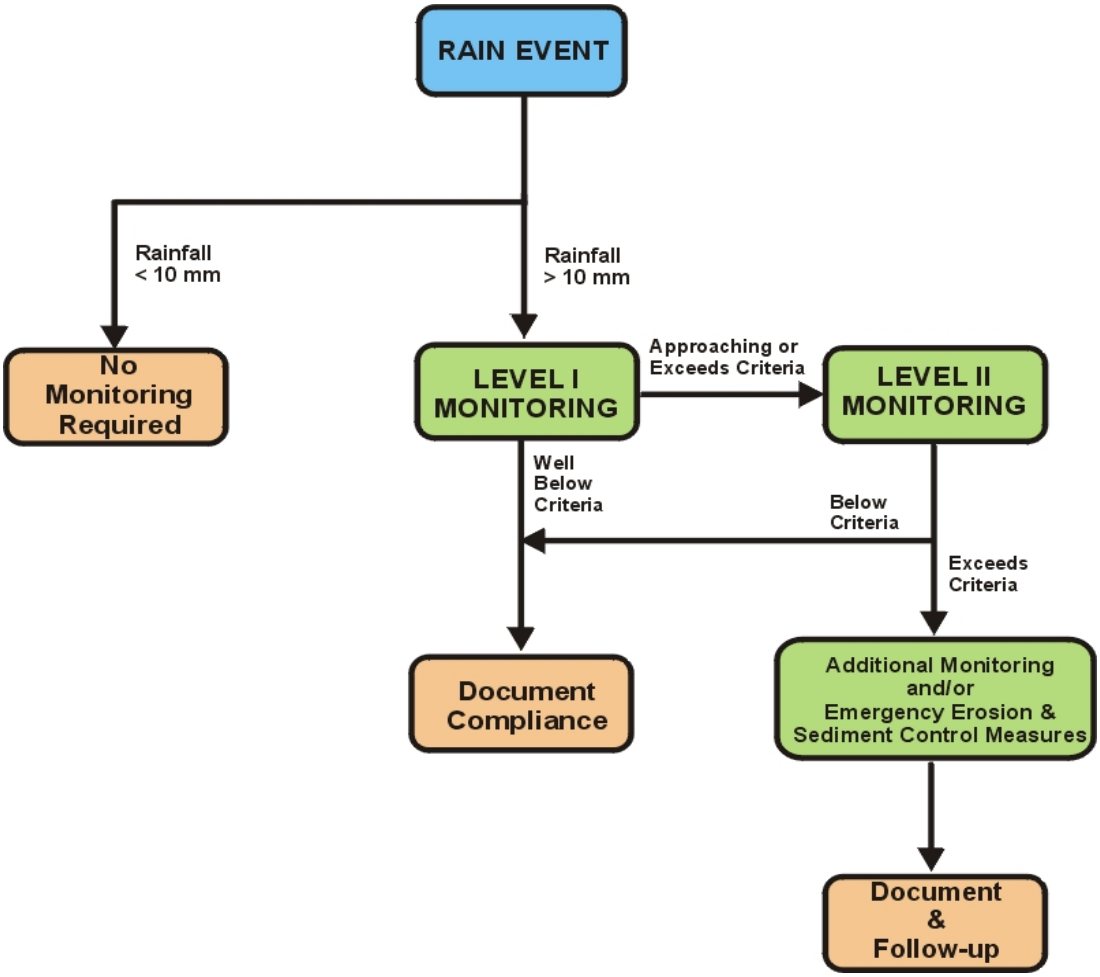
If the summer flood is projected to result in use of the Floodway Channel for more than two weeks, then consideration will be given to conduct additional sampling near the beginning and end of the operation, based on discussion with the MFA. During these additional monitoring events, samples will only be collected from selected Floodway Channel locations and analyzed for the full parameter set, excluding the nutrients, hydrocarbons, and pesticides.

Non-Flood – Periods of prolonged rain or an intense rainfall combined with saturated soils can result in a substantial amount of discharge into the Floodway Channel from the Outfall Sources. At these times the water level can overtop the bank of the Low Flow Channel, without natural or controlled diversion of Red River into the Floodway Channel. Under these conditions, samples will be collected from all of the locations outlined in Section 2 and analyzed for the full parameter set, excluding the nutrients and hydrocarbons. Because river water is not being diverted, the Red River sample locations at the Inlet (S-1 to S-3) will not be sampled as discussed in Section 2

Rain Event

As outlined in the flow chart below, the Rain Event-based monitoring program will be structured so that the level of effort associated with the monitoring is consistent with the level of potential concern. The structure for the 2010 sampling program represents experience obtained during the 2006 to 2009 sampling programs and the modifications made during the 2006 sampling program as discussed in the 2006 Construction Surface Water Monitoring Report (March 2007) and detailed in the October 3, 2006 KGS Group Memorandum (05-1100-01.19.06.03) Red River Floodway Expansion Project; 2006 Surface Water Sampling Program – Precipitation Review.

When a rainfall is less than 10 mm no monitoring is required. When rainfall exceeds 10 mm, a relatively simple monitoring approach ("Level I") will be carried out to indicate whether the downstream conditions are approaching the CCME and Provincial limits or whether the concentration inflow to the Red River is within accepted limits. If the "Level I" downstream conditions approach the CCME and Provincial limits, more rigorous monitoring ("Level II") will be carried out to determine whether additional mitigation control measures are required.



Monitoring Program Flow Chart

Real-time precipitation data will be used to trigger the initiation of the Level I monitoring program. This real-time data will be monitored regularly whenever there are precipitation events to allow the monitoring team to mobilize in order to carry out the surface water sampling without delay following or during rain events.

There are two Environment Canada rainfall gauges within the City of Winnipeg that can be used as a source of real-time rainfall data. This data will not be accessible directly by the monitoring team and is provided by the owners of the rainfall gauge network on a daily basis. As such, a network of unofficial rainfall gauges within the City of Winnipeg is used as a source of real-time rainfall data.

Level I – The "Level I" monitoring program will consist of sampling in the Floodway Channel at all locations except S-23 and S-28, in the Red River upstream and downstream of the Outlet, and in the Seine and La Salle rivers. Field turbidity, using a hand-held turbidity meter, and the water level will be measured and used to estimate the TSS and the flow in the Floodway Channel and Red River.

TSS will be estimated using the site-specific relationships between TSS and field turbidity. These were defined as part of the Baseline Surface Water Monitoring Program and updated following each monthly sampling event during the 2005 to 2009 Construction Surface Water Monitoring. Two relationships were developed: one for Red River water and a second for non-Red River water. The Red River water relationship is based on data collected from the Red River as well as data collected from the Floodway during operation of the Floodway. The non-Red River water relationship is based on data collected from the Floodway when it was not in operation and from the inflowing drains. The TSS and field turbidity relationships will continue to be updated on a monthly basis, allowing the quality of the relationships to improve as more samples are collected.

The estimated TSS and flows will be used in conjunction with a simple mass balance (see attached "Level I Compliance Monitoring Worksheet") to provide an indication as to whether an increase in sediment concentration in the Floodway will have an impact on the Red River downstream of the Floodway Outlet. It should be noted that the estimate of flows and TSS values are considered to be approximate and are to be used in the mass balance to provide a best estimate of the impacts of construction. The factor that has the most sensitivity to the percent increase in sediment concentration in the Red River is the Red River flow; that is, if the Red River flow is quite low, there is a greater risk of exceeding the Provincial Criterion. The effect of the magnitude of the river flow is discussed in the Erosion and Sediment Control Plan.

The estimated TSS will be confirmed by collecting samples at the four locations for laboratory confirmation analysis of TSS along with pH and conductivity.

Level II – The "Level II" monitoring program considers more sample locations that allow for both the assessment of the dilution effect of the Floodway channel downstream of the construction zone and of where the potential contaminant source(s) originate. It will consist of collecting samples at all of the sample locations in the Red River at the Outlet, Floodway Channel and Outfall sources. The field measurements and samples submitted for laboratory analysis would be the same as those for a Level I monitoring.

Spill Event

The Spill Event-based monitoring program will be conducted as directed by the MFA in response to reported spills. It will consist of sampling in the Floodway Channel and in the Red River with samples analyzed for hydrocarbons or pesticides as dictated by the material spilled. Samples will be collected in the Floodway Channel upstream and downstream of the spill point source, at two more locations further downstream in the Floodway Channel, and in the Red River upstream and 1000 m downstream of the Outlet immediately following notification of the spill. In order to track the status of the contaminant plume as it moves downstream, these six sample locations will also be sampled at regular time intervals (based on the flow magnitude during the spill event) for a total of up to three days of monitoring following the spill event.

6.0 REPORTING

The data collected during the event-based monitoring will be summarized in table format outlining the surface water quality. This information will be compared to the 2005 baseline data to assess the accuracy of predictions made and the effectiveness of mitigation measures. All event-based monitoring will be summarized in a letter report each month in which monitoring is conducted. In addition to the monthly summary report, documentation will be provided to MFA immediately after each Level I Rain Event-based monitoring event. The data collected will also be summarized in a separate 2010 Annual Construction Monitoring Report.

TABLE 1: SAMPLE LOCATIONS AND PARAMETERS DURING THE 2010 EVENT-BASED CONSTRUCTION SURFACE WATER MONITORING

Sampling Event [1]	Sample Location [2]						Parameters [3]					
	Red River		Floodway Channel	Agricultural Drains	Seine River [4]	La Salle River	General Chemistry	Total Suspended Solids	Nutrients	Bacterial	Hydro-carbons	Pesticides
	Inlet	Outlet										
Floodway Flow												
Spring Flood - with/without operation	X	X	X	X	X	X	X	X	X	X	CON U/S, CON D/S [6]	CON U/S, CON D/S
- extended flood [5]			All except S-4a, S-13, S-14, S-28				X	X		X		
Summer Flood - with operation	X	X	X	X		X	X	X	X	X	CON U/S, CON D/S [6]	CON U/S, CON D/S
- without operation	X	X	X				X	X		X		
- extended flood [5]			All except S-4a, S-13, S-14, S-28				X	X		X		
Non-Flood		X	X	X	X	X	X	X		X		CON U/S, CON D/S
Rain Event												
Level I		S-34, S-31	All except S-23, S-28		X	X	pH, conductivity	X			CON U/S, CON D/S [6]	
Level II		X	X	X			pH, conductivity	X				
Spill Event												
Spill		S-34, S-31	Specific Locations								X	

Notes:

X - indicates either all sample locations in a category are sampled; or samples are submitted from all locations for laboratory analysis of all parameters in a category

1 - No sampling is required during frozen ground conditions (Dec to Mar and possibly Nov), however, during the unfrozen condition if there is no sample event triggered during a month then at a minimum samples will be collected in the Floodway Channel upstream and downstream of the overall construction area (CON U/S and CON D/S) and analyzed for all parameters except pesticides

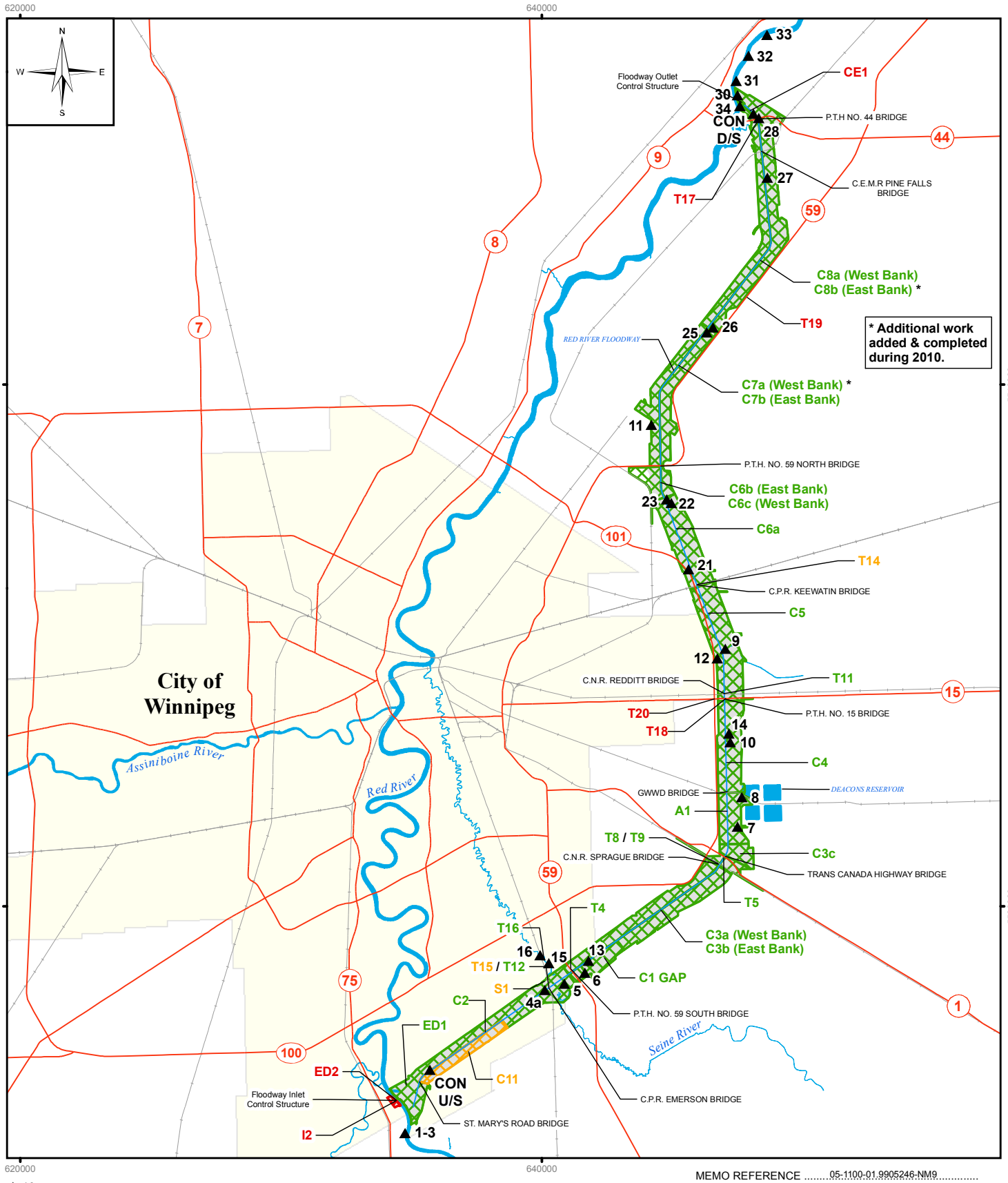
2 - Sample Locations are described in the Sampling Program, shown on Figure 1 and are numbered as follows;
Red River at Inlet - S-1 to S-3
Red River at Outlet - S-30 to S-34
Floodway Channel - CON U/S, CON D/S, S-4, S-13, S-14, S-21, S-23, S-25, S-28
Agricultural Drains - S-5 to S-12, S-22, S-26, S-27
Seine River - S-05 U/S, S-15, S-16
La Salle River - S-37, S-38

3 - Individual laboratory analaysis parameters within the category groups include the following;
General Chemistry - turbidity, pH, conductivity, total alkalinity, bicarbonate, carbonate, hydroxide, hardness, chloride, fluoride, sulphate, nitrate-nitrite, calcium, magnesium, potassium, sodium, iron, manganese, total dissolved solids
Nutrients - ammonia, total phosphorus, total Kjeldahl nitrogen (TKN)
Bacterial - total coliform and E.Coli by m-Coli Blue Membrane Filtration method
Hydrocarbons - fractions F1 to F4 and benzene, toluene, ethylbenzene and xylenes (BTEX)
Pesticides - phenoxy acid herbicide screen (2,4-D, bromoxynil, dicamba, MCPA, picloram), AMPA and glyphosate

4 - Sampling on the Seine River in response to contracts T-15 and T-16 may be discontinued once vegetation is established or results of monitoring indicate no erosion concerns

5 - An extended flood is any flood projected to last more than two weeks, with additional sampling conducted near the start and end of the flood

6 - Only samples collected at CON U/S and CON D/S are submitted for laboratory analysis of hydrocarbons and only upto a maximum of twice per month



▲10 Surface Water Sampling Locations

C0	Completed Prior to 2010		Completed Prior to 2010
C0	Completed During 2010		Completed During 2010
C0	Still Active at End of 2010		Still Active at End of 2010

1:200,000

1 0 1 2 3 4 5

Kilometres

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KGS GROUP

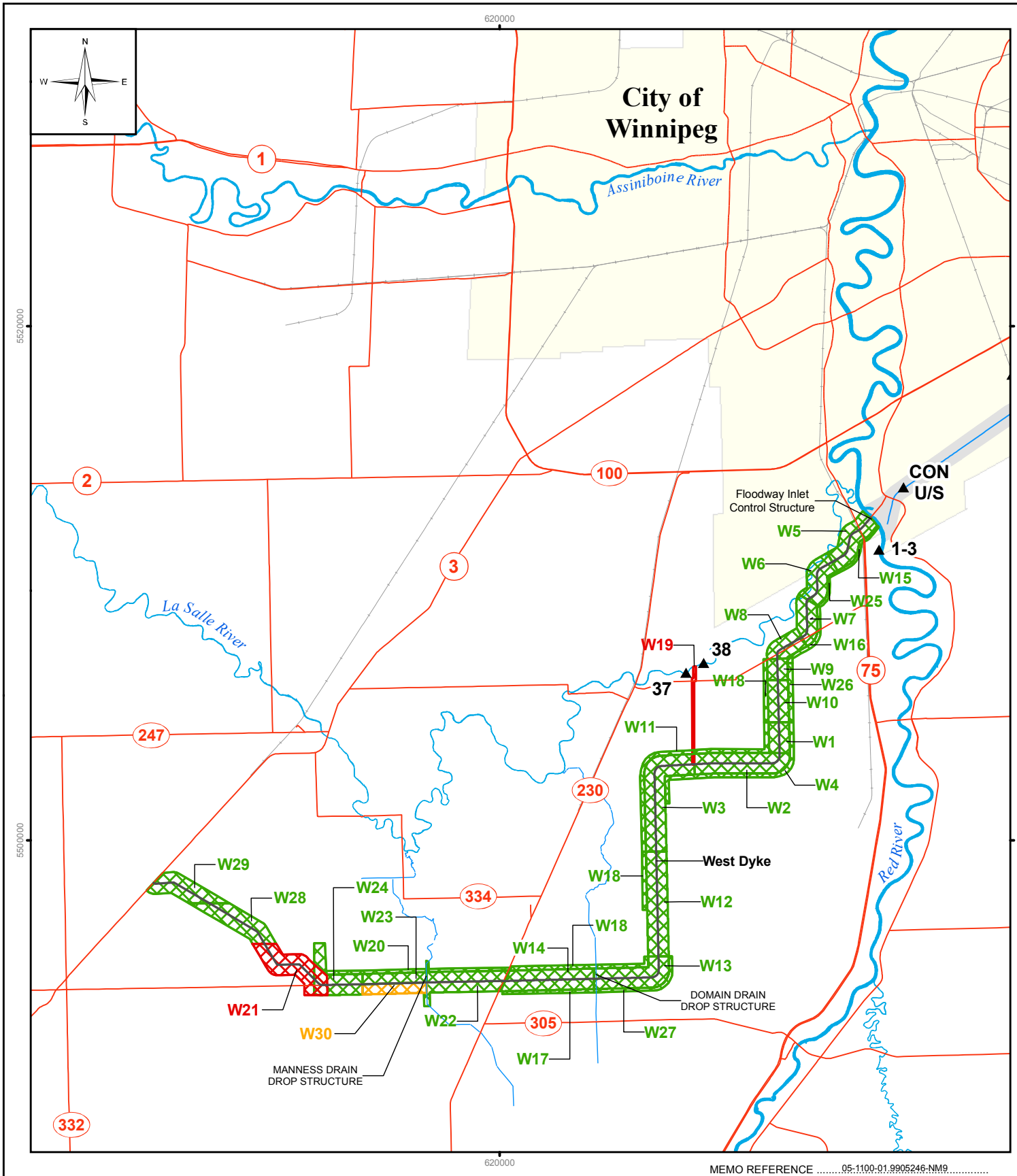
MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

2010 CONSTRUCTION SURFACE WATER MONITORING

FLOODWAY CHANNEL SAMPLE LOCATIONS

MARCH 2011	FIGURE NM9-1	REV 0



▲37 Surface Water Sampling Locations

C0	Completed Prior to 2010		Completed Prior to 2010
C0	Completed During 2010		Completed During 2010
C0	Still Active at End of 2010		Still Active at End of 2010

1:200,000

1 0 1 2 3 4 5

Kilometres

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KGS GROUP

MANITOBA FLOODWAY AUTHORITY

RED RIVER FLOODWAY EXPANSION

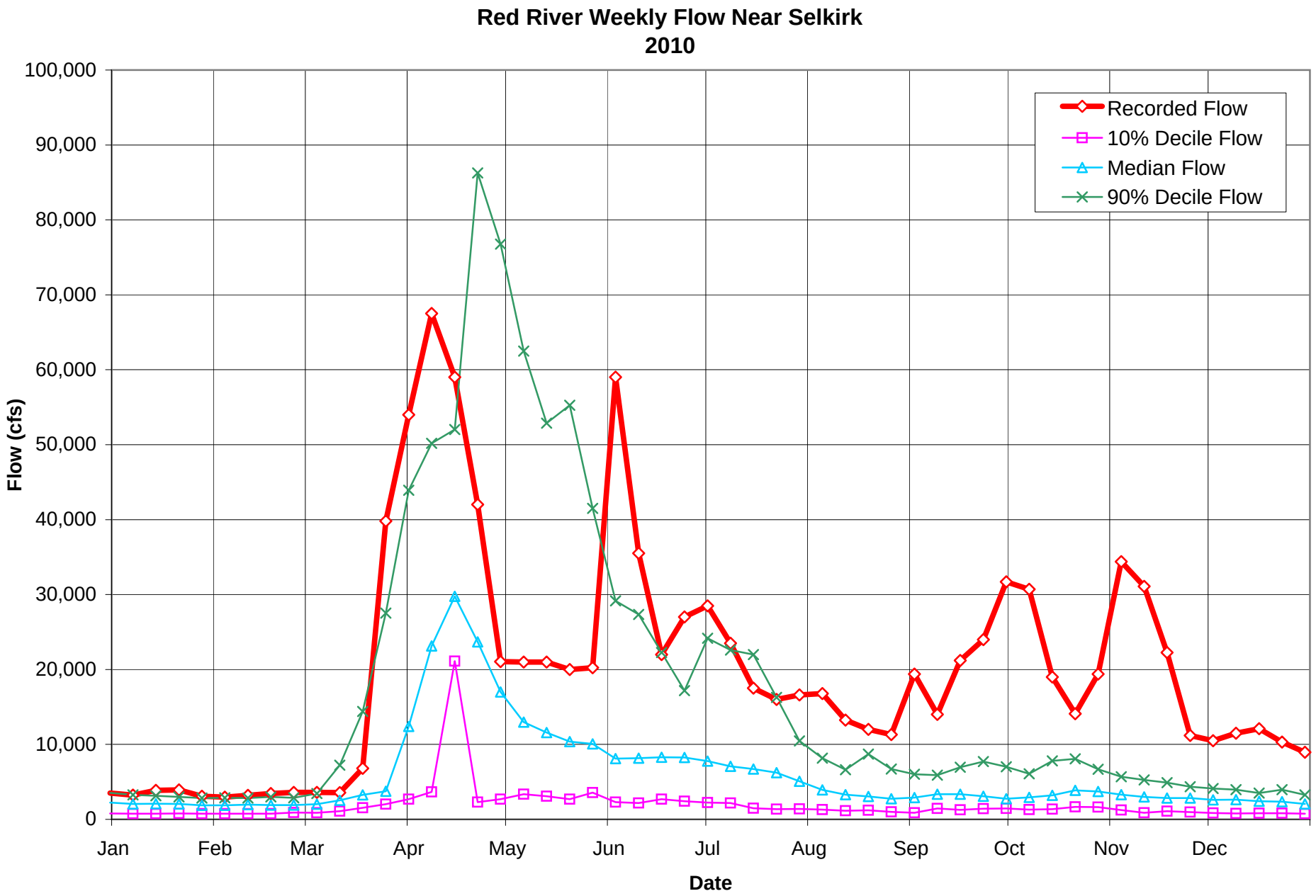
2010 CONSTRUCTION SURFACE WATER MONITORING

FLOODWAY CHANNEL SAMPLE LOCATIONS

MARCH 2011	FIGURE NM9-2	REV 0

APPENDIX B

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


Red River Weekly Flow Near Selkirk
2010
Flow (cfs)
100,000
90,000
80,000
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Date
Recorded Flow
10% Decile Flow
Median Flow
90% Decile Flow

APPENDIX C

ENVIRONMENT CANADA
WINNIPEG INT'L A, MANITOBA – DAILY DATA REPORTS
APRIL TO OCTOBER 2010

Environment Canada Environnement Canada

Canada

Daily Data Report for April 2010

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49°55'00.000" N **Longitude**: 97°14'00.000" W **Elevation**: 238.70 m

Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for April 2010

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	15.1	0.6	7.9	10.1	0.0	M	M	0.0			<31
02†	9.3	1.1	5.2	12.8	0.0	M	M	13.0		3	70
03†	10.1	-0.7	4.7	13.3	0.0	M	M	5.0			<31
04†	16.9	-1.2	7.9	10.1	0.0	M	M	0.0		29	70
05†	15.5	-0.1	7.7	10.3	0.0	M	M	0.0		27	39
06†	11.7	-5.0	3.4	14.6	0.0	M	M	0.0		32	48
07†	9.5	-6.3	1.6	16.4	0.0	M	M	0.0			<31
08†	12.5	-4.6	4.0	14.0	0.0	M	M	M			<31
09†	13.9	2.1	8.0	10.0	0.0	M	M	0.0		26	54
10†	13.3	-2.3	5.5	12.5	0.0	M	M	0.0		29	67
11†	9.1	-3.0	3.1	14.9	0.0	M	M	M			<31
12†	13.2	0.9	7.1	10.9	0.0	M	M	0.0		8	39
13†	15.5	6.3	10.9	7.1	0.0	M	M	0.5		12	67
14†	22.2	11.5	16.9	1.1	0.0	M	M	0.0		14	61
15†	11.5	-1.1	5.2	12.8	0.0	M	M	0.0		32	69
16†	15.5	-5.7	4.9	13.1	0.0	M	M	0.0		2	37
17†	20.0	-0.8	9.6	8.4	0.0	M	M	0.0			<31
18†	21.9	-1.6	10.2	7.8	0.0	M	M	0.0		17	35
19†	23.2	-0.2	11.5	6.5	0.0	M	M	0.0			<31
20†	15.7	0.3	8.0	10.0	0.0	M	M	0.5		2	41
21†	15.7	-4.9	5.4	12.6	0.0	M	M	0.0			<31
22†	22.4	-0.8	10.8	7.2	0.0	M	M	0.0			<31
23†	24.1	3.1	13.6	4.4	0.0	M	M	0.0			<31
24†	19.1	5.8	12.5	5.5	0.0	M	M	M			<31
25†	19.8	1.9	10.9	7.1	0.0	M	M	0.0		16	33
26†	18.4	0.6	9.5	8.5	0.0	M	M	0.0			<31
27†	20.5	-2.2	9.2	8.8	0.0	M	M	M			<31
28†	20.8	3.7	12.3	5.7	0.0	M	M	0.0		18	69
29†	15.0	8.8	11.9	6.1	0.0	M	M	15.0			<31
30†	11.7	8.3	10.0	8.0	0.0	M	M	11.0			<31
Sum				**290.6**	**0.0**	**M**	**M**	**45.0***			
Avg	**16.1**	**0.5**	**8.29**								
Xtrm	**24.1**	**-6.3**								**3**	**70**

Environment Canada Environnement Canada

Canada

Daily Data Report for May 2010

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49°55'00.000" N **Longitude**: 97°14'00.000" W **Elevation**: 238.70 m

Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for May 2010

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	12.7	6.7	9.7	8.3	0.0	M	M	3.5			<31
02†	9.6	1.5	5.6	12.4	0.0	M	M	7.5		36	46
03†	7.0	0.5	3.8	14.2	0.0	M	M	0.5		32	35
04†	13.3	2.1	7.7	10.3	0.0	M	M	15.5		4	54
05†	7.5	1.8	4.7	13.3	0.0	M	M	9.5		3	65
06†	7.2	-2.8	2.2	15.8	0.0	M	M	0.0		3	33
07†	8.1	0.0	4.1	13.9	0.0	M	M	0.0		1	48
08†	12.1	-4.3	3.9	14.1	0.0	M	M	0.0		1	35
09†	15.1	-2.8	6.2	11.8	0.0	M	M	0.0			<31
10†	11.0	6.2	8.6	9.4	0.0	M	M	3.0		11	52
11†	15.9	6.8	11.4	6.6	0.0	M	M	1.5		14	37
12†	13.5	2.9	8.2	9.8	0.0	M	M	0.0		19	32
13†	16.2	0.7	8.5	9.5	0.0	M	M	0.0			<31
14†	23.5	2.6	13.1	4.9	0.0	M	M	0.5		18	39
15†	26.9	9.0	18.0	0.0	0.0	M	M	0.0		22	44
16†	25.3	11.4	18.4	0.0	0.4	M	M	0.5		22	41
17†	26.6	10.0	18.3	0.0	0.3	M	M	0.5		21E	35E
18†	28.4	9.7	19.1	0.0	1.1	M	M	0.0		21	46
19†	29.2	9.7	19.5	0.0	1.5	M	M	0.0		17	33
20†	29.0	10.5	19.8	0.0	1.8	M	M	0.0		20	44
21†	27.5	11.7	19.6	0.0	1.6	M	M	0.0			<31
22†	24.0	13.8	18.9	0.0	0.9	M	M	0.0		13	50
23†	23.4	9.9	16.7	1.3	0.0	M	M	3.5		24	59
24†	19.4	6.4	12.9	5.1	0.0	M	M	5.0		6	67
25†	21.0	12.0	16.5	1.5	0.0	M	M	20.0		20	82
26†	20.5	6.7	13.6	4.4	0.0	M	M	0.0		27	39
27†	13.4	3.8	8.6	9.4	0.0	M	M	0.5		5	44
28†	20.9	11.1	16.0	2.0	0.0	M	M	27.0		3	65
29†	21.1	13.0	17.1	0.9	0.0	M	M	53.0		31	102
30†	16.0	7.9	12.0	6.0	0.0	M	M	6.0		29	50
31†	18.9	5.8	12.4	5.6	0.0	M	M	2.5		31	39
Sum				**190.5**	**7.6**	**M**	**M**	**160.0**			
Avg	**18.2**	**5.9**	**12.07**								
Xtrm	**29.2**	**-4.3**								**31**	**102**

Environment Canada Environnement Canada

Canada

Daily Data Report for June 2010

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49°55'00.000" N **Longitude**: 97°14'00.000" W **Elevation**: 238.70 m
Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for June 2010

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	15.9	6.8	11.4	6.6	0.0	M	M	0.0		32	39
02†	21.9	5.5	13.7	4.3	0.0	M	M	0.0			<31
03†	22.9	8.3	15.6	2.4	0.0	M	M	0.5		19	46
04†	21.9	9.8	15.9	2.1	0.0	M	M	4.5		30	46
05†	20.8	7.9	14.4	3.6	0.0	M	M	9.5		29	32
06†	22.1	12.1	17.1	0.9	0.0	M	M	0.5			<31
07†	25.3	10.9	18.1	0.0	0.1	M	M	0.0			<31
08†	22.2	11.5	16.9	1.1	0.0	M	M	6.0		19	48
09†	13.2	7.3	10.3	7.7	0.0	M	M	4.0		32	54
10†	14.9E	5.6E	10.3E	7.7E	0.0E	M	M	0.5E		M	M
11†	16.9	12.5	14.7	3.3	0.0	M	M	3.0			<31
12†	20.9	13.5	17.2	0.8	0.0	M	M	4.5		32	33
13†	22.1	10.7	16.4	1.6	0.0	M	M	0.5			<31
14†	23.2	7.7	15.5	2.5	0.0	M	M	0.0			<31
15†	24.7	13.9	19.3	0.0	1.3	M	M	0.0			<31
16†	26.9	12.7	19.8	0.0	1.8	M	M	0.0			<31
17†	22.9	16.9	19.9	0.0	1.9	M	M	8.5		11	78
18†	17.6	11.9	14.8	3.2	0.0	M	M	9.5			<31
19†	20.5	11.0	15.8	2.2	0.0	M	M	0.0		35	35
20†	26.3	14.2	20.3	0.0	2.3	M	M	0.5			<31
21†	21.2	14.1	17.7	0.3	0.0	M	M	2.0			<31
22†	26.5	12.0	19.3	0.0	1.3	M	M	1.5		34	61
23†	24.4	13.8	19.1	0.0	1.1	M	M	0.0		34	35
24†	23.3	13.1	18.2	0.0	0.2	M	M	0.0			<31
25†	27.1	13.7	20.4	0.0	2.4	M	M	0.0			<31
26†	25.5	16.9	21.2	0.0	3.2	M	M	14.0		30	65
27†	23.6	11.5	17.6	0.4	0.0	M	M	1.0		1	50
28†	19.9	9.0	14.5	3.5	0.0	M	M	0.0		1	35
29†	20.9	7.9	14.4	3.6	0.0	M	M	0.5			<31
30†	24.5	15.3	19.9	0.0	1.9	M	M	0.0		15	67
Sum				**57.8E**	**17.5E**	**M**	**M**	**71.0E**			
Avg	**22E**	**11.3E**	**16.63E**								
Xtrm	**27.1E**	**5.5E**								**11***	**78***

Environment Canada Environnement Canada

Canada

Daily Data Report for July 2010

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49°55'00.000" N **Longitude**: 97°14'00.000" W **Elevation**: 238.70 m

Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for July 2010

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	30.2	17.4	23.8	0.0	5.8	M	M	1.5		14	46
02†	30.7	21.6	26.2	0.0	8.2	M	M	0.5		19	50
03†	30.5	18.9	24.7	0.0	6.7	M	M	10.0		28	41
04†	26.4	17.7	22.1	0.0	4.1	M	M	0.5		30	33
05†	27.6	15.4	21.5	0.0	3.5	M	M	6.5		22	93
06†	23.9	13.9	18.9	0.0	0.9	M	M	0.5		25	54
07†	25.6	12.9	19.3	0.0	1.3	M	M	0.0		20	35
08†	22.9	12.2	17.6	0.4	0.0	M	M	0.0		31	37
09†	27.4	16.1	21.8	0.0	3.8	M	M	0.0			<31
10†	26.9	13.6	20.3	0.0	2.3	M	M	0.0		33	33
11†	22.6	11.4	17.0	1.0	0.0	M	M	0.0		32	56
12†	24.4	8.6	16.5	1.5	0.0	M	M	0.0			<31
13†	26.5	16.5	21.5	0.0	3.5	M	M	25.5			<31
14†	24.9	13.4	19.2	0.0	1.2	M	M	0.5			<31
15†	25.3	12.6	19.0	0.0	1.0	M	M	0.0		28	54
16†	23.7	13.2	18.5	0.0	0.5	M	M	0.0		30	44
17†	18.2	11.9	15.1	2.9	0.0	M	M	12.0			<31
18†	26.4	11.3	18.9	0.0	0.9	M	M	0.5		27	33
19†	23.9	12.8	18.4	0.0	0.4	M	M	0.0		28	35
20†	25.5	12.4	19.0	0.0	1.0	M	M	0.0		35	46
21†	27.3	11.4	19.4	0.0	1.4	M	M	0.0			<31
22†	23.5	16.6	20.1	0.0	2.1	M	M	7.5			<31
23†	25.6	14.0	19.8	0.0	1.8	M	M	0.5			<31
24†	28.1	14.7	21.4	0.0	3.4	M	M	0.0			<31
25†	29.3	15.5	22.4	0.0	4.4	M	M	0.0		20	35
26†	31.9	19.2	25.6	0.0	7.6	M	M	0.0		17	44
27†	26.8	13.8	20.3	0.0	2.3	M	M	2.0		33	56
28†	24.7	12.8	18.8	0.0	0.8	M	M	0.5		31	33
29†	24.0	9.7	16.9	1.1	0.0	M	M	0.0			<31
30†	25.4	15.9	20.7	0.0	2.7	M	M	0.0		13	33
31†	30.2	13.6	21.9	0.0	3.9	M	M	0.5		27	33
Sum				**6.9**	**75.5**	**M**	**M**	**69.0**			
Avg	**26.1**	**14.2**	**20.18**								
Xtrm	**31.9**	**8.6**								**22**	**93**

Environment Canada Environnement Canada

Canada

Daily Data Report for August 2010

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49°55'00.000" N **Longitude**: 97°14'00.000" W **Elevation**: 238.70 m

Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for August 2010

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	26.8	17.5	22.2	0.0	4.2	M	M	25.0		26	39
02†	29.5	16.1	22.8	0.0	4.8	M	M	4.5		23	63
03†	28.6	15.3	22.0	0.0	4.0	M	M	1.0		28	46
04†	23.9	15.0	19.5	0.0	1.5	M	M	7.5		29	39
05†	21.3	11.1	16.2	1.8	0.0	M	M	0.0		35	35
06†	24.6	6.9	15.8	2.2	0.0	M	M	0.0			<31
07†	27.5	14.3	20.9	0.0	2.9	M	M	0.0		15	33
08†	30.9	17.5	24.2	0.0	6.2	M	M	0.0		31	35
09†	32.9	16.5	24.7	0.0	6.7	M	M	0.0			<31
10†	31.6	19.8	25.7	0.0	7.7	M	M	2.5		19	61
11†	29.3	17.6	23.5	0.0	5.5	M	M	1.0			<31
12†	29.1	16.2	22.7	0.0	4.7	M	M	1.5		13	32
13†	22.3	16.9	19.6	0.0	1.6	M	M	49.5		31	48
14†	19.7	13.8	16.8	1.2	0.0	M	M	2.5		27	61
15†	14.7	7.9	11.3	6.7	0.0	M	M	4.5		29	61
16†	17.9	6.0	12.0	6.0	0.0	M	M	1.5		32	63
17†	14.4	5.9	10.2	7.8	0.0	M	M	0.5			<31
18†	20.9	6.0	13.5	4.5	0.0	M	M	0.0			<31
19†	23.0	8.1	15.6	2.4	0.0	M	M	0.0		2	37
20†	28.6	12.8	20.7	0.0	2.7	M	M	0.0		16	39
21†	25.9	11.6	18.8	0.0	0.8	M	M	0.0		13	33
22†	31.3	17.5	24.4	0.0	6.4	M	M	1.0		16	69
23†	30.1	15.7	22.9	0.0	4.9	M	M	0.0		20	67
24†	18.5	12.7	15.6	2.4	0.0	M	M	0.5		30	63
25†	22.2	8.3	15.3	2.7	0.0	M	M	0.0			<31
26†	28.9	10.7	19.8	0.0	1.8	M	M	0.0		21	52
27†	30.3	15.4	22.9	0.0	4.9	M	M	0.5		17	54
28†	21.2	10.9	16.1	1.9	0.0	M	M	2.5			<31
29†	25.6	13.2	19.4	0.0	1.4	M	M	0.0			<31
30†	19.3	14.2	16.8	1.2	0.0	M	M	38.0		6	41
31†	19.4	10.7	15.1	2.9	0.0	M	M	M			<31
Sum				**43.7**	**72.7**	**M**	**M**	**144.0***			
Avg	**24.8**	**13**	**18.91**								
Xtrm	**32.9**	**5.9**								**16**	**69**

Environment Canada Environnement Canada

Canada

Daily Data Report for September 2010

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49°55'00.000" N **Longitude**: 97°14'00.000" W **Elevation**: 238.70 m
Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for September 2010

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	22.3	8.0	15.2	2.8	0.0	M	M	19.5		18	48
02†	18.0	10.5	14.3	3.7	0.0	M	M	13.0		33	69
03†	18.1	7.0	12.6	5.4	0.0	M	M	0.5		35	48
04†	17.7	4.4	11.1	6.9	0.0	M	M	0.0			<31
05†	20.1	5.3	12.7	5.3	0.0	M	M	0.0			<31
06†	18.4	6.6	12.5	5.5	0.0	M	M	0.0		7	44
07†	14.4	6.7	10.6	7.4	0.0	M	M	0.0		35	37
08†	17.0	4.6	10.8	7.2	0.0	M	M	0.0			<31
09†	19.3	7.2	13.3	4.7	0.0	M	M	3.5		11	52
10†	16.0	12.0	14.0	4.0	0.0	M	M	18.5		14	56
11†	18.1	8.6	13.4	4.6	0.0	M	M	0.0		27	56
12†	19.4	5.8	12.6	5.4	0.0	M	M	0.0		28	52
13†	15.3	3.1	9.2	8.8	0.0	M	M	0.0		29	44
14†	15.3	2.0	8.7	9.3	0.0	M	M	0.0		32	33
15†	16.3	7.5	11.9	6.1	0.0	M	M	0.0			<31
16†	15.4	8.7	12.1	5.9	0.0	M	M	3.5		16	52
17†	11.0	3.2	7.1	10.9	0.0	M	M	0.5		29	54
18†	13.9	0.9	7.4	10.6	0.0	M	M	0.0		29	35
19†	15.3	-1.5	6.9	11.1	0.0	M	M	0.5			<31
20†	13.2	9.6	11.4	6.6	0.0	M	M	1.0		13	41
21†	11.3	5.7	8.5	9.5	0.0	M	M	0.5		30	41
22†	9.7	1.5	5.6	12.4	0.0	M	M	10.0			<31
23†	12.3	6.7	9.5	8.5	0.0	M	M	12.5		36	41
24†	15.6	6.7	11.2	6.8	0.0	M	M	7.0		36	35
25†	17.3	5.9	11.6	6.4	0.0	M	M	0.0		2	32
26†	23.0	9.7	16.4	1.6	0.0	M	M	0.5		19	70
27†	20.8	11.4	16.1	1.9	0.0	M	M	0.5		32	46
28†	19.8E	7.9E	13.9E	4.1E	0.0E	M	M	0.0		18	52
29†	19.6	7.9	13.8	4.2	0.0	M	M	0.0		32	65
30†	18.6	4.7	11.7	6.3	0.0	M	M	1.5		2	50
Sum				**193.9E**	**0.0E**	**M**	**M**	**93.0**			
Avg	**16.8E**	**6.3E**	**11.51E**								
Xtrm	**23.0E**	**-1.5E**								**19**	**70**

Environment Canada Environnement Canada

Canada

Daily Data Report for October 2010

Notes on Data Quality.

WINNIPEG RICHARDSON AWOS
MANITOBA

Latitude: 49°55'00.000" N **Longitude**: 97°14'00.000" W **Elevation**: 238.70 m

Climate ID: 5023226 **WMO ID**: 71852 **TC ID**: YWG

Daily Data Report for October 2010

Day	Max Temp °C	Min Temp °C	Mean Temp °C	Heat Deg Days °C	Cool Deg Days °C	Total Rain mm	Total Snow cm	Total Precip mm	Snow on Grnd cm	Dir of Max Gust 10's Deg	Spd of Max Gust km/h
01†	M	2.4E	M	M	M	M	M	0.5			<31
02†	13.0	-2.1	5.5	12.5	0.0	M	M	0.0		15	33
03†	18.5	3.7	11.1	6.9	0.0	M	M	1.5		18	63
04†	20.4	7.1	13.8	4.2	0.0	M	M	0.0		16	39
05†	21.2	9.7	15.5	2.5	0.0	M	M	0.0		32	56
06†	21.1	5.4	13.3	4.7	0.0	M	M	0.0		26	52
07†	24.0	7.3	15.7	2.3	0.0	M	M	0.0		19	33
08†	25.6	7.5	16.6	1.4	0.0	M	M	0.0			<31
09†	24.8	8.2	16.5	1.5	0.0	M	M	0.0			<31
10†	21.4	6.8	14.1	3.9	0.0	M	M	0.0			<31
11†	24.1	3.9	14.0	4.0	0.0	M	M	0.0		3	41
12†	16.9	4.9	10.9	7.1	0.0	M	M	0.0		32	52
13†	16.3	2.3	9.3	8.7	0.0	M	M	0.0		31	35
14†	13.4	0.2	6.8	11.2	0.0	M	M	0.0		33	52
15†	16.7	-1.2	7.8	10.2	0.0	M	M	0.5		16	67
16†	12.8	-0.2	6.3	11.7	0.0	M	M	0.0		29	63
17†	11.0	-2.9	4.1	13.9	0.0	M	M	0.0		32	35
18†	12.4	0.2	6.3	11.7	0.0	M	M	0.0		28	46
19†	17.3	0.1	8.7	9.3	0.0	M	M	0.0		30	46
20†	11.4	0.9	6.2	11.8	0.0	M	M	0.0		34	59
21†	11.0	-1.4	4.8	13.2	0.0	M	M	0.5		28	35
22†	14.2	0.6	7.4	10.6	0.0	M	M	0.0		4	32
23†	11.8	-2.8	4.5	13.5	0.0	M	M	0.0			<31
24†	13.0	-3.6	4.7	13.3	0.0	M	M	0.0		13	33
25†	11.1	7.4	9.3	8.7	0.0	M	M	14.0		9	35
26†	12.1	6.0	9.1	8.9	0.0	M	M	24.5		1	67
27†	6.0	0.1	3.1	14.9	0.0	M	M	6.0		34	83
28†	3.3	-2.9	0.2	17.8	0.0	M	M	0.0		32	63
29†	2.7	-5.8	-1.6	19.6	0.0	M	M	0.0			<31
30†	2.9	-0.3	1.3	16.7	0.0	M	M	0.5			<31
31†	1.6	-1.9	-0.2	18.2	0.0	M	M	0.0		19	35
Sum				**294.9***	**0.0***	**M**	**M**	**48.0**			
Avg	**14.4**	**1.9E**	**8.16E**								
Xtrm	**25.6**	**-5.8E**								**34**	**83**

Legend
[empty] = No data available
M = Missing
E = Estimated
A = Accumulated
C = Precipitation occurred, amount uncertain
L = Precipitation may or may not have occurred
F = Accumulated and estimated
N = Temperature missing but known to be > 0
Y = Temperature missing but known to be < 0
S = More than one occurrence
T = Trace
* = The value displayed is based on incomplete data
† = Data for this day has undergone only preliminary quality checking

We'd like to hear from you! Please click "Contact Us" to share your comments and suggestions.

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