SEWPCC Upgrading/Expansion
Conceptual Design Report

SECTION 1 - Introduction

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1.0 Introduction

1.1 BACKGROUND

The City commissioned the SEWPCC in 1974 to treat wastewater collected from the south end sewerage catchment. The SEWPCC was expanded in 1993 to increase capacity and improve reliability. UV disinfection and computerized work management systems were added in 1999 and 2003 respectively.

The SEWPCC unit processes consist of raw sewage pumping, screening, pre-aeration and grit removal, primary clarification, high purity oxygen (HPO) generation with pressure swing adsorption units (PSA), high purity oxygen activated sludge, secondary clarification, UV disinfection, sludge storage and hauling to the NEWPCC. Other support functions include odour control, stand-by power generation and a septage receiving station. A layout of the existing facility is shown on Figure 1.1.

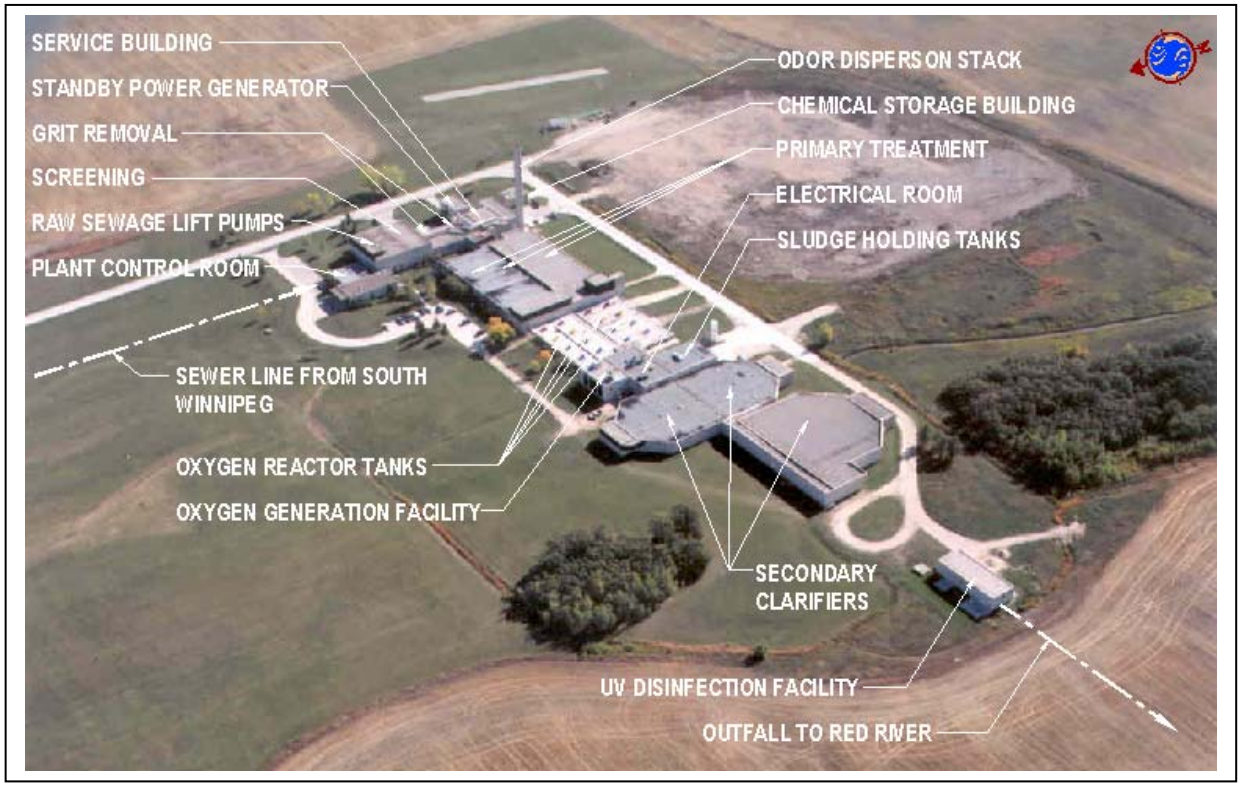

Figure 1.1 - Layout of Existing Facility

Wastewater loading to the SEWPCC has reached its design capacity. Continued development pressure in the SEWPCC catchment area, such as Waverley West, Island Lakes, Sage Creek

and Dawson Trail, necessitates that the SEWPCC be expanded to accommodate the increased loading to the plant. At the same time, there is growing concern that excess nutrient loading to Lake Winnipeg is contributing to the eutrophication of the lake over the long-term. To address this concern Manitoba Conservation is imposing more stringent effluent criteria on the City of Winnipeg for their three wastewater treatment plants, including the SEWPCC.

Manitoba Conservation has issued Environmental Licence No. 2716 for the SEWPCC. This licence specifies a year round effluent quality of 15 mg/L total nitrogen (TN), 1.0 mg/L total phosphorus (TP), 25 mg/L five-day carbonaceous biochemical oxygen demand ($cBOD_5$) and 25 mg/L total suspended solids (TSS) on a 30-day rolling average basis, and a 30 mg/L $cBOD_5$ on a not-to-exceed basis. The City is in the process of clarifying the 30 mg/L $cBOD_5$ not-to-exceed limit with Manitoba Conservation for the SEWPCC. For the purpose of this report the Project Team has assumed that Manitoba Conservation will follow conventional practice and monitor $cBOD_5$ based on 25 mg/L on a 30-day rolling average.

The plant design is complicated by the fact that the collection system experiences very significant extraneous flows during periods of the year. The source of these flows is unknown at this time but the City has retained an engineering consultant to undertake a study of the sewer system shed to determine the source of infiltration/inflow and develop measures to reduce it to acceptable levels. While the extraneous high flows will govern the size of the process components, attention is required to ensure proper operation of these components at low flows that occur in the middle of the night during the dry weather months.

The licence specifies that the effluent criteria will be applied year round, including the high flow period in spring when wastewater temperatures are relatively low. The overall design concept must therefore strike a balance between the need to protect the biological process from “wash out” conditions while reducing the risk of effluent non-compliance during wet weather flow events. The most critical design scenario will be high wet weather flow periods with low temperature.

In January of 2006, through a competitive proposal and interview process, the City engaged the services of the Stantec Consulting Ltd. (Stantec) Team to design an upgrade/expansion to the SEWPCC. The upgraded/expanded facility must meet the more stringent effluent criteria specified in the licence while accommodating growth and addressing high wet weather flows.

Stantec submitted the SEWPCC Upgrading / Expansion Draft Preliminary Design Report (PDR) to the City in March 2007. In early June 2007 the City retained an Independent Review Team (IRT) consisting of J.A. Oleszkiewicz, J.L. Barnard, G.T. Daigger and J.A. Husband to review the Draft PDR. The IRT role was to use their experience to assure the City of Winnipeg that the Stantec Team had evaluated a broad enough spectrum of options and selected the right options for further evaluation in Conceptual Design. The IRT report was submitted to the City in January 2008. After incorporating the City’s review comments the SEWPCC Upgrading / Expansion Final PDR that was submitted to the City in March 2008.

In January 2008 the City authorized Stantec to proceed with the Conceptual Design work. Stantec submitted the SEWPCC Upgrading/Expansion Conceptual Design Report - Draft to the City in December 2008. The City completed an internal review of the Draft Report and provided comments back to Stantec in late February 200. This Conceptual Design Report incorporates the City's review comments.

In order to meet the City's commitment to the Province, the upgraded plant must be commissioned in mid 2012 so that the operational intricacies can be worked out and the plant's biological process stabilized and optimized prior to the license requirements coming into effect on December 31, 2012. The City is currently undertaking a review of alternative project delivery methodologies for the SEWPCC and NEWPCC projects. Detailed design work for the key components of the facility will not be authorized until this decision has been made. The upgrades will take approximately two and a half to three years to construct, leaving one year for detailed design, tendering and contract award. If the City chooses either the traditional design / bid / build or construction management methodologies for delivery of the project by the end of November 2008 they have a reasonable chance of achieving the schedule requirements in the license. If they choose any new delivery methodology that requires significant changes to their legal and project delivery framework, it is unlikely the schedule requirements in the license will be met.

The major components of the project include:

- Improved hauled wastewater (HWW) receiving facilities.
- Increased raw wastewater pumping capacity for improved basement flood protection and an associated increase in the outfall capacity.
- Increased screening and grit removal and improvements to the existing grit removal facility.
- Upgrade of the secondary treatment process to integrated fixed film activated sludge (IFAS) biological nutrient removal (BNR).
- Increased secondary clarifier capacity.
- Increased ultraviolet (UV) disinfection capacity and ability to provide UV disinfection year round.
- Biosolids management facilities.
- Improved flood protection of the facility.

1.2 PROJECT OBJECTIVES

The City's project objective is to upgrade and expand the SEWPCC to meet more stringent effluent criteria while accommodating increased influent flows and deliver this critical project both on time and on budget. The revised effluent limits include effluent objectives of 15 mg/L total nitrogen and 1 mg/L total phosphorous and year round effluent disinfection. The design should also consider more stringent effluent requirements for future project phases. This will allow for long term planning beyond this current expansion and provide for more efficient process modifications in future if required.

1.3 CONCEPTUAL DESIGN SCOPE

The primary objectives of this Conceptual Design Report (CDR) are as follows:

- Evaluate the traditional and IFAS BNR process options and select the preferred BNR process.
- Refine wet weather flow treatment scenarios and define how these flows would be managed.
- Refine the details associated with all the major items of work required to complete the project.
- Develop conceptual facility layouts for the preferred option.
- Update the opinion of probable cost to complete the project.
- Update the project schedule.
- Support the City in discussions with Manitoba Conservation and in public communication.

1.4 SEWPCC COMPREHENSIVE CODE REVIEW

As part of the conceptual design development, Stantec reviewed the Comprehensive Code Review report for the SEWPCC provided by the City. That report was prepared by CH_2MHill and was issued in October, 2006. The 2006 study considered requirements and guidelines reflected in the Manitoba Building Code (MBC), in the Canadian Electrical Code (CEC), and in National Fire Protection Association (NFPA) publications. The Code Review report cited a number of items at the SEWPCC that were assessed to be in noncompliance with current code requirements and standards. Many of those items were considered to be "grandfathered," however, some of them were noted to be potentially subject to mitigation requirements depending on the extent of alteration proposed for any specific area. Stantec has developed the Conceptual Design for the SEWPCC upgrade / expansion based on the following premises:

- All new construction that is undertaken as part of the treatment process upgrade / expansion project will be designed to be in full compliance with current applicable codes and guidelines.
- Areas of the plant that are not planned for significant modification for the purposes of expanding and upgrading the treatment process will not be subject to code mitigation
- measures as part of the upgrade / expansion project; but might be mitigated separately by the City as part of other projects.

1.5 RISK AND CRITICALITY REVIEWS

In November, 2002, the City Water and Waste Department initiated a program for Risk and Criticality Assessment at the three City water pollution control centres. As part of the Conceptual Design, Stantec reviewed a set of reports provided by the City in August, 2008 related to reliability upgrades for the SEWPCC. Those reports summarized preliminary engineering evaluations and were prepared by SNC-Lavalin Engineers and Constructors Inc. for the City in 2007 and 2008. The following reports were included, labeled as SEWPCC Reliability Upgrades Job Packages:

- 0101 - Fire Alarm System Functional Design Report, August 2007.
- 0104 - Seal Water and Drain Upgrades Functional Design Report, March 2007.
- 0105 - Electrical Switchgear Inspection and Upgrades Functional Design Report, February, 2008.
- 0106 - Standby Power Upgrades Functional Design Report, January, 2008.
- 0107 - Gas Detection Upgrades Functional Design Report, December, 2007.
- 0108 - Wet Well Upgrades Functional Design Report, January, 2008.
- 0109 - Control Interlocking Upgrades, December, 2007.
- 0110 - Rating of Hoists, January, 2008.
- 0111 - Fire Extinguishers Functional Design Report, February, 2007.
- 0112 - Headworks Upgrades Functional Design Report, February, 2008.
- 0113 - Electrical Classification Upgrades Functional Design Report, December, 2007.
- 0114 - Fire, Flood, and Safety Upgrades Functional Design Report, January, 2008.
- 0115 - Thermal Oxidizer System Upgrades Functional Design Report, January, 2008.

These reports refer to a completed *Reliability Upgrades SEWPCC Preliminary Report*. Stantec has not been provided a copy of this report.

The Job Package reports listed above include recommendations for a number of reliability upgrades in several areas of the plant. It is Stantec's understanding that the City has proceeded with a limited portion of the recommended reliability upgrade work to date, and is considering scheduling for some of the other recommended upgrade actions. Some of the recommended reliability upgrade actions listed in the SNC reports relate to items that serve support functions and that are not exclusively focused on treatment capacity expansion and upgrade. Other recommended actions relate closely to the proposed SEWPCC treatment capacity expansion and upgrade. An example may be drawn from the Headworks Upgrades Functional Design Report, Job Package 0112. That report includes recommendations for modifications of the raw wastewater pumping drywell for flood protection, including construction of a low partition isolation wall, modification of pump shaft seals, valve actuators, and other controls. It is Stantec's observation that such work in the drywell would most feasibly be integrated with the proposed replacement of one of the existing raw wastewater pumps. Some of the other recommended reliability upgrade actions related to area electrical classifications, electrical switchgear, and standby power should be coordinated closely with the detailed design for the upgrade / expansion.

In consideration of these observations, Stantec has not included the reliability upgrade actions recommended in the SNC reports as specific items of focus in the Conceptual Design study for the SEWPCC upgrade / expansion. Stantec has completed the Conceptual Design study based on the premise that an initial step of the detailed design phase for the upgrade / expansion project would include a meeting with the City to confirm the status of each of the listed reliability upgrade actions, and to determine how to address the recommended actions in coordination with the upgrade / expansion design.

1.6 PROJECT TEAM

1.6.1 City Representatives

The City representatives involved in the guidance of the preparation of this report include:

Allan Zaleski , Treatment Process Specialist for the Water and Waste Department.

Arnold Permut, Wastewater Systems Planning Engineer for the Water and Waste Department and Deputy Project Manager for the SEWPCC project.

Bill Borlase, Manager of Wastewater Services for the Water and Waste Department.

Dwight Gibson, Senior Project Manager for the Water and Waste Department.

Jerry Comeau, Senior Project Manager for the Water and Waste Department and Project Manager for the SEWPCC project.

Ken Smyrski, Superintendent of the COW's three wastewater treatment plants.

Paul Lagasse, Wastewater Engineer for the Water and Waste Department responsible for operations of the COW's three wastewater treatment plants.

Mike Shkolny, Manager of Engineering for the Water and Waste Department.

Nicholas Szoke, Senior Wastewater Facilities Planning Engineer for the Water and Waste Department.

Renée Grosselle, Compliance Supervisor for the Water and Waste Department.

Ron Hahlweg, Supervisor of the SEWPCC.

1.6.2 Prime Consultant

This report is submitted by Stantec Consulting Ltd. as prime consultant.

1.6.3 Subconsultants

The subconsultants on the Stantec Team include:

TetrES Consultants Inc. (TetrES)

EMA Inc.

Bowker & Associates, Inc.

Dyregrov Consultants (Dyregrov)

Value Management Consulting, Inc.

SMA Consulting Ltd.

1.7 ACRONYMS

ABC – Air Bearing Control
ACGIH – American Conference of Government Industrial Hygienists
ACM – Asbestos Containing Material
AFF – Annual Average Flow
AOB – Ammonia Oxidizing Bacteria
ASME – American Society of Mechanical Engineers
ASR – Air/Solids Ratio
ASRS – Automated Septage Receiving Station
BNR – Biological Nutrient Removal
cBOD – Carbonaceous Biochemical Oxygen Demand
CCTV – Closed Circuit Television

CEPT – Chemically Enhanced Primary Treatment
CEC _ Canadian Electrical Code
CLP – Commercial Lighting Program
COD – Chemical Oxygen Demand
COTS – Commercial Off The Shelf
CPU – Central Processing Unit
DAF – Dissolved Air Flotation
DC – Direct Current
DCS – Distributed Control System
DO – Dissolved Oxygen
DSC – Disconnect Switch Center
D/T – Dilution Threshold
DWF – Dry Weather Flow
EBPR – Enhanced Biological Phosphorous Removal
US EPA – United States Environmental Protection Agency
F/M – Food to Microorganism Ratio
FRP – Fiberglass Reinforced Plastic
FST – Final Settling Tank
GBT – Gravity Belt Thickener
GT – Gravity Thickener
HEPA – High Efficiency Particulate Air
HGL – Hydraulic Grade Line
HID – High Intensity Discharge
HLR – Hydraulic Loading Rate
HMI – Human Machine Interface
HMIS – Hazardous Material Information System
HPO – High Purity Oxygen
HRT – Hydraulic Retention Time
HST – High Speed Turbine
HVAC – Heating Ventilation and Air Conditioning
HWW – Hauled Wastewater
HWWF – Hauled Wastewater Facility
H_2S – Hydrogen Sulfide
ICI – Industrial, Commercial and Institutional
IFAS – Integrated Fixed Film Activated Sludge
IDI – Infilco Degremont Inc.
IGV – Inlet Guide Vanes
I/I – Inflow and Infiltration
I/O – Input/Output
IRT – Independent Review Team
LCP – Local Control Panel
LED – Light Emitting Diode
LEL – Lower Explosive Limit
MBC – Manitoba Building Code
MCC – Motor Control Center
MCP – Master Control Panel
MCRT – Mean Cell Residence Time
MDF – Maximum Day Flow
MFP – Multi-Function Processor
MJP – Modified Johannesburg Process
ML – Mixed Liquor
MLSS – Mixed Liquor Suspended Solids
MLVSS – Mixed Liquor Volatile Suspended Solids
MMF – Maximum Month Flow
MPN – Most Probable Number
MWF – Maximum Week Flow
NE – North End
NEWPCC – North End Water Pollution Control Center
NH_3 – Ammonia
NFPA – National Fire Protection Association
NOB - Nitrite Oxidizing Bacteria
OIT – Operator Interface Terminal
OLE – Object Linking and Embedding
O&M – Operation and Maintenance
OPC – OLE for Process Control
ORP – Oxygen Reduction Potential
PAC – Programmable Automation Controller
PAO - Phosphorous Accumulating Organisms
PC – Primary Clarifier
PDR – Preliminary Design Report
PE – Primary Effluent
PFD – Process Flow Diagram

P&ID – Process and Instrumentation Diagram
PLC – Programmable Logic Controller
POP – Performance Optimization Program
PPCP – Pharmaceutical and Personal Care Products
PSA – Pressure Swing Adsorption
PS – Primary Sludge
PST – Primary Settling Tank
PVC – Polyvinyl Chloride
RAS – Return Activated Sludge
rbCOD – Readily Biodegradable Chemical Oxygen Demand
RDT – Rotary Drum Thickener
RFP – Request for Proposal
RSP – Raw Sewage Pump
RTU – Remote Terminal Unit
SC – Secondary Clarifier
SALR- Surface Area Loading Rate
SCADA – Supervisory Control and Data Acquisition
SCVFA – Short Chain Volatile Fatty Acids
SE – South End
SEWPCC – South End Water Pollution Control Centre
SNMP – Simple Network Management Protocol
SLR – Solids Loading Rate
SOR – Surface Overflow Rate
SRT – Solids Retention Time
SS – Stainless Steel
TKN – Total Kjeldahl Nitrogen
TLV – Threshold Limit Value
TN – Total Nitrogen
TP – Total Phosphorous
TSS – Total Suspended Solids
TWAS – Thickened WAS
$\mu_{AUT-MAX}$ – Maximum Specific Growth Rate
UPS – Uninterruptible Power Supply
UV – Ultraviolet
UVT – Ultraviolet Tranmissivity
VFA – Volatile Fatty Acids
VFD – Variable Frequency Drive
WAS – Waste Activated Sludge
WB – Westbank Process
WE – West End
WEWPCC – West End Water Pollution Control Center
WRHWWP – Winnipeg Regional Hauled Wastewater Plan
WWF – Wet Weather Flow
WWO – Wet Weather Overflows