

**FRASER VALLEY REGIONAL DISTRICT**

**JOINT ABBOTSFORD MISSION ENVIRONMENTAL  
SYSTEM  
(J.A.M.E.S.) WATER POLLUTION CONTROL CENTRE**

**ENVIRONMENTAL IMPACT STUDY**  
(IN SUPPORT OF DECEMBER 17, 1999  
REGISTRATION UNDER MSR)

**OCTOBER 2001**

**DAYTON & KNIGHT LTD.**  
**Consulting Engineers**

**in association with**

**Hatfield Consultants Ltd.**  
**FRASER VALLEY REGIONAL DISTRICT**  
**JOINT ABBOTSFORD MISSION ENVIRONMENTAL SYSTE**

**JOINT ABBOTSFORD MISSION ENVIRONMENTAL SYSTEM  
(J.A.M.E.S.) WATER POLLUTION CONTROL CENTRE  
ENVIRONMENTAL IMPACT STUDY**

**CONTENTS**

- 1.0 INTRODUCTION
- 2.0 EIS OBJECTIVES
- 3.0 QUALIFIED PROFESSIONALS
- 4.0 RECEIVING WATER QUALITY OBJECTIVES AND USES
- 5.0 EFFLUENT QUANTITY AND QUALITY
  - 5.1 JAMES Discharge
  - 5.2 Other Discharges
  - 5.3 Source Controls
- 6.0 DISCHARGE DILUTION MODELING AND PREDICTED IMPACTS
  - 6.1 Initial Dilution Zone (IDZ)
  - 6.2 Modeling Criteria
  - 6.3 Discharge Modeling and Impacts
  - 6.4 Present Disinfection Requirements
  - 6.5 River Dilution
- 7.0 ENVIRONMENTAL MONITORING RESULTS
  - 7.1 Monitoring Sites
  - 7.2 Monitoring Program and Results
  - 7.3 Findings
- 8.0 COMMENTS FROM ENVIRONMENT CANADA AND MINISTRY OF HEALTH
- 9.0 CONCLUSIONS AND RECOMMENDATIONS

**FIGURES**

- 1 Fraser River Characteristics near JAMES Outfall and Location of Monitoring Stations
- 2 Profile through Outfall

## CONTENTS (cont'd.)

### APPENDICES

- 1 Permit PE-00351 - **Not available**
- 2 Plant Operational Data
  - [app2-a.pdf](#)
  - [app2-b.pdf](#)
  - [app2-c.pdf](#)
  - [app2-d.pdf](#)
  - [app2-e.pdf](#)
  - [app2-f.pdf](#)
  - [app2-g.pdf](#)
  - [app2-h.pdf](#)
  - [app2-i.pdf](#)
  - [app2-j.pdf](#)
  - [app2-k.pdf](#)
  - [app2-l.pdf](#)
  - [app2-m.pdf](#)
  - [app2-n.pdf](#)
  - [app2-o.pdf](#)
  - [app2-p.pdf](#)
  - [app2-q.pdf](#)
  - [app2-r.pdf](#)
  - [app2-s.pdf](#)
  - [app2-t.pdf](#)
  - [app2-u.pdf](#)
  - [app2-v.pdf](#)
  - [app2-w.pdf](#)
- 3 Source Control Regulations
  - a) [Regulations Governing the Admission of Wastes into Sewers, August 1995](#)
  - b) [City of Abbotsford, Sewer Rates and Regulations By-Law 2001, January 1, 2001](#)
- 4 Dilution Modeling Results
  - [app4-a.pdf](#)
  - [app4-b.pdf](#)
  - [app4-c.pdf](#)
  - [app4-d.pdf](#)
  - [app4-e.pdf](#)
- 5 [Hatfield Consultants Ltd. October 2000 Environmental Impact Study \(water, sediment, benthos\)](#)
- 6 [Letter from Environment Canada dated October 19, 2001](#)

# **(J.A.M.E.S.) WATER POLLUTION CONTROL CENTRE ENVIRONMENTAL IMPACT STUDY**

## **1.0 INTRODUCTION**

Sewage treatment and disposal for citizens of the Fraser Valley Regional District (FVRD) communities of Abbotsford and Mission is provided by the Joint Abbotsford Mission Environmental System (JAMES) Water Pollution Control Centre (WPCC). The discharge is authorized under the Ministry of Water, Land and Air Protection (MWLAP) Permit PE 00351 that was last amended on March 7, 1996. A copy of this Permit is enclosed in Appendix 1 for reference. The permitted discharge is for 48,500 m<sup>3</sup>/d of secondary treated effluent to the Fraser River. Figure 1 illustrates the discharge location.

A permit amendment to increase the discharge quantity and to allow for upgrading of treatment facilities was applied for in October 1997. This application has been held in abeyance because the FVRD initiated a Liquid Waste Management Plan (LWMP) in 1997. Stage 1 of the LWMP was approved by the MWLAP in October 1998. The FVRD has placed the Stage 2 LWMP process on hold while it determines the merits of completing the plan. This led the FVRD to make an application on December 17, 1999 to register the effluent discharge under the Municipal Sewage Regulation (MSR).

To support the application the FVRD must complete an Environmental Impact Study (EIS) and an Operating Plan (OP). This report is the EIS in support of the December 17, 1999 application for registration under the MSR. A separate document forms the OP.

The present application is for a maximum day flow for 70,000 m<sup>3</sup>/d through the existing outfall for a period of up to 5 years. Within the 5 year period the FVRD intends to construct a new outfall that extends to the main channel in the Fraser River. The proposed new outfall will be the subject of a future MSR registration application and a new EIS to support the application.

## 2.0 EIS OBJECTIVES

A Guideline for preparation of an EIS have been prepared by the MWLAP. The Guideline document was issued in December 2000.

The general requirements (objectives) for an EIS are set out in the Guideline as follows:

“An environmental impact study (EIS), conducted by a qualified professional, is required under the regulation to determine whether a discharge of effluent or the use of reclaimed water will substantially alter or impair the usefulness of the environment or adversely affect human or ecological health. The EIS requirements apply to: use of reclaimed water, discharges to water, discharges to ground, combined sewer overflows, and sanitary sewer overflows.

The EIS must also determine whether the standards and requirements of the MSR for the receiving environment conditions (e.g., minimum dilution requirements for an outfall, minimum subsurface travel time for ground discharges) are met by the proposed discharge.

The objectives of an EIS for discharges to the physical, chemical and biological environment and for use of reclaimed water are to:

- Establish pre-discharge conditions in the receiving environment using existing data and/or by conducting adequate sampling of water, sediment and biota;
- Establish, before and after discharge commences, receiving environment monitoring locations, and sampling parameters and frequencies;
- Assess existing and potential users of the receiving surface water or groundwater, by humans, plants and animals, including references to blue and red species lists;

- Determine whether receiving water quality guidelines are and will be met and under what conditions;
- Carry out analysis, as appropriate to the nature of the discharge and the receiving environment, to determine if the proposed treatment, reuse or disposal system will adversely affect human health or the environment; and
- Provide recommendations to ensure that the proposed treatment, reuse or disposal system will protect human health and the receiving environment, or to recommend against the proposed discharge.”

These general requirements apply Province wide and are intended for a new discharge. For existing discharges the pre-discharge conditions and monitoring program will have been established under the discharge permit requirements. For an existing permitted discharge being registered under the MSR there is no requirement for an EIS or OP, unless requested by the MWLAP manager. For the JAMES discharge the registration application is for an increase in the authorized flow from 48,500 m<sup>3</sup>/d to 70,000 m<sup>3</sup>/d. The MWLAP manager has determined that an EIS and OP are needed because of the flow increase.

For the existing JAMES discharge, the focus of the EIS is on determining if the increased effluent quantity will substantially alter or impair the usefulness of the environment or adversely affect human or ecological health for a continued period of up to 5 years. The FVRD has committed to construct a new outfall (discharge) within 5 years in the main channel of the Fraser River. This new discharge will be the subject of a new MSR application and supporting EIS.

In addition to the aforementioned requirements, the EIS Guideline requires appropriate consultation with stakeholders to ensure relevant input is obtained. Relevant to this EIS a broad number of stakeholders were involved in the Stage 1 preparation of the LWMP (1997 and 1998). Specific to this EIS, Environment Canada, Fisheries and Oceans and the Ministry of Health were asked to provide further input to this EIS.

### **3.0 QUALIFIED PROFESSIONALS**

This EIS has been completed under the direction of the following qualified professionals:

- Brian Walker, P.Eng., Principal-in-Charge, Dayton & Knight Ltd.
- John Boyle, P.Eng., Project Manager, Dayton & Knight Ltd.
- Michael Maclatchy, Ph.D., P.Eng., Dilution Modeling, Dayton & Knight Ltd.
- L.O. Young, M.Sc., R.P.Bio., Aquatic Biologist, Hatfield Consultants
- E. Dobson, M.Sc., R.P.Bio., Environmental Biologist, Hatfield Consultants

#### **4.0 RECEIVING WATER QUALITY OBJECTIVES AND USES**

Water quality objectives for the Fraser River are established by the MWLAP (BC Environment, 1998). The objectives include parameters for dissolved oxygen, residual chlorine, nitrogen, heavy metals and polycyclic aromatic hydrocarbons (PAH). These parameters are applicable to both water and sediment quality.

The Fraser is a major waterway for salmon and other fish species. Also important is commercial use of the river for transportation. Domestic water extraction is not an issue. Water uses generally include recreational (boating and fishing), referred to as secondary contact, but no swimming (primary contact).

#### **5.0 EFFLUENT QUANTITY AND QUALITY**

##### **5.1 JAMES Discharge**

A table which summarizes some of the plant BOD<sub>5</sub> and TSS loadings and another table which summarizes plant effluent NH<sub>3</sub> data in 2000 are attached as Appendix 2.

The permitted maximum day discharge is 48,500 m<sup>3</sup>/d (10.67 MGD).

Present day (year 2000) effluent flows are as follows:

- Average annual flow (AAF) = 46,370 m<sup>3</sup>/d
- Maximum month flow (MMF) = 49,764 m<sup>3</sup>/d
- Maximum day flow (MDF) = 59,746 m<sup>3</sup>/d

The application for MSR registration is for a MDF of 70,000 m<sup>3</sup>/d.

Influent sewage quality for the year 2000 averages as follows:

- BOD<sub>5</sub> = 451 mg/L
- TSS = 280 mg/L

Effluent quality for the year 2000 averages as follows:

- BOD<sub>5</sub> = 73 mg/L (August 2001 average = 20 mg/L)
- TSS = 50 mg/L (August 2001 average = 20 mg/L)
- NH<sub>3</sub> = 26 mg/L

Effluent toxicity (96 hr LT 50) results for recent years are included in Appendix 2 and are summarized as follows:

<u>Date</u>	<u>Pass/Fail</u>
Mar. 18/97	Pass
Mar. 10/98	Pass
Mar. 31/99	Pass
May 11/00	Pass
Aug. 22/01	Fail
Sep. 27/01	Pass

Treatment facilities have been designed to produce the following effluent quality:

- BOD<sub>5</sub> = 45 mg/L maximum

- TSS
  - = 30 mg/L average
  - = 45 mg/L maximum
  - = 30 mg/L average

- Fecal coliforms
  - a) No chlorination
    - 550,000 MPN per 100 mL maximum
    - 400,000 MPN per 100 mL average
    - 200,000 MPN per 100 ML minimum
  - b) Chlorination
    - 20 MPN/100 mL maximum
    - 0 MPN/100 mL minimum

The MSR requirements for an effluent discharge to the Fraser River are BOD<sub>5</sub>/TSS = 45 mg/L, and an ammonia concentration that does not exceed the chronic level specified in the water quality guidelines at the edge of the initial dilution zone (IDZ).

The reasons for the recent relatively high effluent loadings (in particular BOD<sub>5</sub> values) are twofold.

- a) Prior to commissioning of the latest expansion, the existing primary tankage was overloaded and an excessive amount of biosolids have settled out in the primary tankage (and downstream systems). With commissioning of the additional primary tankage, this has improved the settlement capacity of this part of the process. The stored biosolids inventory is being reduced to provide improved final effluent. In August 2001 the influent BOD<sub>5</sub> averaged about 450 mg/L while the effluent BOD<sub>5</sub> averaged 20 mg/L. Effluent BOD<sub>5</sub> averaged 73 mg/L in 2000, thus significant improvement has been achieved.
- b) Industrial loadings have increased dramatically over the last 2-3 years with a 70% increase between mid 1997 to mid 1999.

Discussions are underway between the District, the City of Abbotsford and with about 16 key industries in the area. These discussions are proceeding favourably, with industry generally supportive, including the agreement by one major industry to incorporate recycling. Effective August 1, 2001, weekly composite sampling (and testing by CanTest) of the 16 industrial discharges is being undertaken to characterize these discharges. Rate increases for industrial discharges are planned to be implemented. Pre-

treatment of the industrial pollutant load by pre-aeration of the influent at the JAMES headworks is under design.

These combined actions will bring the effluent quality to within the design effluent quality.

## **5.2 Other Discharges**

There are no other registered effluent discharges to the Fraser River in the immediate vicinity of the JAMES discharge.

## **5.3 Source Controls**

FVRD regulates discharges to its sewage collection system through Regulation No. 95:180, Regulations Governing the Admission of Wastes into Sewers. This FVRD Regulation, which includes provisions for prohibited wastes, restricted wastes, trucked wastes, inspection and monitoring, is attached as Appendix 3.

The City of Abbotsford Sewer Rates and Regulations By-law, No. 1017-2001, which includes similar source control provisions within the City of Abbotsford (the main contributor of sewage within the District), is also attached in Appendix 3.

Both jurisdictions are reviewing their source control and rate structure bylaws and are proactively working with industry to achieve the bylaw requirements (as discussed in Section 5.1).

## **6.0 DISCHARGE DILUTION MODELING AND IMPACT**

The outfall location is shown on Figure 1. Figure 2 is a profile through the outfall on which various riverbed profiles are illustrated.

## 6.1 Initial Dilution Zone (IDZ)

The IDZ for the JAMES discharge is defined by the MSR as follows:

- IDZ height is the distance from the bed to the surface of the water body, in this case approximately 3.6 metres (m) in winter flows and 11.6 m in summer flows
- IDZ width is 100 m
- IDZ length is 100 m upstream and 100 m downstream of the discharge.

## 6.2 Modeling Criteria

Typical values for river temperature, salinity and current from the LWMP work are as follows:

- MDF = 70,000 m<sup>3</sup>/d
- summer temperature 14° C (surface) to 9°C (depth)
- winter temperature 7°C (surface and at depth)
- salinity in winter 1.0 ppt
- salinity in summer 1.0 ppt
- current in summer 2 m/s (surface) down to 0.005 m/s at depth
- current in winter 0.1 m/s (surface) down to 0.005 m/s at depth

Effluent quality criteria (based on year 2000 data) used for modeling are:

- Effluent pH 7.0 to 7.2
- Maximum Ammonia Nitrogen 64 mg ammonia-N/L
- Average Ammonia Nitrogen 26 mg ammonia-N/L
- Maximum Fecal Coliforms MPN = 550,000 per 100 mL  
(no chlorination)
- Average Fecal Coliforms MPN = 400,000 per 100 mL

(no chlorination)

- Maximum Fecal Coliform                      MPN = 20 per 100 mL  
  ( chlorination)

Copies of the Ammonia Nitrogen (NH<sub>3</sub>) data at JAMES for the year 2000 are attached as part of Appendix 2. The fecal coliform and pH data were obtained from discussions with JAMES operations personnel.

### 6.3 Discharge Modeling and Impacts

Modeling of the JAMES discharge was undertaken using the USEPA computer model UMERGE. The discharge was modeled as an equivalent continuous discharge.

The modeling was focused on the “worst case” scenario (i.e., maximum day flow of 70,000 m<sup>3</sup>/day and conditions that cause maximum buoyancy of the discharge plume). Modeling results are contained in Appendix 4. The results are summarized below. For other than the worst case, the water will be deeper and the dilutions will be greater than those shown below. The modeling shows that maximum buoyancy of the plume occurs during summer, when the temperature difference between the discharge and the receiving water is at a maximum.

At the edge of the IDZ for summer conditions:

- bulk dilution    202:1
- maximum ammonia concentration                      0.317 mg N/L
- average ammonia concentration                      0.129 mg N/L
- maximum fecal coliforms (no chlorination)              2723 MPN/100 mL
- average fecal coliforms (no chlorination)              1980 MPN/100 mL
- maximum fecal coliforms (chlorination)              0.10 MPN/100 mL

At the edge of the IDZ for winter conditions:

- bulk dilution 121:1
- maximum ammonia concentration 0.529 mg N/L
- average ammonia concentration 0.215 mg N/L
- maximum fecal coliforms (no chlorination) 4545 MPN/100 mL
- average fecal coliforms (no chlorination) 3306 MPN/100 mL
- maximum fecal coliforms (chlorination) 0.17 MPN/100 mL

From these modelling results, and comparing the allowable 30 day average ammonia concentrations in the Ministry’s Water Quality Guidelines, the following is noted:

**CALCULATED AMMONIA CONCENTRATION AT EDGE OF IDZ  
COMPARED TO ALLOWABLE 30 DAY AVERAGE CONCENTRATION**

	Summer			Winter		
	Calc.	Allowable	Percentage of Allowable	Calc.	Allowable	Percentage of Allowable
Ammonia Concentration at edge of IDZ (mg/L)	0.129	1.80	7.2	0.215	1.90	11.3

NOTE: Both seasons based on effluent ph of 7.2. Summer conditions based on 14°C. river temperature and winter conditions based on 7°C river temperature.

The modeling results show that in winter the plume will surface within the radius of the IDZ, due to the shallow depth of the water and the buoyancy of the plume. For this “worst case” scenario the characteristics of the plume at surfacing will be as follows:

- bulk dilution 121:1
- maximum ammonia concentration 0.529 mg N/L
- average ammonia concentration 0.215 mg N/L
- maximum fecal coliforms (no chlorination) 4545 MPN/100 mL
- maximum fecal coliforms (chlorination) 0.17 MPN/100 mL

These results show that the ammonia levels in the effluent plume are well within the water quality objective at surfacing and at the edge of the IDZ. Fecal coliform levels are about 2000 MPN/100 mL when the effluent is not disinfected. The fecal coliform water quality objective for the Fraser River is 200 MPN/1000 mL (a value set to protect public health for crop irrigation). With disinfection, the fecal coliform levels are less than 1 MPN/100 mL.

#### **6.4 Present Disinfection Requirements**

The present agreement with the MWLAP is that the effluent requires to be chlorinated until the river reaches a flow of 2,040 m<sup>3</sup>/sec, and provided river sampling indicates fecal levels in water samples do not exceed 300 MPN/100 mL.

It is recommended this agreement continue.

#### **6.5 River Dilution**

The 7 day low flow in the Fraser River at Mission (just several kilometres upstream from discharge) is 86,745,000 m<sup>3</sup>/d (1004 m<sup>3</sup>/sec). It is estimated that approximately 40% of the flow goes south of Matsqui Island over the outfall. The 7 day flow over the outfall will be about 35,000,000 m<sup>3</sup>/d (405 m<sup>3</sup>/sec). For the maximum day discharge applied for under the MSR of 70,000 m<sup>3</sup>/d, the available dilution ratio in the south channel would be 500:1 (i.e., 121:1). This dilution ratio is more than 4 times that required by the present diffuser system during worst case winter conditions, thus providing excellent integration of the effluent into the river.

The 500:1 dilution ratio compares with the MSR desirable minimum value of 40:1. The south channel has adequate capacity to assimilate the proposed 70,000 m<sup>3</sup>/d effluent discharge.

## **7.0 ENVIRONMENTAL MONITORING**

At the pre-registration meeting on July 21, 1999 held with MWLAP staff it was agreed that environmental monitoring should be undertaken to determine the present day water and sediment quality and the benthic invertebrate communities in the vicinity of the existing outfall discharge. This task was subsequently carried out by Hatfield Consultants and the findings and conclusions are reported in their October 2000 report (attached as Appendix 5).

A summary of the environmental monitoring assessment relating to the existing outfall is presented in the subsections that follow.

### **7.1 Monitoring Sites**

The five sites are shown on Figure 1.

- Site 1 – immediately downstream from discharge
- Site 2 – 100 m downstream from discharge
- Site 3 – 100 m upstream from discharge
- Site 4 – mouth of Matsqui Slough
- Site 5 – near future proposed outfall extension

Site 5 provides background data for a future outfall extension planned during the next 5 years. This future outfall extension will be the subject of a separate EIS in support of an amendment to the MSR registration.

### **7.2 Monitoring Program and Results**

Water and sediment samples were collected on August 22, 2000.

Water quality results at all sites were within the limits set out in the water quality guidelines. Of note, there was no significant difference between the water quality at any of the five sites, except fecal coliform at 5000 MPN/100 mL at Site 2 (100 m d/s) compared with less than 23 MPN/100 mL at the other sites. Given that the fecal coliform concentrations in the effluent during the sampling period averaged 400,000 MPN/100 mL (no chlorination) before dilution, these results indicate the effluent plume is generally well integrated with the receiving water. The sampled results at 5000 MPN/100 mL compare with the modeled dilution results of 2000 MPN/100 mL for summer conditions. This indicates reasonable modeling accuracy.

Sediment quality results varied, primarily between the Matsqui Slough site and the four other sites. The Slough site sediments comprised about 85% sand with silt and clay making up the rest. The River sites were over 98% sand. The Slough site was higher in TOC and heavy metals compared with the River sites. The downstream River Sites 1 and 2 had slightly higher levels for some metals (aluminum, barium and vanadium) than the upstream Sites 3 and 5. It is not conclusive if these higher levels are due to the effluent discharge, or the Matsqui Slough discharge, or to natural variations in the sediments. PAH levels were all below detection limits.

The benthic communities were similar at Sites 1, 2, 3 and 5. This indicates no observable impact from the effluent discharge. Invertebrate densities were highest at Site 4 – Matsqui Slough – likely due to finer sediments and lower current velocities that allow more stable colonization.

### **7.3 Findings**

The environmental monitoring determined that the only evidence of effluent impact on the receiving water and sediments was higher coliform levels in the water column downstream from the discharge.

## **8.0 COMMENTS FROM ENVIRONMENT CANADA AND MINISTRY OF HEALTH**

Mr. Wong of Environment Canada and Ms. Hutton of Fisheries and Oceans were provided copies of the 1<sup>st</sup> draft of this EIS on September 20, 2001. Mr. Hutton had visited the JAMES plant on September 14, 2001 to view the facilities and discharge. Mr. Wong has replied on behalf of both Environment Canada and Fisheries and Oceans in a letter dated October 19, 2001 (Appendix 6). Environment Canada supports the registration of the existing JAMES discharge.

Mr. Bill Koberstein of the Ministry of Health was contacted and briefed on the proposal to increase the discharge to 70,000 m<sup>3</sup>/d at the existing outfall. He advised of no objections to the proposed increase.

## **9.0 CONCLUSIONS AND RECOMMENDATIONS**

Based on the findings of this EIS the following conclusions are made:

- a) Hatfield concludes that the sediment quality variables indicate very little difference between the three sites near the outfall discharge and the main channel (background) in the Fraser River. This indicates that there has been no significant build-up of any deposits in the sediments from the outfall discharge.
- b) The south channel of the Fraser River in which the existing outfall is located will provide a 500:1 dilution ratio at the proposed 70,000 m<sup>3</sup>/d effluent discharge. The existing diffuser will provide a dilution of 100 to 200:1 (depending on season). This indicates excellent integration of the 70,000 m<sup>3</sup>/d into the south channel river flow.
- c) Average fecal coliform concentrations in the effluent during the summer months (no chlorination) are typically 400,000 MPN/100 mL. The modelling assessment indicates dilutions reduce these fecal concentrations to around 2000 MPN/100 mL, or a 99.5% reduction. This compares favourably to values as measured by Hatfield of around 5000 MPN/100 mL, or a 98.75% reduction, this indicating reasonable modeling accuracy.

- d) The calculated ammonia concentrations at the edge of the initial dilution zone are less than 10% during summer conditions, and just over 10% during winter conditions, of the allowable 30 day average concentrations as set out in the Water Quality Objectives for the Fraser River. This indicates that ammonia in the discharge is not chronically toxic beyond the IDZ.
- e) Based on the findings of this EIS it is concluded that an effluent discharge of 70,000 m<sup>3</sup>/d through the existing JAMES outfall will not substantially alter or impair the usefulness of the environment or adversely affect human or ecological health in the area.
- f) The following recommendations, that supplement the MSR requirements, are made:
1. The present disinfection requirements (Section 6.5) remain in effect.
  2. The MSR registration of the existing discharge location be for an interim period of 5 years to allow the future registration and construction of a new outfall discharge.

Dayton & Knight Ltd.

---

Brian L. Walker, P.Eng.  
Principal-in-Charge

---

John W.C. Boyle, P.Eng.  
Project Manager