OPG's DEEP GEOLOGIC

REPOSITORY

FOR LOW & INTERMEDIATE LEVEL WASTE

DGR EA Follow-up Monitoring Program

March 2011

Prepared by: Nuclear Waste Management Organization

NWMO DGR-TR-2011-10

nwmo
NUCLEAR WASTE MANAGEMENT ORGANIZATION
SOCIÉTÉ DE GESTION DES DÉCHETS NUCLÉAIRES

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Document History

Title:	DGR EA Follow-Up Monitoring Program		
Report Number:	NWMO DGR-TR-2011-10		
Revision:	R000	**Date:**	March 2011
Nuclear Waste Management Organization			
Prepared by:	J. Jacyk		
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EXECUTIVE SUMMARY

Ontario Power Generation (OPG) is undergoing a multi-year planning and regulatory approvals process for a deep geologic repository (DGR) for the long-term management of low and intermediate level waste (L&ILW). As part of the regulatory approvals process for the DGR Project, an environmental assessment (EA) of the long-term management of L&ILW has been conducted and is documented in the Environmental Impact Statement (EIS) (OPG 2011a). This follow-up monitoring program has been prepared to support the EIS.

The EA follow-up monitoring program is designed to ensure that the predictions of effects are validated during the implementation of the project. If the effects are adverse, then further mitigation and contingency procedures will be considered. This follow-up monitoring program addresses the site preparation and construction, and operations phases of the project.

This report focuses on the EA follow-up monitoring program, which is summarized in Tables 3a and 3b. However, because of the interconnected nature of the environmental monitoring framework, the components of three other programs are also discussed where appropriate to provide a complete picture of the environmental monitoring for the DGR project as a whole. A summary of these components is presented in Table 1. The environmental monitoring framework encompasses four groups of monitoring activities:

1. EA follow-up monitoring (Tables 3a and 3b).
2. Environmental Management Plan (EMP) monitoring (Tables 4a and 4b).
3. Radiological regulatory monitoring (Tables 5a and 5b).
4. Conventional regulatory monitoring (e.g., provincial requirements, federal permits and Certificates of Approval) (Table 6).

Because the detailed project design has not been finalized, some of the activities may become irrelevant or redundant, and additional items may be required as the project progresses. Input received from regulators will also be incorporated into the applicable monitoring programs which will be updated accordingly. In addition to the four groups of monitoring activities, additional baseline monitoring (Table 2) will be conducted prior to and during construction in order to acquire information and data with which future monitoring results can be compared.

The EIS (OPG 2011a) identifies a number of residual adverse effects: decreased flow in the North Railway Ditch; increased flow in the drainage ditch at Interconnecting Road during the site preparation and construction and operations phases; loss of a small quantity of eastern white cedar; loss of a small portion of habitat for redbelly dace, creek chub, variable leaf pondweed and burrowing crayfish within the DGR Project footprint; degradation in air quality during the site preparation and construction, and operations phases; increase in noise levels at Baie du Doré during site preparation and construction; exposure to acrolein in air during the site preparation and construction phase; and a diminished quality or value of activities undertaken by Aboriginal peoples at the Aboriginal Burial site located at the Bruce nuclear site resulting from changed aesthetics and increased noise and dust during the site preparation and construction and operations phases.

Although each of these effects was assessed to be not significant, monitoring programs are planned to confirm these predictions and assess the effectiveness of the mitigation measures. Monitoring programs are also planned to verify predictions that the DGR Project will not result in adverse effects to the environment.

Summary tables for each of the monitoring programs are provided. Activities are presented separately for each of the two project phases: site preparation and construction; and operations. The tables include a brief description of the activity, the objective of the monitoring, the relevant EA statement, the type of monitoring, the relevant criteria, and the frequency and location of the activity.

An assessment of the annual performance (i.e., effectiveness of the sampling) of the EA follow-up monitoring program will be completed in conjunction with the preparation of the annual report for the site preparation and construction phase follow-up monitoring, as well as during the operation phase.

A program evaluation of the core components of the EA follow-up monitoring program will be conducted once every five years, or once during each project phase, as a minimum to ensure that the program remains effective and relevant.

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1. INTRODUCTION

Ontario Power Generation (OPG) is undergoing a multi-year planning and regulatory approvals process for a deep geologic repository (DGR) for the long-term management of low and intermediate level waste (L&ILW). Currently, the L&ILW produced as a result of the operation of OPG's nuclear reactors is stored centrally at OPG's Western Waste Management Facility (WWMF) located on the Bruce nuclear site. Although current storage practices are safe and could be continued safely for many decades, OPG's long-term plan is to manage these wastes in a long-term management facility. Throughout this report, OPG's proposal is referred to as the "DGR Project".

As part of the regulatory approvals process for the DGR Project, an environmental assessment (EA) of the long-term management of L&ILW has been conducted and is documented in the Environmental Impact Statement (EIS) (OPG 2011a). This follow-up monitoring program has been prepared to support the EIS. The guidelines for the EIS for the DGR Project require that the proponent include a framework on which effects monitoring and follow-up actions will be based for the life of the project, should it proceed. The environmental monitoring framework, which includes EA follow-up monitoring, has been prepared to address the site preparation and construction, and operations phases of the project. A separate environmental assessment is expected to be required for the decommissioning phase and a follow-up monitoring program will be provided as part of that process.

1.1 Description of the Project

The DGR Project includes the site preparation, construction, operation, decommissioning, and abandonment and long-term performance of above- and below-ground facilities for the long-term management of OPG's L&ILW. Details of the project design are provided in the Preliminary Safety Report (PSR) (OPG 2011b) and Section 4 of the EIS.

1.2 Project Schedule

The construction schedule start date is dependent on the EA review period. Once the EIS review is completed by the joint review panel, the panel will render a licensing decision for a licence to Prepare Site and Construct under the Nuclear Safety and Control Act (NSCA 1997).

The site preparation and construction phase of the project is expected to last five to seven years. The operations phase will follow and is expected to last 40 to 45 years. This timeframe includes a monitoring period subsequent to the final waste emplacement.

1.3 Purpose of the EA Follow-up Monitoring Program

The purpose of the EA follow-up monitoring program is to:

- Verify the predictions and assessments of the environmental effects of the project; and
- Confirm the effectiveness of the mitigation measures.

The EA follow-up monitoring program is designed to ensure that the predictions of effects are validated during the implementation of the project. If the effects are adverse, then further mitigation or regulatory action may be necessary to protect the environment. This follow-up monitoring program addresses the site preparation and construction, and operations phases of the project.

The EA follow-up monitoring program will be carried-out in accordance with CSA N288.4-10 Environmental Monitoring Programs at Class I Nuclear facilities and Uranium Mines and Mills (CSA 2010), CNSC G-296 Developing Environmental Protection Policies, Programs and Procedures at Class I Nuclear Facilities and Uranium Mines and Mills (CNSC 2006a), and CNSC S-296 Environmental Protection Policies, Programs and Procedures at Class I Nuclear Facilities and Uranium Mines and Mills (2006b).

1.4 Environmental Monitoring Framework

The environmental monitoring framework was developed in accordance with CSA N288.4-10, CNSC S-296 and CNSC G-296 and encompasses four groups of monitoring activities:

1. EA follow-up monitoring (Tables 3a and 3b).
2. Environmental Management Plan (EMP) monitoring (Tables 4a, 4b and 4c).
3. Radiological regulatory monitoring (Tables 5a and 5b).
4. Conventional regulatory monitoring (e.g., provincial and federal requirements, permits and approvals) (Table 6).

The following sections present a preliminary description of the activities that will be included in each of the four groups within the framework. Because the detailed project design has not been finalized, some of the activities may become irrelevant or redundant, and additional items may be required as the project progresses. Input received from regulators will also be incorporated into the applicable monitoring programs which will be updated accordingly. In addition to the four groups of monitoring activities, some baseline monitoring (Table 2) will be conducted prior to and during construction in order to acquire information and data with which future monitoring results can be compared.

The objective of the environmental monitoring framework is to ensure that the predictions made in the EA are confirmed, anticipated licensing and legislative requirements are adhered to and best management practice is employed, while minimizing the duplication and overlap of monitoring activities and reporting. A summary of the environmental monitoring components of each of the programs is presented in Table 1.

1.5 EA Follow-up Monitoring

An EA follow-up monitoring activity is further defined in this framework as:

- Having a finite duration; and
- Having an effect or lack of effect that can be monitored or measured.

Though there may be some overlap with another monitoring program, the EA follow-up monitoring program is intended to capture elements that would otherwise not be required (either by licensing or legislation), but satisfy the requirement to confirm an effect (or lack-of), a prediction, an assumption used in assessing the effects, or the effectiveness of a mitigation measure identified in the EIS.

The EIS identified a number of residual adverse effects in the site preparation and construction phase, and the operations phase including:

- Decrease in flow in the North Railway Ditch during the site preparation and construction, and operations phases;

- Increase in flow in the drainage ditch at Interconnecting Road during the site preparation and construction, and operations phases;
- Loss of a small quantity of eastern white cedar in the site preparation and construction phase;
- Loss of small portion of habitat for redbelly dace, creek chub, variable leaf pondweed and burrowing crayfish within the DGR Project footprint in the site preparation and construction phase;
- Increase in concentrations of indicators of air quality during the site preparation and construction and operations phases;
- Increase in noise levels at Baie du Doré during the site preparation and construction phase;
- Exposure to acrolein in air during the site preparation and construction of the project; and
- Diminished quality or value of activities undertaken by Aboriginal peoples at the Aboriginal Burial site located at the Bruce nuclear site resulting from changed aesthetics and increased noise and dust.

Although each of these effects was assessed to be not significant, monitoring programs will be conducted to confirm these predictions and assess the effectiveness of the mitigation measures. Monitoring programs will also be conducted to verify predictions that the DGR Project will not result in adverse effects to the environment.

All EA follow-up monitoring activities are designed to satisfy a specific statement in the EIS and are expected to be discontinued when the requirement has been satisfied or at the end of a predetermined duration. In some cases, a particular monitoring activity may continue as a best management practice under the EMP, but the reporting requirement as part of the EA follow-up will be discontinued. Results of the activities identified in the EA follow-up monitoring program will be provided to the CNSC and CEAA in an annual EA-follow-up monitoring report, as described in Section 15. Reporting requirements for the other three components of the environmental monitoring framework are also discussed in Section 15.

1.6 Environmental Management Plan Monitoring

The purpose of the EMP monitoring is to confirm that the environmental protection measures inherent in the project design are functioning as designed and to ensure that best management practices are employed, in order to minimize the risk of unforeseen and accident-related environmental effects. The majority of EMP monitoring activities involve visual inspections and record keeping that may also be required for permitting or licensing. Once licensing requirements and permitting requirements have been determined, some of these activities may be transferred from the EMP into the appropriate regulatory monitoring program. The activities included in the EMP monitoring program are not necessarily ‘measurable’ activities, e.g., visual inspections, procedural confirmations, records checks.

The duration of the EMP activities are generally ongoing and specific to the phase of the project. An annual EMP monitoring report will summarize the results and effectiveness of the EMP.

1.7 Radiological Regulatory Monitoring

The environmental monitoring described under the radiological regulatory monitoring program characterizes those activities that have typically been required in the CNSC licence for OPG waste facilities. As these activities are likely to be a requirement of the licence itself, they are not duplicated under the EA follow-up monitoring program even if they will also serve to confirm

predictions or effectiveness of mitigation measures presented in the EIS. This grouping of activities is limited to those that can be characterized as environmental monitoring and does not represent a complete list of the typical radiological regulatory requirements for monitoring and/or reporting. The monitoring activities described in Tables 5a and 5b are expected to be ongoing, with a re-evaluation of the monitoring requirements at each licensing phase or at the time of licence renewal.

Included in the radiological regulatory monitoring tables are the radiological monitoring activities that are expected to be reported to the CNSC in the quarterly operation report. The activities align with the current monitoring program at the Western Waste Management Facility (WWMF).

1.8 Conventional Regulatory Monitoring

Conventional regulatory monitoring activities are those that are required by federal or provincial legislation, including those required for a permit or certificate of approval, with the exception of those required for follow-up monitoring under CEAA or those required under licensing (radiological regulatory requirements). Since permit approvals will be obtained once the project design is finalized, the activities presented in this section are an indication of the general scope of the monitoring required, with the understanding that additional details will be provided in the permit applications, and eventually the permits themselves.

1.9 Report Structure

The following sections focus on the EA Follow-up monitoring program, which is summarized in Tables 3a and 3b. However, because of the interconnected nature of the environmental monitoring framework, the components of the three other programs are also discussed where appropriate to provide a complete picture of the environmental monitoring for the DGR project as a whole.

2. SURFACE WATER MONITORING

Based on the assessment provided in the Hydrology and Surface Water Quality Technical Support Document (TSD) (NWMO 2011a), no adverse effects are predicted for surface water quality provided that the in-design mitigation measures function as expected. Two adverse effects of the DGR Project on hydrology and surface water quantity and flow were identified:

- A 31% reduction in surface water quantity and flow in the North Railway Ditch; and
- A 114% and a 61% increase in surface water quantity and flow in the drainage ditch at Interconnecting Road for site preparation and construction, and operations, respectively.

However, the magnitudes of these two effects are not expected to be significant.

Additionally, no adverse effect to water quality was predicted provided that the stormwater discharge meets the Certificate of Approval (C of A) criteria.

To verify the assumptions used in predicting the effects, to confirm the predicted effects, and to verify that mitigation is effective, a surface water follow-up monitoring program will include a surface water sampling program, flow rate measurements and a visual inspection program. It is described in the following sections.

2.1 Sampling

Results of a preliminary leachate testing and characterization study (Golder 2011) identified several contaminants of potential concern (COPCs): aluminum, ammonia, boron, cobalt, thallium, vanadium, nitrate, and chloride (salinity). Note that the COPC concentrations in the study would be indicative of COPC concentrations in leachate from the rock pile, and is not representative of the water quality in the pond which is expected to meet the C of A discharge criteria and the relevant Provincial Water Quality Objectives (PWQO) (MOEE 1994a). In order to verify that this prediction is accurate, an EA follow-up sampling program for surface water quality will be undertaken for the COPCs (Tables 3a and 3b).

Surface water samples will be collected from three locations:

- The discharge point of the stormwater management pond during site preparation and construction, and operations;
- The discharge point of the shaft sump water during site preparation and construction, and operations (at the stormceptor); and
- The perimeter drainage ditch near the WRMA, at a location to be determined.

Total dissolved solids (TDS) and electrical conductivity will also be monitored as they are representative of dissolved metals and salinity. Nitrate will be evaluated by analyzing samples for Total Kjeldahl Nitrogen (TKN), and un-ionized ammonia will be calculated based on the total ammonia concentrations, pH and temperature.

Monitoring results for each water quality parameter analyzed will be compared with the relevant discharge criterion. The discharge criteria are based on the PWQO. As a value is not provided in guidance documents for TDS and TKN, a discharge criterion will be determined based on the receiving water body (Lake Huron) background concentrations and an assimilative capacity study (see Table 2) that will be completed as part of an application for a Ministry of Environment (MOE) Certificate of Approval for Industrial Sewage Works (C of A (Sewage)). The

determination of background values will be based on the number of analyses and period of record and the variability of the data. The 75th percentile of the entire data set (including outliers) will be used to determine the background values. The chloride concentration criterion is based on the "Priority Substances List Assessment Report Road Salt" (CEPA 2001) toxicity values.

The sampling and analysis protocol will adhere to the MOE publication "Protocol for the Sampling and Analysis of Industrial/Municipal Wastewater" (MOE 1999), as amended from time to time by more recently published editions and the publication "Standard Methods for the Examination of Water and Wastewater" (APHA 2005). All samples will be analyzed at a Standards Council of Canada (SCC) and/or Canadian Association of Laboratory Accreditation Inc. (CALA) accredited laboratory.

The sample frequency, duration, parameters and locations are outlined in Tables 3a and 3b.

In addition, regulatory monitoring (see Table 6) will be required for total suspended solids (TSS). In the absence of a parameter-specific PWQO for TSS, values were based on MOE guidance documents B-1-5 Deriving Receiving-Water Based, point-source effluent requirements for Ontario Waters, (MOEE 1994b) and Procedure F-5-1 Determination of Treatment Requirements for Municipal and Private Sewage Treatment Works Discharging to Surface Waters (MOE F-5-1).

2.2 Visual Inspection

A visual inspection of the SWMP will be conducted weekly during the site preparation and construction phase (Table 3a) and monthly during operations (Table 3b). The inspection will ensure that the pond is free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible sheen, foam or discoloration. Monthly inspections will be conducted during operations as part of the EMP (see Tables 4a and 4b), and will no longer be required under the EA follow-up Monitoring Program. This activity may also be a requirement of the C of A, and may be transferred from the EMP monitoring program to the conventional regulatory monitoring requirements program (Table 6)

Additionally, the EMP will include a visual inspection of the stormwater management system (including the drainage pipes, swales, run-off area and ditches) conducted weekly during site preparation and construction, and monthly during operations to:

- Ensure they do not have extreme erosion wear;
- Ensure that sediment control materials are kept on hand for emergency response and for repair and maintenance purposes; and
- Ensure that the pond is free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible sheen, foam or discoloration or other deleterious substance.

The EMP will also include semi-annual records checks for the stormwater interceptor maintenance program to ensure that the stormwater interceptors are routinely maintained and inspected as per the manufacturer's recommended schedule.

2.3 Flow Rate Measurements

The stormwater management pond (SWMP) discharge volume will be measured weekly, averaged monthly and recorded as part of the conventional regulatory monitoring program (Table 6). The method of measurement will be confirmed in the application for a C of A, but may consist of a water level monitoring installation in the pond near the SWMP outlet. The outlet structure could be calibrated so that the discharge flow rates can be determined based on the water level in the pond.

The flow rates will be recorded and compared with the predicted increase in flow in the drainage ditch at Interconnecting Road calculated in the Hydrology and Surface Water Quality TSD (Table 3a). The purpose of this monitoring is to confirm the assumptions used to predict an increase in flow rates of 114% over the existing annual mean flow. As described in the Hydrology and Surface Water Quality TSD, the calculations were based on change in drainage area and not on measured flow rates. The EA follow-up monitoring program will compare flow rates to the baseline values to confirm that the increase in flow in the drainage ditch at Interconnecting Road is similar to or, less than, the predicted increase of 114%. Baseline flow rate values will be recorded (see Table 2) for one year prior to the site preparation and construction phase. Since the highest flows are predicted for the site preparation and construction phase, the follow-up monitoring will be concluded after three years of monitoring. Provided the increase in flow is within the bounds of the EA predictions, the SWMP discharge flow rates will continue to be monitored only if required under the regulatory monitoring program (see Table 6).

Similarly, quarterly (seasonal) flow monitoring of the North Railway Ditch will be conducted at the south eastern Project Area boundary to ensure that there are no significant changes to stream flow at Stream C as a result of the project (see Table 3a). Flow will also be measured during or immediately following two major storm events each year to confirm that the effect of reduced flow in the North Railway Ditch is not significant, as predicted in the Hydrology and Surface Water Quality TSD. Though the flow is predicted to decrease by 31% during site preparation and construction, the effect was assessed as ‘not significant’. Flow data will be collected for one year prior to the start of site preparation and construction (Table 2) and for a minimum of three years after the start of site preparation and construction (Table 3a) to confirm the assumptions made in the EA.

2.4 Regulatory Requirements

A C of A for the stormwater collection system will be required in accordance with Section 53 of the Ontario Water Resources Act (OWRA 1990). Specific monitoring activities and discharge requirements will likely be included as a condition of the C of A.

3. GROUNDWATER MONITORING

No likely adverse effects on either groundwater flow or quality were identified in the Geology TSD (NMWO 2011b). However, groundwater quality and flow monitoring will be conducted prior to and during site preparation and construction and operations to establish a baseline (see Table 2), to confirm the assumptions made in the EA, and to confirm that there are no adverse effects during the site preparation and construction and operations phases as a result of the WRMA, the SWMP and shaft excavation and dewatering.

EA follow-up monitoring will include hydraulic head and groundwater quality monitoring. The purpose of this monitoring is to confirm the predictions used in the EIS to assess the effects of shaft and repository excavation on the groundwater and solute transport VECs and the water quality VECs, as described in the Geology TSD. The details of the monitoring are provided in Table 3a. If the monitoring results fall within the predictions of the EIS during the site preparation and construction phase, the groundwater monitoring will be transferred to the EMP monitoring program (Table 4b).

No likely adverse effects to the marsh in the northeast portion are predicted, based on the assumptions made in the Geology TSD to estimate the zone of influence during shaft dewatering in the site preparation and construction phase. These assumptions will be verified during the shaft pilot hole and pilot grouting studies prior to construction (Table 2).

Dewatering volumes will also be recorded as part of the conventional regulatory monitoring program (Table 6).

3.1 Groundwater Quality

A sampling program was developed to establish a baseline for the DGR site groundwater quality. The sampling program includes a network of groundwater wells with ongoing quarterly monitoring (see Table 2) and comprises:

- Four DGR-series wells (deep and intermediate geology Valued Ecosystem Components (VECs));
- Three US-series wells (intermediate and shallow geology VECs); and
- Eight new shallow groundwater wells, beginning in 2012 (shallow geology VECs).

Sample analysis includes major ions, general chemistry (e.g. pH, temperature, electrical conductivity), trace elements, and petroleum hydrocarbons.

The shallow groundwater monitoring well network of eight wells will be installed and baseline monitoring will be conducted to align with the current groundwater quality monitoring program in some of the US and DGR-series wells (for a description of these wells, refer to the Geology TSD). The network will comprise upgradient and downgradient wells, and will serve as an early detection network of on-site (leachate from the WRMA or SWMP) or off-site groundwater contamination migrating on or through the DGR site. The upgradient wells will be located in areas unaffected by site activities. The well network will also be capable of detecting changes resulting from the SWMP and changes to the water table near the marsh in the northeast portion of the Project Area.

Monitoring of all the wells (shallow groundwater, US-series and DGR-series) will continue through the site preparation and construction phase as part of the EA follow-up monitoring

program (Table 3a). The EA follow-up groundwater monitoring will be capable of detecting spatial and temporal changes in groundwater quality within the uppermost aquifer beneath the DGR surface structures. In the event that contaminants would be released from any of the DGR facilities into the subsurface environment, it is in this aquifer than any lateral migration of contaminants would first occur.

All samples will be analyzed at a Standards Council of Canada (SCC) and/or Canadian Association of Laboratory Accreditation Inc. (CALA) accredited laboratory. Data will be assessed with an emphasis on identifying abrupt and gradual changes in groundwater quality that potentially indicate impacts from DGR construction and operation. Consideration will be given to the influence of adjacent areas using baseline data collected in advance of facility operation, and using information collected from background wells.

The program will be re-evaluated at the end of the site preparation and construction phase. The program, if continued, will be continued as part of the EMP monitoring program (Table 4b) and will be re-evaluated every 5 years.

3.2 Hydraulic Head Monitoring

EA follow-up monitoring will also include hydraulic head monitoring in some of the existing US and DGR-series wells and the new shallow groundwater wells during site preparation and construction (Table 3a). The monitoring program will begin prior to the site preparation and construction phase to establish a baseline and seasonal variability (Table 2). Hydraulic head monitoring during site preparation and construction will be compared to the baseline monitoring results and will detect any perturbations to the local groundwater system as a result of shaft dewatering. Similar to the groundwater quality monitoring, the program will be re-evaluated at the end of the site preparation and construction phase. The program, if continued, will be continued as part of the EMP monitoring program (Table 4b) and will be re-evaluated every 5 years.

Hydraulic head monitoring may also be a requirement of an MOE Permit to Take Water (PTTW), as summarized in Table 6.

3.3 Zone of Influence and Shaft Drawdown

During the shaft pilot hole investigations and grouting feasibility study (see B-GW-1, Table 2), the groundwater regime in the shafts area will be characterized using a variety of field test methods, and may include: hydraulic conductivity tests, slug tests, and pump tests. The results of this work will be used to calculate the amount of dewatering that will be required during shaft sinking. A key objective of the grouting feasibility study will be to confirm an assumption in the EA that grouting will reduce the effective (bulk) hydraulic conductivities in the top 200 m (i.e. to less than 10^{-7} to 10^{-8} m/s). The results of the aforementioned investigations, coupled with modelling, will be used to establish the zone of influence (ZOI) and drawdown characteristics during shaft dewatering. For the purpose of the EA follow-up monitoring program, dewatering refers to the removal of ingress water into the shafts during shaft sinking.

3.4 Dewatering Volumes

Water volumes will be monitored daily during dewatering and total daily flow volumes will be recorded as part of the regulatory monitoring program to confirm that the daily water takings are below the limit in the PTTW, but will also serve to confirm the effectiveness of the advance

grouting or freezing (Table 6). It is expected that a PTTW will only be required during the site preparation and construction phase, due to the low hydraulic conductivities of the rock and the shaft design itself.

3.5 Geoscientific Data Verification Plan

The Geoscientific Data Verification Plan (NWMO 2011c) provides details of testing and investigations confirming that the geologic/hydrogeologic setting underneath the Bruce nuclear site provides excellent isolation and protection from the repository wastes, as stated in the Gelogly TSD.

3.6 Regulatory Requirements

All new wells will be installed, maintained and monitored in accordance with O. Reg. 903 Wells (Reg. 903).

A PTTW will be required in accordance with Section 34 of the Ontario Water Resources Act and O. Reg. 387/04 – Water Taking (Reg. 387). Water taking will be done in accordance with the regulation and permit requirements, including annual reporting to the Ontario MOE of dewatered volumes by March 31 of every year.

4. SOIL QUALITY MONITORING

There is no adverse effect predicted for soil quality in the Geology TSD (NWMO 2011b), except in the case of a malfunction or accident (e.g., fuel spill). In case of a spill, depending on the volume and nature of the contaminant released, a subsurface investigation and sampling program may be designed and implemented to determine the presence and extent of contamination. Therefore, soil sampling will be undertaken prior to the site preparation and construction phase in order to establish a baseline (Table 2) with which future soil investigation results can be compared.

Appropriate remediation measures will be implemented if necessary, taking into account the nature of the contaminant, the extent of contamination and the results of any post-spill subsurface investigation. This contingency procedure is addressed in Section 13.

4.1 Regulatory Requirements

Analytical soil quality results from any investigation will be compared with baseline conditions or Table 3 of *Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act* (MOE 2009) for a non-potable groundwater condition, as appropriate.

Soil sampling may be required in response to a spill, as defined in Ontario Regulation 675 Classification and Exemption of Spills and Reporting of Discharges (Reg. 675).

5. TERRESTRIAL SPECIES MONITORING

The residual adverse effect of the DGR Project on eastern white cedar identified in the Terrestrial Environment TSD (NWMO 2011d) is predicted to be 'not significant'. Monitoring will be conducted for the eastern white cedar communities and wildlife habitat use adjacent to the areas which will be cleared during the site preparation and construction phase. This monitoring will consist of a one-time inspection after the completion of surface facility construction to confirm the significance of the predicted effect, as summarized in Table 3a.

The loss of some of individual white tailed deer and wild turkey as a result of vehicles strikes is predicted in the Terrestrial Environment TSD, though it was not assessed as an adverse effect as there are no changes expected at the population level of either species. In order to confirm that there is no adverse effect, vehicle strikes will be monitored in the follow-up monitoring program and reported as part of the existing Bruce nuclear site reporting program for one year to confirm EA predictions. Vehicle traffic is predicted to peak in the first year of the site preparation and construction phase. Provided the results confirm the EA predictions in the first year, this activity will be discontinued under the EA follow-up monitoring program and will be transferred to the EMP monitoring program (Tables 4a and 4b).

5.1 Regulatory Requirements

All work will be carried out in compliance with the Species at Risk Act (SARA) (SARA 2002), The Fish and Wildlife Conservation Act (FWCA 1997), Migratory Birds Convention Act (MBCA 1994), and the Ontario Endangered Species Act (ESA 2007).

It is expected that OPG will be subject to a number of additional permitting requirements (e.g., Development, Interface with Wetlands, and Alterations to Shorelines and Watercourses) The DGR Project will also required a Tree Cutting Permit from Bruce County.

6. AQUATIC SPECIES MONITORING

A minor loss of burrowing crayfish habitat is predicted in the Aquatic Environment TSD (NWMO 2011e); however there is alternate suitable habitat for crayfish in most of the moist, low-lying portions of the Project Area.

The aquatic species EA Follow-up monitoring program will include visual inspections, surface water level monitoring, and groundwater well monitoring, as described in Tables 3a and 3b. Visual inspections will be conducted to:

- Verify re-growth of riparian vegetation in disturbed areas (ditches);
- Identify bank stability deficiencies;
- Verify the presence of crayfish chimneys in the Project Area; and
- Monitor the marsh for confirmation that excavation does not dewater and affect marsh habitat.

A staff gauge will be installed in the marsh identified in the northeast portion of the Project Area. Staff gauge readings (water levels) will be measured during dewatering to monitor any drying effect attributable to dewatering activities. Variations outside of seasonal norms will trigger further mitigation (see Section 13.4). Water levels will also be monitored for one year prior to site preparation and construction to establish a baseline (Table 2), as well as post-dewatering until the marsh has been deemed to have fully recovered (should an impact be observed). Groundwater levels will also be monitored in the shallow groundwater well closest to the marsh (see Section 3) to determine water table fluctuations.

During construction of the rail bed crossing, weekly visual inspections will be conducted as part of the EMP monitoring program to confirm that best management practices are undertaken and that regular maintenance of the ditches is completed. The details of the EMP monitoring program are provided in Tables 4a, 4b and 4c.

Monitoring of re-growth of vegetation following construction of the rail bed crossing may be a condition of the In Water Work Permit.

6.1 Regulatory Requirements

All work will be conducted in accordance with Section 35 of the federal Fisheries Act (FA 1985) and Ontario Regulation 169 (Reg.169) under the Conservation Authorities Act (CAA 1990).

Timing of the construction of the rail bed crossing should take place according to the Department of Fisheries and Oceans (DFO) Operational Statement-Timing Windows to ensure that critical life history stages such as spawning activities are protected by restricting the conduct of works or undertakings in and around water at certain times. It is the OMNR that determines the timing windows for a particular watercourse. The South Railway Ditch contains a warm water fish community and the warm water timing window generally begins July 1 and ends March 31. However, in order to minimize the risk for sediment generation and high flow periods, the Saugeen Valley Conservation Authority has recommended an in-water work timing window of July 1 to September 30. In-water work will be scheduled accordingly.

All work will be conducted in accordance with the SARA, and the provincial Endangered Species Act.

7. ATMOSPHERIC MONITORING

A residual adverse effect is predicted on air quality during the site preparation and construction phase and the operations phase in the Atmospheric TSD (NWMO 2011f). The effect was assessed as "may not be significant". Monitoring will be conducted in the site preparation and construction phase to ensure that the effect does not exceed the predictions in the assessment. The continuation of the program will be re-evaluated at the end of every year.

A residual adverse effect for noise was also predicted, but was assessed as 'not significant'. Monitoring will be conducted for noise to confirm the assessment predictions.

In the Human Health Assessment in the EIS, a residual adverse effect was identified for acrolein as a result of air emissions.

Additional monitoring will be conducted to confirm the assumptions used in the assessment and to confirm that no significant effects result from the project. The atmospheric monitoring program comprises follow-up monitoring programs at surface for ambient air emissions, noise emissions and ground vibrations. EMP monitoring includes underground air monitoring. Emissions monitoring at the vent exhaust may be required as part of a C of A (Air) (Table 6).

The atmospheric EA follow-up monitoring program including the tasks, frequency and relevant triggers and criteria is summarized in Tables 3a and 3b. The EMP monitoring program is summarized in Tables 4a and 4b.

7.1 Underground Air Monitoring Program

Air quality of the underground DGR will be monitored under the EMP to ensure that the health and safety of personnel within the DGR is not compromised during underground construction and operations. The monitoring system will verify:

- Levels of noxious gases do not exceed regulatory limits;
- Levels of explosive gases do not exceed explosive limits;
- Temperature and humidity of the DGR remain acceptable for both personnel health and infrastructure integrity; and
- Airflows remain adequate in active work areas.

Air monitoring equipment will be installed. Airflow, CO and NO_2 measurements will be monitored at underground locations, to be determined. Explosive gas monitors will also be installed to monitor a range of potential gases, including methane and hydrogen. Instrumentation measuring airflow, temperature, relative humidity, etc. will be installed and measurements will be monitored remotely on surface at the main control room and will also be available to be monitored underground.

7.2 Surface Air Monitoring Program

Continuous air quality monitors will be installed at the start of the site preparation and construction phase at a secure location in the Project Area near the main access road between the construction activities and the property boundary. Several air quality parameters will be monitored: NO_x, PM_{10}, and $PM_{2.5}$. The monitoring results will be compared with the baseline results and predictions documented in the Atmospheric Environment TSD to confirm that the assessment predictions were reasonable and the integrated mitigation measures are effective.

Continuous sampling will be carried out for a minimum of one year beginning at the start of site preparation and construction, which is the bounding year of the assessment. Continuation of the program will depend on the monitoring results and the data quality. The monitoring program including the tasks, frequency and predicted values and criteria is summarized in Table 3a.

Visual inspections for dust emissions will be conducted daily during site preparation and construction, and operations, at the shafts, access roads within the WRMA, and waste rock pile.

Provided the monitoring values do not exceed the predicted values in the Atmospheric Environment TSD, the significance of the effect will be consistent with the assessment. The predicted values are provided in Table 3a.

There are no current, accurate field methods for measuring acrolein at the levels predicted. However, because acrolein, like NOx is predominantly associated with vehicle emissions, the NOx monitoring will serve as an indicator of the accuracy of the EA predictions for acrolein. For example, if the NOx emissions monitored during the first year of site preparation and construction (the bounding year) are significantly lower than those predicted in the EA, this will serve as an indicator that acrolein is also lower than predicted. Given the relatively low hazard quotient associated with acrolein in the human health assessment of the EA, combined with the conservatism built into the assessment and the temporary nature of the effect, this approach is considered adequate in monitoring the potential effect related to acrolein.

7.3 Noise Monitoring

Integrated sound level meters will be stationed at the three noise receptor locations monitored during the EA field studies (R1, R2, and R3) during the site preparation and construction phase. The results will be compared with the baseline results and predictions documented in the Atmospheric Environment TSD to determine that the assessment predictions were reasonable and the integrated mitigation measures are effective.

During operations, exhaust fans will be maintained in accordance with manufacturer's specifications. The maintenance records will be verified annually as part of the EMP monitoring program (Table 4b).

7.4 Vibrations monitoring

As a minimum, blasting preparation, design and implementation will take place in accordance with the appropriate requirements, for example the Noise Pollution Control (NPC) publication 119 Model Municipal Noise Control By-law (MOE 1978). In addition the following monitoring and follow-up activities will also occur (Table 3a):

- The initial series of regular production blasts shall be monitored at several locations at varying distances from each blast to characterize the site specific ground vibration attenuation rates. This will entail establishing monitoring stations between the blast site and adjacent receptors during the initial series of shaft blasts. The site specific attenuation data developed during this monitoring period will then be used to better define ground vibration effects at the closest sensitive receptors.
- Subsequent routine monitoring of all blasting operations will be carried out in the vicinity of the closest receptors to the blasting operations. As excavation continues within the shaft and underground development, the actual monitoring locations will be routinely and

regularly reviewed so that the closest receptors are always being monitored for ground vibration effects.
- The program may be discontinued based on consistently low vibration measurements once the shaft is advanced below 180 mBGS.
- A communications program may be implemented to keep neighbours informed of the status of activity, as appropriate. During blasting near surface, blasting should take place during daylight hours.

7.5 Regulatory Requirements

Most industrial processes, equipment or modifications to industrial processes and equipment require A C of A (Air). A C of A for the ventilation shaft exhaust may be required in accordance with Section 9 of the EPA (EPA 1990). Regardless of compliance with Section 9, every facility is also required to meet the air quality standards, as stated in Ontario Regulation 419/05 (Reg 419).

Underground air quality monitoring for noxious gases will confirm compliance with Ontario Regulation 854 Mines and Mining Plants (Reg 854).

Annual reporting may be required in accordance with Ontario Regulation 127 Airborne Contaminant Discharge Monitoring and Reporting Regulation (Reg. 127) and the National Pollution Release Inventory (NPRI) as legislated in Sections 46 to 50 of the Canadian Environmental Protection Act (CEPA 1999). The regulatory monitoring is summarized in Table 6.

8. RADIOLOGICAL MONITORING

No residual adverse effects were predicted in the Radiation and Radioactivity TSD (NWMO 2011g). However, monitoring is required as a licensing condition and the results will confirm the assumptions used in the assessment and that no adverse effects result from the DGR project. Note that all radiological monitoring is conducted under the radiological regulatory monitoring program (Tables 5a and 5b).

The radiological monitoring program comprises monitoring of air, surface water, groundwater and workers. The comprehensive radiological monitoring program will be implemented as described in the PSR. The monitoring activities described in this section are limited to those that are applicable to environmental media. These activities are summarized in Tables 5a and 5b.

8.1 Radiological Analysis of Air

During site preparation and construction (shaft sinking and excavation of emplacement rooms), and operations, air monitoring underground for radon will ensure that worker exposure to radon is limited. During operations, radioactivity (tritium, particulate and carbon-14) will also be monitored in the vent exhaust air.

In addition, an external radiation monitoring program will be carried out during the site preparation and construction, and operations phases.

8.2 Radiological Analysis of Groundwater

Radiological analysis will be carried out for samples collected from newly-built monitoring wells described in Section 3.1 to monitor any changes to groundwater radionuclide concentrations in the DGR Project Area, namely tritium and gross beta levels. Wells will be sampled quarterly during site preparation and construction, and operations. This program will be consistent with the existing WWMF monitoring program.

8.3 Radiological Analysis of Surface Water

Water samples collected from surface water will be analyzed to determine radionuclide concentrations in surface water during the site preparation and construction phase and the operations phase. Samples will be collected monthly from the SWMP and from the marsh during site preparation and construction to monitor the potential effect resulting from the operations at the WWMF and other nuclear facilities in the Local Study Area and to establish a baseline for the operations phase. Samples will be analyzed for tritium and gross beta. During operations, samples will be collected and analyzed monthly for tritium and gross beta. The operations phase sampling can be coordinated with the existing monitoring program at the WWMF.

Samples from the sump discharge will be collected weekly and averaged monthly for tritium and gross beta beginning one year prior to operations (to establish a baseline).

A sample will also be collected from the sump discharge and from the SWMP quarterly and analyzed for C-14 beginning one year prior to operations, to establish a baseline for the operations phase. During operations, samples will be collected and analyzed annually. Sample locations, frequency and criteria are summarized in Tables 5a and 5b.

8.4 Worker Dose and Contamination Control

A routine survey program will be conducted to ensure that the DGR remains in compliance with the requirements of the Radiation Protection Requirement (OPG 2001) and the OPG Radiation Protection Procedures.

Quarterly dose accumulation in workers will be monitored, consistent with current practice at the WWMF.

8.5 Regulatory Requirements

The radiation protection program described in the PSR and the EA follow-up monitoring program will comply with the radiation protection program requirements of the following Acts and regulations as applied to licensed OPG facilities and licensed OPG activities:

- Nuclear Safety and Control Act;
- General Nuclear Safety and Control Regulations (SOR/2000-202);
- Radiation Protection Regulations (SOR/2000-203);
- Class I Nuclear Facilities Regulations (SOR/2000-204);
- Nuclear Substances and Radiation Devices Regulations (SOR/2000-207); and
- Occupational Health and Safety Act (Ontario) (OHSA1990).

9. MALFUNCTION AND ACCIDENTS PREVENTION FOLLOW-UP

In most cases, it is predicted that no adverse effects will occur unless there is an accident or malfunction. In order to prevent malfunctions and accidents from occurring, the EMP monitoring program will include an ongoing evaluation of site management practices.

The monitoring program includes visual inspections and records checks. It comprises verification that proper safety procedures and accident prevention programs are in place based on good industry management practice, such as:

- Equipment is properly maintained;
- Proper environmental training is in place; and
- Emergency equipment and procedures are tested.

The malfunctions and accidents prevention monitoring program consists of a checklist of good industry management practice (Table 4c) that will be verified in the field.

9.1 Regulatory Requirements

All spills, as defined by Ontario Regulation 675 Classification and Exemption of Spills and Reporting of Discharges (Reg. 675), will be reported in accordance with Sections 15 and 92 of the Ontario Environmental Protection Act (EPA 1990).

10. SOCIO-ECONOMIC FOLLOW-UP

No residual adverse effects were identified in the Socio-economic Environment TSD (NWMO 2011h). However, given the central role that public attitudes play in determining whether or not socio-economic effects occur and their magnitude, EA follow-up monitoring of public attitudes toward the DGR Project and communication of the results to the public is warranted.

Public attitude research (PAR) will be undertaken to provide directly comparable results to the 2009 PAR, in terms of questions and approach to sampling. At a minimum, the research will be undertaken once during the site preparation and construction phase and subsequent to any accidents or malfunctions of the DGR or associated operations, resulting in a release of radioactive contamination to the environment. During the operations phase, the PAR can be integrated with the PAR for ongoing WWMF operations.

The socio-economic follow-up monitoring program, including the tasks, frequency and relevant criteria, is summarized in Table 3a.

10.1 Regulatory Requirements

In the event a burial site is discovered in the project area, work will proceed in accordance with The Cemeteries Act (CA 1990). The act prohibits the disturbance of a burial site or artefacts associated with the human remains except on instruction of the Coroner or pursuant to a site disposition agreement.

11. ABORIGINAL INTERESTS FOLLOW-UP

There may be a diminishment of the quality or value of activities undertaken by Aboriginal peoples at the Aboriginal burial site located at the Bruce nuclear site. No follow-up monitoring is required at this time. Activities at the site, based on past experience have been infrequent and the diminishment of activities, if it occurred would be a result of dust and noise, each of which are intermittent. Air quality monitoring is discussed in Section 7.

11.1 Regulatory Requirements

There are no regulatory requirements that are applicable to the aboriginal interests follow-up monitoring program.

12. DETAILED SAMPLING PLAN

A detailed sampling plan will be developed for each of the field programs summarized in Tables 2 and 3. The programs will include a statistical evaluation of the adequacy of existing baseline data to provide a benchmark against which to test for project effects, and the need for any additional pre-construction or pre-operational monitoring to establish a firmer project baseline.

The sampling plan will also include a statistical evaluation to support the sampling schedule. The evaluation will address the length of time needed to detect effects given estimated baseline variability, likely environmental effect size and the desired level of statistical confidence in the results (Type 1 and Type 2 errors). The statistical evaluation will be completed in accordance with CSA N288.4-10 and US EPA QA/G-9S.

13. CONTINGENCY PROCEDURES

13.1 Surface Water

If exceedances of the discharge criteria are detected, the SWMP outlet will be closed. Treatment will be applied as appropriate. SWMP water will be tested prior to release to confirm that the treatment is effective and that the discharge criteria are achieved. Daily samples will be collected and analyzed for the first week. Provided there are no exceedances, sampling will revert to the normal frequency. The type of treatment will depend on the parameters that exceed the discharge criteria.

In the event that total suspended solids concentrations exceed the discharge criteria, additional mitigation measures such as additional sediment, erosion and dust control measures can be implemented where appropriate (e.g., additional silt fencing, sediment logs, check dams). This may also be an effective contingency plan to reduce concentrations of some heavy metals such as iron and aluminum which are typically particle-bound.

In the event that a noticeable oil sheen, foam or deleterious substance is noted, the discharge will be closed until the substances can be skimmed off the surface.

The shales that are excavated during shaft sinking have the potential to generate leachate with relatively high salinity. These rocks (about 40,000 m^3) will be reused on-site (e.g. as berm material with a soil cap). In the unlikely event that this relatively small amount of the shale material generates leachate with unacceptable levels of salinity, the leachate could be collected and treated.

There are several methods to treat salinity. Some of these methods can also be used to decrease metal and nutrient concentrations. Common treatment applications are listed below:

- Membrane treatment, which uses chemically-formed microscopic pores to filter out dissolved ions.
- Ion exchange, which uses columns of resins or zeolites to replace, or exchange, unwanted ions. This treatment can be used to remove nitrate as well.
- Reverse osmosis, which uses mechanical pressures to force pure water through a semi-permeable membrane, removing dissolved ions.
- Distillation, which involves boiling water to produce a vapour. The vapour contacts a cool surface where it condenses as a liquid. Dissolved components remain in the boiling solution, resulting in a vapour comprising only water.

Metals can be treated through chemical precipitation. Metals can form a number of insoluble compounds with hydroxide, carbonate and sulphide anions. The treated water will typically be directed into sedimentation ponds or mechanical thickeners so that the precipitated metals suspended in the water can precipitate and settle out.

Ammonia can be removed through several treatment technologies:

- Ion exchange.
- Breakpoint chlorination which involves the addition of sodium hypochlorite or chlorine in specific quantities to maximize the oxidation of ammonia to nitrogen gas and nitrate.

- Alkaline stripping, which involves the injection of air into alkaline waters to produce ammonium and ammonia gas, at proportions that are dependent on the temperature and pH.
- Nitrification, which involves the biological oxidation of ammonia to, eventually, nitrate. Activated sludge and bio-films are generally used to provide a substrate for the bacteria and produce ideal conditions for the reactions.
- Natural degradation, which, depending on the conditions within the stormwater retention pond (i.e. amount of sunlight, temperature, pH, residence time), results in ammonia degradation naturally to nitrate.

Nitrate can be removed by:

- Ion exchange;
- Reverse osmosis; and
- Denitrification, which involves the conversion of nitrate into free nitrogen through biological processes.

The retention pond will designed so that it is never dry and will have body of water that is permanently stored in the pond. It will be designed to retain runoff from 6-hour, 25-mm rainfall event on a 23 Ha area for a period of 24 hours. This time is required remove any sediment from the run-off before discharge. The run-off will be controlled by directing flow through a discharge pipe equipped with a valve that could be closed, as required, to stop flow. The final holding capacity of the pond will be confirmed during detailed design.

There will also be a weir at the discharge end of pond with crest set at a higher elevation than the discharge pipe. Assuming that there would be no control structure (e.g. a gate) in this weir, then the weir crest elevation sets maximum volume of run-off water that can be contained in pond if the aforementioned pipe valve is closed. This volume will be confirmed in the detailed design.

13.2 Groundwater

Based on historical monitoring results at the Bruce nuclear site, seasonal variablility in groundwater pathways is not expected in this area. Any such variability, if present, would be detected by the monitoring well network and additional monitoring points installed as required to ensure downgradient detection capability.

Groundwater levels and quality results will be compared with baseline data to determine whether there is an adverse effect of the DGR on groundwater. If an adverse effect is detected, the groundwater monitoring program may be modified to determine the extent of the effect. If a contaminant plume is detected and is attributable to the DGR, depending on the contaminant, hydrogeological conditions and the plume characteristics, remediation may be considered. Groundwater quality results will also be compared to Table 3 of S*oil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act* (MOE 2004) for a non-potable groundwater condition.

Shaft sinking will be conducted using advance grouting or freezing, hence dewatering will be minimized, however a PTTW will be required in case the water taking exceeds 50,000 L/day, as described in Section 3.6. The maximum daily volume for dewatering will be determined in the permit application. If daily water taking records exceed the maximum daily volume in the

PTTW, dewatering will be halted until mitigation measures can be implemented (e.g., additional grouting).

13.3 Terrestrial Environment

Should a rare or endangered species or its critical habitat be encountered during site preparation and construction, appropriate measures will be implemented to avoid destruction, injury or interference with the species, its residence and/or its habitat (e.g., through siting, timing or design changes). If the foregoing cannot be avoided, work will cease and the local Ontario Ministry of Natural Resources (OMNR) office will be contacted for advice regarding mitigation measures.

13.4 Aquatic Environment

Corrective actions may be required in the event that monitoring results are not consistent with predictions. Examples of mitigation measures include replanting or stabilization of ditches and pond(s), or temporary supply of surface water to the marsh to offset any ongoing dewatering effects.

During construction of the rail bed crossing, the section of South Railway Ditch where the culvert will be placed will be isolated and dewatered. Prior to dewatering the work area, any fish identified in the isolated area will be salvaged and relocated so as to avoid any fish or other aquatic life (frogs, turtles) during construction.

Should a rare or endangered species or its critical habitat be encountered during site preparation and construction, appropriate measures will be implemented to avoid destruction, injury or interference with the species, its residence and/or its habitat (e.g., through siting, timing or design changes). If the foregoing cannot be avoided, work will cease and the local Ontario Ministry of Natural Resources (OMNR) office will be contacted for advice regarding mitigation measures.

If the surface water monitoring program and groundwater level monitoring program, when compared to daily precipitation data, indicate that the wetland water levels may be dropping as a direct result of the shaft dewatering, mitigation measures will be implemented (e.g., a temporary water supply to the marsh).

13.5 Atmospheric Environment

If a visible dust plume is observed, watering will be implemented in non-frozen ground conditions. On-site vehicles and equipment will be equipped and maintained on-site to water roadways as required.

The air modeling in the Atmospheric Environment TSD assumed that all vehicles and equipment engines would meet Tier 2 emission standards. If the air quality monitoring results are higher than predicted, equipment could be replaced with equipment that meets Tier 3 standards or better.

Fisheries and Oceans Canada (DFO) has established a set of guidelines for the use of explosives in or near Canadian fisheries waters in the document Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (Wright et. al. 1998). These guidelines set out that “No explosive may be used that produces or is likely to produce, a peak particle velocity

greater than 13 mm/s in a spawning bed during egg incubation". If the monitoring program detects exceedances of this peak particle velocity and spawning is observed, a mitigation plan will be prepared outlining additional procedures for protecting fish and their habitat, as described in the guidelines. This would allow blasting to continue while meeting the guideline ground vibration limit set out by the Department of Fisheries and Oceans.

If the predicted peak ground vibration levels calculated in the Atmospheric Environment TSD are exceeded, the allowable maximum explosive weight could also be reduced.

13.6 Aboriginal Interests

In the unlikely event during development of the DGR Project, archaeological remains are encountered, all activity in the vicinity of the recovery will be suspended and the Ministry of Culture review officer will be notified immediately.

In the event that human remains are encountered at any time during development of the DGR Project, all activity in the vicinity of the discovery will be suspended and the Ministry of Culture review officer, the Registrar of Cemeteries (Ministry of Government Services), the South Bruce detachment of the Ontario Provincial Police and the local coroner will be contacted immediately.

13.7 Socio-Economic Environment

Similar to Section 13.6, in the unlikely event that artefacts are encountered that may be associated with a cultural or heritage resource, the construction activities will be curtailed until further assessment (i.e., a stage 3 or 4 archaeological assessment) can be undertaken to protect the resource from further disturbance and conserve its cultural heritage values.

13.8 Spills

To mitigate the effects of spills, appropriately equipped and trained on-site spills response teams will be available at all times as part of emergency response programs. For example a spill of diesel fuel would be mitigated by quickly assessing the situation for any immediate health and safety risks to the spills response team, on-site workers and the public by controlling the source of the spill and notifying the appropriate regulatory agencies, deploying containment booms to surround and contain the spill and finally by implementing an effective clean-up program that would likely involve the use of specialized equipment to pump the diesel fuel into secure containers. A spill to one of the on-site ditches would be collected, and directed via the stormwater management ditches to the stormwater management pond where it can be held until it is determined that it is suitable for discharge.

14. BASELINE STUDIES AND PRE-CONSTRUCTION FOLLOW-UP

In some cases, the available baseline data may not be adequate to perform a statistically significant comparison to the measured data, or insufficient information is available to fully address the adequacy of mitigation measures. Some areas that require further study have been identified, and are summarized in Table 2.

Once the sampling protocols for each type of program (e.g., surface water quality, groundwater quality), are developed, the available baseline data will be evaluated using several factors commonly used to select appropriate background values: the number of analyses and the program duration; variability of the data set; the validity and integrity of the recorded values; the potential risk or hazard of each parameter; and the potential for bioaccumulation. Seasonal and diurnal fluctuations will also be considered. If the background data sets are deemed inadequate, further baseline studies may be conducted prior to start of the site preparation and construction phase.

15. RECORD KEEPING AND REPORTING

Reports will be prepared and retained documenting the results of each of the monitoring programs. Each report will be prepared in accordance with CSA 288.4-10 and will include, in addition to the monitoring results:

- A summary and assessment of the field and laboratory QA/QC results, including any non-conformances;
- A summary of any program audit or review results and subsequent corrective actions; and
- A summary of any proposed modifications to the monitoring program.

Regulatory monitoring reports will be prepared as specified by the governing authority.

15.1 EA Follow-up Reports

An EA Follow-up Monitoring Report will be prepared annually and submitted to the CEAA and the CNSC. The annual report will provide conclusions regarding the accuracy of the effects predictions and recommendations to add, discontinue or refine monitoring activities or mitigation measures for the following year. Annual reports will be prepared until all EA follow-up monitoring activities have been satisfactorily concluded, with the approval of the CNSC and the CEAA.

15.2 EMP Monitoring Report

Documentation of all monitoring events, including analytical results and mitigation actions will be recorded, documented and incorporated as described in the DGR Environmental Management Plan (NWMO 2011j) to ensure that all regulatory reporting requirements are met, and that the results of the EA are carried over through the life of the project. Reporting will continue through the site preparation and construction phase and the operations phase. These reports will be retained by OPG.

15.3 Radiological Regulatory Monitoring Reports

The radiological regulatory requirements monitoring activities summarized in Tables 5a and 5b will also be subject to the DGR operations reporting to the CNSC as specified in the licence.

15.4 Conventional Regulatory Monitoring Reports

Summary reports will be prepared as required by the associated permit or approval. It is anticipated that the following reports will be required:

- Monitoring Report – Certificate of Approval (Air);
- Monitoring Report – Certificate of Approval for Industrial Sewage Works; and
- Report – Permit to Take Water.

The reporting frequency and duration will be determined by the governing authority upon issuance of the permit/approval.

Regulatory monitoring and reporting may also be required as part of the in-water works associated with the construction of the rail bed crossing.

16. PROGRAM ASSESSMENT

An assessment of the annual performance of the EA follow-up monitoring program will be completed in conjunction with the preparation of the annual report for the site preparation and construction phase follow-up monitoring, as well as during the operations phase.

The annual assessment will identify the effectiveness of the existing follow-up monitoring program design and identify any problems and gaps. It will be conducted by the person(s) responsible for the operation of the Environmental Management System (EMS). All aspects of the program assessment will be documented and incorporated into the EMP records.

A program evaluation of the core components of the EA follow-up and EMP programs will be conducted once every five years, and once during each project phase, at a minimum in accordance with CSA N288.4-10. Examples of core components are the study design, sampling and analytical procedures, interpretation, QA/QC, reporting, annual reviews and audits. The evaluation will be performed by a person with no direct responsibility for the follow-up program or EMS.

17. REFERENCES

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APPENDIX

APPENDIX A: Environmental Monitoring Summary Tables

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Table 1. Proposed Monitoring Summarized by Category

Environment Component	Baseline	EA Follow-up	Environmental Management Plan	Radiological Regulatory Monitoring Requirements	Conventional Regulatory Monitoring Requirements
Surface Water Quantity and Flow	• Conduct channel characterization and capacity study of the drainage ditch along Interconnecting Rd. (B-SW-2) • Collect flow data near the drainage ditch and North Railway Ditch (B-SW-3 and B-SW-4)	• Monitor flow near SWMP outlet (C-EA-SW3 and O-EA-SW3) • Monitor flow in North Railway Ditch (C-EA-SW4)	Not required	Not required	• Monitor SWMP discharge flow (C-REG-SW3)
Surface Water Quality	• Collect receiving water body baseline surface water samples from the drainage ditch and from MacPherson Bay (B-SW-1) • Conduct an assimilative capacity study and receiving water assessment of MacPherson Bay (B-SW-6) • Monitor stormwater radioactivity (B-RAD-3/ C-LIC-RAD3)	• Collect surface water samples for COPCs (C-EA-SW1 and O-EA-SW1) • Conduct SWMP visual effluent monitoring (C-EA-SW2 and O-EA-SW2)	• Conduct operation and maintenance inspection for stormwater management system (C-EMP-SW1, continuation of C-EA-SW2; and O-EMP-SW1) • Conduct visual inspection of stormwater management system (C-EMP-SW2 and O-EMP-SW2) • Verify storm interceptor inspection and maintenance program records (C-EMP-SW3 and O-EMP-SW3)	• Radiological stormwater monitoring of radioactivity in stormwater management system (O-LIC-RAD3, continuation of B-RAD-3/C-LIC-RAD3) • Radiological sump water monitoring (C-LIC-RAD5 and O-LIC-RAD5)	• Collect Surface Water Management System samples (expected to be limited to TSS) (C-REG-SW1) • Conduct SWMP visual effluent monitoring (C-REG-SW2; will overlap with C-EA-SW2 (3 years) and O-EA-SW2 (1 year)
Groundwater Quality	• Monitor shallow subsurface and bedrock groundwater quality (B-GW-1 and B-GW-2) • Monitor groundwater radioactivity (B-RAD-2/C-LIC-RAD2)	• Monitor shallow subsurface groundwater quality (C-EA-GW2)	• Monitor shallow subsurface groundwater quality (O-EMP-GW2, continuation of C-EA-GW2)	• Radiological groundwater monitoring to determine changes in level of groundwater contamination (O-LIC-RAD2, continuation of B-RAD-2/C-LIC-RAD2)	• Identify and monitor any potentially contaminated groundwater in response to a spill (C-REG-GW1)
Groundwater Flow (Hydraulic Head)	• Monitor shallow subsurface and bedrock hydraulic head (B-GW-1 and B-GW-2) • Establish shaft drawdown characteristics (B-GW-3)	• Monitor shallow bedrock groundwater hydraulic head (C-EA-GW1) • Monitor shallow subsurface groundwater hydraulic head (C-EA-GW3)	• Monitor shallow bedrock groundwater hydraulic head (O-EMP-GW1, continuation of C-EA-GW1) • Monitor shallow subsurface hydraulic head (O-EMP-GW3, continuation of C-EA-GW3)	Not required	• Measure flow, dewatering discharge (C-REG-GW2) • Monitor shallow subsurface hydraulic head to estimate groundwater flow and ZOI (C-REG-GW3; will overlap with O-EMP-GW3 and C-EA-GW3)
Soil Quality	• Collect baseline soil samples (B-SW-1)	• None proposed	• None proposed, except in case of malfunction or accident; (C-EMP-SQ1)	Not required	Not required
Terrestrial Habitat	Not required	• Record white tail deer and wild turkey vehicle strikes (C-EA-TER1) • Monitor plant species communities and wildlife habitat use adjacent to the areas which have been cleared (C-EA-TER2)	• Record white tail deer and wild turkey vehicle strikes (C-EMP-TER1, continuation of C-EA-TER1; and O-EMP-TER1)	Not required	Not required
Aquatic Habitat	• Monitor staff gauge and marsh water level (B-SW-5)	• Monitor re-growth of riparian vegetation at rail bed crossing following removal, note any deficiencies in bank stability (C-EA-AQ1) • Monitor bank stability of new ditches and stormwater management pond, and revegetation (C-EA-AQ2) • Monitor staff gauge water levels (C-EA-AQ3) • Monitor groundwater levels near marsh (C-EA-AQ4) • Observe and document burrowing crayfish activity (C-EA-AQ5 and O-EA-AQ5)	• Conduct site inspections: ○ deleterious substances (C-EMP-AQ1) ○ sediment and erosion control measures(C-EMP-AQ2) ○ on- site machinery(C-EMP-AQ3) ○ fluid leaks (C-EMP-AQ4) ○ vehicle maintenance (C-EMP-AQ5) ○ confirm onsite spill kit is accessible (C-EMP-AQ6) ○ determine if ditch maintenance is required (C-EMP-AQ7 and O-EMP-AQ7)	Not required	• Monitor re-growth of riparian vegetation following removal, note any deficiencies in bank stability (C-REG-AQ1; will overlap with C-EA-AQ1)

Table 1. Proposed Monitoring Summarized by Category

Environment Component	Baseline	EA Follow-up	Environmental Management Plan	Radiological Regulatory Monitoring Requirements	Conventional Regulatory Monitoring Requirements
Air Quality	Not required	• Monitor air quality, NOx and PM (C-EA-ATM1) • Monitor air quality (dust) (C-EA-ATM2)	• Conduct vehicle inspections (C-EMP-ATM1 and O-EMP-ATM1) • Monitor underground air quality: airflow, NOx, CO2 (C-EMP-ATM2 and O-EMP-ATM2) • Monitor underground air quality: explosive gas (C-EMP-ATM3 and O-EMP-ATM3) • Monitor underground air quality: temperature and humidity (C-EMP-ATM4 and O-EMP-ATM4) • Conduct ventilation inspection (O-EMP-ATM5)	• Radiological air monitoring (C-LIC-RAD1 and O-LIC-RAD1) • External radiation monitoring program, fence-mounted TLDs (C-LIC-RAD4 and O-LIC-RAD4) • Radiation and contamination control monitoring (O-LIC-RAD6)[1] • Quarterly dose accumulation (O-LIC-RAD7)[1]	• Submit air quality emissions reports (C-REG-ATM1) • Monitor/model air emissions (C-REG-ATM2)
Noise	Not required	• Monitoring noise (C-EA-ATM3)	Not required	Not required	Not required
Vibration	Not required	• Monitoring vibrations (C-EA-ATM4) • Identification of spawning depressions in the North Railway Ditch (C-EA-ATM5)	Not required	Not required	Not required
Socio-Economic	Not required	• Conduct public attitude research (PAR) (C-EA-SE1)	Not required	Not required	Not required

Notes:

() Activity ID from Tables 2 through 6.

[1]This monitoring activity includes all pathways of radiological contamination but assumes that air would be the primary pathway.

Table 2. Baseline Monitoring Program						
Activity ID	**Baseline Monitoring Activity**	**Objective**	**Schedule**	**Frequency**	**Location**	**Type of Monitoring**
Surface Water						
B-SW-1	Collect receiving water body baseline surface water samples from the drainage ditch and from MacPherson Bay	Establish baseline for surface water sampling program and for C of A permit applications	Beginning one year prior to site preparation and construction	Quarterly	The drainage ditch* at Interconnecting Rd. Lake Huron (MacPherson Bay) at the ditch outlet.	EA follow-up monitoring program and regulatory monitoring (C of A and PTTW)
B-SW-2	Conduct channel characterization and capacity study of the Drainage Ditch along Interconnecting Rd.	Determine if upgrades are necessary to the existing ditch to accommodate the predicted increase in flow	2012	1 time	The drainage ditch between Interconnecting Rd and Lake Huron (MacPherson Bay)	EA follow-up monitoring program
B-SW-3	Collect flow data near the SWMP outlet at the Drainage Ditch	Establish baseline for flow measurements; confirm flow assumptions in the EA	Beginning one year prior to site preparation and construction	Quarterly and after 2 storm events	Drainage Ditch at Interconnecting Rd	EA follow-up monitoring program
B-SW-4	Collect flow data for the North Railway Ditch at the south eastern Project Area boundary	Establish baseline for flow measurements; confirm flow assumptions in the EA	Beginning one year prior to site preparation and construction	Quarterly and after 2 storm events	North Railway Ditch at Stream C	EA follow-up monitoring program

Table 2. Baseline Monitoring Program						
Activity ID	**Baseline Monitoring Activity**	**Objective**	**Schedule**	**Frequency**	**Location**	**Type of Monitoring**
B-SW-5	Monitor staff gauge and marsh water level	Establish baseline marsh water levels	Beginning one year prior to site preparation and construction	Monthly	Marsh in northeast corner of the Project Area	EA follow-up monitoring program and regulatory monitoring program (PTTW)
B-SW-6	Conduct an assimilative capacity study and receiving water assessment of MacPherson Bay	Determine release criteria for C of A.	2012	One time	Desk-top study	Regulatory monitoring program(C of A)
Groundwater						
B-GW-1	Monitor shallow bedrock groundwater quality and hydraulic head	Determine baseline hydrogeological conditions	On-going	Quarterly monitoring	4 DGR series wells 3 US series wells	EA follow-up monitoring program
B-GW-2	Monitor shallow subsurface groundwater quality and hydraulic head	Determine baseline groundwater conditions	2011	Quarterly monitoring	8 new wells	EA follow-up monitoring program
B-GW-3	Establish shaft drawdown characteristics	Confirm hydraulic conductivities. Model effects of drawdown and ground pre-treatment. Pump test to confirm drawdown characteristics.	2011 to 2013	One time program	Vent shaft location	EA follow-up monitoring program
Radiological						
B-SQ-1	Soil sampling	Establish baseline conditions	Start 2011	One time program	Representative locations	EMP

Table 2. Baseline Monitoring Program						
Activity ID	**Baseline Monitoring Activity**	**Objective**	**Schedule**	**Frequency**	**Location**	**Type of Monitoring**
Radiological						
B-RAD-2	Groundwater monitoring to determine changes in level of groundwater contamination	Establish baseline conditions	Start 2011	See Table 5a		Radiological regulatory requirement monitoring
B-RAD-3	Stormwater monitoring of radioactivity in stormwater management system	Verify predicted effects	Beginning one year prior to operations	See Table 5a		Radiological regulatory requirement monitoring

Note:

*Drainage ditch is normally dry; therefore sample collection may not be possible

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Table 3a. EA Follow-up Monitoring Program – Site Preparation and Construction Phase

Activity ID	Monitoring Activity	Objective	EA Statement	Type of Monitoring	Criteria	Frequency	Duration	Location
Surface Water								
C-EA-SW1	Collect Surface Water Management System samples	Confirm prediction	Discharge from the SWMP is expected to meet the discharge criteria; therefore, no residual adverse effects on surface water quality are expected from the DGR project.	Sampling Event: TKN TDS Free Ammonia Aluminum Boron Cobalt Thallium Vanadium pH Temperature Chloride Electrical Conductivity	Discharge criteria: TBD[1] TBD[1] 0.020 mg/L 0.075[2] mg/L 0.2 mg/L 0.0009 mg/L 0.0003 mg/L 0.006 mg/L 6.5-8.5 TBD[1] 200 mg/L[3] TBD	Once prior to initial discharge, daily during first week of discharge, weekly thereafter for 1 month. (except sump discharge) After initial period is over, quarterly. Once shaft dewatering has commenced, daily during first week of dewatering, weekly thereafter for 1 month (shaft sump location only). After initial period is over, quarterly (to be integrated into the discharge and perimeter ditch sampling program).	Site preparation and construction	1 SWMP discharge sample 1 perimeter drainage ditch location, TBD[4] 1 at shaft sump discharge point (at surface, post-treatment)[4]
C-EA-SW2	Monitor SWMP effluent to ensure effluent from pond is free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible film, sheen, foam or discoloration or any other deleterious substance	Confirm prediction	Discharge from the SWMP is expected to meet the discharge criteria; therefore, no residual adverse effects on surface water quality are expected from the DGR project.	Visual inspection	No observed floating and settleable solids. No oil or other substances that create a sheen, foam or discoloration of the receiving water.	Weekly once SWMP starts discharging.	Site preparation and construction	SWMP discharge
C-EA-SW3	Monitor flow near SWMP outlet to drainage ditch at Interconnecting Road	Confirm effect	A 114 % increase in surface quantity and flow in the drainage ditch at Interconnecting Road is predicted resulting in a residual adverse effect.	Flow measurement	Confirm assumptions in EA used to predict and adverse effect (measured as percent change from mean annual flow) in flow to the drainage ditch.	Weekly flow measurements , averaged monthly	3 years	SWMP discharge

Table 3a. EA Follow-up Monitoring Program – Site Preparation and Construction Phase								
Activity ID	**Monitoring Activity**	**Objective**	**EA Statement**	**Type of Monitoring**	**Criteria**	**Frequency**	**Duration**	**Location**
C-EA-SW4	Monitor flow in North Railway Ditch at the south eastern project boundary	Confirm effect	A 31 % decrease in surface quantity and flow in the North Railway Ditch is predicted resulting in a residual adverse effect.	Visual inspection	Confirm assumptions in EA used to predict and adverse effect (measured as percent change from mean annual flow) in flow to the Drainage Ditch.	Quarterly and during 2 major storm events per year.	3 years	Stream C at North Railway Ditch discharge
Groundwater								
C-EA-GW1	Monitor shallow bedrock groundwater hydraulic head	Substantiate zone of influence and drawdown predictions and to determine whether inflow rates will exceed 50,000 L/day.	Ground treatment over the length of the shaft through the overburden soils and upper 180 m of bedrock will minimize the amount of dewatering.	Shallow and intermediate bedrock groundwater monitoring	Permit to Take Water Application (regulatory requirement (OWRA 1990).	Quarterly monitoring of water levels throughout construction. The program continuation will be re-evaluated after 5 years.	Continuation of the program will be re-evaluated at the end of the site preparation and construction phase.	4 DGR series wells 3 US series wells
C-EA-GW2	Monitor shallow subsurface groundwater quality	Confirm predictions of Geosynthesis program used in the EA.	Establish seasonal fluctuations. Early detection network to identify contamination.	Groundwater sampling program	Compliance with regulatory standards MOE Table 3 MOE 2004) or baseline.	Quarterly monitoring	Continuation of the program will be re-evaluated at the end of the site preparation and construction phase.	8 new wells
C-EA-GW3	Monitor shallow subsurface groundwater hydraulic head	Confirm predictions of Geosynthesis program used in the EA, substantiate zone of influence and drawdown predictions and to determine whether inflow rates will exceed 50,000 L/day.	Zone of influence is estimated at 54 m.	Water level monitoring program	Abrupt or gradual change in groundwater flow.	Quarterly monitoring	Continuation of the program will be re-evaluated at the end of the site preparation and construction phase.	8 new wells
Terrestrial								
C-EA-TER1	Record white tail deer and wild turkey vehicle strikes	Confirm predictions	While a few individuals could be lost because of project-related vehicle strikes, it will have a negligible effect upon the local population.	Reporting	No significant change at a population level	On-going	1 year	DGR Project Area, to be reported under the Bruce nuclear site program

Table 3a. EA Follow-up Monitoring Program – Site Preparation and Construction Phase								
Activity ID	**Monitoring Activity**	**Objective**	**EA Statement**	**Type of Monitoring**	**Criteria**	**Frequency**	**Duration**	**Location**
C-EA-TER2	Monitor plant species communities and wildlife habitat use adjacent to the areas which have been cleared during the site preparation and construction phase.	Confirm effect	As the mitigation measures will not sufficiently reduce or eliminate the effect, there is a residual adverse effect of the DGR Project on eastern white cedar.	Visual inspection	Presence of suitable habitat	One time after construction of surface structures	Single event	Land adjacent to clearing within the Project Area
Aquatic								
C-EA-AQ1	Monitor re-growth of riparian vegetation following removal, note any deficiencies in bank stability	Confirm effect significance, confirm mitigation	There is a residual habitat loss in the south railway ditch for Red belly dace, Creek chubb and variable leaf pondweed from the access road crossing. Vegetate any disturbed areas by planting and seeding preferably with native trees, shrubs or grasses and cover such areas with mulch to prevent erosion and to help seeds germinate. If there is insufficient time remaining in the growing season, the site should be stabilized (e.g., cover exposed areas with erosion control blankets to keep the soil in place and prevent erosion) and vegetated the following spring).	Visual inspection	Healthy established vegetation. No deficiencies in bank stability.	Annually after construction of rail bed crossing	3 growing seasons	Location: disturbed areas; at rail bed crossing
C-EA-AQ2	Monitor bank stability of and of new ditches and stormwater management pond, and revegetation of new ditches	Confirm mitigation	No likely adverse effect identified to Spottail shiner, benthic invertebrates, lake whitefish, Smallmouth bass (Lake Huron VECs), provided in-design mitigation is effective.	Visual inspection	Healthy established vegetation. No deficiencies in bank stability.	One time after construction of drainage ditches and stormwater management pond.	1 growing season	New ditches and SWMP
C-EA-AQ3	Monitor the marsh on-site for confirmation that excavation does not dewater and affect marsh habitat and crayfish.	Confirm effect	There is a residual loss of burrowing crawfish habitat within the Project Area as a result of land clearing activities and construction of surface facilities. Project design avoided the marsh in the northeast portion of the Project area where there is known crayfish habitat.	Monitor staff gauge water levels	Drop in water level outside seasonal /baseline norms and deviation from precipitation event patterns.	Frequency will depend on porosity of rock and effectiveness of mitigation to stop groundwater draw down (grouting excavation). Suggested weekly.	Site preparation and construction phase. Program will be discontinued if there is not observed effect at the end of the phase.	1 representative location within the marsh to be determined

Table 3a. EA Follow-up Monitoring Program – Site Preparation and Construction Phase

Activity ID	Monitoring Activity	Objective	EA Statement	Type of Monitoring	Criteria	Frequency	Duration	Location
C-EA-AQ4	Monitor the marsh on-site for confirmation that excavation does not dewater and affect marsh habitat and crayfish.	Confirm effect	There is a residual loss of burrowing crawfish habitat within the Project Area as a result of land clearing activities and construction of surface facilities. Project design avoided the marsh in the northeast portion of the Project area where there is known crayfish habitat.	Groundwater level	Drop in water level outside seasonal /baseline norms and deviation from precipitation event patterns.	Monthly during dewatering	From the start of shaft dewatering until the completion of excavation of the top 200 m of the shafts, or until the water table recovers from dewatering-related effects.	Groundwater well closest to the marsh installed as part of monitoring activity C-EMP-GW3
C-EA-AQ5	Observe and document burrowing crayfish activity	Confirm effect	There is a residual loss of burrowing crawfish habitat within the Project Area as a result of land clearing activities and construction of surface facilities. Project design avoided the marsh in the northeast portion of the Project area where there is known crayfish habitat.	Crayfish Chimney Survey	Presence of crayfish chimneys	Annually	Beginning after construction of the rail bed crossing for three years.	Project Area
Atmospheric								
C-EA-ATM1	Monitor air quality	Confirm predictions, mitigation and effect	A residual adverse effect of the DGR Project on air quality was assessed as 'may be significant".	Diatomaceous TEOM analyzer) for: PM_{10} $PM_{2.5}$ Continuous NOx analyzers	EIS maximum predictions (ug/m^3): 24-hour PM_{10}: 75.3 24 hour $PM_{2.5}$: 45.7 1-hour NO_2: 321.7 Annual NO_2:18.5	Continuous monitors, log hourly averaged recordings. Data will be downloaded quarterly.	Site preparation and construction phase. Continuation of the program to be re-evaluated at the end of each year.	The monitoring equipment (to be set up in a secure location near the Main Access Road; between the construction activities and the property boundary).
C-EA-ATM2	Monitor air quality – dust emissions	Confirm effect	A residual adverse effect of the DGR Project on air quality was assessed as 'may be significant.	Visual inspections for dust emissions	No visible dust plume	Daily	Site preparation and construction phase	At shafts, access roads within the WRMA, waste rock pile.
C-EA-ATM3	Monitor noise	Confirm predictions, mitigation and effect.	An adverse noise effect is identified through the noise level indicator.	Integrating sound level meter	EIS maximum predictions: R1: 38 dBa R2: 42 dBa R3: 37 dBa	Noise monitoring campaign of sufficient duration to confirm construction noise predictions presented in the assessment. Measurements should be continuous for a period of at least 48 hours.	Site preparation and construction phase. Continuation of the program to be re-evaluated at the end of each year.	Noise monitoring locations R1, R2 and R3 (Baie du Dore, Inverhuron Park and adjacent to Inverhuron Park).

Table 3a. EA Follow-up Monitoring Program – Site Preparation and Construction Phase

Activity ID	Monitoring Activity	Objective	EA Statement	Type of Monitoring	Criteria	Frequency	Duration	Location
C-EA-ATM4	Monitor ground vibrations	Confirm prediction	It should be recognized that these predicted peak ground vibration levels are based on empirical data and should be confirmed once blasting has commenced.		13 mm/s	Once at the start of blasting. Weekly during blasting of the top 100 m, monthly thereafter. Program may be discontinued based on consistently low vibration measurements once shaft is advanced below 100 m.	See Frequency	Several locations, TBD.
C-EA-ATM5	Identification of spawning depressions in the North Railway Ditch	Confirm prediction	Working on the assumption of a maximum vibration limit of 13 mm/s allows the calculation of theoretical maximum charge weights. For a receptor at 150 m away from the blast source, the maximum charge weight per delay would be 250 kg to maintain the 13 mm/s vibration limit	Visual inspection	No spawning depressions in the North Railway Ditches.	Once at the beginning of vent shaft collar development.	One time event	Within 150 m of the vent shaft
Socio Economic								
C-EA-SE1	Conduct public attitude research (PAR)	Confirm beneficial effect	Beneficial effect as a result of increased population, increased educational opportunities	Survey	Provide comparable results to 2009 PAR	At a minimum: • Once during the site preparation and construction phase; and • Subsequent to any accidents or malfunctions of the DGR or associated operations, resulting in a release of radioactive contamination to the environment. To be coordinated with other OPG PARs.	See Frequency	Kincardine and five surrounding municipalities
Aboriginal Interests								

Notes:
N/A = Not applicable
TBD = To be determined
[1]Will be based on the baseline studies
[2]Based on pH values .6.5 and <9.0, in clay free samples
[3]Based on the toxicity values identified in the “Priority Substances List Assessment Report for Road Salts”. (CEPA 2001)
[4]Purpose of these locations is to help identify the source of potential contamination, and will not need to comply with the discharge criteria

		Table 3b: EA Follow-up Monitoring Program – Operations Phase						
Activity ID	**Monitoring Activity**	**Objective**	**EA Statement**	**Type of Monitoring**	**Criteria**	**Frequency**	**Duration**	**Location**
Surface Water								
O-EA-SW1 (continuation of C-EA-SW1)	Collect Surface Water Management System samples	Confirm prediction	Discharge from the SWMP is expected to meet the discharge criteria; therefore, no residual adverse effects on surface water quality are expected from the DGR project.	Sampling Event: TKN TDS Free Ammonia Aluminum Boron Cobalt Thallium Vanadium pH Temperature Chloride Electrical conductivity	Discharge criteria: TBD[1] TBD[1] 0.020 mg/L 0.075[2] mg/L 0.2 mg/L 0.0009 mg/L 0.0003 mg/L 0.006 mg/L 6.5-8.5 TBD[1] 200 mg/L[3] TBD[1]	Quarterly for one year	1 year	1 SWMP discharge sample 1 perimeter drainage ditch location, TBD[4] 1 at shaft sump discharge point (at surface, post-treatment)[4]
O-EA-SW2 (continuation of C-EA-SW2)	Monitor SWMP effluent, to ensure effluent from pond is free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible film, sheen, foam or discoloration or any other deleterious substance	Confirm prediction	Discharge from the SWMP is expected to meet the discharge criteria; therefore, no residual adverse effects on surface water quality are expected from the DGR project.	Visual inspection	No observed floating and settleable solids. No oil or other substances that create a sheen, foam or discoloration of the receiving water.	Monthly	1 year	SWMP discharge
O-EA-SW3 (continuation of C – EA-SW3	Monitor flow at SWMP discharge	Confirm effect	A 114 % increase in surface quantity and flow in the Drainage Ditch at Interconnecting Road is predicted resulting in a residual adverse effect.	Flow measurement	Confirm assumptions in EA used to predict and adverse effect (measured as percent change from mean annual flow) in flow to the Drainage Ditch.	Weekly flow measurements , averaged monthly	1 year	SWMP discharge

		Table 3b: EA Follow-up Monitoring Program – Operations Phase						
Activity ID	**Monitoring Activity**	**Objective**	**EA Statement**	**Type of Monitoring**	**Criteria**	**Frequency**	**Duration**	**Location**
Aquatic								
O-EA-AQ5 (continuation of C-EA-AQ5)	Observe and document burrowing crayfish activity	Confirm effect	There is a residual loss of burrowing crawfish habitat within the Project Area as a result of land clearing activities and construction of surface facilities. Project design avoided the marsh in the northeast portion of the Project area where there is known crayfish habitat.	Crayfish Chimney Survey	Presence of crayfish chimneys	Annually	May extend 2 years into operations, depending on when the rail bed crossing is constructed (see C-EA-AQ5 in Table 3a).	Project Area
Atmospheric								
		Provided monitoring results are not in excess of the EIS predictions during construction, no non-radiological monitoring is required for the EA Follow-up Monitoring Program. Other atmospheric monitoring is included in the EMP and the radiological regulatory requirement monitoring.						
Radiation and Radioactivity								
		See Tables 5a and 5b						

Notes:
TBD = To be determined
[1]Will be based on the baseline studies
[2]Based on pH values .6.5 and <9.0, in clay free samples
[3]Based on the toxicity values identified in the “Priority Substances List Assessment Report for Road Salts”. (CEPA 2001)
[4]Purpose of these locations is to help identify the source of potential contamination, and will not need to comply with the discharge criteria

Table 4a. Environmental Management Plan Monitoring Program – Site Preparation and Construction Phase							
Activity ID	**Monitoring Activity**	**Objective**	**EA Statement**	**Type of Monitoring**	**Criteria**	**Frequency**	**Location**
Surface Water							
C-EMP-SW1	Operation and Maintenance inspection to ensure that the stormwater management system and run-off areas do not have extreme erosion wear. Ensure that sediment control materials are kept on hand for emergency response and for repair and maintenance purposes.	Confirm mitigation	No residual adverse effects on surface water quality are expected from the DGR project provided in-design mitigation is effective.	Visual Inspection	Free of debris and erosion	Weekly	Stormwater management system
C-EMP-SW2 (continuation of C-EA-SW2)	Monitor for accumulation of sediment, sheen, discoloration on the surface, fuel odour, floating debris and visible films or any other deleterious substance	Confirm mitigation	No residual adverse effects on surface water quality are expected from the DGR project provided in-design mitigation is effective.	Visual inspection	Oil and Grease (PWQO): No accumulation of sediment and floating debris and visible films. PWQO Table 1, General Narrative Objectives No deposit of deleterious substances	Weekly	Drainage swales and perimeter ditches
C-EMP-SW3	Ensure that storm interceptor inspection and maintenance program is in place	Confirm mitigation	No residual adverse effects on surface water quality are expected from the DGR project provided in-design mitigation is effective.	Records check	Inspection and maintenance frequency meet manufacturer's specifications	Semi-annually	N/A
Soil Quality							
C-EMP-SQ1	Monitoring for contamination of soil.	Confirm no effect	No direct or indirect likely environmental effects were identified for the soil quality VEC.	Soil sampling and subsurface investigation program.	Compliance with regulatory standards MOE Table 3 (MOE 2004) or restore to baseline	Preliminary investigation prior to site preparation and as required	As needed and where needed in response to a malfunction or accident
Terrestrial							
C-EMP-TER1 (continuation of C-EMP-TER1)	Record white tail deer, wild turkey vehicle strikes	Confirm predictions	While a few individuals could be lost because of project-related vehicle strikes, it will have a negligible effect upon the local population.	Reporting	Significant change at a population level	On-going, beginning in year 2 of site preparation and construction.	DGR Project Area, to be reported under the Bruce nuclear site program

Table 4a. Environmental Management Plan Monitoring Program – Site Preparation and Construction Phase							
Activity ID	**Monitoring Activity**	**Objective**	**EA Statement**	**Type of Monitoring**	**Criteria**	**Frequency**	**Location**
Aquatic							
C-EMP-AQ1	Conduct site inspection – deleterious substances	Confirm mitigation	Use measures to prevent deleterious substances such as new concrete (i.e., it is precast, cured and dried before use near the watercourse), grout, paint and preservatives from entering the watercourse.	Visual inspection	No deleterious materials	Weekly during construction of rail bed crossing and ongoing incidental observations	Rail bed crossing
C-EMP-AQ2	Conduct sediment and erosion control measure inspection	Confirm mitigation	Install effective sediment and erosion control measures before starting work to prevent silt/sediment laden runoff from directly entering the water in the south Railway Ditch. Inspect them regularly during the course of construction and make all necessary repairs if any damage occurs.	Visual inspection	Effective sediment an erosion control measures	Weekly during construction of rail bed crossing and ongoing incidental observations	Rail bed crossing
C-EMP-AQ3	Conduct site inspection – on – site machinery	Confirm mitigation	Operation of machinery on land and in a manner that minimizes disturbance to the banks of the south Railway Ditch.	Visual inspection	Machinery on land and bank disturbance minimized	Weekly during construction of rail bed crossing and ongoing incidental observations	Rail bed crossing
C-EMP-AQ4	Conduct site inspection – fluid leaks	Confirm mitigation	Machinery is to arrive on site in a clean condition and is to be maintained free of fluid leaks.	Visual inspection	Machinery is free of fluid leaks	Weekly during construction of rail bed crossing and ongoing incidental observations	Rail bed crossing
C-EMP-AQ5	Conduct site inspection – vehicle maintenance	Confirm mitigation	Wash, refuel and service machinery and store fuel and other materials for the machinery away from the water to prevent any deleterious substance from entering the water.	Visual inspection	No fuel storage or maintenance activities near water.	Weekly during construction of rail bed crossing and ongoing incidental observations	Rail bed crossing
C-EMP-AQ6	Conduct site inspection – confirm onsite spill kit is accessible	Confirm mitigation	Keep an emergency spill kit on site in case of fluid leaks or spills from machinery.	Visual inspection	Spill kit is accessible.	Weekly during construction of rail bed crossing and ongoing incidental observations	Rail bed crossing
C-EMP-AQ7	Conduct site inspection – determine if ditch maintenance is required	Confirm mitigation	The regular maintenance of the ditches will include dredging to extract plant materials from the ditches to permit efficient flow.	Visual inspection	Minimal plant materials	Annually, during the growing season	Stormwater management system

Table 4a. Environmental Management Plan Monitoring Program – Site Preparation and Construction Phase							
Activity ID	**Monitoring Activity**	**Objective**	**EA Statement**	**Type of Monitoring**	**Criteria**	**Frequency**	**Location**
Atmospheric							
C-EMP-ATM1	Conduct vehicle inspections	Confirm air and noise quality predictions	Maintain on-site vehicles and equipment.	Records check	Equipment is maintained is as per manufacturer's specification	Annually.	All construction vehicles, in designated vehicle maintenance bays/areas.
C-EMP-ATM2	Monitor underground air quality	Confirm assumption	No likely adverse effect identified.	Air monitoring station controlled remotely at surface: CO NO2 airflow	Mines and Mining Plants Regulation (Reg 854)	On-going during underground construction	Intake at Main Shaft and underground locations, TBD
C-EMP-ATM3	Monitor underground air quality (explosive gas)	Confirm assumption	No likely adverse effect identified.	Explosive gas monitor, including: methane hydrogen	Mines and Mining Plants Regulation (Reg 854)	Ongoing during underground construction	Underground locations, TBD
C-EMP-ATM4	Monitor underground air quality (temperature and humidity)	Confirm assumption	No likely adverse effect identified.	Wet bulb Temperature Dry bulb Temperature Humidity	Mines and Mining Plants Regulation (Reg 854)	Ongoing during underground construction	Intake at Main Shaft and underground locations, TBD.
Radiological							
See Table 5a							

Table 4b. Environmental Management Plan Monitoring Program – Operations							
Activity ID	**Monitoring Activity**	**Objective**	**EA Statement**	**Type of Monitoring**	**Criteria**	**Frequency**	**Location**
Surface Water							
O-EMP-SW1 (continuation of C-EMP-SW1)	Conduct operation and maintenance inspection to ensure that the stormwater management system and run-off areas do not have extreme erosion wear. Ensure that sediment control materials are kept on hand for emergency response and for repair and maintenance purposes.	Confirm mitigation	No residual adverse effects on surface water quality are expected from the DGR project provided in-design mitigation is effective.	Visual Inspection	Free of debris and erosion	Monthly during operations	Stormwater management system
O-EMP-SW2 (continuation of C-EMP-SW2)	Monitor for accumulation of sediment, sheen, discoloration on the surface, fuel odour, floating debris and visible films or any other deleterious substance	Confirm mitigation	No residual adverse effects on surface water quality are expected from the DGR project provided in-design mitigation is effective.	Visual inspection	Oil and Grease (PWQO): No accumulation of sediment and floating debris and visible films. PWQO Table 1, General Narrative Objectives No deposit of deleterious substances	Monthly	Stormwater management system
O-EMP-SW3 (continuation of C-EMP-SW3)	Ensure that storm interceptor inspection and maintenance program is in place and up to date	Confirm mitigation	No residual adverse effects on surface water quality are expected from the DGR project provided in-design mitigation is effective.	Records check	Inspection and maintenance frequency meet manufacturer's specifications and are up to date	Semi-annually	N/A
Groundwater							
O-EMP-GW1 (a continuation of C-EA-GW1)	Monitor shallow bedrock groundwater hydraulic head	Substantiate zone of influence and drawdown predictions and to determine whether inflow rates will exceed 50,000 L/day.	Ground treatment over the length of the shaft through the overburden soils and upper 180 m of bedrock will minimize the amount of dewatering	Shallow and intermediate bedrock groundwater monitoring	Permit to Take Water Application (regulatory requirement (OWRA 1990)	Quarterly monitoring	4 DGR series wells 3 US series wells
O-EMP-GW2 (a continuation of (C-EA-GW2)	Monitor shallow subsurface groundwater quality	Confirm predictions of Geosynthesis program used in the EA.	Establish seasonal fluctuations. Early detection network to identify contamination.	Groundwater sampling program	Compliance with regulatory standards MOE Table 3 MOE 2004) or baseline conditions	Quarterly monitoring	8 new wells

Table 4b. Environmental Management Plan Monitoring Program – Operations

Activity ID	Monitoring Activity	Objective	EA Statement	Type of Monitoring	Criteria	Frequency	Location
O-EMP-GW3 (a continuation of C-EA-GW3)	Monitoring shallow subsurface hydraulic head	Confirm predictions of Geosynthesis program used in the EA, substantiate zone of influence and drawdown predictions and to determine whether inflow rates will exceed 50,000 L/day	Zone of influence is estimated at 54 m.	Water level monitoring program	Abrupt or gradual change in groundwater flow.	Quarterly monitoring	8 new wells
Terrestrial							
O-EMP-TER1 (continuation of C-EMP-TER1)	Record white tail deer, wild turkey vehicle strikes	Confirm predictions	While a few individuals could be lost because of project-related vehicle strikes, it will have a negligible effect upon the local population	Reporting	Significant change at a population level	On-going	DGR Project Area, to be reported under the Bruce nuclear site program.
Aquatic							
C-EMP-AQ7 (continuation of C-EMP-AQ7)	Conduct site inspection – ditch maintenance	Confirm mitigation	The regular maintenance of the ditches will include dredging to extract plant materials from the ditches to permit efficient flow.	Visual inspection	Minimal plant materials	Annually, during the growing season	Stormwater management system
Atmospheric							
O-EMP-ATM1 (continuation of C-EMP-ATM1)	Conduct vehicle inspections	Confirm air and noise quality predictions	Maintain on-site vehicles and equipment.	Records check	Equipment is maintained as per manufacturer's specification	Annually.	All construction vehicles, in designated vehicle maintenance bays/areas.
O-EMP-ATM2 (continuation of C-EMP-ATM2)	Monitor underground air quality	Confirm assumption	No likely adverse effect identified.	Air monitoring station controlled remotely at surface: CO NO2 airflow	Mines and Mining Plants Regulation (Reg 854)	On-going during operations	Intake at Main Shaft and underground locations, TBD.
O-EMP-ATM3 (continuation of C-EMP-ATM3)	Monitor underground air quality (explosive gas)	Confirm assumption	No likely adverse effect identified.	Explosive gas monitor, including: methane hydrogen	Mines and Mining Plants Regulation (Reg 854)	On-going during operations	Underground locations, TBD.
O-EMP-ATM4 (continuation of C-EMP-ATM4)	Monitor underground air quality (temperature and humidity)	Confirm assumption	No likely adverse effect identified.	Wet bulb Temperature Dry bulb Temperature Humidity	Mines and Mining Plants Regulation (Reg 854)	On-going during operations	Intake at Main Shaft and underground locations, TBD.

Table 4b. Environmental Management Plan Monitoring Program – Operations							
Activity ID	**Monitoring Activity**	**Objective**	**EA Statement**	**Type of Monitoring**	**Criteria**	**Frequency**	**Location**
O-EMP-ATM5	Conduct ventilation inspection	Confirm mitigation	Maintain fresh air and return air raise fans.	Records check	Fans maintained in good working order, maintenance conducted and recorded as per manufacturer's instructions.	Annual records check	N/A
Radiation and Radioactivity							
See Table 5b							

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Table 4c. Environmental Management Plan Monitoring Program - Accident Prevention Checklist			
Activity ID	**Task**	**Activity Type**	**Frequency**
C-EMP-MA1	Verify that all work is carried out in compliance with all applicable air emissions regulations and by-laws. Vehicles/machinery to be in good repair, equipped with emission controls as applicable and operated within regulatory requirements.	Visual inspection and records check	Quarterly during site preparation and construction
C-EMP-MA3	Verify that storing, mixing and cleaning operations are carried out away from surface water bodies.	Visual inspection	Quarterly during site preparation and construction
C-EMP-MA4	Verify that all activities including maintenance procedures are controlled to prevent the entry of petroleum products, debris, rubble, concrete, uncured cement leachate, or other deleterious substances into surface water bodies.	Visual inspection	Quarterly during site preparation and construction
C-EMP-MA5	Verify that hazardous substances (including fuel) are stored, handled and applied in a manner to prevent release to surface water. A spill response kit to be on site in the event of a spill. Immediately contain and clean up any spills in accordance with provincial regulatory requirements. Report spill to the Ontario Spills Actions Centre (1-800-268-6060).	Visual inspection	Quarterly during site preparation and construction
C-EMP-MA6	Verify that construction machinery and equipment arrive on-site in a clean condition, are maintained free of fluid leaks, and are equipped with appropriate silencers.	Visual inspection, records inspection	As equipment is received on site
C-EMP-MA7	Verify that on-site vehicles are properly maintained.	Visual inspection, records inspection	Quarterly during site preparation and construction
C-EMP-MA8	Ensure a tight project footprint is maintained.	Visual inspection	Quarterly during site preparation and construction
C-EMP-MA9	Verify that washing or refuelling is taking place in the designated area.	Visual inspection	Quarterly during site preparation and construction and operations
C-EMP-MA11	Verify that work areas are clearly defined and identified.	Visual inspection	Quarterly during site preparation and construction and operations
C-EMP-MA12	Verify that workers are wearing protective gear (e.g. safety work boots, hard hats, safety goggles, safety vests etc.) in accordance with the Occupational Health and Safety Act and regulations.	Visual inspection	Quarterly during site preparation and construction and operations

Table 4c. Environmental Management Plan Monitoring Program - Accident Prevention Checklist			
Activity ID	**Task**	**Activity Type**	**Frequency**
C-EMP-MA13	Verify that access to work areas for fire and emergency vehicles is maintained.	Visual inspection	Quarterly during site preparation and construction and operations
C-EMP-MA14	Verify that all work areas and machinery are stabilized and made safe and secure at the end of each workday to prevent accidents from occurring to people and the environment.	Visual inspection	Quarterly during site preparation and construction and operations
C-EMP-MA15	Verify that appropriate training and operating procedures are in place, and that training is current/up-to-date.	Records check	Annually during site preparation and construction and operations
C-EMP-MA16	Verify that suitable fire detection and suppression equipment such as automatic fire suppression systems on diesel transfer equipment is in place and follows a routine testing schedule.	Visual inspection and records check	Quarterly during site preparation and construction and operations
C-EMP-MA17	Verify that drills for emergency assembly in underground refuge stations are practiced.	Records check	Once per year
C-EMP-MA18	Verify contamination and dose rate monitoring programs are in place and are properly recorded.	Visual inspection and records check	Quarterly during operations
C-EMP-MA19	Verify that combustible materials and ignition sources are kept to a minimum.	Visual inspection	Quarterly during site preparation and construction and operations
C-EMP-MA20	Verify that waste generated in the building is be disposed of in accordance with applicable legislation (i.e. Ontario Regulation 347, as amended).	Records check	Quarterly during site preparation and construction and operations

Table 5a. Radiological Regulatory Monitoring Program – Site Preparation and Construction						
Activity ID	**Monitoring Activity**	**Objective**	**Type of Monitoring**	**Criteria**	**Frequency**	**Location**
Radiological						
C-LIC-RAD1	Air monitoring	Confirm no effect, confirm effectiveness of mitigation	Air monitoring: Radon	Radon < 150 Bq/m^3 (NWMO 2011h)	1 sample per month/location during underground construction. Continuation of the program will be re-evaluated based on the results.	DGR Project Site; TBD
C-LIC-RAD2	Groundwater monitoring to determine changes in level of groundwater contamination	Verify predicted effects	Groundwater sample: Tritium Gross beta	Establish Baseline	Quarterly	8 new monitoring wells
C-LIC-RAD3	Stormwater monitoring of radioactivity in stormwater management system	Verify predicted effects	Grab sample: Tritium Gross Beta Carbon-14	Establish Baseline (Bq/L)	Tritium and Gross Beta: monthly, beginning one year prior to operations: Consistent with the existing WWMF radiological monitoring program. Carbon-14, quarterly beginning one year prior to operations.	1 sample from SWMP, 1 from marsh
C-LIC - RAD4	External radiation monitoring program	Verify predictions	Average gamma dose rate. Thermoluminescent Dosimeters (TLD) mounted on the fences	0.5 uGy/h	Changed and analyzed quarterly. Consistent with the existing WWMF radiological monitoring program	Existing WWMF north fenceline TLDs

Table 5a. Radiological Regulatory Monitoring Program – Site Preparation and Construction						
Activity ID	**Monitoring Activity**	**Objective**	**Type of Monitoring**	**Criteria**	**Frequency**	**Location**
C-LIC-RAD5	Sump water monitoring	Verify predicted effects	Grab sample: Tritium Gross Beta Carbon-14	WWMF DRL for Tritium and Gross Beta in surface water (1.75E+14 and 9.63E+09 Bq/mo, respectively) Carbon-14, TBD	Tritium and Gross Beta: weekly samples averaged monthly, beginning one-year prior to operations. Consistent with the existing WWMF radiological monitoring program. Carbon-14: quarterly beginning one year prior to operations.	1 sample from stormceptor at sump discharge

Notes:
TBD = To be determined

Table 5b. Radiological Regulatory Requirements Monitoring Program – Operations						
Activity ID	**Monitoring Activity**	**Objective**	**Type of Monitoring**	**Criteria**	**Frequency**	**Location**
Radiation and Radioactivity						
O-LIC-RAD1 (continuation of C-LIC-RAD1)	Air monitoring	Confirm mitigation; verify predicted effects	Air monitoring: radon, tritium, particulate and carbon-14	Radon <150 Bq/m3 (NWMO 2011b). Tritium, particulate and carbon-14 will be compared to the same DRLs as the WWMF (2.67E+15, 5.62 E+10 and 8.19E+13 Bq/week respectively).	Radon: TBD based on results (See C-LIC-RAD1) Tritium, particulate and carbon-14: continuous, analyzed weekly	Selected underground locations for Radon, TBD. Vent exhaust and WPRB exhaust for tritium, particulate and carbon-14.
O- LIC-RAD2 (continuation of C-LIC-RAD2)	Groundwater monitoring to determine changes in level of groundwater contamination	Verify predicted effects	Groundwater sampling: tritium and gross beta	Compared to baseline Consistent with the existing WWMF radiological monitoring program	Quarterly	8 newly built monitoring wells
O- LIC-RAD3 (continuation of C-LIC-RAD3)	Stormwater monitoring of radioactivity in stormwater management system.	Verify predicted effects	Grab sample: Tritium Gross Beta C-14	Baseline (Bq/L) Consistent with the existing WWMF radiological monitoring program	Tritium and Gross Beta: monthly. Carbon-14: annually.	1 sample from SWMP, 1 from marsh

Table 5b. Radiological Regulatory Requirements Monitoring Program – Operations						
Activity ID	**Monitoring Activity**	**Objective**	**Type of Monitoring**	**Criteria**	**Frequency**	**Location**
O- LIC-RAD4 (continuation of C-LIC-RAD4)	External radiation monitoring program	Verify predictions	Average gamma dose rate Thermoluminescent Dosimeters (TLD) mounted on the fences	0.5uGy/h	Changed and analyzed quarterly. Consistent with the existing WWMF radiological monitoring program.	DGR fence line, the number of sample locations TBD.
O-LIC-RAD5 (continuation of C-LIC-RAD5)	Sump water monitoring	Verify predicted effects	Tritium Gross Beta Carbon-14	WWMF DRL for Tritium and Gross Beta in surface water (1.75E+14 and 9.63E+09 Bq/mo, respectively). Consistent with the existing WWMF radiological monitoring program. Carbon-14: TBD.	Tritium and gross beta: weekly samples averaged monthly, beginning one-year prior to operations. Carbon-14: annually.	1 sample from stormceptor at sump discharge

Table 5b. Radiological Regulatory Requirements Monitoring Program – Operations						
Activity ID	**Monitoring Activity**	**Objective**	**Type of Monitoring**	**Criteria**	**Frequency**	**Location**
O-LIC-RAD6	Radiation and contamination control		Routine Survey Program	Compliance with the requirements of the Radiation Protection Requirements (OPG 2001). Consistent with the existing WWMF radiological monitoring program.	To be specified in the operations licence application	To be specified in the operating licence application
O-LIC-RAD7	Quarterly dose accumulation		Whole body dose and skin beta dose according to work group.	Compliance with the requirements of the Radiation Protection Requirements (OPG 2001). Consistent with the existing WWMF radiological monitoring program.	To be specified in the operating licence application	To be specified in the operating licence application

Notes:
TBD – To be determined

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Table 6. Conventional Regulatory Monitoring Program								
Activity ID	**Monitoring Activity**	**Objective**	**Regulatory Body**	**Type of Monitoring**	**Criteria**	**Frequency**	**Location**	**Requirement**
Surface Water								
C-REG-SW1	Collect Surface Water Management System samples	Comply with Section 53 of the Ontario Water Resources Act	MOE	Sampling Event: TSS	40 mg/L (MOE 1994b and MOE F-5-1)	Quarterly	1 SWMP discharge sample	Comply with conditions of C of A
C-REG-SW2	Monitor effluent – ensure effluent from pond is free of floating and settleable solids and does not contain oil or any other substance in amounts sufficient to create a visible film, sheen, foam or discoloration or any other deleterious substance	Comply with Section 53 of the Ontario Water Resources Act	MOE	Visual inspection	No observed floating and settleable solids. No oil or other substances that create a sheen, foam or discoloration of the receiving water.	Monthly.	SWMP discharge	Comply with conditions of C of A
C-REG-SW3	Monitor flow	Comply with Section 53 of the Ontario Water Resources Act	MOE	Flow measurement		Weekly flow measurements , averaged monthly	SWMP discharge	Comply with conditions of C of A
Groundwater								
C-REG-GW1	Identify and monitor any potentially contaminated groundwater in response to a spill.	Comply with Ontario Regulation 675.	MOE	Groundwater sampling program	Compliance with regulatory standards MOE Table 3 (MOE 2004) or baseline conditions	As needed	Where needed in response to malfunction or accident	Ontario Regulation 675
C-REG-GW2	Measure flow	Comply with Section 34 of the Ontario Water Resources Act	MOE	Flow monitoring	Daily takings limit as specified in the PTTW	Daily during dewatering for duration of site preparation and construction or as specified in the PTTW. Annual Reporting to the MOE.	At point of discharge at surface	PTTW
C-REG-GW3	Monitor shallow subsurface hydraulic head to estimate groundwater flow and ZOI	Comply with Section 34 of the Ontario Water Resources Act	MOE	Water level monitoring program	Abrupt or gradual change in groundwater flow	Quarterly monitoring for duration of site preparation and construction or as specified in the PTTW	8 new wells	PTTW

Table 6. Conventional Regulatory Monitoring Program

Activity ID	Monitoring Activity	Objective	Regulatory Body	Type of Monitoring	Criteria	Frequency	Location	Requirement
Aquatic								
C-REG-AQ1	Monitor re-growth of riparian vegetation following removal, note any deficiencies in bank stability	Confirm effect significance, confirm mitigation	MNR	Visual inspection	Healthy established vegetation. No deficiencies in bank stability.	Annually after site preparation and construction of access road crossing. For a minimum of 2 growing seasons. If no distressed vegetation or bank instability is noted, program may be discontinued.	Location: disturbed areas; at access road crossing	In water work permit, Fisheries Act via Saugeen Valley Conservation Authority
Atmospheric								
C-REG-ATM1	Report air emissions	Comply with Ontario Regulation 127	MOE	Modelling	O.Reg 127	Annually	Online Report	NPRI/Reg 127 Reporting
C-REG ATM-2	Monitor/model air quality emissions	Comply with Ontario Regulation 419	MOE	Modelling and/or monitoring	O. Reg 419	Annually	Vent exhaust	C of A (Air)
Radiological								
See Tables 5a and 5b								

Notes:
PTTW – Permit to Take Water
MOE – Ontario Ministry of the Environment
C of A – Certificate of approval
MNR – Ministry of Natural Resources
NPRI – National Pollutant Release Inventory
ZOI – Zone of influence