Environmental Assessment Registration for the Envirosystems Facility: Modification to Temporarily Store and Clean Low-Level NORM Waste and Equipment, and Treat Wash-Water

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List of Acronyms

AIS	Atlantic Industrial Services
Bq/g	Becquerels per gram
CCME	Canadian Council of Ministers of the Environment
CNSC	Canadian Nuclear Safety Commission
DRLs	Derived Release Limits
EA	Environmental Assessment
FPTRPC	Federal Provincial Territorial Radiation Protection Committee
HRM	Halifax Regional Municipality
HRWC	Halifax Regional Water Commission
ICRP	International Commission on Radiological Protection
KMKNO	Kwilmy'kw Maw-klusuaqn Negotiation Office
Leq	Equivalent Sound Level
mSv/a	millisievert per year
NSE	Nova Scotia Environment
NORM	Naturally Occurring Radioactive Material
PTNSR	Packaging and Transport of Nuclear Substances Regulations
TDG	Transportation of Dangerous Goods
UDRLs	Unconditional Derived Release Limits
UNSCEAR	United Nations Scientific Committee on the Effects of Atomic Radiation
VC	Valued Component

Glossary

Becquerel (Bq): A unit of radioactivity, equivalent to 1 nuclear transformation per second. Used as a measurement of the quantity of a radionuclide.

Derived Release Limits (DRLs): Provide an estimate of public dose from measured releases of NORM.

Dose Constraint: The upper bound on the annual dose that members of the public or incidentally exposed workers should receive from the planned operation of any source (typically measured in millisieverts (mSv)).

Effective Dose Limit: The sum of all tissue equivalent doses multiplied by the appropriate tissue weighting factors associated with each respective tissue (typically measured in millisieverts (mSv)).

Naturally Occurring Radioactive Material (NORM): A material found in the environment containing radioactive elements of natural origin

Sievert (Sv): The Sievert is the unit of radiation equivalent dose, H, that is used for radiation protection purposes, for engineering design criteria and for legal and administrative purposes. The Sievert is the unit of absorbed radiation dose in living organisms modified by radiation type and tissue weighting factors. Multiples of Sieverts (Sv) used in the Health Canada Guidelines include millisieverts (mSv) and microsieverts (µSv).

Unconditional Derived Release Limits (UDRLs): Within the Unrestricted classification, the radioactive activity of Naturally Occurring Radioactive Material (NORM) below which NORM can be released in the public domain without restrictions.

1.0 Introduction

Envirosystems Inc. is requesting an amendment to their existing Industrial Approval to allow for the receiving and temporary storage of low-level Naturally Occurring Radioactive Materials (NORM) waste and equipment, cleaning of low-level NORM impacted equipment, and treatment of subsequent wash-water. The proposed site for this project is an existing Envirosystems' property and facility, located at 25 Akerley Blvd., Dartmouth, Nova Scotia. Because this proposal is considered a modification to the existing facility, Envirosystems is required to register the Project as a Class 1 undertaking under the Nova Scotia *Environment Act* and Environmental Assessment Regulations.

This environmental assessment (EA) document is intended to substantially fulfill requirements for Registration of a Class 1 Undertaking under the Environmental Assessment Regulations. The EA process is intended to support and better define the Project through early consideration of potential environmental effects and mitigation measures.

2.0 Proponent and Project Identification

2.1 PROPONENT INFORMATION

Name of the Proponent: Envirosystems Inc.
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2.2 PROJECT INFORMATION

Name of the Undertaking: Environmental Assessment Registration for the Envirosystems Facility: Modification to Temporarily Store and Clean Low-Level NORM Waste and Equipment, and Treat Wash-Water.

Location of the Undertaking: Dartmouth, Halifax Regional Municipality, Nova Scotia

2.3 PROJECT BACKGROUND

Envirosystems Inc., currently operates in Nova Scotia and New Brunswick, and is the most comprehensive provider of industrial cleaning and waste management services in Atlantic Canada. In Dartmouth, Nova Scotia, Envirosystems operates a processing facility permitted to receive and collect non-regulated industrial wastes including oil, oily solids as filters, absorbent materials and sludge and industrial wastewaters. At this facility, materials are bulked individually based on compatibility and stored for subsequent shipment to an offsite approved disposal facility. The facility operates under a Re-refinery and Wastewater Industrial Approval No. 2004-042042-T05 from Nova Scotia Environment (NSE) (Appendix A), which prescribes the criteria for material acceptance, storage and treatment of materials. At this facility, Envirosystems holds two additional Industrial Approvals for the following activities:

- Used Oil Collection and Storage Operation (No. 2007-055775-T02); and
- Storage and Handling of a Waste Dangerous Goods (No. 2004-038682-R01).

In accordance with condition 3.g) of their Industrial Approval (No. 2004-042042-T05), Envirosystems has requested an amendment to their existing Approval, to permit the following activities at the facility:

- Receive and temporarily store low-level NORM (≤ 70 Becquerels per gram (Bq/g)) waste that will be bulked for transport to an approved NORM disposal facility;

- Receive and temporarily store piping and similar equipment with scale build-up that may contain low-levels of Naturally Occurring Radioactive Materials (NORM) (≤70 Bq/g);
- Clean the equipment by removing the scale build-up using city water at high pressures and store the wash-water in dedicated storage tanks; and
- Treat the wash-water so that the treated wastewater meets applicable guidelines and discharge criteria.

Because these amendments are considered modifications to the existing undertaking, Envirosystems is required to register this Project as a Class 1 Undertaking pursuant to the Nova Scotia *Environment Act* and Environmental Assessment Regulations, as per Section 3(2): "The Act and these regulations may apply to a modification, extension, abandonment, demolition or rehabilitation of an undertaking listed in Schedule "A" which was established either before or after March 17, 1995".

There are no requirements under the *Canadian Environmental Assessment Act*, 2012 (CEAA 2012) as the proposed Project is not listed as a designated project as per Section 2 of the Regulations Designating Physical Activities and the Project does not take place on federal lands.

NSE reviewed a preliminary project description and comments were received on the proposed Project following review from several federal and provincial governmental departments. These comments and questions have been addressed in the following sections.

2.4 GEOGRAPHIC LOCATION

The property and existing facility are located in Dartmouth, Nova Scotia, in the Burnside Business Park at 25 Akerley Boulevard (Figure 1). Burnside Business Park is dedicated to commercial and industrial businesses. The Akerley property (PID # 00128306) is zoned as a General Industrial Use Zone (I-2 Zone), under Dartmouth's Land Use By-Law.

The property is situated approximately 15 km from Halifax, and is approximately 8, 000 square metres (m^2). It has a paved yard with security fencing, controlled access, security alarm systems and adjacent to a four lane highway. The proposed NORM storage area will be positioned in the southwest corner of the property, and consist of a portable equipment pad (approximately 90 m^2) and a portable storage container (approximately 40 m^2). The proposed NORM treatment and wastewater area is to be located within the existing facility, and the NORM wash pad area will be positioned south west of the existing facility, within the property boundaries (Figure 2).

The nearest residential land-uses (i.e. apartments and condominium developments) are located approximately 800 m to 1000 m southwest of the proposed site on Windmill Road and Basinview Drive. Given that the surrounding area is industrial in nature and that the property, including the proposed NORM storage area, and treatment and wastewater area, has security fencing, controlled access and security alarm systems, there are no credible pathways for public exposure to NORM contaminants. In addition, NORM impacted equipment to be received at the site will be concealed and protected from weather; therefore, NORM contaminants will not be released into the environment or provide any other opportunity for public exposure.

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Sources: bing Imagery (c) Microsoft 2015

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Site Location Plan - 25 Akerley Blvd., HRM, Nova Scotia

Stantec
ENVIRONSYSTEMS

Figure 1

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Sources: bing Imagery (c) Microsoft 2015

Disclaimer: This map is for illustrative purposes to support this Stantec project; questions can be directed to the issuing agency.

Site Plan - 25 Akerly Blvd. Nova Scotia

Stantec
ENVIROSYSTEMS

Figure 2

2.5 PURPOSE AND NEED FOR THE PROJECT

Since 1995, Envirosystems has grown from a regional provider of industrial services into a North American leader with dozens of locations across North America and a workforce of over 1000 experienced professionals. Envirosystems provides expertise in industrial services, environmental services, project management and robotic services. The Envirosystems' Akerley facility has been in operation for 22 years. Envirosystems is requesting that its Industrial Approval be updated to reflect the current need for temporary storage and cleaning of low-level NORM material and subsequent wash-water treatment services within Nova Scotia, particularly to target equipment from offshore oil and gas operations. The modified operation ***will not*** include treatment of flow-back waters from hydraulic fracturing operations.

Under existing environmental regulations and facility approvals, there are currently no approved NORM cleaning and treatment facilities within Nova Scotia. The present practice is to transport NORM impacted decommissioned equipment to western Canada at an approved NORM disposal facility. As the oil and gas industry matures in Nova Scotia, and as other industries begin to realize the potential for NORM contamination, the need for these services will increase across the province. For example, beyond oil and gas production, low-level NORM (≤70Bq/g) contaminated materials can be generated via mineral extraction and processing, metal recycling, forest products, thermal-electric production, water treatment facilities and tunneling and underground works. An approved facility in Nova Scotia would greatly reduce the transportation requirements and associated environmental impacts from out of province shipping of this material. Having an approved facility in Nova Scotia would have a positive effect on the local economy and create a source of employment within the province. The proposed Project amendments to allow for the receiving and temporary storage of low-level NORM wastes and equipment, cleaning of low-level NORM (≤70Bq/g) impacted equipment, and treatment of associated wash-water will provide Nova Scotia with a reliable, environmentally responsible and local option for this type of material.

Envirosystems is an experienced provider of NORM management services. They have performed decontamination of NORM impacted equipment and have removed, contained and packaged millions of litres of NORM impacted sludge and wastewater. Specifically, Envirosystems has participated in handling NORM materials generated from onshore and offshore oil & gas operations in Newfoundland and Nova Scotia for over a decade.

2.6 NATURALLY OCCURING RADIOACTIVE MATERIALS (NORM)

2.6.1 Background Information

Naturally occurring radioactive material (NORM) is a material found in the environment containing radioactive elements of natural origin (CNSC, 2014).

There are three basic types of radiation that can be emitted by NORM:

1. **alpha (α)** radiation is composed of heavy, charged particles that are unable to travel significant distances, and can generally be absorbed or stopped by 1-2 centimeters of air or a thin piece of tissue;

2. **beta (β)** radiation consists of lighter charged particles than alpha particles. Beta radiation can travel a few hundred times farther than alpha particles (up to 2 metres). This type of radiation is more capable of penetration than alpha particles; and

3. **gamma (γ)** radiation consists of high-energy rays, and is extremely penetrating. This type of radiation can be stopped by a metre of concrete or several metres of water (Health Canada, 2014).

There are two primary units of measurement related to radiation protection:

1. **Becquerel (Bq) (= Activity):** A unit of radioactivity, equivalent to 1 nuclear transformation per second. Used as a measurement of the quantity of a radionuclide; and

2. **Sievert (Sv) (= Biological Effect):** The Sievert is the unit of radiation equivalent dose, H, that is used for radiation protection purposes, for engineering design criteria and for legal and administrative purposes. The Sievert is the unit of absorbed radiation dose in living organisms modified by radiation type and tissue weighting factors. Multiples of Sieverts (Sv) used in the Health Canada Guidelines include millisieverts (mSv) and microsieverts (μSv).

NORM primarily contains uranium, thorium and potassium, and any of their radioactive decay products such as radium and radon (CNSC, 2013; CNSC, 2014). These elements are considered a primary contributor to an individual's yearly natural background radiation dose. Every day, people are exposed to small levels of ionizing radiation from both the human and natural environment; this is referred to as natural background radiation. The United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) identifies four major sources of public exposure to natural radiation:

1. **Cosmic radiation:** Originating from a variety of sources, including the sun and other celestial events in the universe. Ionizing radiation penetrates the earth's atmosphere and becomes absorbed by humans which results in natural radiation exposure. Exposure to cosmic radiation increases when flying in an airplane and residing in regions of higher altitudes;

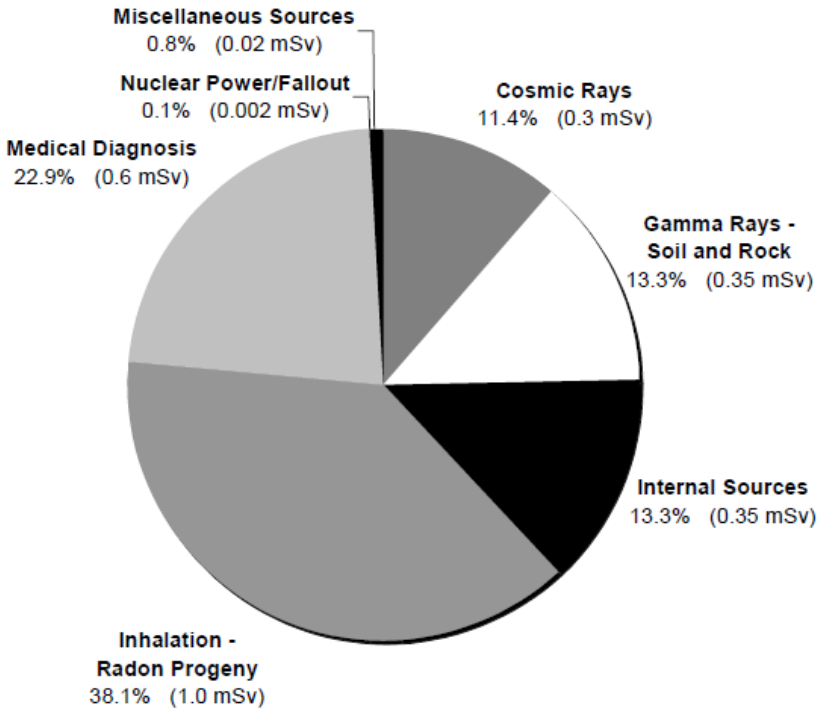
2. **Terrestrial radiation:** The earth's crust is a significant source of natural radiation as it contains natural deposits of uranium, potassium and thorium. Amounts of radioactive minerals vary significantly depending on location and geology. Traces of these minerals are also found in building materials, such as brick and cement blocks, granite counter tops and glazed tiles;

3. **Inhalation:** Inhalation of radioactive gases such as radon and thoron gases, are produced by minerals found in soil and bedrock, resulting in exposure to natural radiation. Similarly to

terrestrial radiation, radon and thoron levels vary considerably by location depending on the composition of soil and bedrock; and

4. **Ingestion:** Trace amounts of radioactive minerals are naturally found in the contents of food and drinking water. For example, bananas contain potassium-40, a radioactive substance present in nature and found in many other common foods such as red meats, white potatoes, carrots and Brazil nuts (CNSC, 2012; CNSC, 2013; Health Canada, 2014).

Figure 3 demonstrates the approximate percent of each source of background radiation dose received by the average Canadian. This chart demonstrates that cosmic radiation (variable with elevation), contributes to approximately 0.3 mSv/a over most of Canada (Health Canada, 2000; Health Canada, 2014). Terrestrial radiation accounts for 0.35 mSv/a, and inhalation of radon progeny contributes to roughly 1.0 mSv/a (Health Canada, 2000; Health Canada, 2014). In total, the average Canadian receives a typical annual dose of approximately 2.0 mSv from background radiation (Health Canada, 2000; Health Canada, 2014).



Source: Health Canada, 2014

Figure 3 Average Annual Radiation Dose of Each Source of Background Radiation Received by the Average Canadian

As indicated, NORM is often found in low concentrations in its natural state. However, industries exist where NORM becomes pre-concentrated through a production process, at concentrations above normal background levels, resulting in a potential for raised exposures to workers. Such industries include:

- **Forest Products:** Mineral ashes left from combustion may concentrate small amounts of NORM present naturally in plant materials and coal;
- **Mineral Extraction and Processing:** NORM may be released or concentrated in a process stream during the processing of ore;
- **Oil and Gas Production:** NORM originating in geological oil and gas formations is usually brought to the surface in produced water. As the water approaches the surface, temperature changes can cause radioactive elements to precipitate, resulting in scales and sludge to collect in water separation systems;
- **Tunneling and Underground Works:** Small amounts of radioactive minerals or gases may be present in underground caverns, sewer systems or tunnels; and
- **Water Treatment Facilities:** Treated fresh or wastewater may release radon (geothermal sources, fisher hatcheries) (CAPP, 2000; Health Canada, 2014).

2.6.2 Applicable Guidelines and Regulations

This section describes the guidelines and regulations that are applicable to the proposed Project; particularly the management and transportation of NORM impacted equipment, as well as the discharge of NORM impacted wash-water.

The proposed Project will not accept shipments of NORM impacted materials exceeding 70 Bq/g, therefore shipments received at the facility will be exempt from federal regulations and requirements.

2.6.2.1 Federal Regulations and Guidelines

Canadian Guidelines for the Management of Naturally Occurring Radioactive Material

As NORM is not considered part of the nuclear fuel cycle, it does not fall under the control of the Canadian Nuclear Safety Commission (CNSC), which licenses and controls radioactive materials associated with the nuclear fuel cycle. Accordingly, NORM is exempt from the *Nuclear Safety and Control Act*. NORM-related activities, therefore, fall under the jurisdiction of the provinces and territories which have resulted in inconsistencies in the interpretation and application of radiation safety standards across Canada related to NORM.

To harmonize standards and reduce jurisdictional gaps and overlaps, the Federal Provincial Territorial Radiation Protection Committee (FPTRPC), an intergovernmental committee, was established to support federal, provincial and territorial radiation protection agencies in carrying out their respective mandates (Health Canada, 2014). In 2000, the Canadian NORM Working Group, on behalf of the FPTRPC, developed the Canadian Guidelines for the Management of

Naturally Occurring Radioactive Materials (NORM) (referred henceforth as the Health Canada Guidelines) (Health Canada, 2000). The Health Canada Guidelines were revised in 2011.

The Health Canada Guidelines are an extension of international radiation protection practices and consensus standards recommended by the International Commission on Radiological Protection (ICRP) and the Canadian Nuclear Safety Commission (CNSC). The Health Canada Guidelines set out principles and procedures for the detection, classification, handling and material management of NORM in Canada. The Health Canada Guidelines also provide a framework for the development of more detailed NORM management practices and guidelines by regulatory authorities, affected industries and specific workplaces.

The FRTRPC recommend that the annual incremental effective dose to persons exposed to NORM as the result of work practices be limited to the values provided in Table 1. Health Canada has adopted these effective dose limits as recommended by the ICRP. These limits represent the foundation for all other radiation protection program recommendations within the Health Canada Guidelines.

Table 1 Radiation Dose Limits for Occupationally Exposed Workers, Incidentally Exposed Workers and Members of the Public

Affected Group	Annual Effective Dose Limit (mSv)[1]	Five Year Cumulative Dose Limit (mSv)
Occupationally Exposed Workers	20	100
Incidentally Exposed Workers and Members of the Public	1	5

Source: Health Canada, 2014

The Health Canada Guidelines provide the following definitions for the three categories of affected groups:

a) **Occupational Exposed Workers:** Employees who are exposed to NORM sources of radiation as a result of their regular duties. According to the Health Canada Guidelines, occupationally exposed workers' average annual effective dose should not exceed 20 mSv/a;

b) **Incidentally Exposed Workers:** Employees whose regular duties do not include exposure to NORM sources of radiation, but who work in an occupational exposure environment. Their average annual effective dose limit should not exceed 1mSv; and

c) **Members of the Public:** Persons who do not encounter occupational exposure to NORM. In accordance with the guidelines, the annual effective dose limit for members of the public is also 1mSv. As a conservative measure to further limit public exposure, the Health Canada Guidelines have adopted an incremental 0.3 mSv/a as an upper bound to the annual 1 mSv

[1] These limits exclude natural background and medical exposures to NORM.

dose to the public (referred by Health Canada as the dose constraint). The dose constraint would allow for exposures from other sources without the annual public dose limit being exceeded. The use of this incremental 0.3 mSv/a value is also recommended by the ICRP (Health Canada, 2014).

The Health Canada Guidelines include four NORM program classifications, summarizing the requirements for managing NORM (Table 2). Program classifications were established according to the level of risk and exposure to the general public and occupational workers, in order to identify the scope of the required NORM material management program.

Table 2 NORM Management Program Classifications

Classification	Description
Unrestricted	Potential doses (from other sources) to public is ≤ 0.3 mSv/a and workers ≤1.0 mSv/a. The guidelines recommend that NORM may be released with no radiological restrictions when the associated dose is no more than 0.3 mSv in a year. The radioactive hazard associated with this dose in considered insignificant.
NORM Management	Doses from sources of NORM exposures have potential to be >0.3 mSv/a, but ≤1.0 mSv/a to the public and workers. Levels of radioactivity in this category require further evaluation to determine the extent of protective measures to be applied. Public access should be restricted.
Dose Management	Doses from all sources of NORM exposures have potential to be >1.0 mSv/a but < 5.0 mSv/a to workers. The work site should be assessed periodically to measure changes in conditions and to facilitate worker dose calculations.
Radiation Protection Management	Doses from all sources of NORM exposures have potential to be >5.0 mSv/a, but < 20 mSv/a to workers. Beyond the management program requirements for this classification, a formal radiation protection program must also be developed.

Source: Health Canada, 2014

In addition to NORM program classifications, the Health Canada Guidelines include provisions to assist in NORM material management. Derived Release Limits (DRLs) provide an estimation of public dose from measured releases of NORM. A Radiation Assessment or Material Management program may compare measurement results to DRLs. In accordance with the Health Canada Guidelines, there are two classifications for material management:

1) **Unrestricted Classification:** Health Canada Guidelines recommend that NORM can be released without radiological restrictions when the associated incremental dose is ≤0.3 mSv/a. This incremental dose of ≤0.3 mSv/a allows for general public exposures to NORM sources without the public annual limit of 1.0 mSv from being exceeded. DRLs for the amount and concentration of NORM materials that meet this criterion are shown in Table 3 as Unconditional Derived Release Limits (UDRLs); and

2) **Release with Conditions:** NORM material in excess of the UDRLs provided in Table 3, require additional considerations prior to release. According to the Health Canada Guidelines, upon

release, NORM material must not contribute any incremental dose that would be greater than 0.3 mSv/a (Health Canada, 2014).

Table 3 presents values of UDRLs that must be met for the unrestricted release of NORM. Unrestricted release of NORM in accordance with concentrations qualifying as UDRL will deliver a maximum effective dose of ≤ 0.3 mSv/a.

Table 3 Unconditional Derived Release Limits – Unrestricted Release of NORM

NORM Radionuclide	Aqueous (Bq/L)	Solid (Bq/kg)	Air (Bq/m^3)
Uranium-238 Series (all progeny)	1	300	0.003
Uranium-238 (U-238, Th-234, Pa-234m, U-234)	10	10,000	0.05
Thorium-230	5	10,000	0.01
Radium-226 (in equilibrium with its progeny)	5	300	0.05
Lead-210 (in equilibrium with bismuth-210 and polonium-210)	1	300	0.05
Thorium-232 Series (all progeny)	1	300	0.002
Thorium-232	1	10,000	0.006
Radium-228 (in equilibrium with Ac-228)	5	300	0.005
Thorium-228 (in equilibrium with all its progeny)	1	3000	0.003
Potassium-40	n/a	17,000	n/a

Source: Adapted from Health Canada, 2014

Standards for the Transportation of NORM

Shipments of NORM impacted materials exceeding 70 Bq/g fall under federal regulations, the Packaging and Transport of Nuclear Substances Regulations (PTNSR) and the Transportation of Dangerous Goods Regulations (TDG). The TDG regulations provide rules for the transportation and temporary storage of materials designated as waste dangerous goods. In accordance with TDG regulations, NORM materials with an activity level greater than 70 Bq/g are classified as Class 7, Radioactive Materials.

Transportation of NORM with radioactivity ≤70 Bq/g is exempt from federal transportation regulations. For NORM materials ≤70 Bq/g, transportation vehicles do not require placement of radioactive placards or labels on vehicles or packaging. It is required however, for such materials to possess proper transportation manifests to identify materials as NORM.

Prior to shipment, NORM material must be assessed to determine the activity concentration. The Health Canada Guidelines categorize shipment standards into three classes:

1) **Unrestricted NORM Shipments:** Materials that meet the following two criteria do not require additional considerations for transportation:

    a. Meets the CNSC exemption criteria under the PTNSR; and

    b. Meets the UDRLs criteria for unrestricted release of NORM.

2) **NORM Shipments Subject to Canadian Guidelines:** NORM shipments having an activity concentration greater than the UDRLs are recommended to:

    a. Complete a transport manifest that contains the descriptor "*Naturally Occurring Radioactive Material – NORM*"; and

    b. Securely package the material in a manner that effectively prevents release or redistribution of any NORM contamination during transport.

3) **NORM Shipments Governed by the Federal Transport Regulations:** NORM shipment of materials exceeding 70 Bq/g s fall under federal jurisdiction, and are required to comply with PTNSR Regulations and TDG Regulations. NORM materials falling under federal jurisdiction typically require four to six weeks to prepare for shipment, as it involves several comprehensive steps (Health Canada, 2014).

2.6.2.2 Provincial Regulations and Guidelines

There are currently no general regulations in Nova Scotia regarding the storage, treatment and disposal of NORM waste. It is expected that the provincial regulation of NORM impacted material in Nova Scotia will take place through permit conditions (under the Activities Designation Regulations), and site-specific NORM management plans in accordance with the Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) (Health Canada, 2014).

In 2014, NSE developed site-specific permit conditions for a pilot project for Envirosystems to treat NORM impacted flow-back waters from a former onshore drilling site in Kennetcook, NS (Approval 2014-088503-R02; Approval to Operate-Temporary Industrial Wastewater Treatment System, located at 660 McElmon Road, Debert). For this particular project, NSE adopted the Health Canada Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) UDRLs discharge criteria and the Canadian Council of Ministers of the Environment (CCME) limits. The treatment system for NORM impacted wash-water in this case consisted of two dual bag house filters, followed by five PV2000 carbon vessels in series. The NORM treated wash-water was further treated by a Reverse Osmosis Filtration system. Results, as shown in Table 4, reveal that wastewater was treated to meet the Health Canada Guideline UDRLs criteria (NSE, 2014a). The treatment system was also successful in treating wastewaters to meet the national

CCME guidelines for release into a water body (NSE, 2014a). The combined treatment system was deemed successful in removing NORM radionuclides and any other parameters, and considered safe for disposal by the provincial government (NSE, 2014b).

Table 4 Summary of Test Results from Treated Hydraulic Fracturing Wastewater

ANALYTE	UNITS	HC URDL	Nova Scotia Environment APPROVAL LIMITS	Kennetcook PONDS SAMPLES - Highest Concentrations	NORM Filtered Water Sample # 25850	RO Treated Water Sample #25848
Uranium	Bq/L	1	1	<0.03	0.002	<0.001
Lead-210	Bq/L	1	1	<0.2	<0.01	<0.01
Radium-226	Bq/L	5	5	12.8	1.4	<0.05
Radium-228	Bq/L	5	5	0.7	<0.7	<0.7
Thorium-228	Bq/L	1	1	0.16	<0.1	<0.1
Thorium-230	Bq/L	5	5	0.037	<0.1	<0.1
Thorium-232	Bq/L	1	1	<0.1	<0.1	<0.1

Source: Adapted from NSE, 2014a

At the Debert facility, a NORM site assessment was conducted which focused on the perimeter of the waste water holding lagoon, property boundary, and drums of solid waste that had accumulated from the initial stages of the treatment process. Assessment results revealed that NORM management fell under the "unrestricted" category. Additionally, material at the facility did not show any activity above background levels to warrant further investigation or calculation of the incremental dose for worker exposure. However, precautions were still taken at this site. For example, Gieger Counter readings were measured upon opening filter vessels. In terms of worker safety, respirators and P100 cartridges were used while handling filter vessels, and otherwise the 2 m rule was followed to ensure workers were not in proximity to potential radiation sources.

2.6.2.3 Halifax Water Requirements

Halifax Water is the municipal water, wastewater and stormwater utility serving the HRM. The utility is incorporated under the *Halifax Regional Water Commission Act*, with authority to own and operate water supply, wastewater and stormwater facilities. Halifax Water defines rules and regulations for discharging sewage and/or wastewater into wastewater facilities under Schedule "B" Rules and Regulations for Water, Wastewater and Stormwater Services. In accordance with Schedule "B", "no person shall discharge into wastewater facilities, sewage or wastewater containing waste radioactive substances in excess of concentrations greater than those specified for release to the environment under the *Nuclear Safety and Control Act* and regulations or amended versions thereof". As NORM is not considered part of the nuclear fuel cycle, it does not fall under the control of the CNSC, and is exempt from the *Nuclear Safety and Control Act*. Therefore, there are no provisions for the discharge of NORM into Halifax Water's wastewater and/or stormwater systems. Under Schedule "B", Halifax Water has defined discharge concentration limits for parameters that must be met when releasing sewage and/or

wastewater into wastewater facilities. In accordance with Schedule "B", no person shall discharge into wastewater facilities, sewage or wastewater containing a concentration in excess of any of the limits set out in Table 5.

Proponents must obtain authorization from the Halifax Regional Water Commission (HRWC) for discharge of sewage or wastewater into wastewater facilities. In accordance with Schedule "B", discharge concentration limits must not be exceeded upon release of sewage or wastewater into wastewater facilities. The HRWC may also include additional provisions if deemed necessary to safely discharge sewage or wastewater. Envirosystems has received authorization from the HRWC to discharge treated wastewater given that wastewater meets discharge concentration limits as outlined in Schedule "B"- Rules and Regulations for Water, Wastewater and Stormwater Services and complies with the provisions of Schedule "A" – Halifax Regional Water Commission Schedule of Rules and Regulations.

Table 5 Halifax Water Sewage and/or Wastewater Discharge Concentration Limits – Wastewater Facilities

Substance	Milligrams per Litre
Aluminum, Total	50
Antimony, Total	5
Arsenic, Total	1
Barium, Total	5
Benzene, Total	0.01
Beryllium, Total	5
Biochemical Oxygen Demand	300
Bismuth, Total	5
Cadmium, Total	0.7
Chemical Oxygen Demand	600
Chlorides	1500
Chloroform	0.05
Chromium, Total	2
Cobalt, Total	5
Copper, Total	1
Cyanide, Total	2
1, 2 – Dichlorobenzene	0.05
1, 4 – Dichlorobenzene	0.08
Cis – 1, 2 – Dichloroethylene	4.0
Trans – 1, 3 – Dichloropropylene	0.15
Ethylbenzene	0.15
Fluoride	10
Iron, Total	50
Lead, Total	1

Table 5 Halifax Water Sewage and/or Wastewater Discharge Concentration Limits – Wastewater Facilities

Substance	Milligrams per Litre
Manganese, Total	5
Mercury, Total	0.01
Methylene chloride	0.2
Molybdenum, Total	5
Nickel, Total	2
Oil & Grease – mineral or synthetic in origin	15
Oil & Grease – animal or vegetable origin	150
Phenolic Compounds (4AAP)	1
Phosphorus, Total	10
Selenium, Total	1
Silver, Total	2
Sulphates Expressed as SO4	1500
Suspended Solids, Total	300
Sulphide (as H2S)	1.0
1, 1, 2, 2 – Tetrachloroethane	0.5
Tetrachloroethylene	0.5
Tin, Total	5
Titanium, Total	5
Toluene	0.01
Total Kjeldahl Nitrogen	100
Trichloroethylene	0.5
Vanadium, Total	5
Xylenes, Total	1.0
Zinc, Total	2

Source: Adapted from Halifax Water, 2011

3.0 Project Description

Envirosystems is seeking approval to amend their existing Industrial Approval to allow for the receiving and temporary storage of low-level NORM wastes and equipment, cleaning of low-level NORM impacted equipment, and treatment of associated wash-water. The existing property and facility, located at 25 Akerley Blvd., is currently zoned as a General Industrial Use Zone (I-2 Zone), under Dartmouth's Land Use By-Law. In accordance with Part 13, subsection 42(1) of the by-law, industrial enterprises except obnoxious uses and uses creating a hazard to the public shall be permitted in an I-2 Zone. An "obnoxious use", as defined under Dartmouth's Land Use By-Law refers to, "a use which from its nature or operation, creates a nuisance or is offensive by the creation of noise, vibration, glare, electrical interference, fire explosion hazard

or by reasons of the emission of gas, fumes, dust, oil, or objectionable odor, or by reason of the unsightly store of goods, wares, merchandise, salvage, refuse matter, waste or other material" (As amended by By-law C-514, Feb 15/84). Under this definition, the proposed Project amendments do not classify as an obnoxious use, nor do they create a hazard to the public as there will be no exposure pathways to emissions, contaminants or effluents.

This section describes the required site preparation and construction, and the proposed operations applicable to the Project; particularly for the receiving and temporary storage of low-level NORM waste and equipment, impacted equipment cleaning and treatment, and treatment of NORM impacted wash-water. For a detailed process flow diagram, refer to Appendix C. Proposed monitoring and management activities and programs, as well as schedule, emissions and effluents, and decommissioning and reclamation requirements are also addressed in this section.

3.1 SITE PREPARATION AND CONSTRUCTION

The aspects of the proposed Project will occur within the confines of the existing Envirosystems Akerley facility. The existing and proposed site is located in a highly developed industrial area, characterized by paved surfaces and roads, chain link fences and restricted access. The footprint of the existing property will not expand. The containment storage systems, including the laydown pad, storage container, and the separate segregated storage area for NORM impacted equipment cleaning will be positioned in the yard of the facility, within property boundaries. There will be no new ground disturbances of any "greenfield" areas or disturbance of natural environments. No direct habitat loss and/or disturbances to wildlife are expected.

3.2 OPERATIONS

3.2.1 Receiving of Low-Level NORM Impacted Waste and Equipment (≤ 70 Bq/g)

The Akerley site will receive low-level (≤70 Bq/g) NORM impacted waste and equipment from the source via a flatbed truck, van body trailer or other appropriate transport trucks capable and permitted to haul the material. Only materials with activity ≤70 Bq/g will be received at the Akerley facility. NORM impacted material with a total specific activity of ≤70 Bq/g is exempt from TDG regulations. Vehicles transporting NORM material ≤70 Bq/g do not require placement of radioactive placards or labels on vehicles or packaging. Proper transport manifests identifying the material as NORM are required.

NORM impacted waste and equipment will be analyzed for radioactive content before being received at the facility. Envirosystems personnel will confirm radioactive content prior to acceptance. The radioactive content of equipment and waste received at the facility will be confirmed through the use of a calibrated detector with an attached pancake probe (Appendix C). Prior to acceptance, Envirosystems personnel will take an initial reading of materials. A reading in counts per minute (CPM), standing roughly 1-2 cm away from the material will be taken. If the reading is less than 200 CPM, the material will be accepted. If the reading is greater than 200 CPM, but less than 2000 CPM, the material will be labeled as NORM

contaminated and accepted. If the reading is greater than 2000 CPM, material will be sent to the lab to determine activity level in Bq/g. If the activity level is less than or equal to 70 Bq/g, the material will be labeled as NORM contaminated and accepted. If the activity level is greater than 70 Bq/g, the material will be rejected, and will not be accepted at the Akerley facility. Materials with NORM activity >70 Bq/g will be shipped to an approved facility.

Low-level NORM impacted equipment will be packaged at the source, with 6 mil polyethylene sheeting, plugs, caps or other containment, to contain the NORM materials and reduce the potential of a release during transportation. Expected NORM impacted waste and equipment predicted to arrive at the facility will vary, but generally includes 6, 10, and 16 inch piping in lengths of 4 to 8 metres, valves and hoses of varying diameter, and waste containers. Impacted equipment typically arrives from offshore oil and gas operations in waste skips or baskets (Photo 1).

Photo 1 NORM Impacted Equipment Arriving at the Source.

A very low volume of NORM impacted equipment is initially expected at the Akerley facility (approximately 6-8 pieces of equipment per year). This volume is expected to increase as offshore gas projects begin decommissioning. The actual amount of NORM equipment and waste resulting from potential future offshore decommissioning of gas projects is currently unknown. However, it is estimated that, at peak demand, an additional 1-2 trucks entering and leaving the facility per week could occur at the proposed facility, over a project term of roughly18-24 months. Current operations at the Akerley facility consist of approximately 2-4 trucks entering and leaving the facility per day. Transportation of materials will be consistent with current operations at the site and zoning requirements. Transportation will occur along existing roads and designated routes.

3.2.2 Temporary Storage of Low-Level NORM Impacted Waste and Equipment (≤ 70 Bq/g)

Upon acceptance of low-level NORM impacted waste and equipment, Envirosystems will temporarily store the materials in designated areas. Instances may occur where the facility receives low-level NORM impacted wastes from clients where further NORM treatment is not

required or suitable. In such cases, the low-level NORM impacted waste will be stored temporarily in fully contained storage systems until transportation for final disposal at an approved NORM disposal facility. Low-level NORM impacted equipment requiring further treatment at the Envirosystems site will be temporarily stored in fully contained storage systems in preparation for cleaning.

The proposed NORM storage area will be positioned in the south west corner of the property, and consist of an approximately 90 m^2 portable laydown pad and a 40 m^2 portable storage container (Photo 2a, b). The containment system will be constructed of steel and contain a laydown pad and storage container.

The laydown pad is self-contained with a built in collection sump, a steel floor and side walls, without any floor drains (Photo 2a). The laydown pad has an above ground platform, designed to collect water and solids, as required. In this application, it will be used as a secondary containment pad for bulkier NORM contaminated equipment and components. These materials will arrive packaged or sealed such that the NORM contaminants are protected from exposure. Should the packaging be compromised and a leak occurs, the collected effluent will be diverted to a gutter system where solid and liquid separation will occur. Collected fluid will be directed to a feed tank for the wash-water treatment process and treated before discharge. Any solids collected in the side gutter can be manually removed and disposed of appropriately. The storage container has a corrugated steel floor, a 0.30 metre berm and does not possess any floor drains (Photo 2b). The storage container has a corrugated steel floor and is approximately 2 metres wide and 16 metres long.

a.

b.

Photo 2 Proposed Laydown Pad and Storage Container

Containment systems will have a complete compliment of emergency response equipment and the following safety items will be implemented:

- Envirosystems' Safe Work Practices associated with NORM (Appendix B);
- Inventory management system;
- Regular safety inspections;

- Regular radiation monitoring;
- Personnel protective equipment; and
- NORM safety training of personnel.

3.2.3 Low-Level NORM Impacted Equipment Cleaning

NORM deposits are generally seen as scale deposits on the inside surface of production equipment, such as piping, valves, tubulars, risers, waste containers and other offshore-related mechanical equipment. Upon acceptance of NORM impacted equipment, the type, amount and orientation of the scale and other contaminates will be assessed, and a suitable cleaning method will be chosen. Cleaning methods will be chosen in an effort to reduce the amount of wash-water generated, and protect worker safety. Typically, High Pressure Water Blasting (HPWB) operations will be required to successfully remove hard scale and deposits from surfaces of process equipment, piping and other components. HPWB operations will use city water (provided by Halifax Water) to remove scale from NORM impacted equipment. HPWB operations will be in accordance with the existing Envirosystems' HPWB Safe Work Practices. High pressure system components will include a high pressure pump (NLB Model 10305D or equivalent), hoses, lances and/or specialized nozzles (such as Banshee Polishing Nozzles). Envirosystems does not intend to use abrasives, solvents or surfactants, at this time, to assist with low-level NORM impacted equipment cleaning.

NORM impacted equipment cleaning will occur in a second, segregated storage container, outfitted with a portable and automated cleaning system (Photo 3). The cleaning system container is designed to capture 100% of the wash-water and mist generated from HPWB operations. This unit is self-contained with approximately 2 metre high walls on all sides and 13 metre slots cut out on each side for pipe entry. Treated equipment can be either re-used by the client, or recycled at an approved, local, metal recycling facility. Resulting NORM wash-water will be collected and stored in storage tanks at the facility.

Photo 3 Proposed NORM Impacted Equipment Cleaning Container

3.2.4 Treatment of NORM Impacted Fluids

Wash-water generated during the cleaning process will be treated first through a NORM Treatment Unit, to remove any NORM particles from the wash-water to below Health Canada's UDRLs (Aqueous) (Table 3). Given that NORM typically occurs as insoluble deposits inside of piping, filters and other water treatment components, the majority of NORM can be removed thru basic filtration processes. Pollution Prevention officers from Halifax Water will conduct initial inspections of the treatment system prior to commencement of operations.

The NORM Treatment Unit consists of mechanical filtration and carbon adsorption. Mechanical filtration includes a multi-purpose industrial filter bag, and housing and polyester filter bags sized to remove down to 5 micron particles. After mechanical filtration, the wash-water is pumped through a bed of granular activated carbon, adsorption media which is housed in a series of 2000-lb of carbon adsorption vessels. The life of the carbon media is dependent upon the level of contamination in the wash-water however; frequent carbon change outs are not expected. Spent carbon will be analyzed for NORM and disposed of at an approved facility. To ensure parameters are in accordance with HRWC's discharge criteria (Table 5), NORM treated wash-water will be further processed through an Ultrafiltration and/or a Reverse Osmosis treatment system.

Ultrafiltration is a pressure-driven process that removes emulsified oils, metal hydroxides, colloids, emulsions, dispersed material, suspended solids and other large molecular materials from water and other solutions. Ultrafiltration excels at the clarification of solutions containing suspended solids, bacteria, and high concentrations of macromolecules, including oil and water. It is expected that the HRWC discharge criteria can be achieved using the Ultrafiltration unit alone. However, if required, a Reverse Osmosis system will be used to address any remaining contaminants.

Reverse Osmosis treatment systems involve the reversal of osmotic pressure in order to drive water away from dissolved molecules. Reverse Osmosis depends strictly on ionic diffusion to affect separation. Given that the osmotic pressure of many process streams is quite high, Reverse Osmosis membranes must operate at pressures of 400-1,200 psi (29-83 bars), which restricts available membrane geometries. Reverse Osmosis treatment systems are commonly applied during seawater desalination.

Treated wash-water will be collected and stored in batches of up to 80,000 litres in isolated storage tanks for testing and confirmation that all applicable parameters are below Health Canada's UDRL criteria and HRWC's discharge criteria, by independent accredited third party laboratories. All samples shall be sent to Halifax Water Pollution Prevention staff prior to discharge to ensure compliance with provisions listed under Schedule "A" – Halifax Regional Water Commission Schedule of Rules and Regulations and Health Canada's UDRL criteria. Once each batch has been confirmed to comply with the applicable guidelines and discharge criteria, the treated wash-water will be discharged into Halifax Water's sewer system from the Akerley facility (Figure 4). If any batch of treated wash-water does not meet the guidelines and discharge

criteria, the batch will be re-processed, stored and tested again to ensure applicable requirements are met prior to discharge.

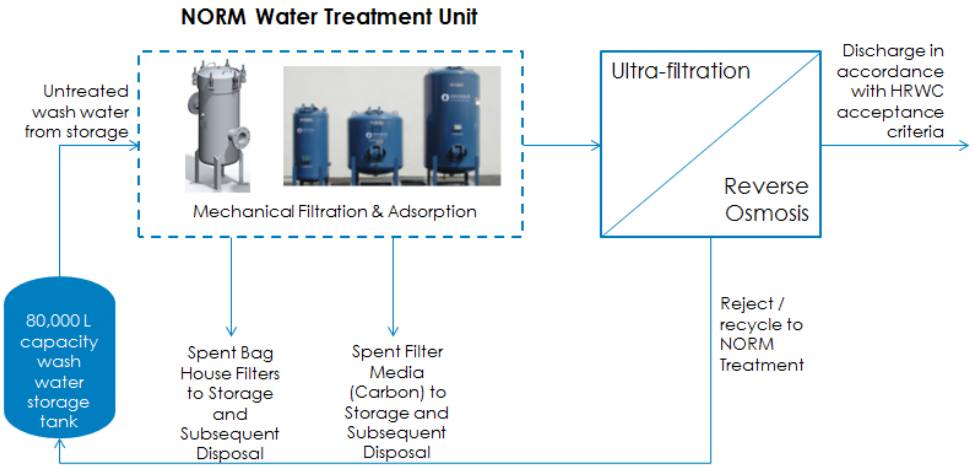


Figure 4 Proposed Treatment of NORM Impacted Fluids

Envirosystems will be responsible to maintain a written log recording the time, volume and flow rate of each batch discharged into the municipal wastewater system. They will also be responsible for monthly reporting of the flow, including a photo of the meter showing the readings at the end of each month, as well as sample results and any performance issues with the NORM Treatment Unit.

Envirosystems will containerize and store separately any solids and sludge wastes, generated as part of their treatment system. Envirosystems will test and analyze solid and sludge wastes for NORM contamination levels, and subsequently transport reject materials produced from the various waste streams to an approved facility. NORM disposal facilities are restricted to accept only NORM materials that are below, or equal to, 70 Bq/g. As the Envirosystems facility receives only incoming materials for treatment with activity levels ≤70 Bq/g, it is not expected after treatment for the generated waste streams to have radionuclide activity levels above 70 Bq/g. As validation, Envirosystems has had independent NORM testing performed on samples of the various waste streams of their treatment system by Saskatchewan Research Council; the results of which have shown that the total radionuclide activity is less than 5% of the allowable 70 Bq/g criteria.

3.3 MONITORING AND MANAGEMENT

Envirosystems' "*Safe Works Practices – Naturally Occurring Radioactive Materials*" (Appendix B) outlines the workplace practices that are to be complied with to ensure workers and the environment are protected from potential hazards associated with NORM. NORM safety training shall be provided to all Envirosystems personnel and contractors who are either responsible for the management of NORM or who are likely to encounter NORM during their work in order to

develop the skills necessary to reduce radiation exposures, and reduce the risk of personnel and environmental contamination. NORM radiation safety training includes the following topics:

- Sources of NORM accumulations in the oil and gas industry;
- Classification of risks associated with materials contaminated with NORM;
- NORM units of radioactivity and radiation dose;
- Radiation dose control aims and objectives;
- Public and occupational radiation dose limits;
- Correct use of radiation detection instrumentation for NORM radiation surveys;
- Purpose of NORM surveys;
- Safe work practices for personnel working in NORM contaminated environments;
- Organization of work areas for the decontamination of NORM contaminated equipment;
- Decontamination procedures for tools and equipment contaminated with NORM;
- Management of the injured worker contaminated with NORM; and
- Management of waste contaminated with NORM.

No person shall be allowed to work in a NORM impacted area or with NORM impacted equipment until they have received the required level of radiation safety training.

Additionally, Envirosystems has committed to equipping personnel with personal dosimeters to calculate the incremental annual effective dose workers are exposed to at the facility. Dosimeters will be registered with Health Canada and results of radiation dosimeter will be retained and reviewed to determine adequacy of control measures implemented by Envirosystems Inc. (Appendix B). This data will be used to verify that the appropriate NORM program classification is unrestricted.

Upon acceptance of material, a background reading in µSv/hr, near to but not at the material or suspected area will be taken. Then, a reading in µSv/hr, about 1-2 cm away from the material or suspected area will be taken. If the second reading (total surface dose rate) is greater than 0.15 µSv.hr, a potential incremental dose in mSv/a will be calculated. If an assessed incremental dose is greater than 0.3 mSv/a, NORM Management program will be implemented, as outlined in the Health Canada Guidelines. The maximum daily recommended time will be determined based on:

- Maximum incremental effective dose of 0.3 mSv/a;
- Measured radiation exposure rate at a typical working distance from the material in µSv/hr; and
- Expected number of working hours per year under the assumed exposure conditions.

This procedure is illustrated in Appendix C (Process Flow Diagram).

The Health Canada Guidelines for the Management of NORM recommend that NORM be released without radiological restrictions when the associated dose is ≤0.3 mSv/a. The radioactive hazard associated with this dose is considered insignificant (Health Canada, 2014). Given that the Envirosystems facility will only receive NORM impacted equipment and waste that is ≤70 Bq/g, and due to the low estimated volume to be received at the facility, Envirosystems predicts that the incremental effective dose will fall within the unrestricted NORM management program classification. Regardless, Envirosystems commits to taking proactive measures to ensure safety to workers and the public. For example, public access is currently, and will continue to be, restricted. There are no credible pathways for public exposure. Additionally, Envirosystems employees will wear the proper personal protective equipment and dosimeters in order to accurately analyze exposure levels.

Envirosystems' contingency plan currently includes provisions to provide awareness of how to manage emergency response intervention to prevent harm to people, prevent or minimize environmental damage, minimize property damage and maintain the continuity of business. This document will be updated to reflect the proposed Project amendments.

3.4 SCHEDULE

Envirosystems operates on a year-round basis and maintains a full-time office. Hours of operation are Monday to Friday 8:00 am to 5:00 pm. If the volume of equipment and waste received at the proposed facility increases, evening and weekend shifts may be required.

Pending approval, activities will commence with the mobilization of the portable containment systems, including the laydown pad and storage containers. Mobilization of equipment is anticipated to occur within 2-3 weeks of approval. During this time frame, Envirosystems has committed to providing NORM safety training to applicable personnel and contractors who are either responsible for the management of NORM or who are likely to encounter NORM during their work, in order to develop the skills necessary to reduce radiation exposures and reduce the risk of personnel and environmental contamination. Envirosystems' "Safe Works Practices – Naturally Occurring Radioactive Materials" outlines the workplace practices that are to be complied with to protect workers and the environment from the hazards associated with NORM (Appendix B). NORM impacted equipment cleaning and subsequent wash-water treatments are anticipated to begin within 2 to 3 months of approval, subject to customer demand.

3.5 EMISSIONS AND EFFLUENTS

Proposed Project activities (receiving and temporary storage of NORM impacted waste and equipment, equipment cleaning, and treatment of NORM impacted wash-waters) will be consistent with current facility operations approved by NSE (Approval No. 2004-042042-T05; No. 2004-038682-R01; and No. 2007-055775-T02), and any subsequent amendments (Appendix A).

The proposed Project amendments will not generate air pollution beyond those of the current Envirosystems operations. Any monitoring of air pollution will be conducted at the request of NSE and in accordance with the Nova Scotia Air Quality Regulations and the facility Approval (or

future amendments). Envirosystems shall operate the facility in a manner which minimizes odor and volatile organic carbon (VOC) pollutants and does not cause adverse impacts to the receiving environment. Air pollution from the facility shall not exceed a maximum opacity of twenty percent (20%).

The proposed Project amendments will not generate noise at levels beyond those of the current Envirosystems operations. As per the requirements of the current operating Approval and standard provincial guidelines, sound from the operation will be maintained at the following levels (L_{eq}) at the property boundaries:

- L_{eq} 65 dBA 0700-1900 hours (Days);
  60 dBA 1900-2300 hours (Evenings); and
  55 dBA 2300-0700 hours (Nights).

Monitoring of sound levels shall be conducted at the request of NSE. If monitoring is required, the location of monitoring stations will be established by the Administrator and may include points beyond the property boundary.

Air pollution, noise, and odor complaints will be recorded and records made available to NSE upon their request. If air pollution, noise or odors are deemed excessive by NSE, Envirosystems will mitigate the impacts to the satisfaction of NSE.

The proposed Project amendments will generate wastewater effluents. NORM impacted equipment will be cleaned inside self-contained storage systems, using city water at high pressure to remove scale. Wash-water will be treated first through the facility's NORM Treatment Unit, to meet the Health Canada Guidelines, followed by Ultrafiltration and/or Reverse Osmosis to lower contaminants to meet discharge parameters in accordance with HRWC's discharge criteria. Treated wash-water will be collected and stored in batches in isolated tanks at the Akerley facility for testing and confirmation of compliance, by an accredited, independent party. Once each batch has been confirmed to meet the applicable guidelines, the treated wash-water will be discharged into HRWC's sewer system.

To proactively avoid spills or leaking of wash-water effluents, storage and handling areas of the facility lack open floor drains. The facility yard area is paved, curbed and sloped towards a containment sump that allows for containment of spills or leaks on the property. Inside the facility, in the offloading bay area, a containment sump and curbed contained area exists where trucks can unload and load shipments. If a spill were to occur, any liquids would be captured within the containment area, as all containers are surrounded by secondary containment sized to contain 110% of the volume of the largest container. Other control measures include implementing Envirosystems' best practices for handling of materials, such as established contingency plans outlining emergency response procedures for spills and safe work practices that are to be complied with when working with NORM.

As per the current facility operations approved by NSE, Envirosystems is required to complete a groundwater monitoring program at the request of NSE, and will be responsible to mitigate any negative groundwater impacts which are found to result from the operation of the facility.

The only solid materials generated from the proposed Project will consist of solids and sludge created during the treatment process. Solids and sludge will be collected and stored in appropriate and approved containers, and based on site acceptance criteria and waste corresponding analysis for NORM and other contaminants, disposed of at an approved disposal facility.

3.6 DECOMMISSIONING AND RECLAMATION

The Envirosystems' facility is expected to be in operation for the foreseeable future with proper maintenance, according to market requirements. When permanent shut down of the facility is planned, Envirosystems' will work with NSE to prepare a final decommissioning and reclamation plan according to regulations at the time. In general, it is expected that the equipment at the processing facility will be decontaminated and removed, and any required site remediation will be conducted.

4.0 Scope of the Environmental Assessment

The proposed Project must be registered for an EA as per Section 3(2) of the Environmental Assessment Regulations of the Nova Scotia *Environment Act* as a Class 1 Undertaking. This report substantially fulfills the requirements for Project registration under this legislation.

There are no requirements under the *Canadian Environmental Assessment Act*, 2012 (CEAA 2012) as the proposed Project is not listed as a designated project as per Section 2 of the Regulations Designating Physical Activities and the Project does not take place on federal lands.

4.1 VALUED COMPONENT (VC) IDENTIFICATION

The scope of the EA for the proposed Project has been determined by the Proponent and Stantec, and is based upon the proposed Project elements and activities, the professional judgment of the study team, consultations with NSE and previous site information.

This EA focuses the evaluation of potential environmental effects of the proposed Project amendments on Valued Components (VCs). VCs are broad components of the biophysical and socio-economic environments that, if altered by the Project, may be of concern to regulatory agencies, the Mi'kmaq of Nova Scotia, scientists, and/or the general public.

Table 6 indicates scoping considerations and selection of VCs used in this EA based on potential effects pathways and standard mitigation measures.

Table 6 Scoping of VCs

Component	Scoping Considerations	VC
	Biophysical Environment	
Groundwater	The proposed Project is not anticipated to interact with groundwater resources. City water will be used to clean NORM impacted equipment, within self-contained storage systems. The possibility of groundwater contamination through spills or leakage is reduced as self-contained storage systems are constructed of steel, without floor drains. The facility yard area is paved, curbed and sloped towards a containment sump that allows for containment of any spills or leaks on the property. Inside the facility, in the offloading bay area, a containment sump and curbed contained area is located where trucks can unload and load shipments. If a spill were to occur, liquids would be captured within the containment area, as all containers are surrounded by secondary containment sized to contain 110% of the volume of the largest container. Envirosystems will continue to comply with existing permit conditions for groundwater monitoring which indicate that the Approval Holder shall install and implement a groundwater monitoring program at the request of NSE, and that the Approval Holder shall be required to mitigate any negative groundwater impacts found to result from the operation of the facility.	• Not a VC; no likely pathways
Surface Water, Fish and Fish Habitat	The proposed Project is not anticipated to interact with surface water, fish or fish habitat. The cleaning of low-level NORM impacted equipment will result in the generation of wash-water that will require dedicated collection and treatment. All operational aspects of the proposed Project will occur within the confines of the current Envirosystems' facility, in self-contained storage systems. Treated wash-water will be collected and stored in batches into isolated tanks at the facility for independent third party testing and confirmation that all applicable parameters are below Health Canada's NORM guidelines and HRWC's discharge criteria prior to discharge into Halifax Water's sewer system. These guidelines and criteria are based on dose calculations and an assumption of daily water intake by human receptors. No similar guidelines exist for intake of the various NORM isotopes by aquatic life, though there is a parallel that can be drawn from the literature for total uranium (combination of all the NORM uranium isotopes). That is, there exists a very good similarity between the Health Canada drinking water guideline for total uranium of 20 ug/L and the CCME water quality guideline (CWQC) for total uranium for protection of fresh water aquatic life at 15 ug/L (long term exposure). This relationship likely exists for all NORM isotopes and by extension, having guidelines protective of aquatic life.	• Not a VC; no likely pathways
Wetlands	The proposed Project is not anticipated to interact with wetlands. Wetlands are valued resources, protected by the Nova Scotia *Environment Act* and Regulations. No wetlands (naturally occurring or anthropogenic) are present on the existing facility site and there will be no discharges to wetlands or any other interactions with wetlands.	• Not a VC; no likely pathways

Table 6 Scoping of VCs

Component	Scoping Considerations	VC
Flora and Fauna	The proposed Project is not anticipated to interact with flora or fauna. The proposed Project will not result in any new ground disturbance of "greenfield" areas or disturbance of natural environments. The existing facility is located in a heavily developed industrial area, characterized by paved surfaces, roads, and chain link fences. All aspects of the proposed Project will occur on the existing site. Therefore, no habitat loss or disturbance to wildlife is expected.	• Not a VC; no likely pathways
Atmospheric Environment	The Envirosystems' Akerley facility is situated in a General Industrial Use Zone (I-2 Zone) under Dartmouth's Land Use By-Law, which is separated from residential areas and sensitive land uses. This facility is an existing operation that has procedures for the receiving, handling, treatment and storage of hazardous and non-hazardous materials. Existing permit conditions require that air pollution from the facility shall not exceed a maximum opacity of 20%, and monitoring and mitigation may be required by request of the Department if odor or air pollutants are deemed excessive. The proposed Project is not expected to produce any air pollution, or interact with the atmospheric environment. Envirosystems will continue to comply with existing permit conditions. Emissions and effluents are further discussed in Section 3.5.	• Not a VC; no likely pathways
Acoustic Environment	The Envirosystems' Akerley facility is situated in a heavily developed industrial area that is separated from residential areas and sensitive land uses. The receiving, temporary storage, equipment cleaning, and the treatment and discharge of NORM impacted wash-water will not generate noise at levels beyond those of the current Envirosystems operations. As per Envirosystems' industrial approval permits, sound levels measured at the facility property boundaries shall not exceed 65 dBA from 0700-1900 hours, 60 dBA from 12900-2300 hours and 55 dBA from 2300-0700 hours. Envirosystems will continue to comply with existing permit conditions. Emissions and effluents are further discussed in Section 3.5.	• Not a VC; no noise emissions exceeding currently permitted limits
Socio-economic Conditions		
Land Use	The Envirosystems' Akerley facility is zoned as a General Industrial Use Zone (I-2 Zone), under Dartmouth's Land Use By-Law, and is located on private land with restricted access. The proposed amendments will be consistent with current operations at the site and zoning requirements.	• Not a VC; consistent with current land use designation

Table 6 Scoping of VCs

Component	Scoping Considerations	VC
Transportation	The Envirosystems' Akerley facility is zoned as a General Industrial Use Zone (I-2 Zone), under Dartmouth's Land Use By-Law, and is located on private land with restricted access. The proposed amendments will be consistent with current operations at the site and zoning requirements. Current operation at the Akerley facility includes approximately 2-4 trucks entering and leaving the facility per day. Shipments of NORM impacted equipment are currently very rare. Envirosystems' estimates that they will receive approximately 6-8 pieces of NORM impacted equipment per year. NORM impacted equipment will be packaged securely at the source, to contain the NORM materials and to prevent any scale from escaping. Only materials with activity ≤ 70 Bq/g will be received at the Akerley facility. Transportation of materials will be along existing roads and designated routes. Therefore, the proposed Project is not expected to significantly increase traffic on public roads. This volume is expected to increase as offshore oil and gas operators begin decommissioning operations.	• Not a VC; minor incremental increase in trucking at site.
Cultural and Heritage Resources	The proposed Project will not result in any new ground disturbances. The existing facility is located in a highly developed industrial area, characterized by paved surfaces, roads, and chain link fences. Therefore, the proposed Project is not expected to interact with cultural and heritage resources.	• Not a VC; no likely pathways
Municipal Infrastructure	The proposed Project will interact with municipal infrastructure. The Project will generate wash-water during the cleaning process of low-level NORM impacted equipment. The generated wash-water effluent will be treated to meet applicable guidelines then discharged into Halifax Water's sewer system from the Akerley facility. Effects on municipal infrastructure are discussed in the VC.	• VC due to discharge of treated wastewater to municipal sewer.

5.0 Consultation and Engagement

NSE reviewed a preliminary project description and comments were received following review by several federal and provincial governmental departments. These comments and questions were addressed where required in this EA.

A presentation was held on December 9, 2015 with the NSE EA Officer and additional NSE employees. The purpose of this presentation was to: provide an informal overview of the proposed Project; address technical aspects and concerns regarding NORM; identify and discuss issues and concerns to inform the scope of the EA; and to discuss the proposed Project schedule and required regulatory approvals.

Envirosystems developed a Public and Government Relations communications strategy specific to the proposed Project. The purpose of the strategy was to actively engage with stakeholders and decision-makers to enhance their understanding of the proposed Project. Envirosystems has actively engaged in a series of face-to-face meetings with federal, provincial and municipal

elected officials. Envirosystems also held open houses on January 28 and 29, 2016 for neighboring businesses that expressed an interest in or may be potentially affected by the proposed Project. Invitations were delivered to each neighbor within a 250 m radius. The purpose of these activities was to introduce various stakeholders to Envirosystems, provide adequate information of the proposed Project, and address any comments, suggestions or concerns (Table 7).

As recommended by the Nova Scotia Office of Aboriginal Affairs, a project information package, outlining the proposed Project, scope of the EA, and the public engagement approach was developed and provided to the Kwilmy'kw Maw-klusuaqn Negotiation Office (KMKNO) and the Sipekne'katik First Nation for review and comment on January 26, 2016. Upon EA Registration, no comments had been received from the KMKNO or the Sipekne'katik First Nation in regards to the proposed Project (Table 7).

Table 7 outlines all the steps taken by Envirosystems to identify the concerns of the public and Aboriginal people, and includes a list of all concerns expressed by the public and Aboriginal people, where provided, and steps taken by the proponent to address any concerns.

Table 7 Engagement activities undertaken by the proponent, including comments expressed by stakeholders and the proponent's responses to concerns of stakeholders.

Activity	Date	Stakeholder(s)	Purpose	Comments	Proponent Responses
Telephone Calls & Emails	December 5, 2015; January 25 & February 9, 2016	Aaron MacMullin, Executive Assistant to Dartmouth North MLA	Project briefing	N/A	N/A
Email	January 12, 2016	Trevor Floyd & Allan Billard, Executive Assistants to the Minister of Environment and Finance	Project briefing	N/A	N/A
Meeting	February 11, 2016	Nova Scotia Department of Energy (Bill O'Halloran, & Scott Weldon)	Company introduction, project briefing, & EA overview	1. It is important to handle NORM responsibly. Helpful to have local company provide the service. 2. What is the likelihood of finding high-levels of NORM? 3. Are we allowed to discharge the treated water into Halifax Water system?	1. Comment noted. 2. It is very rare. In Newfoundland, it was only found twice in 10 years. If high-levels are found, it gets shipped to Saskatchewan for treatment. 3. Yes, but the water has to be treated to meet Halifax Water's discharge criteria.
Meeting	February 11, 2016	Darren Fisher, Dartmouth-Cole Harbour Member of Parliament	Company introduction, project briefing, & EA overview	1. What are the opportunities for engagement? 2. Questions about the concentration of radioactive materials and whether they are hazardous in their concentrated form.	1. The proponent has held open house for neighbours, met with all levels of government and sent project information letters to the KMKNO and the Sipekne'katik First Nation. Further opportunities during the EA for public comments. 2. Envirosystems will only be accepting materials with low level NORM concentrations as per Health Canada's Guidelines for NORM Management. Any materials that are above the threshold will not be accepted at the facility, and will be transported directly to an approved disposal facility in western Canada.

Table 7 Engagement activities undertaken by the proponent, including comments expressed by stakeholders and the proponent's responses to concerns of stakeholders.

Activity	Date	Stakeholder(s)	Purpose	Comments	Proponent Responses
Meeting	January 8, 2016	Mike Savage, Mayor of Halifax Regional Municipality	Company introduction, project briefing, & EA overview	1. What are the opportunities for engagement? 2. Potential employment opportunities. 3. Suggested to present to Environmental & Sustainability Committee. 4. If treated safely and responsibly in Nova Scotia, that is a better option for the province as opposed to shipping elsewhere for treatment.	1. The proponent has held open houses for neighbours, met with all levels of government and sent project information letters to the KMKNO and the Sipekne'katik First Nation. Further opportunities during the EA for public comments. 2. Comment noted. 3. Comment noted. 4. Comment noted.
Email requesting meeting	February 9 & 10, 2016	Tony Mancini, Halifax Regional Municipality, Councilor for Harbourview-Burnside-Dartmouth East	Emailed company introduction and project briefing	N/A	N/A
Open House	January 28 & 29, 2016	Invitations were delivered to each neighbor within a 250 metre radius of the proposed facility (25 Akerley).	Company introduction, project briefing, & EA overview	Invitations to attend open houses were sent out but no responses were received. Additional public review period during the EA review.	N/A
Letter	January 26, 2016	KMKNO and Sipekne'katik First Nation.	Company introduction, project briefing, & EA overview	Offer to discuss project. No comments have been received to date.	N/A
Meeting	TBD	Maritimes Energy Association (Ray Ritcey)	Company introduction, project briefing, & EA overview		

Table 7 Engagement activities undertaken by the proponent, including comments expressed by stakeholders and the proponent's responses to concerns of stakeholders.

Activity	Date	Stakeholder(s)	Purpose	Comments	Proponent Responses
Meeting	TBD	Halifax Chamber of Commerce (Valerie Payn & Nancy Conrad)	Company introduction, project briefing, & EA overview		

As part of the EA process, this EA Registration document will be subject to a public review process as required under Environmental Assessment Regulations. The document will be posted on the NSE website (http://www.novascotia.ca/nse/ea/) with paper copies at several locations including near the Project area. NSE will also provide Mi'kmaq organizations including the KMKNO and the Sipekne'katik First Nation with the NSE website for this EA Registration document in a formal letter. Publication dates and Registration document locations will be advertised in one Province-wide newspaper and one local newspaper. Public and Mi'kmaq comments regarding the EA Registration will be collected and reviewed by NSE to inform the Minister's decision regarding the proposed Project.

6.0 Valued Component and Effects Management

6.1 EFFECTS ANALYSIS METHODS

A focused approach is used for the EA using the VCs identified in the scoping process described in Section 4.0. An EA is a planning tool that allows for the identification of predicted Project effects, the designing of mitigation strategies to reduce adverse effects and proposing of monitoring programs, where required.

Given the nature of this EA, only one VC (Municipal Infrastructure) was identified as having a potentially substantial interaction with the proposed Project activities. For the selected VC, potential Project-VC interactions are identified and effects, including proposed mitigation, are predicted. Effects are analyzed using existing knowledge, professional judgment, and other analytical tools, where appropriate.

To assess the potential environmental effects of the Project and determine the significance of an effect, the study team has considered the magnitude, frequency, duration, geographical extent and reversibility of the potential effect, where applicable. In particular, regulatory and industry guidelines have been used for this EA, to determine thresholds of significance for predicted environmental effects after application of mitigation (*i.e.*, residual effects).

Requirements for follow-up and monitoring are primarily linked, in this EA, to existing and amended permit conditions and HRWC requirements.

6.2 MUNICIPAL INFRASTRUCTURE: WASTEWATER DISCHARGE TO MUNICIPAL SEWER SYSTEM

6.2.1 Potential Effects

The proposed activities at the existing Envirosystems facility include receiving, temporarily storing and cleaning of piping and similar equipment with potential scale build-up that may contain low-levels of NORM (≤ 70Bq/g) and treatment of wash-water. The footprint of future operations remains within the confines of the Akerley facility, and these activities are generally similar to current operations covered under Envirosystems' existing industrial approvals. Cleaning NORM

impacted equipment will typically occur through the removal of scale build-up using city water at high pressures, resulting in the creation of wash-water. Potential effects to the municipal infrastructure could occur from the release of wash-water into the municipal sewer system.

Project-related contamination could affect the municipal sewer system from the release of wastewater effluents associated with the operations. For contamination to occur, release of wastewater effluent would have to be in violation of the applicable Health Canada Guidelines and the HRWC's discharge criteria. The proposed Project's wash-water treatment process and monitoring and sampling program are designed to prevent this from occurring.

6.2.2 Proposed Mitigation and Monitoring

The proposed mitigation measures include treating the wash-water to meet Health Canada's UDRLs (Aqueous) (Table 3) and HRWC's discharge criteria (Table 5). To meet the applicable guidelines and discharge criteria, wash-water will be treated first through a NORM Treatment Unit, to remove any NORM particles from the wash-water. The NORM treated wash-water will be further processed through an Ultrafiltration and/or a Reverse Osmosis treatment system to achieve compliance to Halifax Water's municipal sewer system discharge criteria. HRWC Pollution Prevention officers will conduct an initial inspection of the treatment systems prior to commencing operations.

To proactively avoid spills or possible leaking of wash-water effluents, storage systems are designed to capture and retain any spills or leaks of NORM impacted solids or liquids. Storage systems will be self-contained with built in collection sumps, steel floors and side walls, without floor drains.

The proposed monitoring program will consist of testing each treated wash-water batch prior to discharge. Testing and confirmation of compliance will occur through an independent third party laboratory. Monitoring results will also be sent to the HRWC Pollution Prevention staff. Envirosystems will maintain a written log of all treated wastewater batch discharges, and will be held responsible for monthly reporting of the flow, including a photo of the meter showing the readings at the end of each month, sample results and any performance issues with wash-water treatment systems. If any batch of treated wash-water is observed to be in violation of the Health Canada Guidelines or HRWC's discharge criteria, the batch will be re-processed, stored and tested again to ensure all requirements are met prior to discharge.

Envirosystems is committed to following their *Safe Works Practices – Naturally Occurring Radioactive Materials* (Appendix B) and best practices for handling of materials, including established contingency plans outlining emergency response procedures for spills. Envirosystems' Safe Work Practices for NORM outline workplace practices that are to be complied with to ensure workers and the environment are protected from the hazards associated with NORM (Appendix B). NORM safety training shall be provided to applicable Envirosystems personnel and contractors who are either responsible for the management of NORM or who are likely to encounter NORM during their work. No person shall be allowed to work in a NORM contaminated area until they have received the required level of radiation safety training.

6.2.2.1 Summary

The proposed Project will generate wash-water that will require dedicated collection and treatment. The combination of the NORM Treatment Unit and Ultrafiltration and/or Reverse Osmosis are proven technologies that have been successfully applied in Nova Scotia as a mechanism for treating low-level NORM contaminated wash-water to meet Health Canada Guidelines and HRWC's discharge criteria. Operational aspects of the process will occur within the confines of the current Envirosystems facility and within fully contained storage systems designed to capture and retain any spills or leaks of NORM contaminated solids or liquids.

Assuming the application of proposed mitigation and monitoring measures are implemented, the integrity of the wash-water treatment process is maintained and compliance is continuous, significant Project-related effects on municipal infrastructure are not likely to occur or can be managed through the proposed monitoring program to ensure discharge of wastewater into the sewer system is in accordance with the Health Canada Guidelines and HRWC's discharge criteria.

7.0 Other Approvals Required

As stated in Section 2.0, the Proponent is required to register this Project as a Class 1 Undertaking pursuant to the *Nova Scotia Environment Act* and Environmental Assessment Regulations.

Other relevant provincial regulations include the Activities Designation Regulations, which require an amendment to the existing Industrial Approval (No. 2004-042042-T05) from NSE for operation of the proposed Project. Copies of existing approval permits are included in Appendix A.

Requirements under the *Canadian Environmental Assessment Act*, 2012 (CEAA 2012) are not anticipated as this type of operation is not listed as a designated project as per Section 2 of the Regulations Designating Physical Activities, and does not occur on federal lands.

8.0 Funding

The proposed Project will be 100 percent privately funded.

9.0 Additional Information

A detailed process flow diagram is found in Appendix C.

10.0 Summary

The proposed activities at the existing Envirosystems facility include the receiving and temporary storage of low-level NORM waste and equipment, cleaning of low-level NORM impacted equipment, and treatment of subsequent wash-water. NORM impacted material with a total specific activity of ≤70 Bq/g is exempt from TDG regulations and does not require any special consideration. Cleaning NORM impacted equipment will occur through the removal of scale build-up using city water at high pressures. The proposed Project will generate wash-water that will require dedicated collection and treatment. The combination of the NORM Treatment Unit and Ultrafiltration and/or Reverse Osmosis are proven technologies that have been successfully applied in Nova Scotia as a mechanism for treating low-level NORM contaminated wash-water to meet Health Canada Guidelines and HRWC's discharge criteria. Operational aspects of the process will occur within the confines of the current Envirosystems facility and within fully contained storage systems designed to capture and retain any spills or leaks of NORM contaminated solids or liquids. These activities are generally similar to current operations covered under Envirosystems' existing industrial approvals.

Activities associated with the proposed Project, including monitoring and reporting, will be conducted in accordance with the terms and conditions of the Industrial Approval (No. 2004-042042-T05) pursuant to the Activities Designation Regulations, as well as future amendments to the Industrial Approval.

Assuming the mitigation and monitoring measures specified in this EA are implemented, and the facility continues to operate according to existing and any future federal and/or provincial guidelines and approvals, significant Project-related effects are not likely to occur.

11.0 References

Canadian Association of Petroleum Producers (CAPP). 2000. Guide: Naturally Occurring Radioactive Material (NORM). Calgary, Alberta.

Canadian Nuclear Safety Commission (CNSC). 2013. Fact Sheet: Natural Background Radiation. Retrieved from: http://nuclearsafety.gc.ca/eng/pdfs/Fact_Sheets/Fact-Sheet-Background-Radiation-eng.pdf

Canadian Nuclear Safety Commission (CNSC). 2014. Fact Sheet: Naturally Occurring Radioactive Materials (NORM). Retrieved from: http://www.nuclearsafety.gc.ca/pubs_catalogue/uploads/NORM-factsheet-eng.pdf

Health Canada. 2000. Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) – Prepared by the Canadian NORM Working Group of the Federal Provincial Territorial Radiation Protection Committee. Ottawa, Ontario.

Health Canada. 2014. Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) (revised) – Prepared by the Canadian NORM Working Group of the Federal Provincial Territorial Radiation Protection Committee. Ottawa, Ontario.

Nova Scotia Department of Environment (NSE). 2014a. Summary of Test Results, Treated Hydraulic Fracturing Wastewater, AIS Debert. Retrieved from: http://www.novascotia.ca/nse/pollutionprevention/docs/summary-sampling-results.pdf

Nova Scotia Department of Environment (NSE). 2014b. What the Test Results Tell Us. Retrieved from: http://www.novascotia.ca/nse/pollutionprevention/docs/what-the-test-results-tell-us.pdf

APPENDIX A
EXISTING PERMITS

NOVA SCOTIA
Environment
Environmental Monitoring and Compliance

30 Damascus Road
Suite 115
Bedford, NS
Canada B4A 0C1

902 424-7773 T
902 424-0597 F
www.gov.ns.ca

February 11, 2014

Our File Number: 30100-31-/BED-038682

Mr. Sid Hales
Envirosystems Incorporated (Atlantic Industrial Services**)**
11 Brown Ave
Dartmouth, NS
B3B 1Z7

Dear Mr. Hales:

RE: Approval to Operate - Waste Dangerous Goods Storage Facility
Approval No. 2004-038682-R01
PID # 128306

Enclosed please find operational Approval Number 2004-038682-R01 for the operation of waste dangerous goods storage facility at 25 Akerley Blvd, Dartmouth, Halifax Regional Municipality, Nova Scotia.

Strict adherence to the attached terms and conditions is imperative in order to validate this approval.

This Approval or a copy is to be kept on-site at all times. All personnel involved in your operation must be made fully aware of the terms and conditions of this approval. Failure to comply with the Terms or Conditions of an Approval is an offence.

Despite the issuance of this Approval, the Approval Holder is still responsible for obtaining any other authorization which may be required to carry out the activity, including those which may be necessary under provincial, federal or municipal law.

Should you have any questions, please contact Robert Cuthbert, Central Region, Bedford Office at (902) 424-7773.

Yours Truly

Norma Bennett
District Manager

cc
Eimas #: 2004-038682-R01

NOVA SCOTIA
Environment

APPROVAL

Province of Nova Scotia
***Environment Act*, S.N.S. 1994-95, c.1**

APPROVAL HOLDER: **Envirosystems Incorporated**

SITE PID: **128306**

APPROVAL NO: **2004-038682-R01**

EXPIRY DATE: **February 7, 2024**

Pursuant to Part V of the *Environment Act*, S.N.S. 1994-95, c.1 as amended from time to time, approval is granted to the Approval Holder subject to the Terms and Conditions attached to and forming part of this Approval, for the following activity:

Operation and reclamation of a Waste Dangerous Goods Storage facility at or near 25 Akerley Blvd, Dartmouth, Halifax Regional Municipality in the Province of Nova Scotia.

Administrator Norma J Bennett

Effective Date February 13/2014

TERMS AND CONDITIONS OF APPROVAL

Nova Scotia Environment

Approval Holder:	Envirosystems Incorporated
Project:	Waste Dangerous Goods Storage Facility
Site:	25 Akerley Blvd, Dartmouth, Halifax Regional Municipality PID # 128306
Approval No:	2004-038682-R01
File No:	30100-31-/BED-038682

Reference Documents:

- Application dated '2014/01/16 and attachments.
- All previous approvals and submissions.

1. **Definitions**

a) "Act" means the Environment Act S.N.S. 1994-1995, c.1 and includes all regulations made pursuant to the Act.

b) "Associated works" means any building, structure, processing facility, pollution abatement system or stockpiles of material.

c) "Department" means the Central Region, Bedford Office, of Nova Scotia Environment located at the following address:

Nova Scotia Environment
Environmental Monitoring and Compliance Division
Central Region, Bedford Office,
Suite 115, 30 Damascus Road,
Bedford, Nova Scotia, B4A 0C1.

Phone: (902) 424-7773
Fax: (902) 424-0597

d) "Facility" means the waste dangerous goods storage and associated works.

e) "Minister" means the Minister of Nova Scotia Environment.

f) "NSE" means Nova Scotia Environment.

2. Scope of Approval

a) This Approval (the "Approval") relates to the Approval Holder and their application and supporting documentation, as listed in the reference documents above, to operate the Facility, situated at or near 25 Akerley Blvd, Dartmouth, Halifax Regional Municipality (the "Site").

b) The Facility shall be operated as outlined in the applications for approval dated March 14, 2008, January 15, 2004 and November 16, 2004, 2014/01/16 including all supporting documentation included with the applications.

c) The Facility shall include storage and handling of waste dangerous goods situated at the Site and identified in the application as an existing " drum storage area" and shall not include areas of the Site approved for used oil rerefining, wastewater treatment or glycol recovery and treatment.

d) The Approval Holder shall comply with all terms and conditions associated with the Environmental Assessment Approval granted by the Minister on December 2, 2003 to Quantex Technologies Incorporated and transferred to Atlantic Industrial Services in the letter dated July 14, 2008

3. General Terms and Conditions

a) The Approval Holder shall operate its Facility in accordance with provisions of the:

i) *Environment Act* S.N.S. 1994-1995, c.1, as amended from time to time;
ii) Regulations, as amended from time to time, pursuant to the above Act;

b) The Approval Holder is responsible for ensuring that they operate the Facility on lands which they own or have a lease or written agreement with the landowner or occupier. The Approval Holder shall be responsible for ensuring that the Department has, at all times, a copy of the most recent lease or written agreement with the landowner or occupier. Breach of this condition may result in cancellation or suspension of the Approval.

c) If there is a discrepancy between the reference documents and the terms and conditions of this Approval, the terms and conditions of this Approval shall apply.

d) Any request for renewal or extension of this Approval is to be made in writing, to the Department, at least ninety (90) days prior to the Approval expiry.

e) The Minister or Administrator may modify, amend or add conditions to this Approval at anytime pursuant to Section 58 of the Act.

f) This Approval is not transferable without the consent of the Minister or Administrator.

g) (i) If the Minister or Administrator determines that there has been non-compliance with any or all of the terms and conditions contained in this Approval, the Minister or Administrator may cancel or suspend the Approval pursuant to subsections 58(A)(1) and 58(A)(2) of the Act, until such time as the Minister or Administrator is satisfied that all terms and conditions have been met.

(ii) Despite a cancellation or suspension of this Approval, the Approval Holder remains subject to the penalty provisions of the Act and regulations.

h) The Approval Holder shall notify the Department prior to any proposed extensions or modifications of the Facility, including process changes or waste disposal practices which are not granted under this Approval. Extensions or modifications to the Facility may be subject to the Environmental Assessment Regulations. An amendment to this Approval will be required before implementing any change.

i) Pursuant to Section 60 of the *Act*, the Approval Holder shall submit to the Administrator any new and relevant information respecting any adverse effect that actually results, or may potentially result, from any activity to which the Approval relates and that comes to the attention of the Approval Holder after the issuance of the Approval.

j) The Approval Holder shall immediately notify the Department of any incidents of non-compliance with this Approval.

k) The Approval Holder shall bear all expenses incurred in carrying out the environmental monitoring required under the terms and conditions of this Approval.

l) Unless specified otherwise in this Approval, all samples required to be collected by this Approval shall be collected, preserved and analysed, by qualified personnel, in accordance with recognized industry standards and procedures.

m) Unless written approval is received otherwise from the Administrator, all samples required by this Approval shall be analysed by a laboratory that meets the requirements of the Department's "Policy on Acceptable Certification of Laboratories" as amended from time to time.

n) The Approval Holder shall submit any monitoring results or reports required by this Approval to the Department. Unless specified otherwise in this Approval, All monitoring results shall be submitted within 30 days following the month of monitoring.

o) The Approval Holder shall ensure that this Approval, or a copy, is kept on Site at all times and that personnel directly involved in the Facility operation are made fully aware of the terms and conditions which pertain to this Approval.

4. Acceptance of Waste Dangerous Goods

a) The Approval Holder is authorized to accept waste dangerous goods from within the Province of Nova Scotia. Prior written approval is required from the Department to accept waste dangerous goods from outside the Province of Nova Scotia.
Before accepting waste at the Facility the Approval Holder must identify the waste dangerous goods and obtain Material Safety Data Sheet for that waste and any additional information necessary for safe storage, handling, and disposal of the waste

b) The Approval Holder shall be limited to storage and handling of the following waste dangerous goods:

- waste paint and lacquers,
- waste paint thinners,
- waste aerosol paint cans,
- waste toluene,
- waste xylene,
- spent batteries,
- spent battery acid (sulphuric acid),
- small quantities of lab chemicals and
- waste hydrochloric,
- waste sulphuric,

- waste sulphamic
- waste citric acid and
- waste phosphoric acid

c) All waste dangerous goods shall be liquid, semi-liquid or solid.

d) Waste dangerous goods shall not contain substances listed in Column 1 of Table 1 in concentrations greater than those listed in Column 2 of Table 1, without the express written approval of the District Manager, Central Region. Approval Holder shall not store any biomedical waste or explosives at the facility.

Table 1

Column 1 *Substance*	*Column 2* *Maximum Concentration (mg/l)*
polychlorinated biphenyls	5.0
pesticides/herbicides	1.0

e) (i) All waste dangerous goods must be sampled and analysed by or for the Approval Holder prior to acceptance if the Approval Holder knows or reasonably expects that the wastes may contain substances listed in Table 1 or do not meet the requirements of section 4(b).

(ii) The Approval Holder shall be required to analyse waste dangerous goods for specific contaminants at the request of the Department.

(iii) The Approval Holder shall immediately notify the Regional Manager when waste dangerous goods have been found to contain in excess of concentrations specified in Table 1.

(f) All drums or transportation containers shall be immediately inspected upon receipt. Leaking drums or containers shall be placed in overpack drums or immediately have contents transferred to an approved container.

(g) Waste dangerous goods which do not meet acceptance criteria shall be rejected by the Approval Holder and immediately returned to the generator of the waste dangerous goods. Written notification shall be made to the District Manager of the Department within 48 hours.

5. Waste Dangerous Goods Storage and Handling

a) The Approval Holder shall not store in excess of total of 20,500 litres of waste dangerous goods at the Facility.

b) Approval Holder shall not process, treat, mix, bulk or dispose waste dangerous goods at the Facility .

c) All loading and unloading of bulk waste dangerous goods shall be completed within the receiving areas of the Facility.

d) All waste dangerous goods shall be handled in a manner which minimizes generation of vapour at the Facility and the Site.

e) Incompatible waste dangerous goods shall not be loaded or unloaded in the receiving area the same time.

f) All floors in the loading/unloading and storage areas shall be constructed of smooth impervious material with secondary containment or sloped to an impermeable drainage collection sump capable of holding a spill.

g) Individual waste dangerous goods or groups of compatible dangerous goods shall have secondary containment to meet the specifications of condition 5(l). Secondary containment shall be constructed such that potential spills of dangerous goods do not come in contact with or pass under incompatible materials. A separate containment area shall be required for acids.

h) A trained employee of the Facility shall be present during all dangerous goods handling operations.

i) The storage and handling areas of the Facility shall have no open floor drains.

j) All storage racks, vehicles, railcars, ventilation ducts, containers and tanks associated with flammable dangerous goods shall be electrically grounded to prevent build up of static electric charges.

k) All waste dangerous goods that are accepted by the Facility shall be stored in drums, containers or tanks composed of materials which are compatible with the goods stored therein.

l) All containers shall be completely surrounded by secondary containment sized to contain 110% of the volume of the largest container in the specifically contained area or 100% of the volume of the largest container plus 10% of the

aggregate capacity of all other containers in the contained area, whichever is greater.

m) All containers shall be stored upright and kept off the floor. All products and dangerous goods shall be stored in accordance with manufacturers specifications.

n) Door openings shall be provided with sills or ramps to prevent accidental spillage of dangerous goods beyond the Facility.

o) The Facility shall be constructed of impervious or liquid tight materials where the outside walls meet the floor.

p) Sufficient aisle space shall be provided between containers/drums to allow the unobstructed movement of persons, transfer equipment, fire protection equipment, spill control equipment, and decontamination equipment to any part of the Facility.

q) The Approval Holder shall ensure that all storage areas, containers and tanks containing products and dangerous goods are labelled to clearly identify their contents including:
   (i) Waste name, composition and physical state
   (ii) The hazard(s)associated with the waste
   (iii) The date the accumulation started
   (iv) The date the container has been filled
   Labels must be durable, weather resistant, and able to withstand deterioration or change from exposure to storage conditions

r) The Approval Holder shall use monitoring equipment to monitor the explosive concentrations of flammable vapour in the Facility if a release is suspected or immediately prior to transfer of waste dangerous goods in that area.

s) Storage of received waste dangerous goods shall not exceed ninety (90) calendar days from receipt of waste at the Facility.

t) All waste dangerous goods shall only be stored inside the building.

u) All transfers of waste dangerous goods shall be conducted using containment pads or drip pans to capture spills or drips during transfer operations.

w) The Approval Holder shall ensure that all sludges and solid wastes associated with the Facility, including tank and containers bottoms, shall be disposed in a manner acceptable to the Department.

x) At least once a week, container storage areas must be visually inspected for leaking and deteriorating containers The Approval Holder must record inspections in a log, including the date and time of the inspection, the name of the inspector, observations made, and the date and nature of any repairs. These records must be kept for a minimum of three years

6. Air Emissions

a) a) Sound levels measured at the Site property boundaries shall not exceed the following equivalent sound levels (Leq):

Leq 65 dBA 0700-1900 hours (Days)
60 dBA 1900-2300 hours (Evenings)
55 dBA 2300-0700 hours (Nights)

b) Monitoring of sound levels shall be conducted at the request of the Department. The location of the monitoring station(s) for sound will be established by a qualified person retained by the Approval Holder and submitted to the Department for approval, this may include point(s) beyond the property boundary of the Site.

b) The Approval Holder shall operate the Facility in a manner which minimizes odour and volatile organic carbon (VOC) emissions and does not cause adverse impacts to the receiving environment.

c) If noise, odour or VOC emissions become unacceptable to the Department the Approval Holder shall be required to mitigate the impacts to the satisfaction of the Department.

d) Monitoring of air emissions shall be conducted at the request of the Department.

7. Groundwater

a) The Approval Holder shall be required to install and implement a groundwater monitoring program at the request of the Department.

b) The Approval Holder shall be required mitigate any negative groundwater impacts which are found to result from the operation of the Facility.

8. Spills or Releases

a) All spills or releases shall be reported to the Department in accordance with the Act and the *Environmental Emergency Regulations.*

b) Spills or releases shall be cleaned up immediately following industry standards and practices.

c) An adequate quantity of spill/release response material is to be maintained at the Facility at all times.

d) The Approval Holder shall update their contingency plan to address discharges of dangerous goods, fires or other emergency situations. The contingency plan shall be developed and updated in accordance with the Department Contingency Plans Guidelines, as amended from time to time.

e) The Approval Holder shall maintain zero liquid effluent discharge from the Site and/or Facility during all activities associated with the waste dangerous goods handling facility.

9. Record Keeping

a) The Approval Holder shall maintain an up-to-date inventory of waste dangerous goods which are stored at the Facility. The inventory shall consist of informational requirements of Section 11(2) of the *Dangerous Goods Management Regulations.*
Inventory shall also include the type, weight, destination and date of materials shipped from the site

b) The inventory shall be made available to the Department for inspection upon request.

10. Closure Plan

a) Three (3) months prior to abandonment/closure the Approval Holder shall file with the Department a detailed closure plan.

b) The closure plan shall outline the method and practices for the handling and disposal of all waste materials on site.

11. Insurance

a) The Approval Holder shall maintain environmental impairment liability insurance in the amount of a minimum one million dollars ($1,000,000).

RECEIVED
MAR 27 2015

NOVA SCOTIA
Environment

Suite 224, Sunnyside Mall
1595 Bedford Highway
Bedford NS B4A 3Y4
Tel: (902) 424-7773
Fax: (902) 424-0597

Our File Number: 92100-30-BED-042042

March 17, 2015

Mr.Andre Lachevrotiere
Atlantic Industrial Services
25 Akerley Boulevard,
Dartmouth, N.S.
B3B 1Z7

Dear Mr.Lachevrotiere:

RE: Approval to Operate and Reclaim - Used Oil Re-refining, and associated Wastewater Treatment Facility Industrial Approval No. 2004-042042-T05

Enclosed please find Approval # 2004-042042-T05 for the operation and reclamation of a used oil re-refining, and associated wastewater treatment facility situated at 25 Akerley Boulevard, Dartmouth, Halifax Regional Municipality, Nova Scotia.

This facility is authorized only to accept feedstock listed in the section 5 of this Approval. This includes wastewater treatment that is associated with waste hydrocarbons accepted at the facility.

Strict adherence to the attached terms and conditions is imperative in order to validate this approval.

Should you have any questions, please contact Tad Czarnik at the Central Region, Bedford Office at (902) 424-7773.

Yours truly,

Norma Bennett
District Manager

cc: Tad Czarnik, P. Eng., Regional Engineer

Eimas #: 2004-042042-T05

NOVA SCOTIA
Environment

APPROVAL

Province of Nova Scotia
***Environment Act*, S.N.S. 1994-95, c.1**

APPROVAL HOLDER: **Envirosystems Incorporated**

APPROVAL NO: **2004-042042- T05**

EXPIRY DATE: **December 28, 2022**

Pursuant to Part V of the *Environment Act*, S.N.S. 1994-95, c.1 as amended from time to time, approval is granted to the Approval Holder subject to the Terms and Conditions attached to and forming part of this Approval, for the following activity:

The operation and reclamation of a used oil re-refinery and associated wastewater treatment facility and associated works, at or near 25 Akerley Boulevard, Dartmouth, Halifax Regional Municipality in the Province of Nova Scotia.

Administrator Nova Bun
Effective Date March 17th, 2015

TERMS AND CONDITIONS OF APPROVAL

Nova Scotia Environment

Approval Holder: Envirosystems Incorporated

Project: Used oil re-refinery, associated wastewater treatment facility and associated works
25 Akerley Boulevard,
Dartmouth, Halifax Regional Municipality

Approval No: 2004-042042-T05

File No: 92100-30-BED-042042

Reference Documents:

- Application for Approval dated 13 August, 2012 and attachments
- Fax from Envirosystems Inc. to NSE dated August 28, 2012 and attached letter from Envirosystems Inc. to Kim Fawcett, Halifax Water, dated August 28, 2012 , signed by Scott Sangster
- e-mail from Kim Fawcett to Scott Sangster dated September 13, 2012
- e-mail from Scott Sangster to Kim Fawcett dated 9/24/2012
- e-mail from Scott Sangster to Tad Czarnik dated 9/28/2012
- Letter from Halifax Regional Water Commission dated December 20, 2012, signed by Kim Fawcett CET.

1. Definitions

a) "Act" means the *Environment Act* S.N.S. 1994-1995, c.1 and includes all regulations made pursuant to the Act.

b) "Administrator" means the manager of the Central Region Office of the Nova Scotia Environment or the manager's designate.

c) "Department" means the Central Region, Bedford Office, of the Nova Scotia Environment located at the following address:

Nova Scotia Environment
Environmental Monitoring and Compliance Division
Central Region, Bedford Office,
Suite 115, 30 Damascus Road,
Bedford, Nova Scotia, B4A 0C1.

Phone: (902) 424-7773
Fax: (902) 424-0597

d) "Facility" means the used oil re-refinery, and associated wastewater treatment facility.

e) "Wastewater" means wastewater that is associated with the oil re-refinery feedstocks listed in condition 5 (a) and which is not deemed to be waste dangerous goods under Transport Canada's Transportation of Dangerous Goods Regulations or under schedule B of the Dangerous Goods Management Regulations. This definition does not apply to wastewater which may be classified as waste dangerous goods due to the flash point and that is intended for treatment through the Oil Re-refinery

f) "Minister" means the Minister of Nova Scotia Environment.

g) "NSE" means the Nova Scotia Environment.

2. Scope of Approval

a) This Approval (the "Approval") relates to the Approval Holder and their application and supporting documentation, as listed in the reference documents above, to operate the Facility, situated at or near 25 Akerley Boulevard, Dartmouth, Halifax Regional Municipality (the "Site").

b) This Approval replaces previous Approval 2004-042042-R02 which is now null and void.

3. General Terms and Conditions

a) The Approval Holder shall construct, operate and reclaim its Facility in accordance with provisions of the:

i) *Environment Act* S.N.S. 1994-1995, c.1, as amended from time to time;
ii) Regulations, as amended from time to time, pursuant to the above Act;

b) The Approval Holder is responsible for ensuring that they operate the Facility on lands which they own or have a lease or written agreement with the landowner or occupier. The Approval Holder shall be responsible for ensuring that the Department has, at all times, a copy of the most recent lease or written agreement with the landowner or occupier. Breach of this condition may result in cancellation or suspension of the Approval.

c) If there is a discrepancy between the reference documents and the terms and conditions of this Approval, the terms and conditions of this Approval shall apply.

d) The Minister or Administrator may modify, amend or add conditions to this Approval at any time pursuant to Section 58 of the Act.

e) This Approval is not transferable without the consent of the Minister or Administrator.

f) (i) If the Minister or Administrator determines that there has been non-compliance with any or all of the terms and conditions contained in this Approval, the Minister or Administrator may cancel or suspend the Approval pursuant to subsections 58(2)(b) and 58(4) of the Act, until such time as the Minister or Administrator is satisfied that all terms and conditions have been met.

(ii) Despite a cancellation or suspension of this Approval, the Approval Holder remains subject to the penalty provisions of the Act and regulations.

g) The Approval Holder shall notify the Department prior to any proposed extensions or modifications of the Facility, including the area, process changes or waste disposal practices which are not granted under this Approval. An amendment to this Approval will be required before implementing any change. Extensions or modifications to the Facility may be subject to the *Environmental Assessment Regulations*.

h) Pursuant to Section 60 of the *Act*, the Approval Holder shall submit to the Administrator any new and relevant information respecting any adverse effect that actually results, or may potentially result, from any activity to which the Approval relates and that comes to the attention of the Approval Holder after the issuance of the Approval.

i) The Approval Holder shall immediately notify the Department of any incidents of non-compliance with this Approval.

j) The Approval Holder shall bear all expenses incurred in carrying out the environmental monitoring required under the terms and conditions of this Approval.

k) Unless specified otherwise in this Approval, all samples required to be collected by this Approval shall be collected, preserved and analysed, by qualified personnel, in accordance with recognized industry standards and procedures.

l) Unless written approval is received otherwise from the Administrator, all samples required by this Approval shall be analysed by a laboratory that

meets the requirements of the Department's "Policy on Acceptable Certification of Laboratories" as amended from time to time

m) The Approval Holder shall submit any monitoring results or reports required by this Approval to the Department. Unless specified otherwise in this Approval, All monitoring results shall be submitted within 30 days following the month of monitoring.

n) The Approval Holder shall ensure that this Approval, or a copy, is kept on Site at all times and that personnel directly involved in the Facility operation are made fully aware of the terms and conditions which pertain to this Approval.

o) The Approval Holder shall hold a valid Used Oil Collectors Approval for the Site if handling or storing used oil.

4. Air Emissions

a) Sound levels measured at the Site property boundaries shall not exceed the following equivalent sound levels (Leq):

Leq 65 dBA 0700-1900 hours (Days)
60 dBA 1900-2300 hours (Evenings)
55 dBA 2300-0700 hours (Nights)

b) Monitoring of sound levels shall be conducted at the request of the Department. The location of the monitoring station(s) for sound will be established by the Administrator and may include point(s) beyond the property boundary.

c) Air emissions from the facility shall not exceed a maximum opacity of twenty percent (20%)

d) The Approval Holder shall operate the Facility in a manner which minimizes odour and volatile organic carbon (VOC) emissions and does not cause adverse impacts to the receiving environment.

e) All noise and odour complaints must be recorded, and records made available to the Department upon request.
If noise, odour or VOC emissions are deemed excessive by the Department, the Approval Holder shall be required to mitigate the impacts to the satisfaction of the Department. Mitigation may include, but not be limited to, a reduction in storage volumes of waste/wastewater, the installation of air emission control equipment to meet the requirements of the Department or the reduction or cessation of operation.

f) Wastewater shall be processed in such a manner to reduce hydrogen sulphide gas emissions.

g) Monitoring of air emissions shall be conducted at the request of the Department.

5. Feedstock Acceptance Criteria

a) The Approval Holder shall only receive, handle, store and treat the following feedstocks for the purposes of hydrocarbon recovery and associated wastewater treatment:

- Used oil as defined in the *Used Oil Regulations* and associated wastewater
- Waste hydrocarbon fuels and associated wastewater
- Used oil filters
- Oily rags
- Used floor dry absorbent
- Oily sludges/solids associated with industrial cleaning of hydrocarbon contaminated sources and associated wastewater

b) The Facility is authorized to handle only the hydrocarbon feedstocks specified in 5(a) that have been analytically shown not to be contaminated as described in Appendix I. It is the responsibility of the Approval Holder to ensure that hydrocarbon feedstock meets this criteria. Records to this effect are to be kept on Site for a period of at least two years and are to be made available to the Department upon request.

c) The Approval Holder shall perform an initial batch processing/sampling
- upon receipt of feedstock from new source
- upon any change in feedstock regardless of source

d) The receipt of alternate feedstock, not listed in 5(a) shall require prior written approval of the Administrator.

6. Feedstock/Product Storage and Transfer

a) The vehicle loading/unloading and/or the parking area is to be designed such that any spillage, etc is directed to a sump that is capable of holding a minimum of 120% of the storage volume of the vehicle being loaded/unloaded.

b) Feedstock and product storage is restricted to aboveground tanks that are within the confines of the Site. Transport vehicles shall not be used for the storage of feedstock or product on Site.

c) Feedstock and product storage tanks shall be surrounded by a containment dyke that is designed to retain not less than 110% of the capacity of the largest tank or 100% of the capacity of the largest tank plus 10% of the aggregate capacity of all other tanks, whichever is greater.

d) The base and walls of the dyked area shall have an impermeable lining of concrete or other material that is designed, constructed and maintained to be liquid tight.

e) On Site feedstock/product transfer is to occur in piping that is contained within the confines of containment structures that have impermeable linings of concrete or other material that is constructed and maintained to be liquid tight.

f) A trained employee of the Facility shall be present during all wastewater and used oil handling/transfer operations.

7. Feedstock/Product Record Maintenance

a) The Approval Holder shall maintain records of all feedstock shipments received for a period of two years from the date of receipt of shipment. These records shall include the following details:

i) type of feedstock
ii) source of feedstock
iii) volume of feedstock
iv) volume of hydrocarbon/used oil recovered
v) volume of wastewater treated
vi) volume of solids/sludges disposed
vii) date of receipt of shipment and
viii) continuous total petroleum hydrocarbon readings from the on-line oil content monitor (OCM) of the ultra filtration unit.
ix) sampling results

b) Final product from the Facility shall not be used or distributed unless it has been analytically shown not to be contaminated as described in Appendix I. It is the responsibility of the Approval Holder to ensure the final product meets this criteria. Records of the above are to be maintained on Site for a period of at least two years and made available to the Department upon request.

c) Prior to January 31 of each year the Approval Holder shall complete and submit a written report which includes information respecting the volume of used oil and/or product burned during the previous calendar year.

8. Liquid Effluent

a) The Approval Holder shall discharge all treated wastewater from the Facility into the municipal sanitary sewer system unless granted approval for an alternative discharge or disposal site by the Administrator.

b) The Approval Holder is responsible for ensuring that they have a current written agreement with Halifax Regional Water Commission (HRWC) to discharge wastewater into the municipal sewer system .

c) The Approval Holder shall be responsible for ensuring that the Department has, at all times, a copy of the most recent written agreement with the Halifax Regional Water Commission .Breach of this condition may result in cancellation or suspension of the Approval.

d) The Approval Holder shall contact the Department immediately should a change in discharge location for the wastewater be considered. No change in discharge location for the wastewater shall take place without prior written approval from the Department.

e) The Approval Holder shall conduct monitoring of the liquid effluent when requested by the Department.

f) Based on the sample results, the Department may require remedial action.

9. Solid Waste

a) Tank bottoms, treatment sludge, wastewater sludges and other solid wastes generated from the Facility shall be disposed at an approved facility in a manner which is approved by the Department.

b) The Approval Holder shall provide a plan describing solid wastes and disposal practices on or before January 30, 2013. The solid wastes shall be disposed in accordance with solid waste disposal plan subject to review and approval by the Department.

10. Spills or Releases

a) All spills or releases shall be reported to the Department in accordance with the Act (Part VI) and the *Emergency Spill Regulations*.

b) Spills or releases shall be cleaned up immediately in accordance with the Act.

c) The Approval Holder shall maintain an up to date contingency plan to address discharges of dangerous goods, fires or other emergency situations. This plan is to meet the requirements of the Nova Scotia Environment "Contingency Planning Guidelines" as amended from time to time.

10. Site Specific Requirements

a) A trained employee of the Facility shall be present during the operation of the ultra filtration unit and during the transfer of wastewater, product or liquid effluents to/from the unit.

Appendix I

Contaminated Feedstock or Product Limits

Maximum Allowable Concentrations

Polychlorinated Biphenyls (PCB's)	5.0 mg/kg
Total Organic Halogens (TOX) (as Chlorine)	1000 mg/kg
Cadmium	2 mg/kg
Chromium	10 mg/kg
Lead	100 mg/kg

NOVA SCOTIA
Environment
Environmental Monitoring and Compliance

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Suite 115
Bedford, NS
Canada B4A 0C1

902 424-7773 T
902 424-0597 F
www.gov.ns.ca

Our File Number: 36500-30BED-055775

March 17, 2015

RECEIVED
APR 0 1 2015

Mr.Andre Lachevrotiere
Atlantic Industrial Services
25 Akerley Boulevard,
Dartmouth, N.S.
B3B 1Z7

Dear Mr. Lachevrotiere:

RE: Approval to Operate - Used Oil Collection and Storage
Approval No. 2007-055775-T02
PID # 00128306

Enclosed please find Approval # 2007-055775-T02 for the Used Oil Collection and Storage operation at 25 Akerley Blvd, Dartmouth, Halifax Regional Municipality, Nova Scotia.

Strict adherence to the attached terms and conditions is imperative in order to validate this approval.

Despite the issuance of this Approval, the Approval Holder is still responsible for obtaining any other authorization which may be required to carry out the activity, including those which may be necessary under provincial, federal or municipal law.

Please note that this approval expires December 31, 2020. Section 5(b) of this approval requires the annual submission of a volume report. Section 6 of this approval requires the annual submission of an Operational Reporting Form. The attached Central Region Operational Reporting Form is to be returned to the undersigned prior to December 31 in each year of the approval.

Should you have any questions, please contact Robert Cuthbert, Inspector, Central Region, Bedford Office at (902) 424-7773.

Yours Truly,

Norma Bennett
District Manager

Eimas #: 2007-055775-T02

NOVA SCOTIA
Environment

APPROVAL

Province of Nova Scotia
***Environment Act*, S.N.S. 1994-95, c.1**

APPROVAL HOLDER: **Envirosystems Incorporated**

SITE PID: **00128306**

APPROVAL NO: **2007-055775-T02**

EXPIRY DATE: **December 31, 2020**

Pursuant to Part V of the *Environment Act*, S.N.S. 1994-95, c.1 as amended from time to time, approval is granted to the Approval Holder subject to the Terms and Conditions attached to and forming part of this Approval, for the following activity:

A Used Oil Collection and Storage operation, and associated works, at 25 Akerley Blvd, Dartmouth, Halifax Regional Municipality in the Province of Nova Scotia.

Administrator _____

Effective Date March 17th, 2015

TERMS AND CONDITIONS OF APPROVAL

Nova Scotia Environment

Approval Holder:	Envirosystems Incorporated
Project:	Used Oil Collection and Storage
Site:	25 Akerley Blvd, Dartmouth, Halifax Regional Municipality PID # 128306
Approval No:	2007-055775-T02
File No:	36500-30BED-055775

Reference Documents:

- Application dated December 13, 2010 and attachments.

1. **Definitions**

a) "Act" means the *Environment Act* S.N.S. 1994-1995, c.1 and includes all regulations made pursuant to the Act.

b) "Department" means the Central Region, Bedford Office, of Nova Scotia Environment located at the following address:

Nova Scotia Environment
Environmental Monitoring and Compliance Division
Central Region, Bedford Office,
Suite 115, 30 Damascus Road,
Bedford, Nova Scotia, B4A 0C1.

Phone: (902) 424-7773
Fax: (902) 424-0597

c) "Facility" means the Used Oil Collection and Storage operation and associated works.

d) "Minister" means the Minister of Nova Scotia Environment.

2. Scope of Approval

a) This Approval (the "Approval") relates to the Approval Holder and their application and supporting documentation, as listed in the reference documents above, to operate the Facility, situated at 25 Akerley Blvd, Dartmouth, Halifax Regional Municipality (the "Site").

b) This Approval authorizes the collection, storage and conveyance of used oil or contaminated used oil as defined in the *Used Oil Regulations*, to another approved used oil collector or to a Nova Scotia Environment (NSE) **approved** used oil treatment or storage facility.

c) The applicable operating fee must be submitted annually to the Department prior to December 31st.

3. General Terms and Conditions

a) The Approval Holder shall operate its used oil collection and storage operation in accordance with provisions of the:

   i) *Environment Act* S.N.S. 1994-1995, c.1; as amended from time to time;
   ii) Regulations, as amended from time to time, pursuant to the above Act; **Please ensure that these documents are on record and reviewed regularly for compliance.**

b) The Approval Holder is responsible for ensuring that they operate the facility on lands which they own or have a lease or written agreement with the landowner or occupier. The Approval Holder shall be responsible for ensuring that the Department has, at all times, a copy of the most recent lease or written agreement with the landowner or occupier. Breach of this condition may result in cancellation or suspension of the Approval.

c) If there is a discrepancy between the reference documents and the terms and conditions of this Approval, the terms and conditions of this Approval shall apply.

d) The Minister or Administrator may modify, amend or add conditions to this Approval at anytime pursuant to Section 58 of the Act.

e) This Approval is not transferable without the consent of the Minister or Administrator.

f) (i) If the Minister or Administrator determines that there has been non-compliance with any or all of the terms and conditions contained in this Approval, the Minister or Administrator may cancel or suspend the Approval pursuant to subsections 58(2)(b) and 58(4) of the Act, until such time as the Minister or Administrator is satisfied that all terms and conditions have been met.

(ii) Despite a cancellation or suspension of this Approval, the Approval Holder remains subject to the penalty provisions of the Act and regulations.

g) The Approval Holder shall notify the Department prior to any proposed extensions or modifications of the Facility, including the active area, process changes or waste disposal practices which are not granted under this Approval. An amendment to this Approval will be required before implementing any change. Extensions or modifications to the Facility may be subject to the Environmental Assessment Regulations.

h) Pursuant to Section 60 of the *Act*, the Approval Holder shall submit to the Administrator any new and relevant information respecting any adverse effect that actually results, or may potentially result, from any activity to which the Approval relates and that comes to the attention of the Approval Holder after the issuance of the Approval.

i) The Approval Holder shall immediately notify the Department of any incidents of non-compliance with this Approval.

j) The Approval Holder shall bear all expenses incurred in carrying out the environmental monitoring required under the terms and conditions of this Approval.

k) Unless specified otherwise in this Approval, all samples required to be collected by this Approval shall be collected, preserved and analysed, by qualified personnel, in accordance with recognized industry standards and procedures.

l) Unless written approval is received otherwise from the Administrator, all samples required by this Approval shall be analysed by a laboratory that meets the requirements of the Department's "Policy on Acceptable Certification of Laboratories" as amended from time to time.

m) The Approval Holder shall submit any monitoring results or reports required by this Approval to the Department. Unless specified otherwise in this Approval, All monitoring results shall be submitted within 30 days following the month of monitoring.

n) The Approval Holder shall ensure that this Approval, or a copy, is kept on Site at all times and that personnel directly involved in the Facility operation are made fully aware of the terms and conditions which pertain to this Approval. Copies may be distributed to clients and other business interests and includes your company's operators of used oil collection vehicles.

o) The enclosed Used Oil Collectors Approval Certificate of Acceptance is to be completed and returned to the Administrator within 15 days receipt of this Approval.

3. **Used Oil Storage**

a) The storage of used oil collected under this approval is limited to tanks 110, 120, 130, 400,and 410 (295,000 l) provided these tanks are not used for treatment and processing.

b) This Approval does not authorize de-watering (other than by gravity separation), blending, or treatment of used or contaminated used oil. The addition of any substance to used or contaminated used oil is prohibited.

c) The *Petroleum Storage Regulations* may be applicable where used oil stored in vehicles or trailers exceeds three consecutive days. Contact the Administrator when oil storage in vehicles/trailers exceeds 24 hours.

4. **Use and Transfer**

a) Used oil collected may not be transferred, sold, or used by any person that is not a Nova Scotia Environment approved used oil collector or operating an approved Nova Scotia Environment used oil return facility, unless the used oil is analysed to verify that it is not contaminated used oil as defined in the *Used Oil Regulations*. The Certificate of Analysis confirming the oil is not contaminated is to accompany the transfer of used oil to any other party not authorized as a Used Oil Collector.

b) Except as authorized under Section 13 of the *Used Oil Regulations*, the used oil collected shall not be used as a fuel source or otherwise burned unless it has been analysed to ensure that the used oil is not contaminated used oil as defined in the *Used Oil Regulations*.

c) All equipment is to be checked daily for leakage and repaired immediately as required. Spill cleanup equipment (i.e. shovels, brooms, and sufficient

quantities of absorbent material) shall be kept on board each collection vehicle.

d) The disposal of sludge or gravity separated water from any vehicle or container must receive prior written approval from the Administrator, unless disposal is at a Nova Scotia Environment approved facility.

5. Record Keeping and Reporting

a) Pursuant to Section 9(3) of the *Used Oil Regulations*, please forward to the Administrator the certificate(s) of analysis for all contaminated used oil collected. Weekly summaries are to be sent to the Central Region, Bedford Office by the 30th of each month.

b) Prior to January 31, of the next year, please forward to the Administrator a written report documenting the quantity and distribution of all oil collected in the current year.

6. Site Specific Conditions

a) The enclosed Central Region Operational Reporting Form is to be completed and returned to the Administrator by December 31 in each year of the approval. The approval may be revoked or suspended for non-payment.

b) In the event of storage capacity changes, an amendment may be required. Should storage capacity increase, the required amendment may include an adjustment to the pre-paid fee. It is a requirement of this approval to immediately notify NSE of any change in processes including storage and handling.

NOVA SCOTIA
Environment

CERTIFICATE OF ACCEPTANCE

USED OIL COLLECTOR'S APPROVAL

I _____ Agent for Envirosystems Incorporated

Company Agent Company

hereby acknowledge that I have received a Used Oil Collector's Approval from Nova Scotia Environment which expires December 31, 2020. My signature below certifies that I have read and agree to abide by the terms and conditions of that Approval.

Also, I hereby acknowledge that I do/do not de-water (other than by gravity separation) or otherwise treat used oil that I have collected. In the event that I do treat used oil, I understand that I must first acquire an Industrial Approval, and I am to adhere to the terms and conditions therein. I currently do/do not have an Industrial Approval issued by Nova Scotia Environment, the Approval No. being _____ which expires _____.
Y / M / D

_____
Agent

_____
Date

APPENDIX B
SAFE WORKS PRACTICES – NATURALLY OCCURRING RADIOACTIVE MATERIALS

ENVIROSYSTEMS

SWP – NATURALLY OCCURRING RADIOACTIVE MATERIALS (NORM)

SAFE WORK PRACTICE

Table of Contents

PURPOSE

This SWP outlines the workplace practices that are to be complied with to ensure workers and the environment are protected from the hazards associated with Naturally Occurring Radioactive Materials (NORM).

NORM is an acronym for naturally occurring radioactive materials comprising radioactive elements found in the environment. Long-lived radioactive elements of interest include uranium, thorium and potassium and any of their respective radioactive decay products such as radium and radon. Some of these elements have always been present in the earth's crust and within the tissues of all living beings. Although the concentration of NORM in most natural substances is low, higher concentrations may arise as the result of human activities.

SCOPE

This SWP applies to all Envirosystems Regions that undertake work involving materials that are known or believed to be contaminated with NORM.

LEGISLATION

The transportation of NORM is regulated federally through the Transportation of Dangerous Goods Act if the material being transported has a specific activity greater than 70 Becquerels per gram (Bq/g).

NORM is not currently regulated from a worker exposure point of view in Canada. Handling and disposal of NORM contaminated materials are regulated by provincial and territorial governments and should be confirmed for each area NORM materials are encountered and waste generation is anticipated.

Health Canada's Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) provides guidance with respect to worker exposure and waste classification and are generally adopted by most provincial government agencies as a code of practice.

DEFINITIONS

Absorbed Dose: The mean energy deposited by ionizing radiation per unit mass of the body or organ or tissue of the body. Unit: gray (Gy), 1 Gy = 1 joule per kilogram.

Activity: The number of nuclear transformations that occur in a quantity of material per unit of time. Unit: Becquerel (Bq), 1 Bq = 1 disintegration per second.

ALARA: A principle of risk management according to which exposures are kept as low as reasonably achievable, economic and social factors being taken into consideration. A guiding principle of radiation protection.

Alpha Decay: A high-energy positively charged particle ejected from the nucleus of an unstable atom, consisting of two protons and two neutrons.

Background Radiation: The radiation to which an individual is exposed arising from natural radiation sources such as terrestrial radiation from radionuclides in the soil, cosmic radiation from space, and naturally occurring radionuclides deposited in the body from foods, etc.

Becquerel (Bq): An SI unit of radioactivity, equivalent to 1 nuclear transformation per second. Used as a measurement of the quantity of a radionuclide since the number of radioactive transformations (disintegrations) is directly proportional to the number of atoms of the radionuclide present.

Beta Decay: The ejection of a high-energy negatively charged subatomic particle from the nucleus of an unstable atom. A beta particle is identical in mass and charge to an electron.

Contamination: Radioactive material present in excess of natural background quantities in a place it is not wanted.

Contamination control: The process employed to control the spread of NORM to uncontrolled areas where it can become an insidious source of radiation hazard to personnel.

Decay: A process followed by an unstable nucleus to gain stability by the release of energy in the form of particles and/or electromagnetic radiation. NORM materials decay with the release of alpha particles, beta particles and/or gamma photons.

Decay Series (Radioactive Decay Series): A succession of radionuclides, each member of which transforms by radioactive decay into the next member until a stable nuclide results. The first member is called the "parent", the intermediate members are called "progeny" and the final stable member is called the "end product". In the two NORM decay series; uranium-238 and thorium-232 are the "parents," and lead-206 and lead-208 are the "end products".

Decontamination: The reduction or removal of NORM from equipment surfaces prior to equipment repair, recycling or disposal for the purpose of radiation dose reduction to personnel.

de minimis: refers to a level of risk which is too small to be concerned with -- some refer to this as a "virtually safe" level. Materials with de minimis amounts of radioactivity contain no more than background levels.

Diffuse NORM: NORM-contaminated material in which the radioactive concentration is uniformly dispersed. It is generally low in radioactive concentration, and relatively large in volume.

Discrete NORM: NORM-contaminated material in which radioactive substances are concentrated, or not uniformly dispersed throughout the material. It generally has much higher levels of radioactive concentration in a localized volume than diffuse NORM.

Dosimeter: A device for measuring a dose of radiation that is worn or carried by an individual.

Effective Dose: Radiation dose for primary radiation dose limits. It represents the sum of the equivalent doses received by different tissues of the human body, each multiplied by a "tissue weighting factor" (w_T). Unit: sievert (Sv).

Equivalent Dose: The absorbed dose multiplied by a "radiation weighting factor", (w_R), which accounts for the different potential for adverse effects of the different types of radiation. Unit: sievert (Sv).

Gray (Gy): Radiation damage is dependent on the absorption of radiation energy and is approximately proportional to the concentration of absorbed energy in tissue. The gray is the SI unit of absorbed radiation dose corresponding to the absorption of 1 joule of radiation energy per kilogram of material. For gamma and beta radiations, the gray is numerically equal to the sievert.

Half-life, Biological: The time required for the body to eliminate half the quantity of a substance taken into the body. A major factor in determining a radionuclide's Dose Coefficient.

Half-life, Radioactive: The time required for a radioactive material to lose half of its activity through radioactive decay.

Incidentally Exposed Workers: Employees whose regular duties are not expected to result in exposure to NORM radiation. The public annual dose limit of 1 mSv applies to this category of workers in an occupational exposure environment.

Incremental Dose: Radiation dose found in excess of the local background radiation dose.

Occupationally Exposed Workers: Employees who expect to receive exposure to sources of NORM radiation as a result of their regular duties. The annual occupational dose limit of 20 mSv applies to this category of workers in an occupational exposure environment.

Radiation (Gamma): Electromagnetic radiation or photon energy emitted from an unstable nucleus in the process of ridding itself of excess energy. Highly penetrating, gamma rays lose energy as they pass through atoms of matter.

Radiochemical Analysis: Analysis of the radioactive content of a NORM sample. Radiochemical analysis will identify and quantify the concentration of various radionuclides in the NORM sample.

Radionuclide or Radioisotope: A particular form of an element, characterized by a specific atomic mass and atomic number, whose atomic nucleus is unstable and decays or disintegrates with a statistical probability characterized by its physical half-life.

Radium-226: A radioactive element with a half-life of 1600 years. It is a particularly hazardous decay product of natural uranium, and is frequently the dominant NORM nuclide. It decays into the radioactive gas Radon-222.

Radon: The only radioactive gas generated during natural radioactive decay processes. Two radioisotopes of radon are present – radon and thoron, each a decay product of radium. Radon (Rn-222) is found in the uranium decay series while thoron (Rn-220) is found in the thorium decay series.

Radon Progeny: The products of radon (radon-222) or thoron (radon-220) decay with short half-lives. Radon decay products include; Polonium-218 (RaA), Lead-214 (RaB), Bismuth-214 (RaC), and Polonium-214 (RaC'). Thoron decay products include; Polonium-216 (ThA), Lead-212 (ThB), Bismuth-212 (ThC), Polonium-212 (ThC'), and Thallium-208 (ThC").

Shielding: The reduction of radiation beam intensity by interposing, between the source and an object or person that might be exposed, a substance that absorbs radiation energy, either by collision, in the case of particulate radiation, or by absorption of waveform energy, in the case of gamma photons.

Sievert (Sv): The sievert is the unit of radiation equivalent dose that is used for radiation protection purposes, for engineering design criteria and for legal and administrative purposes. The sievert is the SI unit of absorbed radiation dose in living organisms modified by radiation type and tissue weighting factors. The unit of dose for the terms "equivalent dose" and "effective dose". Multiples of sieverts (Sv) used in the *Guidelines* include millisieverts (mSv) and microsieverts (µSv).

Specific Activity (Radioactive Concentration): The number of becquerels per unit of mass of a material. Units: Bq/g and kBq/kg.

Unconditional Derived Release Limits (UDRL): Within the Unrestricted classification, the radioactive activity of NORM below which NORM can be released into the public domain without restrictions.

TRAINING

NORM safety training shall be provided to all Envirosystems personnel and contractors who are either responsible for the management of NORM or who are likely to encounter NORM during their work (refer to Table 1: NORM Radiation Safety Training Requirements). The principle objective behind NORM safety training is the development of skills that will help reduce radiation exposures, minimize the risk of personnel and environmental contamination and where possible keep radiation doses As Low As Reasonably Achievable (ALARA). NORM radiation safety training shall include instruction on the following topics:

- Sources of NORM accumulations in the oil and gas industry
- Classification of risks associated with materials contaminated with NORM
- NORM units of radioactivity and radiation dose

- Radiation dose control aims and objectives
- Public and occupational radiation dose limits
- Correct use of radiation detection instrumentation for NORM radiation surveys
- Purpose of NORM surveys
- Safe work practices for personnel working in NORM contaminated environments
- Organization of work areas for the decontamination of NORM contaminated equipment
- Decontamination procedures for tools and equipment contaminated with NORM
- Management of the injured worker contaminated with NORM
- Management of waste contaminated with NORM

No person shall be allowed to work in a NORM contaminated area until they have received the required level of radiation safety training described in the Table below.

Group	Requirements/Responsibilities	Frequency
Operations	Mandatory training for operation personnel working with NORM-contaminated equipment. • Responsible for conducting initial external and internal surface dose rate surveys • Responsible for permit issuance and ensuring all precautions/ PPE are identified • Ensure that area restrictions (flagging/tagging) are implemented and maintained • NORM-contaminated waste labeling • Compliance with PPE	Re-qualify every three (3) years

Table 1: NORM Radiation Safety Training Requirements

ORIGIN OF NORM

NORM is present in various concentrations in every part of the earth's mantle. It is present in the tissues of all living animals, including humans. Although the concentration of NORM in most natural substances is so low that the risk is generally regarded as negligible, higher concentrations may arise as the result of human intervention. Some industrial operations may liberate naturally occurring radioactive materials present in the earth's crust - the plowing of a field, for example, can release radon, a naturally occurring radioactive gas, from the soil. Other industrial processes, such as gas processing, may act to concentrate NORM.

Envirosystems employees may be exposed to NORM while working at various customer locations from their industrial processes. Most customers have an employee orientation program that will educate Envirosystems employees on the potential NORM sources specific to that worksite and the necessary control measures to protect against exposure. Any Envirosystems equipment that comes in contact with any potential NORM material at a customer site will need to be treated as potentially NORM contaminated as required by this SWP.

RADIATION UNITS

Radioactivity describes how much radiation is being produced by a radioactive source. During the radioactive decay process, radioactive atoms disintegrate into more stable atoms and in doing so release energy. The energy released is what we call radiation.

Only a fraction of the radiation being emitted is actually seen by the detector. NORM radiation survey instruments detect a percentage of disintegration and display in either counts per minute (CPM) or counts per second (CPS). It is important to note that the CPM readings from survey instruments are not the true amount of radiation present.

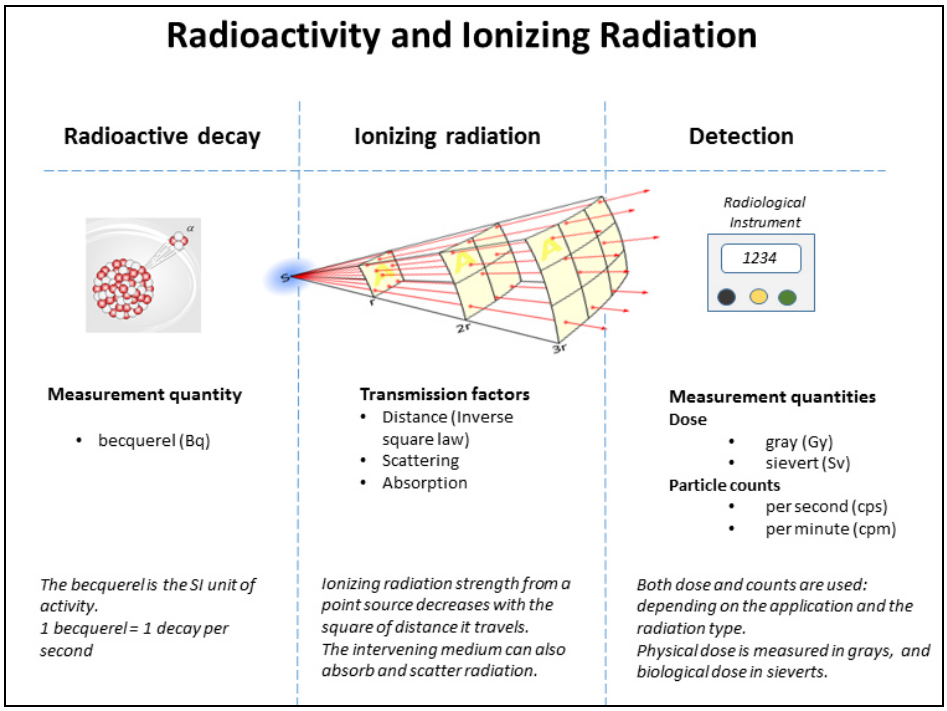


Figure 1: Radioactivity and Ionizing Radiation

When measuring radiation there are two quantities which are relevant to radiation protection:

- Activity - how much radiation is there; and
- Exposure (dose) - how dangerous is it.

There is no direct connection between how much radiation is being produced (the radioactivity of a source) and how harmful the produced radiation field is (the dose rate of the field).

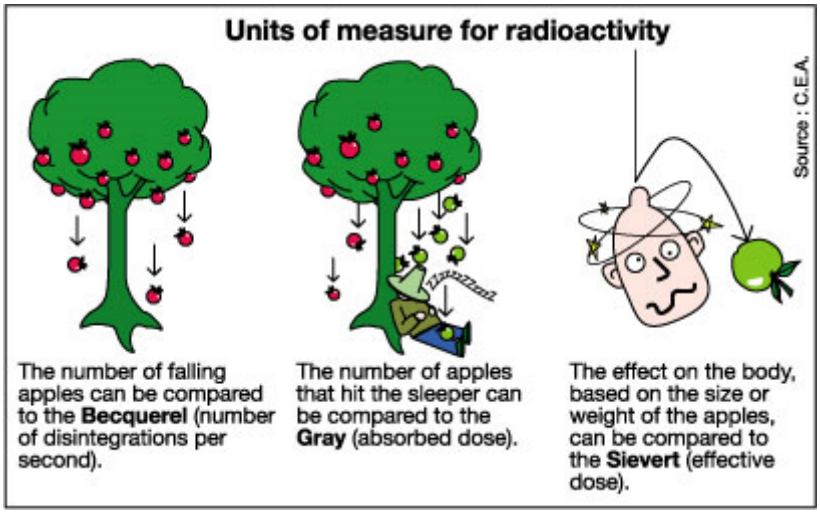


Figure 2: Units of measure for radioactivity

The Becquerel (Bq) measures the activity of a radioactive source, giving the number of atoms which, within a particular time frame, transform and emit radiation.

The Gray (Gy) measures the absorbed dose, giving the energy transferred by ionizing radiations to the material upon encountering it. Absorbed dose tells us how much energy has been deposited in a kilogram of a substance by radiation, BUT it doesn't tell us about the biological consequences of that energy deposited in tissue.

The Sievert (Sv) evaluates the effects of ionizing radiation on living material. At equal doses, the effects of radioactivity on living tissue depends on the type of radiation (alpha, beta, gamma, etc.), on the organ concerned and also on the length of exposure.

Equivalent Dose is measured in Sievert (Sv). Equivalent dose is absorbed dose weighted for the degree of the effect of different radiations. Different types of radiation produce different amounts of biological damage for a given energy deposited in the body.

Effective Dose is measured in Sievert (Sv). Effective dose is equivalent dose weighted for susceptibility to effect of different tissues. It is a single value representing the whole-body risk of stochastic (chance) effects resulting from exposure to radiation.

RADIATION DETECTION

People do not possess any sense organs that can detect radiation. We cannot see, hear, feel, taste or smell radiation. We must rely entirely on instruments for the detection and measurement of radiation.

There are two general categories of radiation measuring instruments:

- Survey instruments and
- Dosimeters.

Survey instruments measure external dose rate, the rate at which radiation is received:

- Count rate, counts per minute (CPM)
- Radiation dose rate (µSv/hr)
- Exposure rate (mR/hr).

Dosimeters measure external radiation dose (mSv). They measure cumulative radiation dose, the total amount of radiation received in a given time. They are designed to be worn by the user.

PHYSICAL AND CHEMICAL PROPERTIES

Radioactive decay processes - Atoms contain a dense nucleus of positively charged protons and non-charged neutrons. Surrounding the nucleus are orbiting negatively charged electrons. The ratio of neutrons to protons will determine whether a nucleus is radioactive. Atoms with too many or too few neutrons in the nucleus are unstable *(radioactive)* and will undergo radioactive decay. This involves the release of an electrically charged particle, either an alpha (α) or a beta (β^-) particle, from the nucleus. Gamma (γ) radiation is the release of energy from the nucleus in the form of an electromagnetic wave or photon, following the ejection of an alpha or beta particle. The type and energy of the radiation released determines many critical factors: how far the emission may travel, how damaging the radiation is to living organisms, and how best it may be detected and measured.

Alpha Radiation (α) - Alpha radiation is a large subatomic particle consisting of two protons and two neutrons emitted from the nucleus. The alpha particle, because of its high mass, carries with it a high amount of energy. As a result of its two protons, it has a positive electrical charge that interacts strongly with surrounding matter. It is, therefore, easily stopped, penetrating only a few centimeters of air, or being blocked by thin layers of materials such as paper or the layers of dead cells on the surface of the skin. Since alpha particles do not penetrate to the radiation-sensitive cells in the basal layer of the skin, no health hazard can arise from alpha particles emitted from outside the body; however, if alpha particle emitting substances are ingested or inhaled, hazardous irradiation of the sensitive cells lining the lungs and digestive tract can take place.

As a result of its low penetration ability, alpha particles may only be detected if the alpha emitter is present on the exposed surface of equipment, or is present in the form of an airborne dust. Alpha radiation contained within enclosed process equipment cannot be detected through equipment walls. However, NORM alpha and beta emitters often release gamma energy coincident with the ejection of these sub-atomic particles. If gamma radiation is found, alpha and/or beta emitters will also be present.

Beta Radiation (β^-) - The beta particles associated with the NORM radioactive decay process are negatively charged, high-energy electrons. Beta particles interact less strongly than alpha particles with matter. They have greater penetrating power than alpha particles and are capable of traveling several meters in air and delivering a significant radiation dose to the living cells of tissues below the surface layer of the skin and to the cornea of the eye.

Beta radiation is readily stopped by thin sheets of metal, glass, and plastic. Beta particles, like alpha particles, can only be detected on the surface of contaminated equipment or when present in airborne dust. Gamma photons can be emitted during beta decay events. Equipment contaminated internally with beta emitters can often be identified by the gamma radiation detected during external monitoring surveys.

Gamma radiation (γ) - Gamma radiation is electromagnetic radiation of short wavelength similar to x-rays. Gamma radiation is a secondary radiation emitted following the emission of an alpha or beta particle. Similar to x-rays, gamma radiation is highly penetrating and can pass through the body delivering a radiation dose to all parts of the body. Gamma emissions are frequently used to disclose the presence of alpha and/or beta radioactivity during NORM screening surveys.

A portion of any emitted gamma radiation will penetrate the intact walls of equipment. This is the primary external hazard from NORM accumulations within industrial processing equipment. Because of the penetrating power of gamma radiation, and because detectors that are highly sensitive to it are readily available, gamma ray monitoring is the primary screening tool for the detection of NORM contamination within operating equipment.

In the case of NORM, radioactive decay is frequently a sequential process involving many radioactive decay steps until a stable element is formed. These decay series, or schemes are unique for each radioactive element. In any natural sample (for example, uranium ore) all these elements are present.

BASIC PRINCIPLES OF WORKER PROTECTION

The primary purpose of this NORM SWP is to provide guidelines and instructions on how to minimize radiation doses received by personnel working on or around NORM contaminated equipment. Radiation doses shall be kept within recommended occupational exposure limits and whenever possible ***As Low As Reasonably Achievable (ALARA)*** when working on or around NORM contaminated equipment. Adopting this attitude when working with radioactive materials places a limitation on risk.

Occupationally exposed workers can receive radiation doses from either external or internal radiation sources or both. External exposures occur when unshielded radioactive material comes in close contact, or is in close proximity to an external part of the body. Internal exposures occur when radioactive material inadvertently enters the body through inhalation, ingestion or absorption through the skin or open wound. Inhalation is the principal route for incorporation of radioactive material into the body. There are several methods available to reduce the external and internal exposure to NORM.

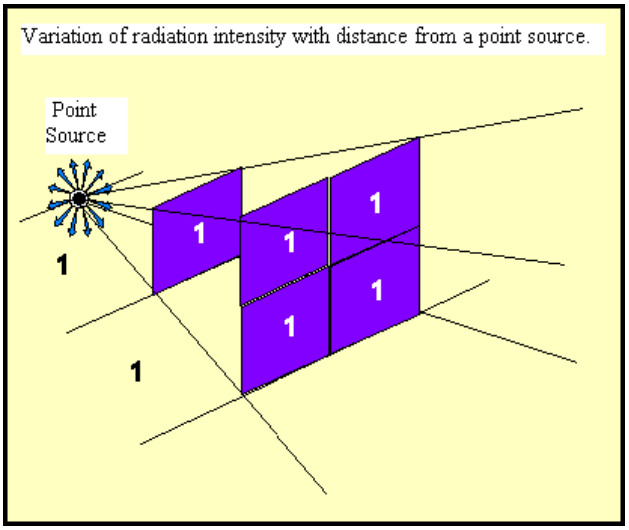
Protection from external radiation hazards

In keeping with the principles of ALARA, external radiation doses above background should, if possible, be eliminated; and, if not, minimized. Radiation dose received from an external radiation source depends on the biological effectiveness of the radiation, strength of the source, its distance, the nature of the shielding and exposure time. Radiation doses may be reduced by three specific approaches that can be used either independently or jointly:

Time - Minimize the duration of exposure. Reducing the time of exposure in an area where radiation is present will reduce the overall dose proportionately. Reducing the exposure by one-half reduces the exposure or radiation dose received by one-half. The longer the exposure time the greater risk of a radiation induced injury. Elevated radiation fields must be identified so people may limit their time in these areas. As per Radiation Protection Regulations (SOR/2000-203) and Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM) warning signs must be posted in areas exceeding 25 µSv/h (microsieverts/hour).

Distance - When possible, maximize distance between the source of radiation and exposed persons. Distance is the most easily applied principle of radiation protection. Increasing the distance, combined with limiting exposure time is the most effective way of minimizing radiation dose. The way that the intensity of ionizing radiation varies with distance from the source of the radiation is strongly influenced by the shape of the source.

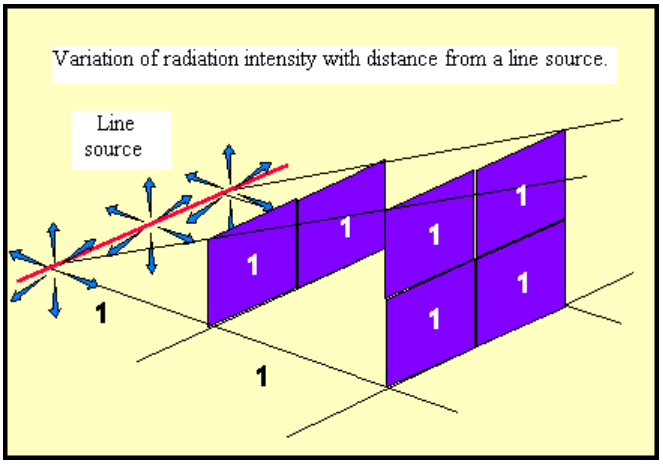
- Point Source – Dimensions of the source are small compared to the distance at which we measure the intensity. Increasing the distance from a point source follows the Inverse Square Law, i.e. the radiation intensity is inversely proportional to the square of the distance of separation. In other words, if the distance between the source of radiation and the exposed person were doubled, the radiation intensity would be one quarter of the original intensity. Similarly, by tripling the distance the radiation intensity would drop to one ninth of the original radiation intensity.



$$\text{Intensity} \propto \frac{1}{distance^2}$$

Figure 3: Point source (from MIT Nuclear Reactor Laboratory)

- Line Source – Some sources, such as a pipe or tank, cannot be treated as a point source. If the source of the radiation is spread along a line which is long and thin compared to the distance at which the intensity of the radiation is being measured then the intensity varies inversely with the perpendicular distance from the line. This means that if the distance from the source is increased by a factor of two, the intensity of the radiation drops by a factor of two; if the distance is increased by a factor of three, the intensity drops by a factor of three, etc.



$$\text{Intensity} \propto \frac{1}{distance}$$

Figure 4: Line source (from MIT Nuclear Reactor Laboratory)

- Plane (or Area) Source – If the source of the radiation is spread over a surface whose dimensions are large compared with the perpendicular distance from the surface at which the intensity of the radiation is measured, the intensity varies very little with the distance from the surface.

Shielding - Reduce the intensity of radiation by providing shielding. Shielding is the most expensive method for minimizing radiation dose. For NORM, shielding is a method of last resort. For any NORM deposits inside equipment, the equipment wall will stop all alpha and beta radiation. Alpha particles are readily absorbed by thin layers of any material, such as clothing, placed in their path. Beta particles are readily absorbed by materials such as plastics, glass, or metal foils. Gamma radiation is difficult to stop and may require significant thicknesses of very dense materials, such as lead, to reduce the radiation intensity. Considerations of size, weight, and cost set a practical limit to the amount of shielding that can be used. For the uranium-238 decay series of radionuclides, shielding of 2.3 cm of steel will reduce the intensity of gamma radiation by one-half.

Prevention of internal radiation exposure

Internal radiation exposure occurs when NORM enters the body and is of much greater concern than external radiation exposures from NORM. Radiation from NORM has a high linear energy transfer characteristic (transfer of energy in a localized area), and as such alpha and beta particles and to a lesser extent gamma photons, can cause serious damage to soft tissues such as the lungs or digestive system.

Furthermore, due to the extended retention time (several decades) of some radioisotopes within the body, a very high cumulative dose may build up over time. It is therefore very important to minimize the risk from internal radiation exposure hazards by preventing the entry of radioactive material into the body.

Internal contamination can be prevented by avoiding inhaling, ingesting, or absorbing radioactive materials through the use of engineering controls, appropriate personal protective equipment and suitable work practices.

Inhalation - is the most common route of entry. All feasible measures must be taken to prevent NORM particles from becoming airborne. Industrial operations, such as welding, grinding or cutting can create an inhalation hazard. Possible controls include using engineered ventilation controls, air filtration, good house- keeping, and closure of emission points. If the dust cannot be controlled through these measures, workers must wear appropriate respiratory protection.

Ingestion - of NORM may occur when contaminants are deposited on food, drinks or smoking materials. Possible controls include good housekeeping, restrictions on eating, drinking, smoking or applying cosmetics in the workplace areas where contamination may be present, and good personal hygiene.

Absorption - of NORM into the body is limited to entry through open cuts or abrasions. Thoroughly clean and cover any cuts or abrasions. Protective coveralls also prevent NORM from coming in contact with the skin.

Specific Worker Protection Measures		
1	**Worker Training**	All workers must be advised of the presence and potential hazards of NORM, and instructed in the measures for minimizing their exposure. Unauthorized and untrained personnel are to be prohibited from entering NORM work areas. Supervisors must ensure that workers are properly trained, have appropriate protective clothing and equipment, and observe safe work practices.
2	**Work Site Monitoring**	Operators must measure and document NORM radiation levels when personnel are working on or around NORM-contaminated or radioactive equipment.

Specific Worker Protection Measures		
3	**Radiation Area Identification**	Identify or mark equipment that is NORM contaminated. Post radiation warning signs for areas where radiation intensities exceed 25 µSv/h. Encourage workers to minimize their time in posted areas. Preplan work on NORM-contaminated equipment to minimize the time spent in the immediate vicinity of the equipment. Preassemble all necessary tools and equipment. Minimize manual handling of NORM-contaminated equipment. Keep NORM-contaminated materials as far from the body as feasible. Minimize the generation of airborne dusts where the potential exists during handling or mechanical work, by keeping NORM contaminated materials wet, covered and undisturbed.
4	**Maintenance Controls**	Equipment dismantled for repair: • If remaining on-site with trained tradesmen, remove loose contamination. • If transported off site to informed person, remove loose contamination and package according to Transportation packaging and shipping regulations. • If transported offsite to uninformed trades person, clean to the de minimis levels.
5	**PPE - Clothing**	Wear personal protective equipment, including hooded disposable coveralls, rubber boots, full face respirator and rubber or leather gloves when working on or in NORM-contaminated equipment. Discard contaminated PPE (disposable coveralls, boots or gloves) with NORM waste. **NOTE: Contaminated PPE is to be put in drums labeled as "NORM Contaminated".**
6	**PPE - Respiratory Protection**	Full face respirators with NIOSH-approved P-100 High-Efficiency Particulate (HEPA) filters are recommended. Use and maintain respiratory protective equipment in accordance with Envirosystems Respiratory Protective Equipment SWP.
7	**Confined Space Entry**	Follow normal confined space entry procedures, including gas testing for oxygen sufficiency, and elevated levels of flammable and toxic gases. Wear personal protective equipment (disposable hooded coveralls, gloves, rubber boots, protective goggles and half/full face respiratory protection) when entering the vessel. Evaluate the surface contamination and radiation dose rate inside the vessel for work requirements. **Personnel working in the confined space will wear radiation dosimeters. The customer or Envirosystems designate, will ensure radiation dosimeters are provided to personnel prior to entry and ensure the results are documented.**

Specific Worker Protection Measures		
8	**Housekeeping and Contamination Control**	Establish a controlled area and equip with suitable radiation monitors to check personnel and equipment for NORM contamination upon leaving the controlled area. Clean area regularly with wet sweeping, wash down or HEPA filter vacuuming. Segregate NORM-contaminated scale, sludges, solids, and equipment into labeled impervious containers and place in controlled storage. DO NOT PLACE NORM WASTE IN WITH REGULAR GARBAGE. Use plastic 6 mil drop sheets on expanded metal gratings, gravel, or other surfaces where the cleanup of loose NORM contaminants would be difficult.
9	**Transportation Controls**	NORM-contaminated equipment or waste being transported off-site must be monitored, classified, packaged and labeled as required by Department of Transportation, Canadian Nuclear Safety Commissions Packaging and Transport of Nuclear Substances Regulations, and the Transportation of Dangerous Goods Regulations.
10	**Personal Radiation Hygiene**	Do not allow eating, drinking, smoking and applying cosmetics in any area where NORM-contaminated materials are being handled. After work in such areas, personnel must remove any contaminated clothing and wash their hands and face, or shower.
11	**Provisions for unrestricted release**	Monitor all materials released for unrestricted use or disposal and ensure they meet the de minimis criteria listed in **Management of NORM contaminated Wastes** of this SWP.

Table 2: Specific Worker Protection Measures

NORM EXPOSURE GUIDELINES

In 2000 Health Canada published, and in 2011 revised the **Canadian Guidelines for the Management of NORM** that applies to all sources of technologically enhanced NORM (i.e. concentrated in industrial processes). The Health Canada guidelines were established in accordance with the recommendations of international radiological protection agencies. Four NORM Program classifications have been established (according to the level of risk and exposure to the general public & occupational workers) to identify the scope of the required NORM Program.

CLASSIFICATION	DESCRIPTION
Unrestricted	Estimated incremental effective dose to public is <0.3 mSv/yr and workers <1.0 mSv/yr Levels of radioactivity are considered of no importance in terms of potential effect on human health or the ecosystem and for all practical purposes considered non-radioactive. No further action is needed to control doses or materials.
NORM Management	Estimated incremental effective dose from sources of NORM exposures have potential to be > 0.3 mSv/yr but ≤ 1.0 mSv/yr to public or incidental workers. Public access would need to be restricted. However, worker access would be unrestricted. Levels of radioactivity in this category require further evaluation to determine the extent of protective measures to be applied. The NORM Management Program may include: • Introduction of incidentally exposed worker access restrictions, • Introduction of shipping and/or material management, • Changes in work practices.
Dose Management	Estimated incremental effective dose from all sources of NORM exposures have potential to be > 1.0 mSv/yr but ≤ 5.0 mSv/yr to occupationally exposed workers. The Program should include: • Worker notification of radiation source, • Consideration of work procedures and protective clothing, • Application of engineering controls where appropriate, • Training to control and reduce worker dose, • Introduction of a worker dose estimate program, • Reporting of worker doses to the National Dose Registry (NDR).
Radiation Protection Management:	Estimated effective dose from all sources of NORM exposures have potential to be > 5.0 mSv/yr but ≤ 20 mSv/yr to occupationally exposed workers. In addition to the requirements of the Dose Management Program, the following should be included: • Introduction of formal radiation protection program, • Personal radiation dosimetry program, • Protective equipment, clothing and work procedures to reduce worker dose and the spread of contamination.

Table 3: NORM Program Classification

Whenever a NORM Management, Dose Management or Radiation Protection Management Program has been implemented, a periodic review is needed to:

- determine if there have been changes that may affect the radiation dose,
- monitor the effectiveness of the NORM program, and
- determine if modifications are required.

Radiation Dose Limits

Health Canada has adopted the dose limits recommended by the International Commission on Radiological Protection (ICRP). These dose limits are described below. They are defined in terms of incremental dose, which is the dose resulting from the work practice in question. These limits are exclusive of natural background and medical exposure.

The effective dose accumulated over a given period includes:

- the effective dose from external sources and
- the committed effective dose from intakes of radionuclides in that period.

Affected Group	Annual Effective Dose Limit (mSv)	Five Year Cumulative Dose Limit (mSv)
Occupationally Exposed Workers	20 (average) 50 (maximum in one year)	100
Incidentally Exposed Workers and Members of the Public	1	5

Table 4: Radiation Dose Limits

Since the hazards of radiation created by NORM do not differ from those of manmade radioisotopes that are regulated by the Canadian Nuclear Safety Commission (CNSC), Envirosystems Inc. has adopted these internationally recognized radiation dose limits for “Incidentally Exposed NORM Workers”.

Envirosystems Inc. is committed to complying with the basic philosophy of radiation protection by keeping personal radiation exposures As Low As Reasonably Achievable (ALARA).

NORM CONTAMINATION CONTROL

The word *contamination* is used to describe the presence of unwanted material on the surfaces of structures, equipment and/or personnel. The contamination can be either permanently bonded to a surface (*fixed contamination)* or resting on a surface where it can easily be removed through casual contact with the surface or by air currents *(removable contamination)*. NORM contamination refers to the deposition of naturally occurring radioactive material on the interior surfaces of equipment associated with the processing of crude oil and natural gas materials. *Contamination control* is the process employed to control the spread of NORM to uncontrolled areas where it can become an insidious source of radiation hazard to personnel. *Decontamination* is the reduction or removal of NORM from equipment surfaces prior to equipment repair, recycling or disposal for the purpose of radiation dose reduction to personnel.

NORM contamination control is required whenever NORM contaminated equipment has to be opened, inspected or cleaned.

The control measures described below are to be put into effect whenever the decontamination of equipment is required. Failure to implement these recommendations may result in implementing an expensive and time-consuming decontamination procedure.

Equipment surface decontamination

Chemicals and physical agents can be used to remove NORM contamination from equipment surfaces. Hydroblasting, abrasive blasting, vacuum and ultrasonic cleaning, buffing and grinding are frequently used physical decontamination methods. Remember, the by-product of any chemical or physical process used to remove NORM contamination will eventually become contaminated with NORM. It is important that the spread of this contaminated material be controlled.

NORM contamination control

The level of control required will be dictated by the amount of NORM contamination detected on equipment surfaces. General principles that can be adopted for NORM contamination control are as follows:

1. **Assess the hazard** - Use a survey meter with a pancake detector to determine the risk category for the NORM. NORM surveys should be conducted for the equipment and waste from potential NORM processes every time when they are opened for access regardless of the past NORM testing results.
2. **Protect the work area** - The level of protection will depend on the decontamination method being employed.

   Flushing

   When flushing/cleaning equipment that is NORM contaminated, filter socks are to be used at the equipment discharge point to prevent solids from exiting the equipment. Additional filter socks and booms must be used downstream of the equipment, depending how the discharge water will be contained to provide additional means of capturing NORM contamination (particles, polymers, etc.). The water is allowed to drain through the socks/booms and be transferred to a temporary storage tank. The contaminated filter socks are to be disposed according to Table 8: NORM Waste Disposal Options in the Section titled Management of NORM Contaminated Waste.

   Hydroblasting

   The control of NORM contaminated water is essential when this decontamination method is being employed. NORM hydroblasting activities should be kept separate from all other hydroblasting activities to ensure that cross contamination does not occur (i.e. NORM with hydrocarbons). The spread of water to uncontrolled areas must be restricted through the use of appropriate water containment systems. All water used for hydroblasting shall be treated as contaminated with NORM until it has been checked for NORM contamination (best practice is to collect and filter water at the source to control the spread of NORM contamination).

Abrasive blasting, buffing and grinding

Airborne NORM contaminated dust is a by-product of this decontamination method. Local exhaust ventilation, or other acceptable ventilation techniques, will be required to prevent airborne particulates that are contaminated with NORM from migrating to clean uncontrolled areas. The decontamination of small pieces of equipment can be carried out in a ventilated enclosure.

Working surface protection

When equipment is brought into a workshop for repair, protect the surface where the equipment is to be repaired. Cover the working surface with paper and place a sheet of 6 mil plastic over the paper. Hold both the paper and plastic and secure with masking or duct tape. Post a NORM radiation hazard warning sign at the perimeter of the protected area.

3. **Worker protection** - Wear appropriate PPE and HEPA filter equipped respiratory protection while performing NORM decontamination work. Operations must assess the NORM radiation dose to determine if any special radiation dose control measures are required.

   "2-Meter" Rule: When personnel are working within 2 meters of opened NORM contaminated equipment, a respirator fitted with P100 (HEPA) filters is to be worn.

   Workers performing "blinding" tasks are not subject to the 2-Meter rule since the risk of direct contact with NORM contaminated surfaces and the potential for exposure to airborne particulate is minimal.

4. **Waste materials** - Treat all NORM decontamination materials as suspected of being contaminated with NORM. Operations will be responsible for measuring the level of NORM present in the waste material.

5. **Make measurements** - The success of decontamination can be assessed by measuring the level of NORM contamination present with a pancake detector. It may not be possible to remove all NORM contamination; measurements will indicate whether or not the remaining NORM contamination represents a continuing hazard. When all work is completed treat all protective coverings as NORM contaminated. Check all working surfaces that may have come in contact with NORM contaminated equipment for contamination before declaring them free of NORM contamination. If a surface is found to be contaminated, wash the affected area with a damp cloth or vacuum the surface with a HEPA filter equipped vacuum cleaner. Recheck the surface after it has been cleaned.

NORM DECON AREA PROTOCOL

The main purpose of a NORM Decon area is to have a controlled area where workers change from their potentially NORM contaminated clothing into their clean regular PPE/clothing and, where required to provide a controlled area for the decontamination of personnel and PPE. Clean personnel and equipment are only allowed on the clean side. The NORM Decon area should have a NORM monitor (pancake detector) available that can be used to check workers for NORM contamination thus preventing personnel from taking contaminated clothing and equipment outside of the controlled area and designated NORM Decon Area.

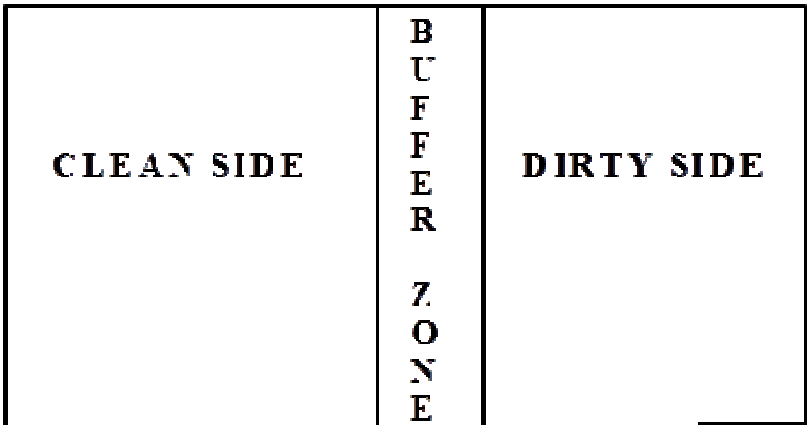


Figure 5: Controlled NORM PPE Decon Area Schematic

The NORM decon area can be as simple as a flagged off area or can be constructed out of scaffolding pipe covered by plastic such that it looks like a greenhouse. The NORM decon areas should be constructed in close proximity to where work is being done at NORM contaminated vessels, towers, etc. The decon area should be divided into a "clean" and "dirty" side.

- Each side should have benches and coat hooks to hang 'dirty' or clean PPE and tools.
- The dirty side should have 2 waste drums for disposal of "NORM contaminated" and "NOT Contaminated" PPE and articles.
- Maintain a supply of garbage bags and respirator wipes in each decon area.
- The flooring can be the existing concrete pad or in case of graveled areas, a plywood floor is recommended but not necessary. Plywood floors give workers a dry area to walk on in case of rain. Coarse rubber holed matting (to capture any loose NORM contaminated debris that may fall off PPE) can be used to cover the flooring on the dirty side.

The size and number of the NORM decon areas will depend on the number of workers using the room and the available space in the work area. If possible, situate the NORM decon areas in a shaded area (and make windows in each room) as it can act like a green house in these plastic covered tents.

General Entry & Exit Procedures

Non NORM contaminated personnel shall:

1. Enter the "clean side".
2. Remove clean footwear, etc.
3. Don HEPA respirator, then enter the "dirty side".
4. Don protective footwear, coveralls, gloves, etc.
5. Leave through the "dirty side" door to NORM work area.

Potentially NORM contaminated persons shall:

1. Enter the "dirty side" where the worker will be first checked for NORM contamination with a NORM monitor by a trained worker.
2. Remove all potentially contaminated PPE (except respirator), start with gloves, coveralls, hard hat, and then foot wear (if required).
    i. Place contaminated PPE that is not reusable or won't be used again (i.e. torn disposable coveralls) in "NORM contaminated PPE" marked drum.
    ii. Keep contaminated PPE that is reusable or will be used again (i.e. after rest break) in "dirty side" and reuse at later time.
    iii. Place non contaminated PPE or articles in "NOT contaminated" marked drum or remove from NORM area for further use.
3. Remove contaminated footwear before going to "clean side".
4. Wear non-contaminated respirators to "clean side" and remove.
5. PPE and tools remain in "dirty side" until checked for NORM and found to be free of contamination.

MANAGEMEMT OF PERSONNEL CONTAMINATED WITH NORM

Incidents involving the NORM contamination of personnel shall be reported ***immediately*** to the Supervisor/Manager, as per Envirosystems Incident Management Policy. As soon as possible, implement the following precautionary measures:

External Contamination

Face and hands are the most frequent body parts to become contaminated.

1. Determine the extent of contamination with a pancake detector.
2. Remove any contaminated clothing.
3. Immediately flush contaminated areas of skin with copious amounts of *lukewarm water* for approximately two (2) to three (3) minutes being careful not to spread radioactive contamination to other areas. Monitor the contaminated area.
4. If necessary, wash skin again with mild soap and lukewarm water. Work lather into contaminated skin area by rubbing gently for approximately three (3) minutes and rinse thoroughly. If necessary wash again with a mild abrasive soap, soft brush and lukewarm warm water. ***DO NOT*** use any strong abrasive detergents or hard brushes. The use of harsh abrasives will damage the skin and allow radioactive material to penetrate into the subsurface layers skin creating an additional internal contamination problem.
5. Monitor the affected area and if it is still contaminated ***DO NOT*** attempt to wash it any more. The radioactive contaminant may be bound to protein of the skin and will be extremely difficult to remove.
6. Use copious amounts of water or an appropriate medically approved solution for decontamination of the eyes.
7. Employee must visit medical professional for necessary assessment.

Internal Contamination

Following the inhalation of radioactive material, forced coughing and blowing of the nose should be induced immediately. Keep sputum and nose blows to check for radioactive contamination. If radioactive material has been accidentally ingested, the mouth is to be rinsed immediately with water. Employee must visit medical professional for necessary assessment.

Injuries contaminated with NORM

When a personal injury occurs, **treatment of the injury takes precedence,** even with contaminated persons. Remove all contaminated clothing from the injured person before he/she leaves the accident site.

1. Minor injuries should be treated at or near, the scene of the incident. If the wound is on the face take care not to contaminate the eyes, mouth or nostrils. Wash any wound with copious quantities of lukewarm water and encourage bleeding. Then wash the area surrounding the wound with mild soap and lukewarm water.
2. Apply a first aid dressing. The injured area is to be monitored to establish the level of residual radioactivity, if any.
3. Employee must visit medical professional for necessary assessment.

MANAGEMENT OF NORM CONTAMINATED MATERIALS

In the event work materials (e.g.: tools, harnesses, PPE, or clothing) become NORM contaminated from working with NORM contaminated process equipment, the following steps should be taken:

Tools

At the completion of work on NORM contaminated equipment, tools should be checked with a pancake detector to determine if they have become contaminated. If NORM contamination is found on a tool, decontamination can be attempted by:

1. First, wipe the contaminated area with a “respirator” wipe. (**NOTE:** After each attempt at decontamination, the tool is to be re-checked with a pancake detector to determine if any residual contamination remains.) If the tool is still NORM contaminated the wiping procedure is to be repeated and the tool is to be re-checked. Used wipes are to be disposed of as NORM contaminated waste.
2. Second, if the use of wipes is unsuccessful, the tool is to be washed with detergent (e.g.: dilute CLR) in warm water and then rinsed. After cleaning, the previously contaminated tools are to be re-checked to determine if any residual contamination remains. If still contaminated, the washing process is to be repeated. All wash water is to be collected and stored with other NORM wash water.
3. If the NORM contamination cannot be removed from the tools by simple washing, more aggressive methods (e.g.: water blasting) may be required. Alternatively, the tool may be bagged and marked as “NORM contaminated” and used solely for work on NORM contaminated equipment in the future. (**NOTE**: depending on the value of the tool it may be deemed “disposable” by Envirosystems Inc. personnel. If this determination is made, the item is to be disposed of as “NORM Contaminated” waste.)

Fabric Materials (Clothing, harnesses, etc.)

At the completion of NORM related work, potentially NORM contaminated clothing, etc. should be checked with a pancake detector to determine if it has become contaminated. If the article has been found to be NORM contaminated, and it is deemed to be salvaged, then removal of the contamination may be attempted by:

1. First, using the sticky side of duct tape to attempt to capture and lift off the NORM contamination. This can be attempted on clothing that has small areas of surface contamination. This method may also be used for leather (e.g.: boots). Used duct tape is to be disposed of with NORM contaminated waste. (**NOTE:** After each attempt at decontamination, the article is to be re-checked with a pancake detector to determine if any residual contamination remains.)
2. Alternatively, respirator wipes may be used in an attempt to remove NORM contamination from the surface. Used wipes are to be disposed of with NORM contaminated waste.
3. Other articles may be cleaned manually using dilute CLR and a scrub brush. After cleaning, the previously contaminated articles should be re-checked with a pancake detector to determine if any residual contamination remains. If the article is still contaminated the washing process may be repeated and the article re-checked. If decontamination is not successful the article is to be disposed of as "NORM Contaminated" waste.

MANAGEMENT OF NORM CONTAMINATED WASTE

NORM is not considered to be part of the nuclear fuel cycle. At the present time there are no federal or provincial regulations or guidelines that address the management of NORM contaminated waste. One of the problems associated with NORM is the mixture of radioactive isotopes, which are associated with the following naturally occurring radioactive families:

a) Uranium series - Uranium-238 (parent)
b) Thorium series - Thorium-232 (parent)
c) Actinium series - Actinium-232 (parent)

The Uranium series daughter products are the greatest source of concern for the petroleum and natural gas industries. The Thorium and Actinium series may also be present in NORM wastes, but are found at concentrations that would qualify as *De Minimis* radioactive waste. The radioactive daughters in the Uranium-238 series that are the principal source of concern are Radium-226 with a physical half-life of 1,629 years and Lead-210 with a 20.4 year physical half-life. These radioisotopes present long term environmental and human health risks that have to be addressed.

Criteria for classification of NORM waste

There are two types of NORM waste materials described in the Canadian Guidelines for the Management of Naturally Occurring Radioactive Materials (NORM):

1. ***Diffuse Materials*** are defined as bulk materials, usually by-products produced from industrial activities such as water treatment sludge, water, phosphogypsum, fly-ash, polymers etc. Diffuse NORM is generally large in volume, with a relatively low radioactive concentration that is uniformly dispersed throughout the material.
2. ***Discrete Materials*** are usually contaminated equipment such as contaminated pipe, filters, etc. Discrete NORM sources are small in size and exceed the concentration criteria for a diffuse source.

Diffuse Waste (Sludges, soils, scales)

If the scale is removed from the pipe then the removed scale is classified as diffuse waste and its Unconditional Derived Release Limits (UDRL) are described in the table below. Unrestricted release of NORM at the listed concentrations will deliver a maximum effective dose of 0.3 mSv/year under conservative scenarios. Actual effective doses arising from releases of NORM at UDRLs are expected to be substantially less than the 0.3 mSv/year.

NORM Radionuclide	Aqueous, Bq/L	Solid, Bq/kg	Air, Bq/m³
Uranium-238 Series (all progeny)	1	300	0.003
Uranium-238 (U-238, Th-234, Pa-234m, U-234)	10	10,000	0.05
Thorium-230	5	10,000	0.01
Radium-226 (in equilibrium with its progeny)	5	300	0.05
Lead-210 (in equilibrium with bismuth-210 and polonium-210)	1	300	0.05
Thorium-232 Series (all progeny)	1	300	0.002
Thorium-232	1	10,000	0.006
Radium-228 (in equilibrium with Ac-228)	5	300	0.005
Thorium-228 (in equilibrium with all its progeny)	1	300	0.003
Potassium-40	n/a	17,000	n/a

Table 5: Unconditional Derived Release Limits – Diffuse NORM Sources

Where more than one long-lived radionuclide is present in a sample, the appropriate sum of the ratios of the activity of each long-lived radionuclide and its corresponding Release limit must not exceed 1:

$$\frac{Concentration\ NORM\ Isotope\ A}{UDRL\ A} + \frac{Concentration\ NORM\ Isotope\ B}{UDRL\ B} + \ldots + \frac{Concentration\ NORM\ Isotope\ N}{UDRL\ N} \leq 1$$

Discrete Waste (Contaminated pipe, filters, etc.)

A piece of contaminated pipe is usually considered a discrete NORM source hence the total concentration per item must be calculated and the item must meet the criteria stated in the table below.

NORM Radionuclide	Unconditional Derived Release Limit, Bq
Uranium Ore (in equilibrium with all progeny)	1,000
Uranium-238 (partitioned) (in equilibrium with thorium-234 and protactinium-234)	10,000
Thorium-230 (no progeny)	10,000
Radium-226 (in equilibrium with its progeny)	10,000
Lead-210 (in equilibrium with bismuth-210 and polonium-210)	10,000
Thorium-232 (in equilibrium with all progeny)	1,000
Radium-228 (in equilibrium with actinium-228)	100.000
Thorium-228 (in equilibrium with its short-lived progeny)	10,000
Potassium-40	1,000,000

Table 6: Unconditional Derived Release Limits

Where more than one long-lived radionuclide is present in a sample, the appropriate sum of the ratios of the activity of each long-lived radionuclide and its corresponding UDRL must not exceed 1:

$$\frac{Activity\ NORM\ Isotope\ A}{UDRL\ A} + \frac{Activity\ NORM\ Isotope\ B}{UDRL\ B} + \ldots + \frac{Activity\ NORM\ Isotope\ N}{UDRL\ N} \leq 1$$

To calculate the total Becquerels per item multiple the concentartion of radioactivity with the amount of scale removed from the pipe.

The material must also meet the applicable radioactive surface contamination values shown in the table below.

Property	Limit
Dose Rate	0.5 µSv/hr at 50 cm
Surface Contamination	1 Bq/cm² averaged over a 100 cm² area or 200 CPM

Table 7: Surface Contamination Unconditional Derived Release Limits – Discrete NORM

Limits for surface radioactive contamination on equipment, tools or scrap surfaces intended for unconditional release are based on the analysis of personal radiation exposure pathways to a maximum annual dose of 0.3 mSv. These limits are only applicable to fixed surface contamination. Loose surface contamination must be completely removed or all accessible surfaces stripped to ensure complete removal. Discrete NORM sources with surface contamination less than 1Bq/cm² averaged over a 100 cm² area and dose rate less than 0.5 µSv/h at 50 cm can be released without further investigation.

NORM radionuclides associated with the oil and gas industry are Ra-226, Ra-228, Th-228 and Pb-210.

Collection of samples for disposal purposes:

Waste materials that are suspected of being contaminated with NORM must be analyzed for NORM contamination (Bq/g or Bq/L) before they can be released for disposal.

The sample collection procedure for bulk sampling of NORM contaminated materials is described below:

- Wear latex or neoprene gloves to collect samples.
- Place the sample into strong plastic container with screw-on lid.
- Record the date, sample location and name of person collecting the sample on the lid of the container.

Liquid samples:

- Wear latex or neoprene gloves to collect samples
- Collect a one (1) liter sample in a bottle with a leak proof lid. A standard 1 liter, white plastic sample bottle is usually appropriate.
- Record the date, sample collection location, plant and equipment ID, and name of person collecting the sample.

The recommended quantities for sample analysis are as follows:

- Solids – 200 grams (150 ml)
- Liquids – 1 Liter.

These samples require analysis by an offsite laboratory; therefore arrangements are to be made through Management/HSE.

All testing must be completed and the results documented prior to the release or disposal of NORM contaminated material. The test results will determine if special handling/disposal requirements are necessary.

NORM waste handling/disposal options

The table on the following page describes the current accepted practices for NORM waste, which exceeds the *de minimis* (Unconditional Derived) release limits. For material, which is less than the NORM de minimis release limit, dispose accordingly. All reasonable precautions should be taken to minimize the amount of waste and cleaning materials (water, sand, etc.) generated to reduce the cost of disposal.

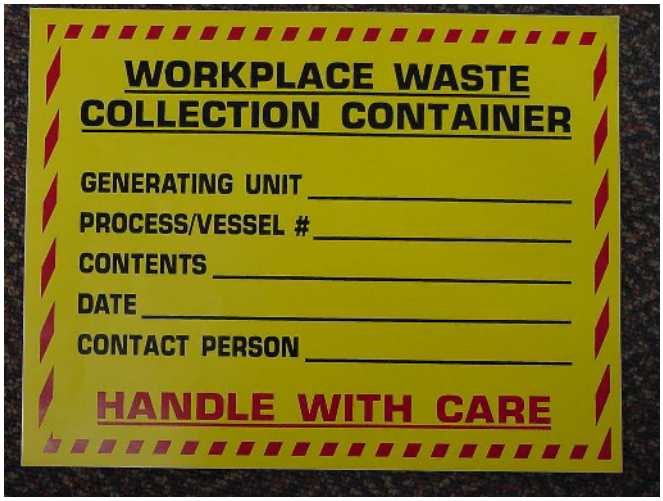
Waste category	Disposal options
NORM-contaminated surplus or scrap material (e.g. piping/valves)	High pressure/low pressure water wash may be effective in reducing NORM contamination by removing loose scales and sludge. Cleaning materials/water will likely become contaminated with NORM and will have to be treated as NORM contaminated. Surplus/scrap material must be re-tested after cleaning and if below the de minimis release limit can be disposed of or recycled. If not below de minimis levels, clean and test again. If still not below de minimis, cover any openings with plastic/duct tape, label material as NORM contaminated (with NORM readings if possible), and place material at designated waste staging area for disposal at an approved NORM disposal facility.
NORM-contaminated loose solids, sludge, scale, polymer, abrasive blast media, etc.	Material of this type must be confirmed as NORM contaminated and placed in sealed drums. Do not mix NORM contaminated or radioactive materials with non-NORM contaminated material intended for off-site disposal. Containers must be labeled "NORM CONTAMINATED MATERIAL" and provide the NORM readings if possible. The sealed containers can be moved to the designated waste staging area for disposal at an approved NORM disposal facility.
NORM-contaminated clothing, PPE, tools, miscellaneous materials.	Same as NORM contaminated solids, sludges, scale.
De Minimis contaminated clothing, PPE, tools, miscellaneous materials for general release.	To be tested and checked for removable radioactive contamination before release.
NORM-contaminated or radioactive water from hydroblasting, water washing operation	Filtration will remove a significant portion of the NORM contamination particulate. **Best practice is to filter water at the source.** After filtration, re-sample the water and determine the NORM concentration. If the water is still contaminated after filtration, it must be filtered again until concentrations are below URDL's. If water cannot be decontaminated it must be disposed at an approved NORM facility.

Table 8: NORM Waste Disposal Options

Labeling for NORM waste containers and NORM contaminated scrap

Material suspected of being contaminated with NORM is to be tested by Operations or a qualified person, to determine the degree of contamination.

Containers holding NORM contaminated material shall be identified with the label shown. (**Note:** The NORM levels should be included on the waste label.) The radiation intensities shown below shall be used to determine the waste classification and level of risk involved.



EXPOSURE MONITORING REQUIREMENTS

Routinely occupied workplace areas in which the radiation dose rate exceeds the normal background level by 10 µSv/h (20 mSv/yr) present the possibility that worker exposures may exceed the recommended annual radiation dose limit. At levels in excess of 2.5 µSv/h (5 mSv/yr), area monitoring must be supplemented by personal dosimetry to determine the actual dose to personnel within the work area, and to provide a direct measure of the effectiveness of radiation dose reduction efforts.

Personal Radiation Dosimetry

Canadian Nuclear Safety Commission (CNSC) requires a licensed dosimetry service to be used when there is likelihood that a worker may receive an annual radiation dose in excess of 5 mSv. Below 5 mSv/yr, CNSC approved techniques may be used to estimate radiation doses. Dosimetry services are typically employed when doses exceed 2 mSv/yr.

All Envirosystems Inc. workers who will be engaged in activities involving exposure to NORM will be equipped with personal dosimeters in order to measure external radiation exposures. Dosimeters will be registered with Health Canada and results of radiation dosimetry will be retained and reviewed to determine adequacy of control measures implemented by Envirosystems Inc.

RESPONSIBILITY FOR IMPLEMENTATION

All levels of management and all employees are responsible for the full implementation and efficient functioning of this SWP.

CONSEQUENCES FOR SWP VIOLATION

Any contravention to this SWP is grounds for discipline up to and including dismissal.

RELATED DOCUMENTS

Health Canada – Canadian Guidelines for the Management of Naturally Occurring Radioactive Material (NORM)
(http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/norm-mrn/index-eng.php)

EVALUATION

This SWP will be reviewed on a yearly basis by the Health and Safety Department.

Revision #	*Change*	*Date of Change*	*Changed by*

APPENDIX C
PROCESS FLOW DIAGRAM

NORM Management

Start

Is NORM suspected?

No

Yes

Select appropriate detector (Ludlum 3-97)

Return instrument to storage for re-use

Is instrument calibrated and functioning?

No

Send instrument for repair/ calibration

Yes

Is the reading (total surface dose rate) > 0.15 µSv/ hr?

Yes

Calculate a potential incremental dose in mSv/a (dose rate – background)*hrs

No

Take an additional reading a 50 cm distance from the material in µSv/hr

Is instrument calibrated and functioning?

No

Yes

Proceed with normal operation

End

Is an assessed incremental dose > 0.3 mSv/a?

Yes

Determine the maximum daily recommended time based on:
- maximum incremental effective dose of 0.3 mSv/a,
- measured radiation exposure rate at a typical working distance from the material (µSv/hr) and
- expected number of working hours per year under the assumed exposure conditions (hr/yr)

Implement NORM Management Program

No

Take a reading about 1-2 cm away from the material or suspected area surfaces in µSv/hr

Attach pancake probe

Take a background reading near to but not at the material or suspected area in CPM

Take a reading about 1-2 cm away from the material or suspected area surfaces in CPM

Is the reading > 200 CPM?

Yes

Is the reading > 2000 CPM?

Yes

Send a sample to the lab to determine activity level in Bq/g

Is the activity level > 70 Bq/g?

Yes

Reject the material

No

Label material/ waste as NORM contaminated (if not already labeled)

Is the dose rate at 50 cm distance > 0.50 µSv/hr?

Yes

No

Take a background reading near to but not at the material or suspected area in µSv/ hr

Accept the material

Label material/ waste as NORM contaminated

Is the material/ waste labeled as NORM contaminated?

No

Proceed with normal operation

NORM contaminated material

NORM contaminated waste

Move NORM contaminated material to a designated area

Put generated waste into drums/ containers

Label drums/ containers as NORM contaminated

Collect representative samples

Send samples for lab analysis

Diffuse (sludge, soils)

Discrete (scale deposits inside material)

Visually assess NORM contaminated material

Is the scale hard (glassy)?

No

Manually remove soft (spongy) scale

Yes

Remove hard scale

Was wash water generated?

No

Yes

Is the material visually clear of scale?

No

Yes

NORM free material?
Total surface dose rate < 0.5 µSv/hr at 50 cm
and
Surface contamination < 200 CPM

Is it possible to further decontaminate?

Yes

No

Yes

No

Place used filters in drums

Pump contaminated wash water thru NORM Treatment Unit to remove ant NORM particles to below Health Canada's guidelines

Pump generated wash water into storage tank

Process the NORM treated wash water through Ultrafiltration and RO System to lower chlorides and other contaminants to below HRWC's discharge criteria

Pump treated wash water to Treated Storage Tank

Test for NORM and HW Discharge criteria

No

Yes

Are the test results in compliance?

Discharge the treated wash water into HW's sewer system

Send contaminated material to an approved NORM disposal facility

Send decontaminated material for reuse or recycling

Remove PPE at the exit of NORM contamination areas

Survey all PPE and tools

Are PPE and tools contaminated
Total surface dose rate > 0.5 µSv/hr at 50 cm
and
Surface contamination > 200 CPM?

No

Dispose as a regular waste

End

Yes

Decontaminate PPE and tools by rinsing off with soap water

Yes

No

Place PPE and tools in NORM-designated container

Send to an approved NORM disposal facility

Is decontamination possible?

Yes

Is the NORM quantity > Unconditional Derived Release Limit (UDRL) for diffuse NORM?

No

NORM Radionuclide	Aqueous, Bq/L	Solid, Bq/kg	Air, Bq/m³
U-238 Series	1	300	0.003
U-238	10	10,000	0.05
Th-230	5	10,000	0.01
Ra-226	5	300	0.05
Pb-210	1	300	0.05
Th-232 Series	1	300	0.002
Th-232	1	10,000	0.006
Ra-228	5	300	0.005
Th-228	1	300	0.003
K-40	N/A	17,000	N/A

Does the sum of the rations of activity of each radionuclide and its corresponding release limit exceed 1?

No

Yes

Dispose of waste with no radiological restrictions at an approved facility

End

Does the material exceed the radioactive surface contamination values?

Yes

No

Dose Rate	0.5 µSv/h at 50 cm
Surface Contamination	1 Bq/cm² averaged over a 100 cm² area or 200 cpm

Is the NORM quantity > Unconditional Derived Release Limit (UDRL) for discrete NORM?

Yes

No

NORM Radionuclide	Bq
Uranium Ore	1,000
U-238	10,000
Th-230	10,000
Ra-226	10,000
Pb-210	10,000
Th-232	1,000
Ra-228	100,000
Th-228	10,000
K-40	1,000,000

Contact licensed NORM treatment/ disposal company to arrange for the pickup and decontamination/ disposal of NORM contaminated material/waste.

Yes

No

Release material with no radiological restrictions

Does the sum of the rations of activity of each radionuclide and its corresponding release limit exceed 1?

Remove PPE at the exit of NORM contamination areas

Is the radioactive concentration > 70 Bq/g

No

Yes

Treat as non-radioactive material for transport purposes only

Include NORM descriptor in the shipping document

Do not affix radioactive placards or labels on the transport vehicle

End

Treat as radioactive material for off-site transport

Affix radioactive placards or labels on the transport vehicle

End

ENVIROSYSTEMS