DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

RCRA Corrective Action
Environmental Indicator (EI) RCRIS code (CA750)
Migration of Contaminated Groundwater Under Control

Facility Name: Virginia Polytechnic Institute and State University
Facility Address: 459 Tech Center Drive (0423), Blacksburg, Virginia 24061
Facility EPA ID #: VAD074747908

1. Has **all** available relevant/significant information on known and reasonably suspected releases to the groundwater media, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMUs), Regulated Units (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

   ☒ If yes - check here and continue with #2 below.

   ☐ If no - re-evaluate existing data, or

   ☐ If data are not available, skip to #8 and enter "IN" (more information needed) status code.

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

Definition of "Migration of Contaminated Groundwater Under Control" EI

A positive "Migration of Contaminated Groundwater Under Control" EI determination ("YE" status code) indicates that the migration of "contaminated" groundwater has stabilized, and that monitoring will be conducted to confirm that contaminated groundwater remains within the original "area of contaminated groundwater" (for all groundwater "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, (GPRA). The "Migration of Contaminated Groundwater Under Control" EI pertains ONLY to the physical migration (i.e., further spread) of contaminated ground water and contaminants within groundwater (e.g., non-aqueous phase liquids or NAPLs). Achieving this EI does not substitute for achieving other stabilization or final remedy requirements and expectations associated with sources of contamination and the need to restore, wherever practicable, contaminated groundwater to be suitable for its designated current and future uses.

Duration / Applicability of EI Determinations

EI Determinations status codes should remain in RCRIS national database ONLY as long as they remain true (i.e., RCRIS status codes must be changed when the regulatory authorities become aware of contrary information).

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2. Is **groundwater** known or reasonably suspected to be **"contaminated"**[1] above appropriately protective "levels" (i.e., applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action, anywhere at, or from, the facility?

☒ If yes - continue after identifying key contaminants, citing appropriate "levels," and referencing supporting documentation.

☐ If no - skip to #8 and enter "YE" status code, after citing appropriate "levels," and referencing supporting documentation to demonstrate that groundwater is not "contaminated."

☐ If unknown - skip to #8 and enter "IN" status code.

Rationale and Reference(s):

The following units have either impacted or potentially impacted groundwater at Virginia Polytechnic Institute and State University (Virginia Tech):

- SWMU 1 – Former Physical Plant Area
- SWMU 2 – Closed Sanitary Landfill (Virginia Department of Environmental Quality Permit No. 109)
- AOC 5 – 2002 Virginia Tech Power Plant Fuel Release.

SWMU 1 – Former Physical Plant Area

SWMU 1 is located in the area between Cowgill Hall and the Perry Street Parking lot near Whittemore Hall and includes the area where the Bishop-Favro building currently stands. SWMU 1 encompasses the area that was the Former Physical Plant Area from 1935 to 1968. The Former Physical Plant was comprised of various buildings and provided maintenance for university buildings and equipment. In addition, a former quarry that supplied building stone used on campus during the early part of the 20th century was located adjacent to the Former Physical Plant in the area behind Derring and Cowgill Halls. The former quarry is believed to have operated from 1899 to 1935. The former quarry reportedly was filled with water from 1935 until the late 1940's, and was subsequently filled with soil and other fill material from the late 1940's until 1952. The area of the former quarry is currently covered by asphalt, various buildings, and grassy areas. Due to uncertainty regarding the methods by which the former quarry was filled, as well as the waste handling procedures that were used at the Former Physical Plant Area, VA Tech, under the direction of the Virginia Department of Environmental Quality (VADEQ), conducted extensive site assessments of these areas in 1993 and 2002. The site assessments included geophysical surveys, in addition to soil and groundwater sampling.

The laboratory results for groundwater samples collected in 1993 and 2002 indicated 11 metals and one volatile organic compound (VOC). As part of the 2002 investigation, the results of detected constituents in groundwater were compared to VADEQs Tier II and Tier III Voluntary Remediation Program (VRP) screening levels.

Metals: Barium concentrations detected during the 2002 sampling event generally ranged from 0.0736 mg/L to 0.214 mg/L, which did not exceed the Tier II screening level of 2.0 mg/L. However, one sample (well MW-5) had a barium concentration of 3.75 mg/L, which exceeded the Tier II screening level of 2.0 mg/L, but did not exceed the Tier III screening level of 36.8 mg/L. Well MW-5 is located in a parking lot and the well cap was loose at the time of sampling, meaning the well may have been impacted by run-off during the years between sampling. Also, the groundwater purged from well MW-5 was grayish and turbid. It should be noted that metals results can be influenced by high turbidity in groundwater samples. Therefore, the barium concentrations for well MW-5 may not be representative. The groundwater samples obtained in 1993 were not analyzed for barium.

Footnotes:

[1] "Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriate "levels" (appropriate for the protection of the groundwater resource and its beneficial uses).

Chromium concentrations ranged from less than 0.001 mg/L to 0.185 mg/L, and one sample exceeded the Tier II screening level of 0.100 mg/L, but did not exceed the Tier III screening level of 2.69 mg/L. The sample exceeding the Tier II screening level was collected in 1993 from well MW-7, which was reported to be turbid. Well MW-7 could not be located for re-sampling in 2002.

Lead concentrations in 1993 ranged from less than 0.001 mg/L to 0.263 mg/L, and samples from four wells exceeded the Tier II screening level of 0.015 mg/L. A Tier III screening level is not established for lead in groundwater. The sample with the highest concentration was from well MW-7, which was turbid and could not be re-sampled in 2002. The sample with the second highest concentration at 0.056 mg/L was upgradient well MW-1. The other two sample locations with lead concentrations exceeding the Tier II screening level were well MW-2, which could not be located to be re-sampled in 2002, and the grab sample from Geoprobe boring CC-1, which was a turbid sample. The 2002 lead results for wells MW-1, MW-3A, MW-4 and MW-5 were less than the Tier II screening level.

Nickel concentrations ranged from 0.00175 mg/L to 0.25 mg/L, and one sample exceeded the Tier II screening level of 0.073 mg/L, but did not exceed the Tier III screening level of 12.8 mg/L. The sample exceeding the Tier II screening level was from well MW-7 in 1993. As previously stated, that well was reported to be turbid and could not be located to be re-sampled in 2002.

Arsenic, beryllium, cadmium, copper, selenium, silver, and zinc concentrations did not exceed the Tier II screening levels.

VOCs: The only VOC detected in either the 1993 or 2002 groundwater sampling events was chloroform in upgradient wells MW-1 and MW-6. The concentrations ranged from 0.004 mg/L to 0.027 mg/L, which do not exceed the Tier II screening level of 0.100 mg/L.

Additional Groundwater Sampling:
Of the seven monitoring wells that were part of the 1993 and 2002 site investigations of SWMU 1, only two wells remain; upgradient wells MW-1 and MW-6. The other five wells were either inadvertently destroyed or paved over during construction activities and could not be located. In November 2010, Virginia Tech conducted additional sampling and analyses of the two remaining wells. From the extensive list of constituents analyzed, including metals, VOCs, and semi-volatile organic compounds (SVOCs) including polyaromatic hydrocarbons (PAHs), only five constituents were detected in groundwater at well MW-6 at very low concentrations. No constituents were detected in well MW-1. Four of the five detected constituents were detected at concentrations less than 0.001 mg/L. Chloroform was detected at a concentration of 0.0044 mg/L, well below the Tier II screening level of 0.08 mg/L.

Although minor groundwater impacts continue to exist at SWMU 1, the constituents detected in groundwater are below EPA's Drinking Water Maximum Contaminant Levels (MCLs) or EPA Region 3 Regional Screening Levels (RSLs) for constituents without MCLs. No additional groundwater investigation or remediation activities are proposed for SWMU 1 as the groundwater impacts at this unit have been remediated to the satisfaction of the VADEQ.

For additional information regarding SWMU 1, please refer to the December 20, 2010 Description of Current Conditions report, prepared by Draper Aden Associates on behalf of Virginia Tech.

SWMU 2 – Closed Sanitary Landfill (VADEQ Permit No. 109)

SWMU 2 is a closed solid waste landfill located to the west of Route 460 Bypass and to the north of Prices Fork Road. On May 30, 1973, the Virginia Department of Health issued Solid Waste Permit No. 109 for this approximately 4.5 acre unlined sanitary landfill. During operation of the landfill, Virginia Tech disposed of general university waste within eight trenches that were constructed without a base liner or leachate collection system. Additionally, asbestos waste was disposed within one well-defined section of the landfill.

Trenches 1 through 6 were closed prior to 1988, and trenches 7 and 8 were closed in 1994. Landfill gas monitoring and groundwater detection monitoring were initiated for the landfill in 1992. Constituents for which groundwater concentrations currently exceed applicable regulatory threshold levels (VADEQ approved groundwater protection standards (GPS)) at SWMU 2 and their maximum concentrations observed on the most recent (May 2010) corrective action monitoring event are as follows:

- 1,1-Dichloroethane – 11 µg/l (MW-3) compared to GPS (1.878 µg/l)

- Arsenic – 13.9 µg/l (MW-2) compared to GPS (10 µg/l)
- Cobalt – 21.2 µg/l (MW-4) compared to GPS (4.695 µg/l)
- Vinyl Chloride - 11 µg/l (MW-3) compared to GPS (2.0 µg/l)

For additional information regarding SWMU 2, please refer to the December 20, 2010 Description of Current Conditions report, prepared by Draper Aden Associates on behalf of Virginia Tech.

AOC 5 – 2002 Virginia Tech Power Plant Fuel Release

In December 2002, Virginia Tech detected a fuel release from its two 137,000-gallon cast-in-place concrete underground storage tanks (USTs) which share a common center wall. The source of the release was determined to be a perforation in the eastern wall of the UST. Prior to July 2002, the USTs were used to store No. 6 fuel oil, which was used to operate the boilers in the Power Plant. The boilers were shifted to use No. 2 fuel oil and, as a result, the USTs were retrofitted in July 2002 to store No. 2 fuel oil.

In response to the release, VADEQ requested Virginia Tech to conduct a site risk and remediation assessment. Soil and groundwater sample results for total petroleum hydrocarbons (TPH) – diesel range organics (DRO) from December 2002/January 2003, in addition to site characterization activities conducted in May 2003, indicated that the petroleum impact appeared to be limited to a soil depth of 12-18 feet below ground surface (bgs) in the vicinity of vent well VW-1, and soil borings B-1, B-2, and B-4, and covered an estimated area of approximately 670 square feet. Contaminant concentrations detected during site characterization are as follows:

Boring Soil Sample Analytical Results		
Soil Sample ID (Depth)	TPH-DRO Concentration (mg/kg)	Naphthalene Concentration (mg/kg)
B-1 (14-15')	390	NA
B-1 (17-17.5')	1,700	0.7
B-2 (16.5')	3,900	NA
B-4 (13-15')	5,400	2.6

Liquid Sample Analytical Results for well VW-1	
Constituent	Sample Result (mg/L)
TPH-DRO	911,000
2-Methylnaphthalene	49,200
Naphthalene	13,400

In March 2004, approximately 143 tons of impacted soil adjacent to the eastern wall of the UST was removed. Further excavation beyond the northwest corner of the tank wall was prohibited due to the close proximity to a buried utility line; therefore, some contaminated soil was left in place. A 16-inch diameter monitoring and recovery sump was placed in the excavation and backfilled to facilitate further product recovery. The perforation in the UST was located and temporarily repaired by Virginia Tech to eliminate the source of the release.

At AOC 5, minimal amounts of free product are observed in the vault sump, and no free product is typically observed in the groundwater well VW-1. A small sheen is observed at times in VW-1, however this well is not believed to monitor true groundwater at the site (true groundwater aquifer is inferred to reside in the deeper bedrock). Remedial actions and monitoring are ongoing for AOC 5 under the direction of VADEQ.

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3. Has the **migration** of contaminated groundwater **stabilized** (such that contaminated groundwater is expected to remain within "existing area of contaminated groundwater"[2] as defined by the monitoring locations designated at the time of this determination)?

☒ If yes - continue, after presenting or referencing the physical evidence (e.g., groundwater sampling/measurement/migration barrier data) and rationale why contaminated groundwater is expected to remain within the (horizontal or vertical) dimensions of the "existing area of groundwater contamination"[2]).

☐ If no (contaminated groundwater is observed or expected to migrate beyond the designated locations defining the "existing area of groundwater contamination"[2]) – skip to #8 and enter "NO" status code, after providing an explanation.

☐ If unknown - skip to #8 and enter "IN" status code.

Rationale and Reference(s):

The groundwater impacts from SWMUs 1 and 2 have been remediated to the satisfaction of the VADEQ, and groundwater contamination actually exceeding applicable regulatory levels is known to exist only at SWMU 2. At SWMU 2, corrective action and corrective action monitoring is ongoing which includes a sentinel well network. The sentinel well data shows that the impacted groundwater at the facility does not exceed the GPS at the property boundary. Sentinel well MW-10 is the most downgradient monitoring point at which no target constituents have been detected at concentrations greater than their respective GPSs. Review of current data in comparison to historical data also confirms that the groundwater plume at SWMU 2 is stable and undergoing natural attenuation.

At AOC 5 the true groundwater aquifer is not believed to be impacted; however, monitoring of the storm water drain downgradient of the site and a shallow vent well VW-1 as well as remediation of the existing impacts is ongoing. To date the facility is not aware of any uncontrolled impacts to groundwater at this site. In addition, based on site-use conditions and site hydrogeology, no uncontrolled exposure pathways to contaminated groundwater are known to exist or are likely in the future. Remedial actions and groundwater monitoring are ongoing at this site in accordance with VADEQ programs. Overall, groundwater is not currently used as a potable or irrigation water supply at Virginia Tech; potable water is supplied to the facility and the surrounding area by the Blacksburg-Christiansburg-VPI Water Authority and withdrawn from the New River (intake is located approximately 5 to 6 miles from the Virginia Tech campus).

[2] "existing area of contaminated groundwater" is an area (with horizontal and vertical dimensions) that has been verifiably demonstrated to contain all relevant groundwater contamination for this determination, and is defined by designated (monitoring) locations proximate to the outer perimeter of "contamination" that can and will be sampled/tested in the future to physically verify that all "contaminated" groundwater remains within this area, and that the further migration of "contaminated" groundwater is not occurring. Reasonable allowances in the proximity of the monitoring locations are permissible to incorporate formal remedy decisions (i.e., including public participation) allowing a limited area for natural attenuation.

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4. Does "contaminated" groundwater **discharge** into **surface water** bodies?

☐ If yes - continue after identifying potentially affected surface water bodies.

☒ If no - skip to #7 (and enter a "YE" status code in #8, if #7 = yes) after providing an explanation and/or referencing documentation supporting that groundwater "contamination" does not enter surface water bodies.

☐ If unknown - skip to #8 and enter "IN" status code.

Rationale and Reference(s):

Virginia Tech is not aware of any complete pathways where impacted groundwater may be discharging to surface water bodies.

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5. Is the **discharge** of "contaminated" groundwater into surface water likely to be **"insignificant"** (i.e., the maximum concentration[3] of each contaminant discharging into surface water is less than 10 times their appropriate groundwater "level," and there are no other conditions (e.g., the nature, and number, of discharging contaminants, or environmental setting), which significantly increase the potential for unacceptable impacts to surface water, sediments, or eco-systems at these concentrations)?

☐ If yes - skip to #7 (and enter "YE" status code in #8 if #7 = yes), after documenting: 1) the maximum known or reasonably suspected concentration[3] of key contaminants discharged above their groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) provide a statement of professional judgement/explanation (or reference documentation) supporting that the discharge of groundwater contaminants into the surface water is not anticipated to have unacceptable impacts to the receiving surface water, sediments, or eco-system.

☐ If no - (the discharge of "contaminated" groundwater into surface water is potentially significant) - continue after documenting: 1) the maximum known or reasonably suspected concentration[3] of each contaminant discharged above its groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) for any contaminants discharging into surface water in concentrations[3] greater than 100 times their appropriate groundwater "levels," the estimated total amount (mass in kg/yr) of each of these contaminants that are being discharged (loaded) into the surface water body (at the time of the determination), and identify if there is evidence that the amount of discharging contaminants is increasing.

☐ If unknown - enter "IN" status code in #8.

Rationale and Reference(s):

N/A

[3] As measured in groundwater prior to entry to the groundwater-surface water/sediment interaction (e.g., hyporheic) zone.

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6. Can the **discharge** of "contaminated" groundwater into surface water be shown to be "**currently acceptable**" (i.e., not cause impacts to surface water, sediments or eco-systems that should not be allowed to continue until a final remedy decision can be made and implemented[4])?

☐ If yes - continue after either: 1) identifying the Final Remedy decision incorporating these conditions, or other site-specific criteria (developed for the protection of the site's surface water, sediments, and eco-systems), and referencing supporting documentation demonstrating that these criteria are not exceeded by the discharging groundwater; OR 2) providing or referencing an interim-assessment[5], appropriate to the potential for impact that shows the discharge of groundwater contaminants into the surface water is (in the opinion of a trained specialists, including ecologist) adequately protective of receiving surface water, sediments, and eco-systems, until such time when a full assessment and final remedy decision can be made. Factors which should be considered in the interim-assessment (where appropriate to help identify the impact associated with discharging groundwater) include: surface water body size, flow, use/classification/habitats and contaminant loading limits, other sources of surface water/sediment contamination, surface water and sediment sample results and comparisons to available and appropriate surface water and sediment "levels," as well as any other factors, such as effects on ecological receptors (e.g., via bio-assays/benthic surveys or site-specific ecological Risk Assessments), that the overseeing regulatory agency would deem appropriate for making the EI determination.

☐ If no - (the discharge of "contaminated" groundwater can not be shown to be "**currently acceptable**") - skip to #8 and enter "NO" status code, after documenting the currently unacceptable impacts to the surface water body, sediments, and/or eco-systems.

☐ If unknown - skip to 8 and enter "IN" status code.

Rationale and Reference(s):

N/A

[4] Note, because areas of inflowing groundwater can be critical habitats (e.g., nurseries or thermal refugia) for many species, appropriate specialist (e.g., ecologist) should be included in management decisions that could eliminate these areas by significantly altering or reversing groundwater flow pathways near surface water bodies.

[5] The understanding of the impacts of contaminated groundwater discharges into surface water bodies is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration to be reasonably certain that discharges are not causing currently unacceptable impacts to the surface waters, sediments or eco-systems.

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7. Will groundwater **monitoring** / measurement data (and surface water/sediment/ecological data, as necessary) be collected in the future to verify that contaminated groundwater has remained within the horizontal (or vertical, as necessary) dimensions of the "existing area of contaminated groundwater?"

☒ If yes - continue after providing or citing documentation for planned activities or future sampling/measurement events. Specifically identify the well/measurement locations which will be tested in the future to verify the expectation (identified in #3) that groundwater contamination will not be migrating horizontally (or vertically, as necessary) beyond the "existing area of groundwater contamination."

☐ If no - enter "NO" status code in #8.

☐ If unknown - enter "IN" status code in #8.

Rationale and Reference(s):

As explained under Questions 2 and 3, above, as well as in the Description of Current Conditions, corrective action groundwater monitoring will continue to be performed at SWMU 2 in accordance with VADEQ regulations. Similarly, environmental monitoring and remedial activities will continue to be implemented at AOC 5. No further action is required at other SWMUs or AOCs.

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8. Check the appropriate RCRIS status codes for the Migration of Contaminated Groundwater Under Control EI (event code CA750), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (attach appropriate supporting documentation as well as a map of the facility).

☒ YE - Yes, "Migration of Contaminated Groundwater Under Control" has been verified. Based on a review of the information contained in this EI determination, it has been determined that the "Migration of Contaminated Groundwater" is "Under Control" at the Virginia Polytechnic and State University facility, EPA ID No. VAD074747908, located at 459 Tech Center Drive, Blacksburg, Virginia, 24061. Specifically, this determination indicates that the migration of "contaminated" groundwater is under control, and that monitoring will be conducted to confirm that contaminated groundwater remains within the "existing area of contaminated groundwater" This determination will be re-evaluated when the Agency becomes aware of significant changes at the facility.

☐ NO - Unacceptable migration of contaminated groundwater is observed or expected.

☐ IN - More information is needed to make a determination.

Completed by _____ Date 12/22/11
Jeanna R. Henry
Remedial Project Manager
EPA Region III

Supervisor _____ Date 12/27/11
Luis Pizarro
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