Memo

To	**Michelle Kaysen / USEPA**	File no	**377882016.2400**
From	**Russ Johnson** **Peter Guerra** **David Pettit**	cc	**D. Sullivan / NIPSCO** **C. Morris, G. Wagner / IDNL** **J. Conroy / NPS** **J. Dodds, R. Pallesen / US EPA**
Date	**September 18, 2017**		
Subject	**Response to EPA Comments** **Revised Costs for SWMU 15** **Corrective Measures Study for Area C** **NIPSCO Bailly Generating Station**		

On June 2, 2017, a technical memorandum entitled "Revised Costs for SWMU 15" was submitted to EPA, which included detailed cost spreadsheets for three of the alternatives evaluated in the Revised Draft Area C CMS Report dated March 18, 2016. The three alternatives re-considered included: (1) full excavation for off-site disposal - Alternative 1, (2) partial excavation for off-site disposal with in situ stabilization and solidification (ISS) of CCR left below the water table – Alternative 4; and (3) encapsulation - Alternative 6. The June 2, 2017 memo revised the Revised Draft CMS Report recommendation for SWMU 15 from encapsulation (Alternative 6) to partial excavation and ISS (Alternative 4).

EPA provided a comment letter dated August 18, 2017, with the subject line "Review of Revised Costs for SWMU 15 (June 2, 2017) and *Coal Ash In-Situ Soil Stabilization Bench Scale Treatability Study* (Kemron Report, CMS Appendix C, 2015)". In that letter, EPA states:

> "As in-situ stabilization and solidification (ISS) is a component of NIPSCO's newly proposed remedy of the coal combustion residuals (CCR) at SWMU 15, results from the previously published bench scale treatability report have become more critical in evaluating potential remedies; therefore, comments are included below."

EPA had two comments under their heading "Revised Costs for SWMU 15", and 10 comments under their heading "KEMRON Report". Each of EPA's comments are reproduced herein, followed by NIPSCO's response. Under the heading "KEMRON Report" a general response is first provided.

<u>Revised Costs for SWMU 15</u>

1. EPA Comment: NIPSCO's original proposed remedy for SWMU 15, documented in the 2015 draft Corrective Measures Study, was encapsulation via a slurry wall and cap. The conclusions of the 2016 geotechnical work and this revised cost estimate indicate that encapsulation is no longer the best option. NIPSCO is now proposing partial excavation/off-site disposal with partial in-situ ISS. The revised costs suggest a smaller difference between a partial excavation option

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and some of the full excavation versions. EPA recognizes the safety concerns associated with excavating the deeper, saturated CCR material; however, NIPSCO should clearly state the rational for selecting a partial excavation option rather than full excavation.

NIPSCO Response – As documented in the Revised Draft Area C Corrective Measures Study Report (CMS Report)[1], both corrective action measures meet the three performance standards, including: (1) protecting human health and the environment; (2) attaining media cleanup standards (MCS); and (3) controlling sources of releases. Based on the current information, both corrective action measures were scored favorably for the balancing criteria, including: (a) long-term effectiveness; (b) toxicity, mobility and volume reduction; (c) short-term effectiveness; (d) implementability; (e) green remediation; (f) community acceptance; and (g) state acceptance. Worker safety is a primary concern for NIPSCO. Remedial options that can minimize issues such as excavation sidewall and bottom instability and proximity to overhead transmission lines while still meeting remedial objectives are viewed as more favorable.

NIPSCO anticipates that additional bench-scale testing using EPA's LEAF Method 1315 "Mass Transfer Rates of Constituents in Monolithic or Compacted Granular Materials Using a Semi-Dynamic Tank Leaching Procedure" will provide results that are more favorable for the proposed ISS alternative (see Comment/Response #7). Once the LEAF-method, bench-scale testing is completed, the CMS Report will be updated, particularly Section 12 (Evaluation of Corrective Measure Alternatives), to reflect the results and the rationale for proposing the partial excavation and ISS option. The evaluation will include a comparison of the revised cost estimates in the June 2017 memo, as amended from the ISS bench-scale study findings.

2. EPA Comment: Post remedial groundwater monitoring does not appear to be included in the cost estimate for the recommended remedy. Though long-term groundwater monitoring associated with OMM [Operation, Maintenance and Monitoring] is not anticipated for an ISS remedy, some monitoring will be necessary to confirm remedy success. A revised Corrective Measures Study will need to contain the details of a post remedial monitoring program.

   NIPSCO Response – As documented on Page 11-1 of the CMS Report, "as part of each alternative, four wells will be monitored downgradient of the SWMU 15 boundary to evaluate the effectiveness of each measure." The costs for long-term monitoring were not included in the CMS Report because it focused on the relative differences between alternatives. The monitoring-well network, the groundwater analyte list, and the sampling frequency is the same for each SWMU 15 alternative. The revised costs for SWMU 15 used the CMS Report spreadsheets as a starting point, and therefore do not include long-term monitoring because these costs constitute a very small fraction of the remedy costs. Costs for long-term monitoring will be included in the next CMS Report.

[1] Amec Foster Wheeler, 2016. Revised Draft Area C Corrective Measures Study, NIPSCO Bailly Generating Station, RCRA Corrective Action Program, EPA ID #000 718 114, Chesterton, Indiana. March 18, 2016.

KEMRON Report

NIPSCO General Response: The ISS Bench-Scale Treatability Study was performed as a comparative analysis of the different reagent formulations as part of a feasibility study. NIPSCO agrees that EPA's LEAF Method 1315 is more representative than the Synthetic Precipitation Leaching Procedure (SPLP) to evaluate ISS effectiveness, and will be utilized in future testing. The SPLP was deemed appropriate at the time of testing for the comparative analysis, as all samples would be treated in the same manner.

It is important to note that under the ISS alternative, the primary means of reducing mass flux of inorganics from CCR is to reduce the CCR permeability. The previous ISS bench-scale testing has shown that the CCR permeability can be reduced by orders of magnitude, which induces a corresponding reduction in mass flux of all CCR constituents. Reduction in mass flux will result in reduced downgradient concentrations of all CCR constituents.

The CMS Report identified aluminum, boron, and manganese as Contaminants of Potential Environmental Concern (COPECs) for IDNL groundwater, with arsenic as a potential drinking water concern. Molybdenum and selenium were added as COPECs for SWMU 15 groundwater. Because a well-defined boron plume exists within the IDNL, boron is the primary analyte for reduction in the next ISS bench-scale study. Conversely, selenium and molybdenum are not COPECs in IDNL groundwater; therefore, any leachate reduction in the solidified CCR mass will be an improvement. Note also that lead is not a COPEC for Area C groundwater (neither the IDNL nor SWMU 15). The goal for lead would be to not significantly increase leachate concentrations resulting from one or more ISS formulations. Although increased lead concentrations are not a desired outcome of the ISS bench-scale study, a significant reduction in the permeability of the solidified mass will offset slight increases in the lead leachate concentrations.

Finally, it is not appropriate to achieve the MCS for any inorganic in the eluent from the solidified CCR. This requirement does not consider the point-of-compliance component of the MCS and the reduced mass flux of inorganics attributed to the reduced permeability of the solidified CCR mass. As indicated in the CMS Report, the compliance point for SWMU 15 groundwater will be established downgradient, at the NIPSCO property boundary.

1. EPA Comment: The bench-scale treatability study used a CCR sample composited from samples collected from soil borings SWMU-15 SB27, SWMU-15 SB28, SWMU-15 SB32, and SWMU-15 SB45. KEMRON then prepared 12 bench-scale mixtures using various reagent combinations of Portland cement, blast ground granulated furnace slag, and Enviroblend® 50/50 As (Enviroblend®) made by Premier Magnesia, LLC. The ISS mixtures were cured for 28 days and then tested for moisture content, bulk density, dry density, unconfined compressive strength, and volumetric expansion. Three of the 12 samples were selected and analyzed for permeability and Synthetic Precipitation Leaching Procedure (SPLP). The rationale for the selection of the three samples was not clear; however, the selection appears to have been based on the samples containing the lowest amount of reagent. Please clarify.

NIPSCO Response: The primary goal of ISS is to reduce mass flux of inorganics from the CCR, which is achieved by: (1) reducing water flux through the CCR by reducing its permeability, and (2) reducing the concentration of inorganics in the solidified CCR porewater. Reduction of mass flux will result in decreased concentrations of all CCR constituents in downgradient groundwater.

A secondary goal of the bench-scale treatability study was to understand the amount of volumetric expansion of the solidified CCR, which is directly related to the amount of reagent added. The unconfined compressive strength (UCS) of the solidified mass was deemed to be much less important because loading of SWMU 15 is not anticipated considering future site use. Therefore, volumetric expansion was deemed to be a more important consideration than UCS in selecting which samples would be further tested for permeability and the SPLP because of the desire to limit mounding beneath the power lines and to increase flexibility for contouring the surface of the solidified mass of CCR. The balance between minimizing volumetric expansion and maximizing the reduction in permeability will be considered in the next bench-scale testing.

2. All three selected ISS formulations achieved approximately 90 percent reductions in arsenic from the untreated CCR which had an SPLP arsenic concentration of 203 micrograms per liter (µg/L); however, none of the ISS mixtures achieved the arsenic cleanup goal of 10 µg/L.

NIPSCO Response: The MCS for SWMU 15 groundwater are to be achieved post-remediation, at compliance points to be established at the downgradient boundary of SWMU 15. Comparison of SPLP eluent concentrations to the groundwater MCS is overly conservative, in NIPSCO's opinion, and does not account for natural attenuation mechanisms, such as adsorption, dispersion and dilution. To provide context, note that the plume of arsenic downgradient of SWMU 15 does not extend far into the IDNL. Wells MW-124 and IDNL-GW13 are positioned close to the downgradient border of SWMU 15 (see Figure 1). A summary of arsenic exceedances of the groundwater MCS of 10 ug/L at these two wells is summarized below.

Well	No. of Detections > 10 ug/L	No. of Detections > 100 ug/L
IDNL-GW-13	25	1
MW-124	24	1

Assuming past data at these two wells reflect current and future conditions, a 90% reduction in arsenic concentrations alone (i.e., not factoring in the expected reduction in permeability of a solidified CCR mass) at the source would result in better than a 95% reduction in the number of exceedances at these two downgradient wells.

Finally, the mass flux of dissolved-phase arsenic will be significantly reduced (by approximately two to four orders of magnitude) once the CCR mass is solidified. NIPSCO also anticipates much lower arsenic concentrations in the eluent using the LEAF Method.

3. The 3 percent Portland cement formulation achieved a boron reduction of 57 percent. However, the Portland cement/blast furnace slag mixture proposed in the June 2, 2017 Revised Costs for SWMU 15 Technical Memorandum; and the 3 percent Portland cement, 6 percent blast furnace slag, and 2 percent Enviroblend® formulation; achieved only 7 and 9 percent reductions in boron concentrations, respectively. It should be noted that prior to reagent mixing, the untreated

CCR SPLP leachate contained 723 µg/L of boron, a concentration below the cleanup criteria of 1,600 µg/L. As the concentration of boron in this composite sample was already below the cleanup criteria, it does not appear that it would be representative of the CCR on site where concentrations of boron in groundwater are in excess of 5,000 µg/L. It is important to determine whether the low initial concentration of boron was a function of compositing or whether the available boron in the composited samples had already been leached out prior to field sample collection. Absent this information, the boron tests may be inconclusive.

<u>NIPSCO Response:</u> As indicated in the Response to Comment #7, NIPSCO intends to conduct another ISS bench-scale study using the LEAF method to potentially improve on boron reduction. Sample material for the bench-scale study was composited from borings SWMU15-SB27, SWMU15-SB28, SWMU15-SB32, and SWMU15-SB45 (see Figure 1) based on visual assessment of the CCR, and the continuity and thickness of the CCR at each location, to ensure that sufficient sample volume would be available for the bench-scale study and that most of the CCR came from below the water table. These requirements necessitated the collection of sample material from borings advanced through deep CCR deposits. The future study will consider groundwater analytical results from the few wells screened within the CCR when designing the sample collection plan. Historically, boron concentrations in groundwater have been elevated at MW-119, where CCR deposits are also deep.

Note that well MW-119 was installed in 2005 and groundwater from that well reflects porewater concentrations that are in equilibrium with the CCR. The pH of groundwater at MW-119 is typically around 9 standard units. Conversely, the aqueous concentrations for the untreated CCR (Table 2 of the Kemron Report) were derived using Method 1312 (SPLP), which uses a pH of 5 standard units. Therefore, it is important to remember that the ISS bench-scale study provides a comparative analysis of the eluent concentrations before and after solidification using a method that differs from field conditions. Amec Foster Wheeler will consider ways to more closely mimic field conditions during the next ISS bench-scale study.

4. The Portland cement/blast furnace slag mixture proposed in the June 2, 2017 Revised Costs for SWMU 15 memo, and the Portland cement/blast furnace slag/Enviroblend® mixture, increased lead concentrations from non-detection (<3.3 µg/L) in the untreated CCR leachate sample to 26 µg/L and 34.8 µg/L, respectively.

   <u>NIPSCO Response</u>: NIPSCO acknowledges that increasing the solubility of any CCR constituents is not a desirable outcome for the ISS treatment technology; however, as discussed above, eluent concentrations from the solidified CCR are not the only consideration in evaluating ISS effectiveness. The overall reduction in flux is also greatly influenced by the reduction in permeability of the solidified CCR. NIPSCO also anticipates much lower lead concentrations in the eluent using the LEAF Method.

5. None of the ISS formulations significantly reduced selenium concentrations from 82.2 µg/L in the untreated CCR sample to near the 4.61 µg/L remedial goal.

   <u>NIPSCO Response</u> – As stated above for arsenic, the MCS for SWMU 15 groundwater are to be achieved post-remediation, at compliance points to be established at the downgradient boundary of SWMU 15. Comparison of SPLP eluent concentrations from the Kemron study to the

groundwater MCS for selenium is overly conservative and does not account for natural attenuation mechanisms. Although the post-treatment concentrations of selenium did not show a significant decline, the mass flux of dissolved-phase selenium will be significantly reduced once the CCR mass is solidified and permeability is reduced by approximately two to four orders of magnitude.

Selenium was not identified as a COPEC for IDNL groundwater; however, any reduction in selenium concentrations from the solidified CCR will be an improvement for Site groundwater.

6. The Kemron ISS evaluation procedure of crushing the sample with a rubber mallet to a "soil like" mixture to ½-inch minus grain size, and then analyzing leachate via SPLP may not be appropriate for this application. ISS works in two ways, (1) physically isolating the metals constituents within the new solidified, lower permeability matrix, and (2) chemically stabilizing the metals constituents into a less mobile or leachable form. Crushing the sample altered the permeability and increased the surface area of the CCR such that the SPLP tests likely over-estimated the concentration of metals that would leach from ISS soil/CCR. This complicates the remedy evaluation.

   NIPSCO Response: NIPSCO agrees that crushing the sample altered the permeability and increased the surface area, likely resulting in artificially high eluent concentrations. This shortcoming does not alter the fact that the proven reduction in solidified CCR permeability will significantly reduce the mass flux of dissolved-phase inorganics. The ISS study has shown that reduced permeability far outweighs reduced concentrations when attempting to reduce mass flux.

7. NIPSCO should perform ISS feasibility evaluations using both SPLP and the EPA's LEAF Method 1315 "Mass Transfer Rates of Constituents in Monolithic or Compacted Granular Materials Using a Semi-Dynamic Tank Leaching Procedure" (https://www.epa.gov/sites/production/files/2015-12/documents/1315.pdf) to better evaluate ISS effectiveness and determine the dominant mechanism in leachate retardation (i.e. geochemical stabilization or physical solidification). The LEAF Method 1315 would likely be more applicable and representative of the site conditions that would result from application of ISS at SWMU 15.

   NIPSCO Response: NIPSCO agrees that additional ISS feasibility evaluations are warranted using EPA's LEAF Method. The value of additional analysis using the SPLP method will be considered. NIPSCO is currently working on a study design and expects to collect sample material from SWMU 15 in fall 2017. An ISS sampling and analysis plan will be prepared for EPA review prior to sampling.

8. Conduct ISS bench scale testing on additional CCR samples containing a broader range of contaminant concentrations, to evaluate the effectiveness of ISS on CCR containing more varied concentrations of contaminants.

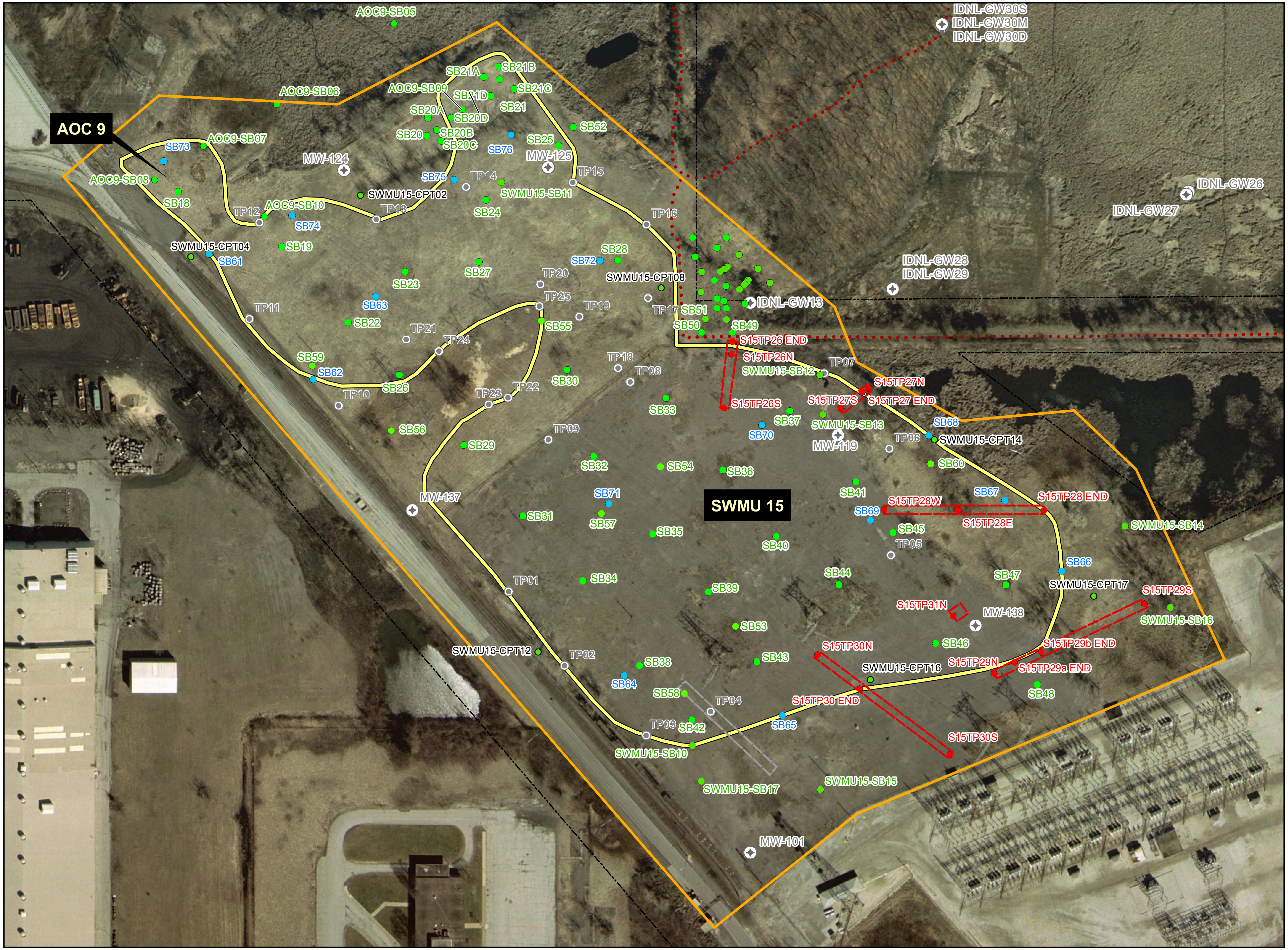
   NIPSCO Response: NIPSCO will consider running more than one test to assess varied concentrations. The study goal will be to collect sample material that appears to be associated more closely with the higher boron concentrations measured in groundwater from wells screened within the CCR (e.g., MW-119, MW-125).

9. Evaluate and identify an effective ISS formulation that does not include blast furnace slag, as this material appears to increase leachable lead concentrations.

   NIPSCO Response: Given the preliminary nature of the previous ISS bench-scale testing using the SPLP method, it may be too early to eliminate one particular formulation from further consideration, especially since the next study will include EPA's LEAF Method. It may become apparent during the study design that including a formulation with blast furnace slag is not appropriate.

10. Evaluate and identify an effective ISS formulation that achieves cleanup goals for arsenic and selenium.

    NIPSCO Response: As detailed in previous comment responses, it is inappropriate to require that solidified CCR eluent achieve MCS, as compliance points are to be established at the downgradient boundary of SWMU 15. Any reduction in arsenic and selenium concentrations in the CCR eluent, in combination with reduced CCR permeability, will result in reduced mass flux of inorganics and the achievement of MCS at the points of compliance that will be established at the property boundary between SWMU 15 and the IDNL.



SWMU 15
Investigation Locations

Northern Indiana Public
Service Company

Bailly Generating Station
Chesterton, Indiana

Legend

- Soil Boring Location
- Soil Boring Location 2016
- Test Pit End Location 2009
- Test Pit End Location 2005
- Monitoring Well Location
- Trail
- Bailly Generating Station Property Line
- Test Pit Location 2009
- Test Pit Location 2005
- Coal Combustion Residual Fill Area
- Approximate Area of Topographic Survey

Location of Site

Notes and Sources

FIGURE 1

Aerial Photo: 2005.
Courtesy of LizardTech, Inc.

- Area of SWMU 15 landfill is 16.56 acres.

-For abbreviated soil boring locations, the full location name is SWMU15-SB##.

N

0 160 Feet

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