# COMMONWEALTH OF KENTUCKY AGREEMENT IN PRINCIPLE

# 2022 ENVIRONMENTAL SAMPLING STRATEGY DOCUMENT

**January 25, 2022**

# I. INTRODUCTION

The Agreement in Principle (AIP) is an agreement between the Commonwealth of Kentucky and the Department of Energy (DOE) to provide independent oversight and assurances that environmental activities at the Paducah Gaseous Diffusion Plant (PGDP) are conducted in a scientific and sound manner. The Agreement is intended to maintain an independent, impartial, and qualified assessment of the environmental impacts into past, present and future DOE activities at the PGDP. This AIP "Environmental Sampling Strategy Document" provides a description and rationale for all environmental sampling activities planned by the Commonwealth of Kentucky AIP staff in 2022. The goal and activities outlined in this plan are designed to facilitate coordination and transparency efforts and prevent or minimize negative coordination and environmental impacts as various types of site activities are carried out in and around the PGDP.

This plan is updated and revised annually or when determined necessary. A very important premise of this document is that it can be easily reviewed and modified/updated, as issues and knowledge progress. If there is a change to this plan, then DOE will be notified. There will be no data results associated with this document; it is a plan that outlines a sampling strategy and rationale. Data results and interpretation will be transmitted to DOE (per requirements set forth in the AIP grant) and presented in the "AIP Annual Report."

The Cabinet for Health and Family Services (CHFS) Radiation Health Branch (RHB) AIP presents their own "Environmental Sampling Strategy Document" and schedule to DOE. This plan specifically covers the Energy and Environment Cabinet (EEC) AIP activities associated with the PGDP.

## II. MISSION STATEMENT

The purpose of the AIP Sampling Plan is to assist in providing an independent evaluation of Quality Assurance/Quality Control (QA/QC) of DOE environmental sampling programs for the Environmental Restoration activities at the PGDP. This is accomplished by reviewing and commenting on a variety of DOE/contractor procedures, as well as observing DOE/contractor field sampling practices. The AIP is also responsible for independent and split sampling of environmental samples from a wide variety of locations (e.g. groundwater monitoring wells, residential groundwater wells, stream sediments, outfalls, surface waters, and biota). Independent sampling is performed when the AIP deems it necessary to augment current DOE sampling efforts in order to independently verify their results.

The Commonwealth of Kentucky's AIP Environmental Monitoring Program is designed to provide an independent assessment on the quality of the human and ecological environment in and around the PGDP.

## III. MAJOR CONTAMINANTS OF CONCERN IN GROUNDWATER

Currently, two offsite groundwater contaminant plumes have been delineated; the Northeast and Northwest Plumes. Both plumes are known to be present in the Regional Gravel Aquifer (RGA) and flow from the plant, north towards the Ohio River. The primary contaminants of concern for the Northwest Plume are trichloroethylene (TCE) and technetium (Tc-99). TCE is the primary contaminant within the Northeast Plume. TCE was once widely used at the plant as a degreasing agent and is thought to exist as a dense non-aqueous phase liquid (DNAPL) within the RGA at locations within the plant fence line. It is hypothesized that DNAPL may also occur as residual pockets within the UCRS and as pockets and stringers within the RGA. As it slowly dissolves, it produces dissolved-phase plumes, which then travel offsite. Tc-99 is a product of nuclear fission and was introduced at the site when spent nuclear fuel was sent to Paducah for reprocessing.

The exact locations of sources to off-site contaminant plumes are not fully understood and multiple sources for each plume are likely. DOE believes that the C-400 area has contributed the most TCE to the dissolved phase Northwest Plume (Garner, Morti, and Smuin, 1995). The C-400 area is also believed to be responsible for much of the Northeast Plume contamination (DOE, 1997). This belief is supported by subsurface sampling and process knowledge concerning activities at the C-400 building, where as much as 23,000 gallons of TCE per month were used during peak operations in the 1970s.

The release mechanism for Tc-99 has not been determined but is thought to originate at the C-400 building where a recovery process occurred. Tc-99 derived from reprocessed fuel rods has contaminated the enrichment cascade buildings. Tc-99 is a neutron absorber and was removed during the enrichment process. The disposal practices for Tc-99 have not been well documented; however, there is an account of a Tc-99 spill inside the C-400 building, and it has been theorized that Tc-99 may have been placed in the C-404 landfill, the C-749 burial ground, and other burial grounds on site.

The area of highest TCE and Tc-99 concentrations in RGA groundwater are found near the C-400 Building, the primary source for the Northwest Plume. At C-400, levels of TCE contamination are highest near the building’s southeastern corner; whereas, Tc-99 tends to be highest at the northwest corner of the building. This understanding may change as results from ongoing C-400 Complex Operable Unit field investigative activities become available. The highest concentration of TCE within the Northeast Plume lies along the plume's southeastern edge. Several source actions have been completed around the C-400 building and now the focus has shifted to investigating and ultimately remediating the area located under the C-400 building.

## IV. GROUNDWATER MONITORING STRATEGY IS INTENDED TO INTEGRATE SAMPLING EFFORTS TO MEET SIX BROAD GOALS:

A. Further validate DOE's sampling/analytical procedures through split sampling or observations of ~5% of the year’s events. Confirmation of DOE analytical results typically performed on the following analysis: Volatile Organic Compounds (VOCs), Tc-99, metals, isotopic radionuclides and PCBs. The AIP will compare the results and report if observed procedures are followed and meet quality standards with findings reported in the Annual Summary Report;

B. Monitor areas where contaminant plume migration is potentially occurring (e.g. fringes of the plume boundaries);

C. Monitor the effectiveness of hydraulic containment systems by monitoring wells that are located in the NW Plume and NE Plume. Monitoring any changes from the Pump and Treat systems to assess the cone of depression and the potential by-pass of higher concentration dissolved phase /areas passing around or under the extraction wells.

D. Sample a subset of residential wells to monitor for the presence of TCE and Tc-99 contamination, in order to compare results against established drinking water standards;

E. Monitor TCE concentrations upwelling from the Northwest Plume into Little Bayou Creek and walk the creek periodically searching (visually or with instrumentation) for new or migrating seeps;

F. Monitor water elevations in 16-19 monitoring wells on the Tennessee Valley Authority (TVA) property as part of a quarterly site wide synoptic groundwater elevation monitoring event;

The AIP groundwater sampling program is designed to meet these six goals while minimizing the number of samples collected through the selection of strategic sampling locations. Table 1 shows all the 2022 sampling planned as part of the AIP sampling program. Table 2 provides the sampling frequency of residential wells, monitoring wells, and seeps that will be split with DOE, or sampled independently by AIP. Table 3, 4, and 5 provide x and y coordinate sample locations. Table 6 provides the x and y coordinates of each TVA synoptic water level collection point. Figure 1 shows the locations of the residential wells to be sampled. Figure 2 shows the locations of the outfalls to be sampled. Figure 3 shows the locations of the monitoring wells and seeps to be sampled. Figure 4 shows the TVA monitoring wells used to obtain water elevations during the quarterly synoptic groundwater elevation events. All analytical and field data gathered by AIP undergoes a QA/QC review process prior to being formatted and transmitted electronically to Four Rivers Nuclear Partnership (FRNP), for entry into the PEGASIS Data Base. AIP also grants permission to FRNP and DOE for release to the public on all data.

The Cabinet for Health and Family Services (CHFS) of Frankfort, Kentucky, analyzes KDWM AIP samples collected for radiological constituents. McCoy and McCoy Laboratories, Inc. conducts analysis of Whole Effluent Toxicity (WET) testing from selected outfalls. The Kentucky Department for Environmental Protection Laboratory, Frankfort, Kentucky is utilized to analyze the vast majority of the other (non-rad) constituents.

**A) Confirmatory Sampling**

The AIP has an obligation to provide confirmation that sampling procedures and analytical results reported by DOE are credible, current, accurate, and being observed/followed at the Paducah Site. The AIP strategy devised to accomplish this objective involves splitting samples with DOE on a regular basis, as well as augmenting DOE's sampling program with independent AIP sampling events. Split sampling, between DOE and AIP, will occur during planned sampling events such as, routine groundwater monitoring, removal actions, technology demonstrations, and environmental investigations. AIP staff will review DOE Contractor procedures related to sampling and look for adherence in the field. On occasion AIP will collect deionized water samples from the contractor in charge of groundwater monitoring to assure certain water quality standards are being met.

The list of routine analytes that could be collected during a confirmatory sampling event may include: 1a) volatiles encompassed in VOC 8260B; 1b) Gross Alpha, Gross Beta and gamma spectroscopy; 1c) metals 6010C; 1d) PCBs 8082A; 1e) isotopic uranium; 1f) uranium (metal); 1g) total suspended solids (TSS); 1h) Chronic Whole Effluent Toxicity (WET); 1i) Acute Whole Effluent Toxicity (WET); and 1j) Hardness. Basic geochemical parameters measured in the field include water temperature, pH, dissolved oxygen, conductivity, oxygen reduction potential (ORP) and turbidity. AIP also records air temperature, barometric pressure, and measures the water level before purging and after parameter stabilization.

**B) Monitoring of Plume Growth and Migration**

The AIP will augment DOE's sampling program to ensure that the spread of the contaminant plumes are adequately being monitored spatially and temporally. The Northeast plume's eastern edge is near the DOE's Water Policy Box administrative boundary. This proximity requires careful monitoring to ensure that early detection is provided for DOE and residents living near the boundary that are not currently under protection of the Water Policy Area. In addition, the AIP is monitoring areas to the west and north of the plant in order to monitor the impact of the Northwest and Southwest plumes. If data indicates that a plume has crossed the Water Policy boundary, DOE will be immediately notified and steps will be taken to contact residents and sample all potentially affected residential wells. TCE is the primary analyte measured; however, Gross Alpha, Gross Beta and gamma spectroscopy may periodically be sampled due to public concern. Basic geochemical parameters will also be measured, including turbidity, temperature, pH, dissolved oxygen, conductivity and ORP.

**C) Monitoring the Effectiveness of the Hydraulic Containment Systems**

The AIP will continue to review results of DOE's sampling of existing wells to monitor the effectiveness of the current Northwest and Northeast plume hydraulic containment (i.e. Pump-N-Treat) systems. DOE currently monitors wells in the immediate vicinity of the extraction wells. The AIP will independently monitor and sample selected locations on a routine basis. TCE, Gross Alpha, Gross Beta and gamma spectroscopy will be the primary analytes measured in samples obtained from these wells. Basic physical and geochemical parameters will also be measured, including water level, turbidity, temperature, pH, dissolved oxygen, conductivity and ORP.

This information will be used to detect temporal changes in the groundwater elevation that may be occurring due to plant activities associated with utility optimization activities. Any observed changes will help assess impacts to the cone of depression.

**D) Residential Well Monitoring Program**

The AIP collects water samples from residential wells located near and outside the Water Policy Box of the PGDP. Groundwater samples may also be collected (at the request of the landowner) within an ~2.5 (two and a half) mile radius from the PGDP or if the determination has been made that the underlying aquifer could reasonably be impacted by the PGDP plumes. This will be done on a case-by-case basis, at the discretion of Kentucky. The AIP is primarily concerned about environmental contamination in residential wells and does not sample for biological or sanitary conditions. The AIP recommends for residents consuming groundwater, to have additional biological testing performed to assure their well is free from harmful bacteria and viruses. TCE, Gross Alpha, Gross Beta and gamma spectroscopy will be the primary analytes measured but samples may also be tested for metals, PFAS and PCBs. All results will be provided to the landowners and DOE. Basic physical and geochemical parameters will also be measured including water level, turbidity, temperature, pH, dissolved oxygen, conductivity and ORP.

If any of the samples collected by KY AIP are contaminated with constituents that could pose a health threat, immediate notification, both verbal and written, will be provided to the resident and DOE. A resampling event with an expedited 7-day laboratory turn around will follow to confirm the sampling results. The property owner and/or resident will be notified regardless of the results of the tests. A letter explaining the results will be sent by KDWM AIP to the resident and DOE soon after the results are compiled.

**E) Monitor TCE Concentrations Upwelling from the Northwest Plume into the Little Bayou Creek.**

In 2022 AIP will split two of the four scheduled DOE contractor seep-sampling events to compare results and confirm sampling procedures are being followed. AIP will also conduct transects of Little Bayou Creek periodically and sample any seeps that are present or discovered.

**F) Monitoring Water Elevations at TVA During Site Wide Synoptic Water Measuring Events.**

The AIP will augment DOE's synoptic site wide groundwater elevation measuring events by requesting access to the Tennessee Valley Authority (TVA) facility, located north of the facility. Water level elevations and associated barometer readings will be obtained during the same week as the PGDP site wide synoptic water elevation measurement event. The data will be compiled and transmitted to DOE to augment and refine the general understanding of groundwater flow conditions near the Ohio River.

**References:**

Department of Energy. 1997. Integrated Remedial Investigation/ Feasibility Study Work Plan for Waste Area Grouping 6 at Paducah Gaseous Diffusion Plant Paducah, Kentucky, DOE/OR/07-1243&D4, Department of Energy, Paducah, Kentucky.

Department of Energy. 2022. Environmental Monitoring Plan Fiscal Year 2022 Paducah Gaseous Diffusion Plant, Paducah, Kentucky, CP2-ES-0006/FR7

Garner, L.K., E.E. Morti, and D.R. Smuin. 1995. *Northeast Plume Preliminary Characterization Summary Report,* DOE/OR/07-1339&D2, KY/ER-65&D2, Environmental Management and Enrichment Facilities, Paducah Gaseous Diffusion Plant, Paducah, Kentucky, July.

| Well# | Location | Screen Zone | Goals | January | February | March | April | May | June | July | August | September | October | November | December | DOE Schedule |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R2 | residential well | unknown | a(1a, 1b), b, d | | **Split** | | | | | | | | | | | **Quarterly** |
| R10 | residential well | unknown | a(1a, 1b), b, d | | **Split** | | | | | | | | | | | **Quarterly** |
| R13 | residential well | unknown | a(1a, 1b), b, d | | **Split** | | | | | | | | | | | **Quarterly** |
| R14 | residential well | unknown | a(1a, 1b), b, d | | **Split** | | | | | | | | | | | **Quarterly** |
| R26 | residential well | unknown | a(1a, 1b), b, d | | **Split** | | | | | | | | | | | **Quarterly** |
| R40 | residential well | unknown | a(1a, 1b), b, d | | **Split** | | | | | | | | | | | **Quarterly** |
| R53 | residential well | unknown | a(1a, 1b), b, d | | **Split** | | | | | | | | | | | **Quarterly** |
| R245 | residential well | unknown | a(1a, 1b), b, d | | **Split** | | | | | | | | | | | **Quarterly** |
| R9* | residential well | unknown | a(1a, 1b), b, d | | | | | | | | | | | **AIP** | | **Annual** |
| R20 | residential well | RGA | a(1a, 1b), b, d | | | | | | | | | | | **AIP** | | **Annual** |
| R21 | residential well | unknown | a(1a, 1b), b, d | | | | | | | | | | | **AIP** | | **Annual** |
| R83 | residential well | unknown | a(1a, 1b), b, d | | | | | | | | | | | **AIP** | | **Annual** |
| R90* | residential well | unknown | a(1a, 1b), b, d | | | | | | | | | | | **AIP** | | **Annual** |
| R114* | residential well | RGA | a(1a, 1b), b, d | | | | | | | | | | | **AIP** | | **Annual** |
| R302 | residential well | RGA | a(1a, 1b), b, d | | | | | | | | | | | **AIP** | | **Annual** |
| MW84A | C-404 | MRGA | a(1a, 1b, 1c, 1e), b | **Split** | | | | | | | | | **AIP** | | | **Semiannual** |
| MW87A | C-404 | MRGA | a(1a, 1b, 1c, 1e), b | **Split** | | | | | | | | | **AIP** | | | **Semiannual** |
| MW90A | C-404 | URGA | a(1a, 1b, 1c, 1e), b | **Split** | | | | | | | | | **AIP** | | | **Semiannual** |
| MW93A | C-404 | MRGA | a(1a, 1b, 1c, 1e), b | **Split** | | | | | | | | | **AIP** | | | **Semiannual** |
| MW420 | C-404 | URGA | a(1a, 1b, 1c, 1e), b | **Split** | | | | | | | | | **AIP** | | | **Semiannual** |
| MW548 | C-404 | RGA | a(1a, 1b, 1c, 1e), b | **Split** | | | | | | | | | **AIP** | | | **Biennial 2021** |
| MW66 | NW Plume | RGA | a(1a, 1b), b, c | | | | | | | | | **Split** | | | | **Semiannual** |
| MW238 | NW Plume | RGA | a(1a, 1b), b, c | | | | | | **AIP** | | | | | | | **NS** |
| MW123 | NW Plume | RGA | a(1a, 1b), b, c | | | | | | | **AIP** | | | | | | **NS** |
| MW137 | NW Plume | RGA | a(1a, 1b), b, c | | | | | | | **AIP** | | | | | | **NS** |
| MW146 | NW Plume | RGA | a(1a, 1b), b, c | | | | | | **AIP** | | | | | | | **Quarterly** |
| MW169 | NW Plume | MRGA | a(1a, 1b), b, c | | | | | **AIP** | | | | **AIP** | | | | **Biennial 2021** |
| MW205 | NW Plume | URGA | a(1a, 1b), b, c | | | | | **AIP** | | | | **AIP** | | | | **Biennial 2021** |
| MW233 | NW Plume | RGA | a(1a, 1b), b, c | | | | | | | | **AIP** | | | | | **NS** |
| MW249 | NW Plume | MRGA | a(1a, 1b), b, c | | | | | **AIP** | | | **AIP** | | | | | **NS** |
| MW236 | NW Plume | RGA | a(1a, 1b), b, c | | | **AIP** | | | | | | | | | | **Semiannual** |
| MW 240 | NW Plume | MRGA | a(1a, 1b), b, c | | | | **AIP** | | | | | | | | | **Semiannual** |
| MW257 | NW Plume | RGA | a(1a, 1b), b, c | | | | | | | | **AIP** | | | | | **Triennial 2019** |
| MW261 | NW Plume | LRGA | a(1a, 1b), b, c | | | **AIP** | | | | | | | | | | **Semiannual** |
| MW262 | NW Plume | LRGA | a(1a, 1b), b, c | | | | | | | **AIP** | | | | | | **Biennial 2021** |
| MW339 | NW Plume | LRGA | a(1a, 1b), b, c | | | | | | | | | **Split** | | | | **Semiannual** |
| MW380 | NW Plume | RGA | a(1a, 1b), b, c | | | | | | | **AIP** | | | | | | **NS** |
| MW381 | NW Plume | RGA | a(1a, 1b), b, c | | | | | | | **AIP** | | | | | | **Triennial 2019** |
| MW340 | NW Plume | LRGA | a(1a, 1b), b, c | | | | | | | | | **Split** | | | | **Semiannual** |
| MW427 | NW Plume | RGA | a(1a, 1b), b, c | | | | | | | **AIP** | | | | | | **Quarterly** |
| MW442 | NW Plume | LRGA | a(1a, 1b), b, c | | | **AIP** | | | | | | | | | | **Biennial 2019** |
| MW460 | NW Plume | LRGA | a(1a, 1b), b, c | | | | **AIP** | | | | | | | | | **Quarterly** |
| MW455 | NW Plume | RGA | a(1a, 1b), b, c | | | **Split** | | | | | | | | | | **Semiannual** |
| MW456 | NW Plume | RGA | a(1a, 1b), b, c | | | **Split** | | | | | | | | | | **Semiannual** |
| MW462 | NW Plume | LRGA | a(1a, 1b), b, c | | | | | **AIP** | | | | | | | | **Semiannual** |
| MW498 | NW Plume | LRGA | a(1a, 1b), b, c | | | **AIP** | | | | | | | | | | **Semiannual** |
| MW502 | NW Plume | LRGA | a(1a, 1b), b, c | | | | | | **AIP** | | | | | | | **Semiannual** |
| MW133 | NW Plume | McNairy | a(1a, 1b), b, c | | | | | | **AIP** | | | | | | | **Semiannual** |
| MW247 | NW Plume | McNairy | a(1a, 1b), b, c | | | | | **AIP** | | | | | | | | **Semiannual** |
| MW356 | NE Plume | RGA/McNairy | a(1a, 1b), b, c | | | | **AIP** | | | | | | | | | **Semiannual** |
| MW252 | NE Plume | LRGA | a(1a, 1b), b, c | | | | | | | | | **AIP** | | | | **Annual** |
| MW294A | NE Plume | RGA | a(1a, 1b), b, c | | | | | **AIP** | | | | | | | | **NS** |
| MW284 | NE Plume | RGA | a(1a, 1b, ), b, c | | | | | **AIP** | | | | | | | | **NS** |
| MW469 | NE Plume | MRGA | a(1a, 1b), b, c | | | | | | | **AIP** | | | | | **AIP** | **Annual** |
| MW470 | NE Plume | LRGA | a(1a, 1b), b, c | | | | | | | | **AIP** | | | | **AIP** | **Annual** |
| MW472 | NE Plume | LRGA | a(1a, 1b), b, c | | | | | | | | | **AIP** | | | | **Annual** |
| MW533 | NE Plume | RGA | a(1a, 1b), b, c | | | | | | | **AIP** | | | | | **AIP** | **Quarterly** |
| MW524 | NE Transect Wells | MRGA | a(1a, 1b), b, c | | **AIP** | | | | | | | | **Split** | | | **Quarterly** |
| MW529 | NE Transect Wells | RGA | a(1a, 1b), b, c | | **AIP** | | | | | | | | **Split** | | | **Quarterly** |
| MW203 | SW Plume | RGA | a(1a, 1b), b, c | | | **AIP** | | | | | **AIP** | | | | | **Annual** |
| MW328 | SW Plume | MRGA | a(1a, 1b), b, c | | | **AIP** | | | | **AIP** | | | | | | **Biennial 2021** |
| MW326 | SW Plume | RGA | a(1a, 1b), b, c | | | | **AIP** | | | | | | | | | **NS** |
| MW329 | SW Plume | RGA | a(1a, 1b), b, c | | | | | | **AIP** | | | | | | | **NS** |
| MW551 | SW Plume | RGA | a(1a, 1b), b, c | | | | **AIP** | | **AIP** | | | | | | | **Biennial 2021** |
| MW139 | C-746 Plume | RGA | a(1a, 1b, ), b, c | | | | | **AIP** | | | | | | | | **Annual** |
| MW366 | C-746 LF | URGA | a(1a, 1b, 1c), b | | | | | | | | **AIP** | | | | | **Quarterly** |
| MW575 (proposed) | SWMU 211a | URGA | a(1a, 1b, 1c), b | | | | | | | | | | | | | **Quarterly** |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MW577 (proposed) | SWMU 211a | URGA | a(1a, 1b, 1c), b | | | | | | | | | | | | | Quarterly |
| MW579 (proposed) | SWMU 211a | URGA | a(1a, 1b, 1c), b | | | | | | | | | | | | | Quarterly |
| MW581 (proposed) | SWMU 211a | URGA | a(1a, 1b, 1c), b | | | | | | | | | | | | | Quarterly |
| SHF-D10 | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| SHF-D11B | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| SHF-D17 | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| SHF-D30B | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| SHF-D74B | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| SHF-D75B | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| SHF-201A | TVA/Synoptic | UCRS | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| SHF-201B | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| SHF-201C | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| SHF-102G | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| TVAGW-1D | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| TVAGW-2D | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| TVAGW-3D | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| TVAGW-4D | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| TVAGW-5D | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| TVAGW-6D | TVA/Synoptic | URGA | f | | WL | | | WL | | | WL | | | WL | | NS by DOE |
| MW135 | TVA | LRGA | a(1a, 1b), b, c | | | | | | | | | | | AIP | | Semiannual |
| MW433 | TVA | RGA | a(1a, 1b), b, c | | | | | | | | | | | AIP | | Quarterly |
| MW439 | TVA | RGA | a(1a, 1b), b, c | | | | | | | | AIP | | | | | Biennial 2021 |
| MW147 | TVA | RGA | a(1a, 1b), b, c | | | | | | | | AIP | | | | | NS |
| MW441 | TVA | RGA | a(1a, 1b), b, c | | | | | AIP | | | | | | | | Quarterly |
| MW445 | TVA | RGA | a(1a, 1b), b, c | | | | AIP | | | | | | AIP | | | Biennial 2021 |
| MW447 | TVA | RGA | a(1a, 1b), b, c | | | | AIP | | | | | | AIP | | | Biennial 2021 |
| MW466 | TVA | RGA | a(1a, 1b), b, c | | | | | | | AIP | | | | | | Biennial 2021 |
| MW168 | C400 | URGA | a(1a, 1b), b, c | | | AIP | | | | | AIP | | | | | Biennial 2021 |
| MW175 | C-400 | MRGA | a(1a, 1b), b, c | | AIP | | | | | | | | AIP | | | Semiannual |
| MW178 | C-400 | URGA | a(1a, 1b), b, c | | | AIP | | | | | | AIP | | | | Quarterly |
| MW341 | C-400 | MRGA | a(1a, 1b), b, c | | | | AIP | | | AIP | | | | | | Quarterly |
| MW342 | C-400 | RGA | a(1a, 1b), b, c | | | AIP | | | | | | AIP | | | | Semiannual |
| MW343 | C-400 | LRGA | a(1a, 1b), b, c | | | AIP | | | | | | AIP | | | | Semiannual |
| MW566 | C-400 | URGA | a(1a, 1b), b, c | | | | | | Split | | | | | | | Quarterly |
| MW567 | C-400 | MRGA | a(1a, 1b), b, c | | | | | | Split | | | | | | | Quarterly |
| MW568 | C-400 | LRGA | a(1a, 1b), b, c | | | | | | Split | | | | | | | Quarterly |
| MW569 | C-400 | URGA | a(1a, 1b), b, c | | | | | | | | Split | | | | | Quarterly |
| MW570 | C-400 | MRGA | a(1a, 1b), b, c | | | | | | | | Split | | | | | Quarterly |
| MW571 | C-400 | LRGA | a(1a, 1b), b, c | | | | | | | | Split | | | | | Quarterly |
| MW572 | C-400 | URGA | a(1a, 1b), b, c | | | | | | | | | | Split | | | Quarterly |
| MW573 | C-400 | MRGA | a(1a, 1b), b, c | | | | | | | | | | Split | | | Quarterly |
| MW574 | C-400 | LRGA | a(1a, 1b), b, c | | | | | | | | | | Split | | | Quarterly |
| MW161 | SWMU 001 | RGA | a(1a, 1b), b, c | | | | | Split | | | | | | | | Semiannual |
| MW545 | SWMU 001 | RGA | a(1a, 1b), b, c | | | | | Split | | | | | | | | Semiannual |
| MW544 | SWMU 001 | RGA | a(1a, 1b), b, c | | | AIP | | | AIP | | | | | | | Semiannual |
| K001 | Outfall | SW | a(1b, 1c, 1d, 1e, 1f, 1g) b | | | | | | | | | AIP | | | | Weekly |
| K010 | Outfall | SW | a(1a, 1b, 1c, 1d,1h, 1j), b | | | | AIP | | | | | | | | | Monthly |
| K013** | Outfall | SW | a(1a, 1b, 1c, 1i, 1j), b | | AIP | | | | | | | | | | AIP | Monthly |
| K020 | Outfall | SW | a(1a, b, 1c, 1i, 1j), b | | | | | | | | | AIP | | | | Monthly |
| C-613 | Sediment Basin Discharge | SW | a(1b, 1c, 1e, 1f, 1g) b | | | | AIP | | | | | AIP | | | | Quarterly |
| L4 | Bayou Creek | SW | a(1b, 1c, 1e, 1f, 1g) b | | | | AIP | | | | | AIP | | | | NA |
| Seeps 2, 5, 6 and 7 *** | Little Bayou Creek | SW | a(1a, 1b), b, c, e | AIP | AIP | AIP | AIP | AIP | AIP | AIP | Split | AIP | AIP | Split | AIP | Quarterly |
| FFS/GEO Lab Bldg C-730, DI | C-730 | SW | a(1a) | | | | | | AIP | | | | | | | NA |
| **Event** | **Totals** | **Screen Zone** | **Goals** | **January** | **February** | **March** | **April** | **May** | **June** | **July** | **August** | **September** | **October** | **November** | **December** | **Total** |
| **Splits** | **34** | | | 6 | 8 | 2 | 0 | 2 | 3 | 0 | 4 | 3 | 5 | 1 | 0 | 34 |
| **AIP Independent** | **106** | | | 1 | 5 | 12 | 12 | 10 | 9 | 12 | 9 | 12 | 10 | 9 | 5 | 106 |
| **Water Levels** | **64** | | | 0 | 16 | 0 | 0 | 16 | 0 | 0 | 16 | 0 | 0 | 16 | 0 | 64 |

**Disclaimer: This schedule is subject to change ex. - weather conditions/DOE coordination issues**

**Goals - are from the 2022 KY AIP Groundwater Strategy Sampling Plan (a - f)**

**Chemical Analysis Codes:**

**1a) VOC 8260B, 1b) Gross Alpha & Gross Beta/Tc-99, 1c) Metals, 1d) PCBs 8082A, 1e) Isotopic Uranium, 1f) Uranium (Metal),**
**1g) Total Suspended Solids (TSS), 1h) Chronic Whole Effluent Toxicity (WET), 1i) Acute Whole Effluent Toxicity (WET Ceriodaphnia), 1j) Hardness**

**WL -** water level (only) - synoptic event on TVA wells
**Split -** with DOE
**AIP -** independent sampling (EEC AIP)
***** - sampled from a spigot/hose
******- sampled based on availability of adequate flow
*******- exact number of seep samples depends on availability

**Abbreviations Used in Schedule**
**UCRS** - Upper Continental Recharge System
**RGA** - Regional Gravel Aquifer
**URGA** - Upper Regional Gravel Aquifer
**MRGA** - Middle Regional Gravel Aquifer
**LRGA** - Lower Regional Gravel Aqu
**PRT** - Multi-Port monitoring well
**NS** - Not sampled by DOE during the year
**NA** - Not available
**SW** - Surface Water or Seep
**KDFWR** - Kentucky Department of Fish and Wildlife Kentucky Wildlife Management Area
**LF** - Landfill

**Table 2**

**Sampling Frequency of RWs, MWs, and Seeps by DOE and KDWM AIP**

| Well# | 2021 DOE sampling Frequency | Last sampled or on schedule to be sampled by DOE | 2022 KDWM AIP Sampling Frequency | Last sampled or on schedule to be sampled by AIP |
|---|---|---|---|---|
| R2 | Quarterly | 2021 | November/AIP | 2022 |
| R9 | Annual | 2021 | February/Split | 2022 |
| R10 | Quarterly | 2021 | November/AIP | 2022 |
| R13 | Quarterly | 2021 | November/AIP | 2022 |
| R14 | Quarterly | 2021 | November/AIP | 2022 |
| R20 | Annual | 2021 | February/Split | 2022 |
| R21 | Annual | 2021 | February/Split | 2022 |
| R26 | Quarterly | 2021 | November/AIP | 2022 |
| R53 | Quarterly | 2021 | November/AIP | 2022 |
| R83 | Annual | 2021 | February/Split | 2022 |
| R90 | Annual | 2021 | February/Split | 2022 |
| R114 | Annual | 2021 | February/Split | 2022 |
| R245 | Quarterly | 2021 | November/AIP | 2022 |
| R302 | Annual | 2021 | February/Split | 2022 |
| MW66 | Semiannual | 2021 | September/Split | 2022 |
| MW84A | Semiannual | 2021 | Jan/Split, Oct/AIP | 2022 |
| MW87A | Semiannual | 2021 | Jan/Split, Oct/AIP | 2022 |
| MW90A | Semiannual | 2021 | Jan/Split, Oct/AIP | 2022 |
| MW93A | Semiannual | 2021 | Jan/Split, Oct/AIP | 2022 |
| MW123 | NS | 2015 | July/AIP | 2022 |
| MW133 | Semiannual | 2021 | June/AIP | 2022 |
| MW137 | NS | 2012 | July/AIP | 2022 |
| MW135 | Semiannual | 2021 | November/AIP | 2022 |
| MW139 | Annual | 2021 | May/AIP | 2022 |
| MW146 | Quarterly | 2021 | June/AIP | 2022 |
| MW147 | NS | 1994 | August/AIP | 2022 |
| MW161 | Semiannual | 2021 | May/Split | 2022 |
| MW168 | Biennial | 2021 | Mar/AIP, Aug/AIP | 2022 |
| MW169 | NS | 2021 | May/AIP | 2022 |
| MW175 | Semiannual | 2021 | Feb/AIP, Oct/AIP | 2022 |
| MW178 | Quarterly | 2021 | Mar/AIP, Sep/AIP | 2022 |
| MW203 | Annual | 2021 | Mar/AIP, Aug/AIP | 2022 |
| MW205 | NS | 2013 | May/AIP, Sep/AIP | 2022 |
| MW233 | NS | 2019 | August AIP | 2022 |
| MW236 | Semiannual | 2021 | March/AIP | 2022 |
| MW238 | NS | 2010 | June/AIP | 2022 |
| MW240 | Semiannual | 2021 | April/AIP | 2022 |
| MW249 | NS | 2005 | May/AIP, Aug/AIP | 2022 |
| MW247 | Semiannual | 2021 | June/AIP | 2022 |
| MW252 | Annual | 2021 | Sept/AIP | 2022 |
| MW257 | Triennial | 2019 | August/AIP | 2022 |

**NS** – not sampled

**Table 2 (Continued)**

**Sampling Frequency of RWs, MWs, and Seeps by DOE and KDWM AIP**

| Well# | 2020 DOE Sampling Frequency | Last sampled or on schedule to be sampled by DOE | 2020 KDWM AIP Sampling Frequency | Last sampled or on schedule to be sampled by AIP |
|---|---|---|---|---|
| MW261 | Semiannual | 2021 | March/AIP | 2022 |
| MW262 | Biennial | 2021 | July/AIP | 2022 |
| MW284 | NS | 2005 | May/AIP | 2022 |
| MW294A | NS | 2005 | May/AIP | 2022 |
| MW326 | NS | NA | April/AIP | 2022 |
| MW328 | Biennial | 2021 | Mar/AIP, July/AIP | 2022 |
| MW329 | NS | 2021 | June/AIP | 2022 |
| MW339 | Semiannual | 2021 | September/Split | 2022 |
| MW340 | Semiannual | 2021 | September/Split | 2022 |
| MW341 | Quarterly | 2021 | Apr/AIP, Jul/AIP | 2022 |
| MW342 | Semiannual | 2021 | Mar/AIP, Sep/AIP | 2022 |
| MW343 | Semiannual | 2021 | Mar/AIP, Sep/AIP | 2022 |
| MW356 | Semiannual | 2021 | April/AIP | 2022 |
| MW366 | Quarterly | 2021 | August/AIP | 2022 |
| MW380 | NS | 2007 | July AIP | 2022 |
| MW381 | Triennial | 2019 | July/AIP | 2022 |
| MW420 | Semiannual | 2021 | Jan/Split, Oct/AIP | 2022 |
| MW427 | Quarterly | 2021 | July/AIP | 2022 |
| MW433 | Quarterly | 2021 | Nov/AIP | 2022 |
| MW439 | Biennial | 2021 | Aug/AIP | 2022 |
| MW441 | Quarterly | 2021 | May/AIP | 2022 |
| MW442 | Biennial | 2019 | Mar/AIP | 2022 |
| MW445 | Biennial | 2021 | April/AIP, Oct/AIP | 2022 |
| MW447 | Biennial | 2021 | April/AIP, Oct/AIP | 2022 |
| MW455 | Semiannual | 2021 | March/Split | 2022 |
| MW456 | Semiannual | 2021 | March/Split | 2022 |
| MW460 | Quarterly | 2021 | March/AIP | 2022 |
| MW462 | Semiannual | 2021 | May/AIP | 2022 |
| MW466 | Biennial | 2021 | July/AIP | 2022 |
| MW469 | Annual | 2021 | July/AIP, Dec/AIP | 2022 |
| MW470 | Annual | 2021 | Aug/AIP, Dec/AIP | 2022 |
| MW472 | Annual | 2021 | Sept/AIP | 2022 |
| MW498 | Semiannual | 2021 | March/AIP | 2022 |
| MW502 | Semiannual | 2021 | June/AIP | 2022 |
| MW524 | Quarterly | 2021 | Feb/AIP, Oct/Split | 2022 |
| MW529 | Quarterly | 2021 | Feb/AIP, Oct/Split | 2022 |
| MW533 | Quarterly | 2021 | July/AIP, Dec/AIP | 2022 |
| MW544 | Semiannual | 2021 | Mar/AIP, Jun/AIP | 2022 |
| MW545 | Semiannual | 2021 | May/Split | 2022 |
| MW548 | Biennial | 2021 | Jan/Split, Oct/AIP | 2022 |

**NS** – not sampled
NA – not available

**Table 2 (Continued)**

## Sampling Frequency of RWs, MWs, and Seeps by DOE and KDWM AIP

| Well# | 2020 DOE sampling Frequency | Last sampled or on schedule to be sampled by DOE | 2020 KDWM AIP sampling Frequency | Last sampled or on schedule to be sampled by AIP |
|---|---|---|---|---|
| MW551 | Biennial | 2021 | April/AIP, Jun/AIP | 2022 |
| MW566 | Quarterly | 2021 | June/Split | 2022 |
| MW567 | Quarterly | 2021 | June/Split | 2022 |
| MW568 | Quarterly | 2021 | June/Split | 2022 |
| MW569 | Quarterly | 2021 | August/Split | 2022 |
| MW570 | Quarterly | 2021 | August/Split | 2022 |
| MW571 | Quarterly | 2021 | August/Split | 2022 |
| MW572 | Quarterly | 2021 | October/Split | 2022 |
| MW573 | Quarterly | 2021 | October/Split | 2022 |
| MW574 | Quarterly | 2021 | October/Split | 2022 |
| Seep* 2, 5, 6, & 7 | Quarterly | 2021 | Jan thru July/AIP, Aug/Split, Nov/Split, Sept/AIP, Oct/AIP, Dec/AIP | 2022 |

**NS** – not sampled
* **-** Seep sampling locations depend on presence and water level in the creek

**Table 3**
**Residential Well X and Y Coordinates**

| Well # | X | Y |
|---|---|---|
| R2 | -7253.69 | 4111.992 |
| R9 | 1986.83 | -2251.3 |
| R10 | -130970 | 6895.25 |
| R13 | -9977.50 | 7018.31 |
| R14 | -10638 | 8353.58 |
| R20 | 4775.28 | 6106.22 |
| R21 | 2856.60 | 11723.4 |
| R26 | -13579.20 | 2945.639 |
| R53 | -11855.00 | 714.84 |
| R83 | 3460.44 | 12290.50 |
| R90 | 9107.89 | 3986.56 |
| R114 | 8510.00 | 9157.00 |
| R245 | -6973.80 | 11182.90 |
| R302 | 5200.00 | 2400.00 |
| **X and Y Coordinates are plant specific** | | |

**Table 4**
**Outfall X and Y Coordinates**

| Outfall | X | Y |
|---|---|---|
| K001 | -7806.25 | -146.875 |
| K010 | -612.50 | -2,231.25 |
| K013 | -1009.38 | -5056.25 |
| K020 | -1925.87 | 5424.411 |
| C-613 | -7558.77 | -11.31 |
| L4 | -8951.71 | 319.68 |
| **X and Y Coordinates are plant specific** | | |

**Table 5**

**Monitoring Well X and Y Coordinates**

| Well # | X | Y |
|---|---|---|
| MW66 | -6872.62 | 978.57 |
| MW84A | -5975.23 | -804.20 |
| MW87A | -5825.09 | -804.98 |
| MW90A | -5688.64 | -793.68 |
| MW93A | -5994.81 | -1028.57 |
| MW123 | -5661.33 | 6125.6 |
| MW133 | -1715.66 | 9124.70 |
| MW135 | -1520.05 | 9137.28 |
| MW137 | -1726.75 | 9150.86 |
| MW139 | -576.59 | 6189.67 |
| MW146 | -5684.18 | 13549.15 |
| MW147 | -5669.28 | 13548.69 |
| MW161 | -6916.9 | -1666.7 |
| MW168 | -4822.50 | -924.80 |
| MW169 | -5558 | -191.4 |
| MW175 | -4379.1 | -1428.3 |
| MW178 | -4073.6 | -1216.2 |
| MW185 | -6601.90 | 952.90 |
| MW233 | -5530.15 | 7300.335 |
| MW203 | -5014.8 | -2159.2 |
| MW205 | -4360.3 | -364.1 |
| MW236 | -5087.79 | 7919.994 |
| MW238 | -5197.0581 | 7505.6366 |
| MW240 | -5195.7829 | 7390.5997 |
| MW247 | -7445.70 | 1360.147 |
| MW249 | -7432.4541 | 1357.752 |
| MW252 | 4228.397 | 5717.894 |
| MW257 | -5972.21 | 442.3827 |
| MW261 | -5979.20 | 442.1934 |
| MW262 | -5379.8 | -292.32 |
| MW284 | 1589.999 | 913.4824 |
| MW294A | 1801.8 | 839.09 |
| MW326 | -6185.001 | -2430.1134 |
| MW328 | -7337.476 | -1962.3084 |
| MW329 | -7347.443 | -1419.371 |
| MW339 | -6468.50 | 663.20 |
| MW340 | -6165.40 | 665.50 |
| MW341 | -3939.16 | -1062.27 |
| MW342 | -4403.56 | -1289.51 |
| MW343 | -4404.16 | -1083.87 |
| MW356 | -1466.38 | 863.45 |
| MW366 | -2246.10 | 6121.18 |
| **X and Y Coordinates are plant specific** | | |

**Table 5 Continued**

**Monitoring Well X and Y Coordinates**

| Well # | X | Y |
|---|---|---|
| MW380 | -5190.31 | 7205.26 |
| MW381 | -4892.90 | 7745.84 |
| MW420 | -5793.53 | -1041.57 |
| MW421 | -4335.43 | -1084.18 |
| MW422 | -4365.74 | -1083.80 |
| MW423 | -4389.45 | -1084.00 |
| MW424 | -4405.68 | -1148.44 |
| MW425 | -4407.35 | -1226.18 |
| MW427 | -9390.18 | 9.54 |
| MW433 | -4526.72 | 12219.07 |
| MW439 | -2679.36 | 12575.82 |
| MW440 | -2688.23 | 12564.90 |
| MW441 | -2696.03 | 12552.96 |
| MW442 | -2827.07 | 11896.27 |
| MW445 | -2412.85 | 11307.21 |
| MW447 | -2424.29 | 11310.49 |
| MW455 | -7557.43 | 1963.20 |
| MW456 | -7560.77 | 1953.78 |
| MW460 | -6616.28 | 1944.07 |
| MW462 | -6180.48 | 1972.47 |
| MW469 | 4049.53 | 8037.38 |
| MW470 | 4066.18 | 8033.74 |
| MW472 | 4904.89 | 7822.45 |
| MW498 | -6767.51 | 1106.62 |
| MW502 | -7927.08 | 1981.00 |
| MW506 | -4013.04 | -1939.93 |
| MW507 | -4013.00 | -1939.89 |
| MW524 | -3314.745 | -876.476 |
| MW529 | -3362.39 | -1675.23 |
| MW533 | -2,312.70 | -1,024.64 |
| MW542 | -6807.55 | -1704.10 |
| MW543 | -6761.36 | -1729.40 |
| MW544 | -6817.935 | -1813.548 |
| MW545 | -6904.303 | -1690.196 |
| MW546 | -6964.33 | -1743.20 |
| MW547 | -6940.44 | -1702.99 |
| MW548 | -6168.19 | -1061.78 |
| MW551 | -6451.253 | -1408.035 |
| MW566 | -4,070.01 | -1,444.92 |
| MW567 | -4,069.74 | -1,449.90 |
| MW568 | -4,069.89 | -1,454.98 |
| MW569 | -4,255.87 | -1,325.71 |
| **X and Y Coordinates are plant specific** | | |

## Table 5 Continued

## Monitoring Well X and Y Coordinates

| Well # | X | Y |
|---|---|---|
| MW570 | -4,255.65 | -1,330.70 |
| MW571 | -4,255.68 | -1,335.70 |
| MW572 | -4,379.98 | -1,458.46 |
| MW573 | -4,059.50 | -1,219.13 |
| MW574 | -4,398.10 | -1,225.19 |
| **X and Y Coordinates are plant specific** | | |

## Table 6
## TVA Water Level X and Y Coordinates

| Well # | X | Y |
|---|---|---|
| SHF-D10 | -6130.60 | 16359.20 |
| SHF-D11B | -6385.92 | 18190.06 |
| SHF-D17 | 1782.156 | 12391.45 |
| SHF-D30B | -1414.04 | 17085.19 |
| SHF-D74B | -3124.52 | 17402.59 |
| SHF-D75B | -5553.68 | 15864.71 |
| SHF-201A | -12888.49 | 17297.87 |
| SHF-201B | -13266.91 | 17195.91 |
| SHF-201C | -13114.97 | 17242.01 |
| SHF-102G | -4839.182 | 12273.117 |
| TVAGW-1D | 2305.382 | 8519.814 |
| TVAGW-2D | 4770.208 | 8073.758 |
| TVAGW-3D | 2759.29 | 10423.70 |
| TVAGW-4D | 3294.697 | 10357.20 |
| TVAGW-5D | 4012.515 | 10380.98 |
| TVAGW-6D | 4839.378 | 10083.34 |
| **X and Y Coordinates are plant specific** | | |

**Figure 1. Residential Well Sampling Locations**

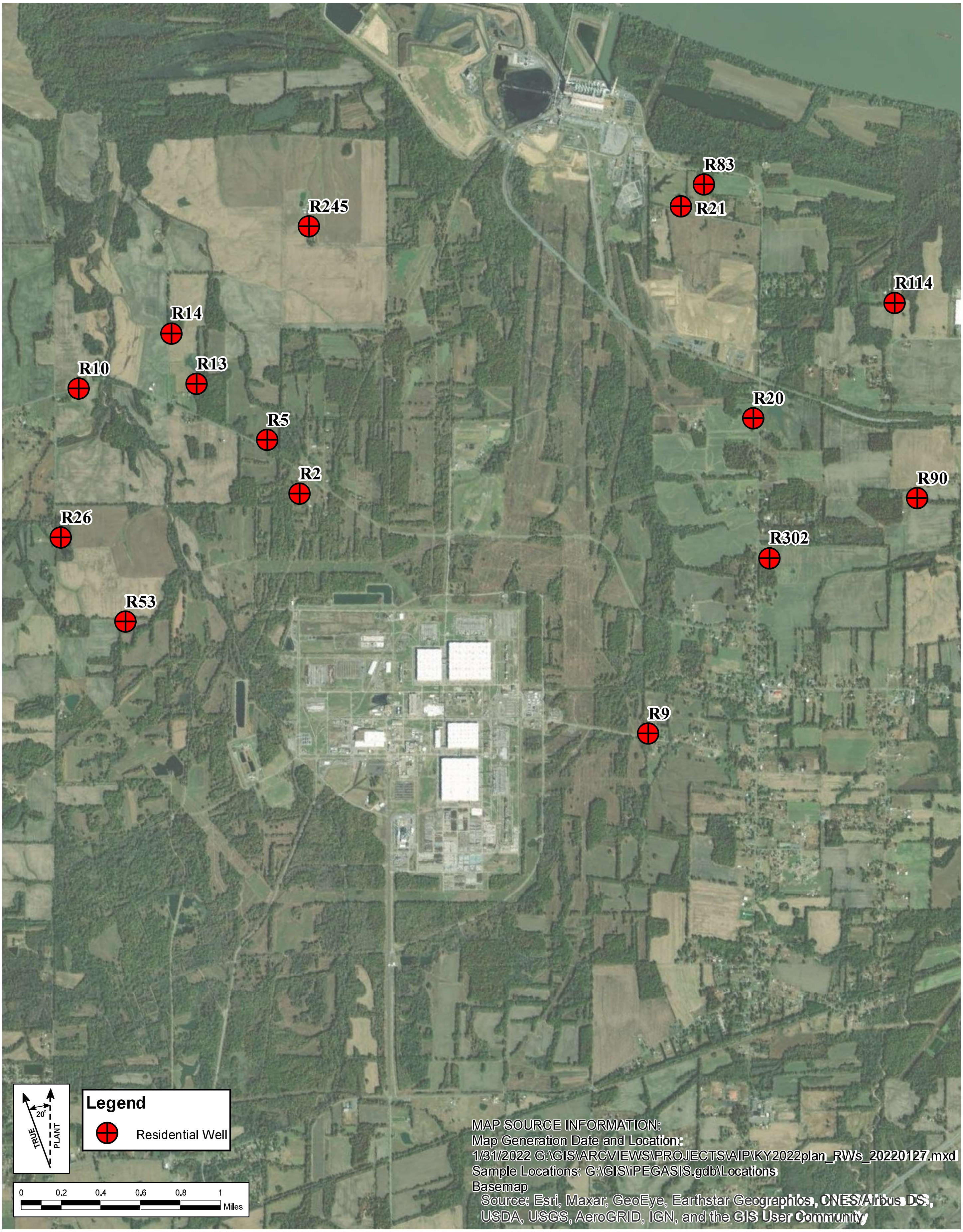
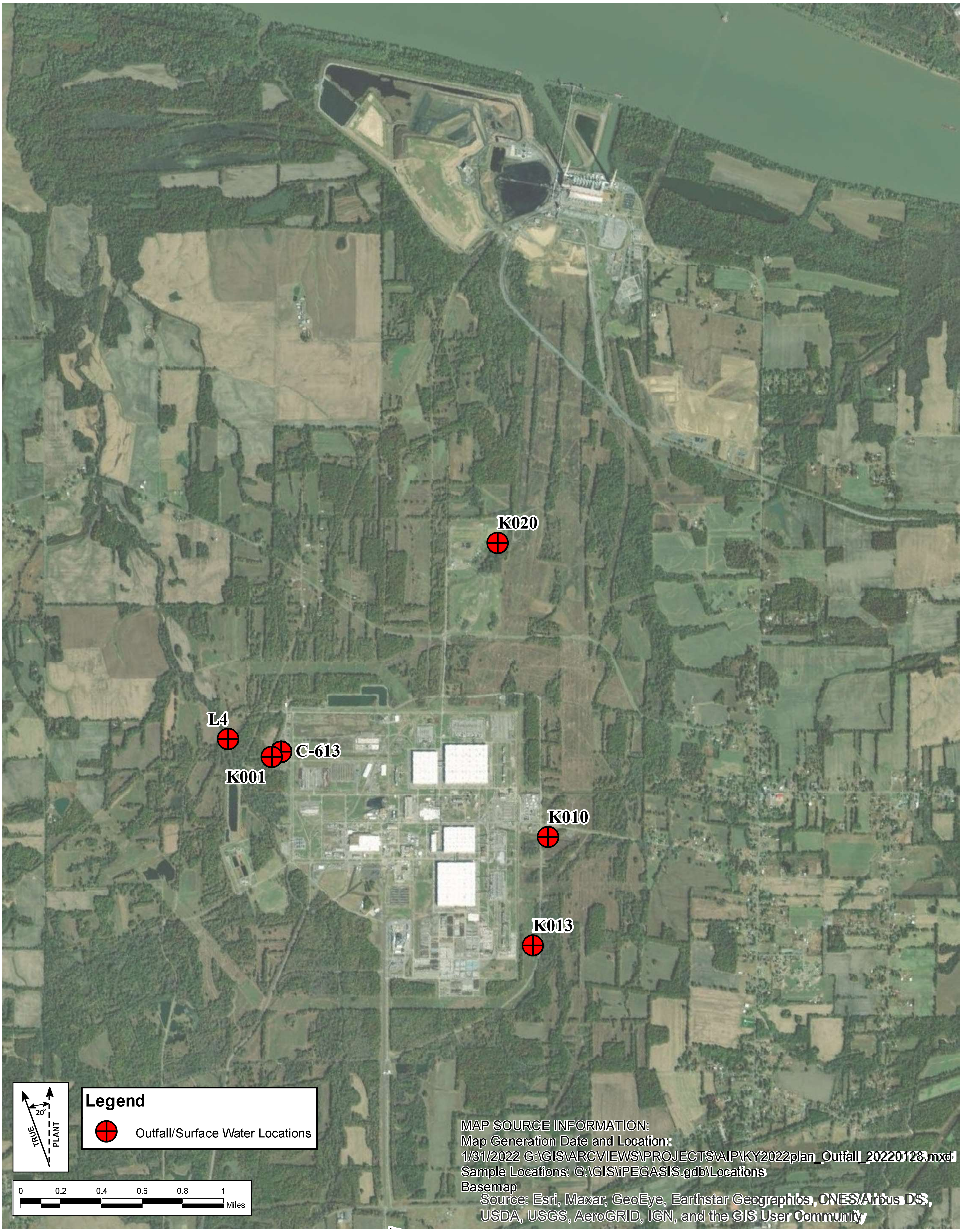


**Figure 2. Outfall Sampling Locations**



## Figure 3. Groundwater Sampling Locations

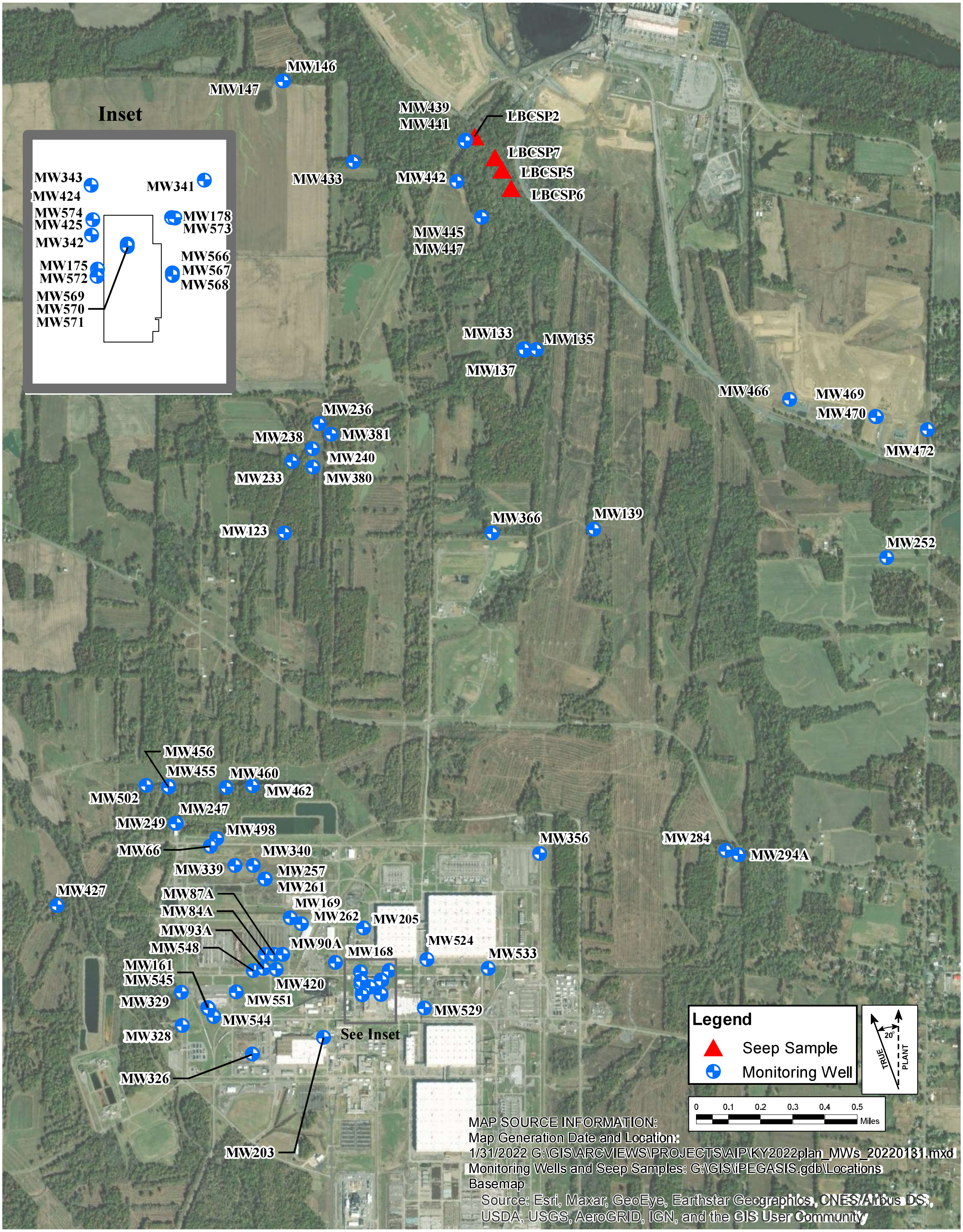


**Figure 4. TVA Synoptic Water Elevation Points**