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Westinghouse

SCANNED

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Nuclear Fuel
Columbia Fuel Fabrication Facility
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USA

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July 14, 2023

Subject: Feasibility Study Work Plan

Mrs. Kuhn:

Per Item 7 of Consent Agreement 19-02-HW, please find attached for your review the *Feasibility Study Work Plan* prepared by AECOM for Westinghouse Electric located in Hopkins, SC.

Please contact me if there are any questions regarding this submission.

Respectfully,

Diana P. Joyner
Principal Environmental Engineer
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Feasibility Study Work Plan

Columbia Fuel Fabrication Facility
Hopkins, Richland County, South Carolina

Westinghouse Electric Company, LLC

Project Number: 60691645

July 2023

Delivering a better world

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Quality information

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Table of Contents

Tables

Figures

Appendices

Acronyms

AOC	Area of Concern
BRA	Baseline Risk Assessment
CA	Consent Agreement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFFF	Columbia Fuel Fabrication Facility
COPCs	constituents of potential concern
CSM	Conceptual Site Model
CVOCs	chlorinated volatile organic compounds
DHEC	South Carolina Department of Health and Environmental Control
EPA	United States Environmental Protection Agency
ERA	Ecological Risk Assessment
ft	feet
ft/day	feet per day
ft/ft	feet per foot
HHRA	Human Health Risk Assessment
MCL	maximum contaminant level
NRC	Nuclear Regulatory Commission
OU	operable unit
RI	remedial investigation
SC	South Carolina
SNM	special nuclear material
Tc-99	Technetium-99
U	uranium
Westinghouse	Westinghouse Electric Company, LLC

1. Executive Summary

The Westinghouse Electric Company, LLC (Westinghouse) Columbia Fuel Fabrication Facility (CFFF) consists of 1,151 acres, with the operational area encompassing 75 acres. CFFF manufactures fuel assemblies and components for the commercial nuclear power industry.

The South Carolina Department of Health and Environmental Control (DHEC) and CFFF entered into a Consent Agreement (CA) on February 26, 2019. The CA requires a Remedial Investigation (RI) to further assess the source, nature, and extent of known constituents of potential concern (COPCs) as well as additional areas where historical releases may have occurred. The CA also requires that the RI be followed by a Feasibility Study (FS) to assess cleanup alternatives.

RI activities were conducted from June 2019 through October 2021. The *Final Remedial Investigation Report* (AECOM, 2023) was submitted to DHEC in February 2023. The results of the RI confirm the presence of COPCs in environmental media including soil, groundwater, sediment, and surface water. The COPCs identified in one or more media include chlorinated volatile organic compounds (CVOCs), nitrate, fluoride, technetium-99 (Tc-99) and uranium (U). The RI did not identify any sources of ongoing impacts. The identified impacts were limited to these media, and the extent of impact in each media is within the facility property boundary with no identified mechanism for future migration offsite. A Baseline Risk Assessment (BRA) conducted as part of the RI indicates that the identified impacts pose no unacceptable risk to human health or the environment.

Based on the results of the RI, the following was recommended: 1) Conduct an FS to assess appropriate cleanup options for CFFF and 2) Develop a groundwater fate and transport model to predict when COPCs in groundwater will fall to below levels of potential concern and/or remain in a steady state condition. Additional details can be found in the *Final Remediation Investigation Report* (AECOM, 2023).

This Work Plan identifies the media and COPCs which will be evaluated in the FS, proposes Remedial Action Objectives for the site, and proposes Remedial Goals - both long term and, where applicable, short term.

2. Introduction

Westinghouse CFFF is located at 5801 Bluff Road (site or property) in Hopkins, approximately 15 miles southeast of Columbia, South Carolina (**Figure 1**). The site includes approximately 1,151 acres, with the operational area encompassing approximately 75 acres centrally located on the site, thereby creating substantial buffers from adjoining properties. The property is primarily surrounded by rural forested and agricultural property with some low-density residential development. CFFF was opened in 1969 and manufactures fuel assemblies and components for the commercial nuclear power industry. Site features are shown on **Figure 2**.

On February 26, 2019, DHEC and CFFF entered into the CA. This CA requires Westinghouse to comprehensively assess potential environmental impacts from current and historical operations at the CFFF by following the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) process. The CERCLA process requires the following incremental steps: Remedial Investigation (RI), Feasibility Study (FS), Record of Decision, Remedial Design/Remedial Action, and Remedial Action completion.

This document constitutes the FS Work Plan (Work Plan) which outlines and describes the proposed activities and anticipated schedule of the FS.

3. Regulatory Framework

In accordance with the CA, CFFF is regulated by both the Nuclear Regulatory Commission (NRC) and DHEC. The NRC regulates radiological safety and decommissioning in accordance with NRC regulations and special nuclear material (SNM) license SNM-1107. In accordance with SNM-1107, CFFF has set aside closure funding to remove radiologically impacted environmental media when the facility is decommissioned (Westinghouse, 2022). DHEC has the authority to require Westinghouse to investigate and cleanup any radiologic or non-radiologic releases to the environment.

4. Site Description, Background, and Physical Setting

4.1 Facility Description and Operational Background

Figures 1 through 3 illustrate the site features discussed below. The CFFF property is located on Bluff Road (SC Highway 48) approximately 15 miles southeast of Columbia, SC and includes approximately 1,151 acres as identified by Richland County Tax Map Series numbers 18600-01-01 and 18601-01-02. The property is surrounded by rural forested and agricultural property with some permanent residences located north and east of the site.

The primary plant building is located approximately 2,700 feet (ft) southwest of Bluff Road on the northern portion of the property with the wastewater treatment plant located near the southwest corner of the plant building. Treated wastewater is piped to the Congaree River approximately 3 miles south of the property boundary where it is discharged under National Pollutant Discharge Elimination System permit SC0001848. A 30-40 ft bluff separates the northern, partially developed portion of the property from the southern floodplain portion of the property. Notable features in the floodplain include Mill Creek (including Upper and Lower Sunset Lakes, **Figure 2**), a man-made canal, and man-made stormwater ditches. **Figure 3** presents a site map including the location of all monitoring wells associated with the project.

Westinghouse purchased the property in 1968, and construction of the CFFF was completed in 1969. Prior to construction the property consisted of farmland and woodlands. The main manufacturing activity is the fabrication of low-enriched U fuel assemblies and components for the commercial nuclear power industry. The manufacturing process generates multiple wastewater streams which are treated by various physical, chemical, and biological processes prior to discharge to the Congaree River.

The facility has been divided into eight operable units (OUs) in recognition of the different types of site activities and potential sources of impact. The OUs are identified as the Northern Storage Area, Mechanical Area (of the plant building), Chemical Area (of the plant building), West Lagoons Area, Wastewater Treatment Area, Sanitary Lagoon Area, Southern Storage Area, and Western Storage Area. The OUs are depicted on **Figure 4** and are described in detail in the *Final Remedial Investigation Work Plan* (AECOM, 2019).

Releases of COPCs have occurred from the wastewater treatment system and manufacturing operations. CFFF has assessed known releases, installed an extensive groundwater monitoring network (beginning in the early 1980s), and initiated various remediation efforts in response to historic events. Additional comprehensive site assessment of groundwater, surface water, sediment and soils has been performed from 2019 – 2021 under the CA. These assessment activities have determined that environmental impacts from historical operations are largely confined to the immediate plant area and there are no offsite impacts. Additional facility background and operational information is included in the *Final Remedial Investigation Report* (AECOM, 2023).

4.2 Historical Investigations

As mentioned above, previous environmental investigations were performed from 1980 to 2019. Summaries of and excerpts from the investigation reports are included in the *Final Remedial Investigation Report* (AECOM, 2023).

4.3 Historical Remediation Activities

Environmental remediation activities were performed beginning in 1998. Summaries of and excerpts from remediation activities are included in the *Final Remedial Investigation Report* (AECOM, 2023).

4.4 Site Geology

CFFF is located within the Upper Coastal Plain physiographic province of SC. The SC Coastal Plain is a southeasterly thickening wedge of sediment overlying bedrock of the North American craton. Thicknesses of this wedge of sediment range from zero ft at the Fall Line (the furthest transgression of the ocean along the southeastern US coast readily evident in the geologic record) to over 3,500 ft in southeastern, SC (Colquhoun, et al., 1983). The Upper Coastal Plain of SC lies between the Fall Line near Columbia to the northeast to the Orangeburg Scarp to the southwest.

Sediments north of CFFF are a series of northwest to southeast trending, Tertiary aged river terraces (fluvial depositional environment) with the oldest Pliocene Epoch (5.33 million to 2.58 million years ago) sediments being located south of the boundary of the Fort Jackson Army base. Sediments comprising the vadose zone and surficial aquifer of the property are a Quaternary Age, Pleistocene Epoch (2.58 million to 11,700 years ago) river terrace, whereas the sediment in the floodplain portion of the site were deposited during the late Pleistocene Epoch (130,000 to 11,700 years ago) to Holocene Epoch (11,700 years ago to present day). The river terrace and floodplain sediment were deposited by the Congaree River which is located approximately three miles south southwest of the southern property boundary.

Surficial aquifer sediments generally occur to a depth of 30 to 40 ft below land surface at the site, depending on topography, and can be differentiated into overbank deposits consisting of clayey silt, clayey sand, silt, sandy silt to silty sand (approximately 8-10 ft thick) and a coarsening downward sand (approximately 20 to 30 ft thick) river channel deposit. Silt and clay lenses and lower permeability silty or clayey sands occur at varying depths within the coarsening downward sands of the surficial aquifer. Geologic cross sections depicting site lithologies are included in the *Final Remedial Investigation Report* (AECOM, 2023).

Sediments of the surficial aquifer unconformably overlie the Upper Cretaceous, late Campanian Age sediments (83.6 million to 72.1 million years ago, a gap of approximately 70 million years) comprising the Black Creek Formation (Nystrom, Jr. et al., 1991). The upper portion of the Black Creek Formation beneath the site is a confining bed composed of dry silt/clay and brittle shale that is encountered throughout the site. This confining clay varies in thickness from 38 to 83 ft based on data gathered during the installation of the four Black Creek Aquifer wells (W-3A, W-49, W-50 and W-71). The elevation of the top of the Black Creek confining clay is undulating but is generally highest west of the plant building in the operational portion of the property and decreases radially in all directions with the lowest elevations being within the floodplain. The surface of this clay is undulating due to the amount of time that this formation was exposed to precipitation and subsequent erosion. Beneath the clay confining unit is a sand aquifer within the lower Black Creek Formation known as the Black Creek Aquifer that is artesian in some areas of SC. These sediments were deposited in an upper delta plain, fluvial environment. Beneath the Black Creek Aquifer is the Middendorf Aquifer which unconformably overlies the crystalline bedrock of the North American craton.

4.5 Site Hydrogeology

The CFFF is underlain by three hydrogeologic units: the surficial aquifer, the Black Creek Aquifer, and the Middendorf Aquifer. The predominant direction of groundwater flow in the surficial aquifer is to the southwest with components of flow to the west and south. The inferred groundwater flow direction in the Black Creek Aquifer is to the southwest. **Figures 5, 6, and 7** illustrate the locations of monitoring wells at the site and groundwater elevation contour (potentiometric) maps for the surficial aquifer – upper zone, surficial aquifer – lower zone, and the Black Creek Aquifer, respectively, for April 2023. Wells installed on top of or within five ft of the Black Creek confining clay are designated as surficial aquifer - lower zone monitoring wells with the rest of the surficial aquifer comprising the upper zone.

Hydraulic conductivity tests (slug tests) were performed during previous scopes of work and during the RI. The hydraulic conductivity values determined by slug tests ranged from 0.06 to 125.20 ft per day (ft/day). Based on these values, the average hydraulic conductivity calculated for the site is 16.44 ft/day.

Because the water table generally mimics topography and the bluff represents a comparatively dramatic change in elevation over a short distance, the horizonal hydraulic gradients were assessed for areas of the site above the bluff, near the bluff, and below the bluff. Across the area of groundwater impact (from well pair W-36/W-122 to well pair W-20/W-109), an average hydraulic gradient of 0.0075 ft per foot (ft/ft) was calculated during the RI for the surficial aquifer for October 2021.

In general, vertical groundwater flow within the surficial aquifer is downward ranging from -0.002 to -0.414 ft/ft. Upward vertical gradients were calculated in the surficial aquifer for well pairs W-22/W-6, W-32/W-11, W-91/W-90 and W-95/W-111 ranging from 0.012 to 0.525 ft/ft. Two of the well pairs (W-32/W-11 and W-91/W-90) with upward gradients are located near areas of steep topography (e.g., the bluff, Western Ditch incisement). Upward gradients in these wells are the result of the upper zone of the water table decreasing in elevation faster than the lower zone.

Groundwater velocity was calculated using Darcy's Law which incorporates hydraulic gradient, hydraulic conductivity and effective porosity. Using an assumed effective porosity of 30 percent (0.30), the average hydraulic gradient, and average hydraulic conductivity, a groundwater flow velocity for the surficial aquifer at CFFF of 150 ft/year was calculated.

Although groundwater flow velocities above the bluff and down the bluff are calculated to be higher than those in the floodplain, the slower groundwater flow velocity in the floodplain inhibits groundwater in a connected aquifer system from flowing faster than the slowest portion of the aquifer. Slower groundwater flow rates in the floodplain cause groundwater from above the bluff and down the bluff to push against slower moving groundwater in the floodplain. Therefore, groundwater flow velocities in the floodplain limit the overall flow rate in the surficial aquifer.

4.6 Site Ecology

The *Baseline Risk Assessment* (AECOM, 2022) documents that the site is comprised of two main ecological communities: 1) a maintained, herbaceous community within the developed area of the facility and 2) a swamp community associated with the Congaree River floodplain. There are extensive areas of planted pines to the north, south, east, and west of these communities.

Vegetation within the developed area includes various grasses, rushes, sedges and ruderal, weedy herbs. The herbaceous community within the developed area is limited in height due to periodic mowing which also prevents the growth of shrubs or trees. Because of this site maintenance limiting the flora and the industrial use of the property, the fauna of this community is expected to be limited. Terrestrial wildlife that may use this area includes but is not limited to rodents, birds, reptiles, and amphibians. Wild boar, whitetail deer, fox, bobcat, and other animals that reside in the planted pines or swamp community may periodically visit this area to feed. Aquatic wildlife that may occur within the ditches includes but is not limited to minnows, tadpoles, and insects.

The swamp community within the property extends along Mill Creek and includes densely forested wetlands, bottomland hardwood forest and the open waters of Lower Sunset Lake and the Gator Pond. The forest canopy within Mill Creek is dominated by tupelo but also includes cypress, whereas the upland portions are dominated by pine, maple, and oak. Periodic flooding of this area deposits nutrient rich sediment across the entire community. Due to this, there is an abundance of flora within the floodplain and this area is highly suitable for its former use as farmland. Subsequently, this area hosts a wide variety of birds, mammals, reptiles, amphibians and obligately aquatic animals such as fish, tadpoles, crayfish, and insects.

There are five federal and five state species listed as threatened and endangered species within Richland County based on information from the South Carolina Heritage Trust website in conjunction with the South Carolina Department of Natural Resources. None of the federally or state-listed species known to occur in Richland County have been observed at the CFFF facility, with the possible exception of the Wood Stork, a low concern species which was reportedly observed on the facility property according to a single account. Based on the known ranges and the habitat requirements of these ten species, besides the Wood Stork, their occurrence on or adjacent to the facility is unlikely except for a moderate potential for the Rafinesque's big-eared bat and the spotted turtle.

5. Feasibility Study Work Plan

5.1 Overview of Remedial Investigation and Risk Assessment

RI activities were conducted from June 2019 through October 2021 and included the following:

- Completion of 91 soil and/or lithologic borings.
- Collection of 103 soil samples.
- A private water supply well survey within 1 mile of the property boundary.
- Sampling of four private water supply wells.
- Collection of 120 groundwater samples from temporary monitoring wells.
- Installation of 57 additional permanent monitoring wells.
- Semi-annual sampling of permanent monitoring wells including 118 wells in October 2021.
- Collection of 12 surface water samples.
- Collection of 172 sediment samples.
- Grain size analysis of five aliquots of sediment and 13 soil samples.
- Installation of staff gauges and pressure transducers at six locations within CFFF's surface water bodies to continuously monitor surface water elevations.
- Installation of pressure transducers in 13 monitoring wells and one piezometer to continuously monitor groundwater elevations.
- Slug tests at a total of 21 monitoring wells.
- Bathymetric surveys of the Gator Pond, Upper Sunset Lake, and Lower Sunset Lake.
- Survey of the new borings, monitoring wells, staff gauge locations and portions of the stormwater ditch.

The data generated by this work confirmed that the following COPCs are present in environmental media (soil, groundwater, sediment and/or surface water):

- chlorinated volatile organic compounds (CVOCs),
- nitrate,
- fluoride,
- technetium-99 (Tc-99), and
- uranium (U).

Soil samples were collected in accessible locations where COPCs could potentially have been released. Some areas of the site were not accessible for sample collection due to site infrastructure such as overhead and underground utilities, above ground storage tank containment, and wastewater treatment lagoons. The soil sampling indicated that a vadose zone source for Tc-99 does not exist and concentrations of CVOCs in soil are minimal, occur only in the shallow subsurface, and will continue to attenuate. Soil samples collected from the deeper subsurface in the highest areas of CVOC impact to groundwater and the highest areas of CVOCs in soil gas did not contain detectable concentrations of CVOCs which confirmed that a vadose source for leaching of CVOCs to groundwater does not exist within the accessible areas.

Figure 8 illustrates the lateral extent of COPCs detected in groundwater that exceeded their respective Maximum Contaminant Levels (MCLs); **Figure 9** illustrates COPCs detected in surface water samples collected during the RI; **Figure 10** illustrates COPC detections in sediment samples collected from the ditches and Gator Pond including nitrate and fluoride detections above their respective calculated background concentrations; and **Figure 11** illustrates U and Tc-99 detections in sediment samples collected from the floodplain that exceeded their respective Residential Use Screening Levels (RUSLs). The RI did not identify any sources of ongoing impacts and found that the extents of the identified impacts were well within the facility property boundary. Additionally, the RI provided no evidence that these impacts have or will affect properties off-site in the future.

A Baseline Risk Assessment (BRA), which included a Human Health Risk Assessment (HHRA) and an Ecological Risk Assessment (ERA), was conducted as part of the RI to assess what risks these impacts might pose to human health and the environment. The BRA indicated that the impacts pose no unacceptable risk to human health or the environment.

A visual, 3-dimensional Conceptual Site Model (CSM) was created using data collected during the RI as well as previous investigations to illustrate the source, nature, and extent of the COPCs. The CSM will be used to support the decision process during the screening and selection of remedial alternatives. The CSM is included in this Work Plan as **Appendix A.**

Based on the findings of the RI, the following actions were recommended:

- The FS should be conducted to assess which cleanup options are appropriate for CFFF.
- To support the CSM and FS, a groundwater fate and transport model should be developed to predict when COPCs in groundwater will fall to below levels of potential concern and/or remain in a steady state condition.

5.2 Additional Data Collection

5.2.1 Monitored Natural Attenuation Parameters

Monitored Natural Attenuation (MNA) involves tracking the natural degradation of contaminants without the introduction of foreign microorganisms, nutrients, oxygen, or mechanical enhancement. To accomplish this, preliminary studies are performed to determine the natural mechanisms resulting in degradation of target constituents. Periodic sampling is then performed to monitor the actual degradation rates of the target constituents.

Since periodic groundwater sampling is already performed at the site on a semi-annual basis, this Work Plan proposes the addition of MNA parameter analyses to the semi-annual groundwater sampling for select monitoring wells. The monitoring wells selected for MNA parameter analysis will include wells where the highest concentrations of each COPC have been detected, historically. Additionally, the selected wells should include those along the flow path and the perimeter of the plume for each COPC. An initial list of proposed monitoring wells selected for MNA parameter analysis is included as **Table 1.**

5.2.2 Groundwater Fate and Transport Modeling

Results from the MNA parameter data collection and analysis will be evaluated to determine the dominant processes that are occurring. This evaluation will be incorporated into a groundwater fate and transport model that will be developed to predict when COPCs in groundwater will fall to below levels of potential concern and/or remain in a steady state condition. The model will be used to further support the CSM to aide in the screening and selection of Remedial Alternatives during the FS.

5.3 Development of Remedial Action Objectives and Remedial Goals

5.3.1 Target Media and Contaminants of Potential Concern

This Work Plan recognizes that there are no current or immediate risks to human health or the environment. Additionally, CFFF has discontinued use of PCE, so possible future CVOC impact to soil has been eliminated. Impacted soil beneath the Chemical Area and Wastewater Treatment OUs will be removed during site decommissioning in accordance with the CA. Therefore, the objectives are to mitigate potential risks based on the current industrial use and the conservative future residential use of the site. The media that will be addressed in the FS include groundwater, surface water, and soil/sediment containing COPCs identified in the RI. The targeted list of COPCs that will be addressed in the FS include CVOCs, nitrate, fluoride, Tc-99, and U. **Table 2** summarizes which media contain exceedances for which COPCs. The FS will only consider remedies for constituents in media where exceedances are documented.

5.3.2 Remedial Action Objectives

Remedial action objectives (RAOs) are divided into short-term and long-term objectives and are defined as the following:

- Short-term – Protection of human health and the environment by reducing or maintaining COPC impacts below the site-specific remedial goals for each targeted media for current Industrial/Commercial use. For surface water exposures, ecological exposure criteria are considered.

- Long-term - Meet site-specific remedial goals and maintain compliance with applicable or relevant and appropriate requirements (ARARs) for each COPC and target media for Unrestricted use.

The bounds of the FS will be within the facility property boundary since the identified COPC impacts do not extend to adjacent, offsite properties and are not expected to do so in the future. The considered remedial alternative should include remedial technologies that are most capable of achieving the RAOs.

5.3.3 Remedial Goals

Remedial goals (RGs) are defined as numerical criteria for environmental media that, when exceeded, result in a violation of statutory regulations. Based upon the RAOs above, a distinction has been developed between Short-Term RGs and Long-Term RGs. The proposed RGs are discussed by media below and a summary is provided in **Table 3.**

5.3.3.1 Groundwater / Surface Water Remedial Goals

For the state of South Carolina, the United States Environmental Protection Agency (EPA) MCL serves as the groundwater RG for this site as well as the long-term surface water RG. This includes the RG for U of 30 micrograms per liter. The RG for Tc-99 is 900 picocuries per liter converted from the MCL of 4 millirem per year for beta particle and photon radioactivity from man-made radionuclides (EPA, 2002). The Short-Term Remedial Goal for CVOCs is based upon the EPA Region IV Surface Water Screening Values for Hazardous Waste Sites (EPA, 2018).

Surface water exceedances during the RI were limited to fluoride in the Gator Pond (SW-23) and tetrachloroethene (tetrachloroethylene) in the Eastern Ditch (SW-17 and SW-18). All three of these exceedances are understood to be driven by groundwater daylighting into surface water features. Thus, evaluation of groundwater remediation alternatives will consider effectiveness for addressing surface water exceedances in lieu of standalone surface water remedies.

5.3.3.2 Soil / Sediment Remedial Goals

The RGs proposed for COPCs will not make any distinction between soil and sediment. The same RG values will be used for both media.

This work plan also notes that there were no exceedances of screening criteria in vadose zone soil identified within the RI as stated in above Section 5.1. The minimal detections of CVOCs in soils were ruled out as potential on-going sources for impacting groundwater or vapor intrusion during the BRA (AECOM, 2022). Additionally, the Tc-99 detections in vadose zone soil during the RI were below the laboratory's minimum detectible concentration (MDC), and therefore indistinguishable from the instrument's background value. Absent a recognized exceedance of screening criteria for COPCs in vadose zone soil in the RI, the FS will not evaluate vadose zone remedial technologies.

Neither nitrate, fluoride, nor any CVOCs were identified with sediment exceedances in the RI, so no RGs are considered for these COPCs in solid media in this Work Plan. The RI compared sediment results for Tc-99, and U speciated as U233/234, U235/236, or U238 to Residential Use Screening Levels (RUSLs) published in the Nuclear Regulatory Commission *Consolidated Decommissioning Guidance* (NUREG-1757, Volume 2, Revision 2, Appendix H). However, under a final decommissioning, Derived Concentration Guidance Levels (DCGLs) based upon NUREG 1575 would be calculated to develop site specific cleanup criteria for these radionuclides. Therefore, during the FS DCGLs will be developed for soil/sediment for the site and will be used to guide remedial decision making for sediments. In the interim RUSLs will serve as the long-term RGs, while Industrial Use Screening Levels will serve as the short-term RGs.

5.4 Identification and Initial Screening of Remedial Technologies

As part of the FS, a list of applicable remedial technologies will be developed as a preliminary screening step in the evaluation process based on the targeted media and COPCs.

Candidate technologies will be screened based on the following criteria:

- **Applicability and appropriateness to the Site.** Applicability and appropriateness of a potential technology will consider the specific constituents present; the media; the nature, extent, and status of the sources of contamination; the physical conditions of the site and surroundings; and the ability of the technology to achieve the defined RAOs.

- **Technical feasibility and implementability.** Technical feasibility and implementability of a potential technology will consider steps and procedures required for implementation as well as site-specific conditions (size, topography, current and future land use, drainage routes, surface conditions, and other permanent conditions); practicality; and probability of success. In assessing practicality and probability of success, the remedial approach performance history and implementation impacts to public welfare and the environment must also be considered.

- **Relative cost.** Relative cost of a technology examines the expected level of expense required to implement the technology at the Site relative to the other remedial technologies. This is not a detailed cost estimate but, rather, a general judgment based on experience implementing the technology at similar sites.

General remedial technologies that may be evaluated as part of the preliminary screening process are summarized below:

- **No Action.** No Action is included as a benchmark for the comparison of costs and benefits associated with other technologies. No corrective action would be taken as a result of no-action response; however, monitoring would be conducted.

- **Institutional Controls.** ICs are typically implemented as tools designed to protect human health, the environment, and to maintain the current and future integrity of the remedy at contaminated sites. ICs are generally non-engineered mechanisms such as administrative and/or legal controls that minimize or eliminate the potential for human exposure to contamination and/or protect the integrity of a remedy. These are typically designed to work by limiting land and resource use at a site, or by providing guidance to help modify human behavior at a site. ICs that are implemented via deed restrictions offer greater risk control than local or regional zoning.

- **Containment.** Containment can prevent risk to human health and the environment by restricting migration in pathways defined in the CSM. A number of technologies and different materials are available for use in establishing migration barriers including physical methods such as capping, slurry walls, grout curtains, or sheet piling. Migration barriers can also include hydraulic methods such as recovery/extraction wells, subsurface interceptor trenches, or underdrains to collect groundwater before it migrates to a receptor.

- **Removal.** Removal involves physically removing the media from the subsurface to reduce the risk. This action may consist of excavation of soil and sediment or extraction of groundwater.

- **Treatment.** Treatment actions involve the reduction or alteration of COPC concentrations in the targeted media to reduce the mobility, volume, and/or toxicity of the contaminants. This action may consist of several methods including but not limited to injecting a chemical oxidant or enhanced reductive dechlorination.

5.5 Remedial Alternatives Development and Evaluation

Remedial technologies that pass the initial screening will be retained for further evaluation and incorporated as a component of a remedial alternative. As part of the FS, a detailed evaluation of the remedial alternatives will be performed using the following criteria:

- **Protection of human health and the environment, including attainment of remediation goals**. The assessment against this criterion will describe how the alternative, as a whole, achieves and maintains protection of human health and the environment.

- **Compliance with applicable or relevant and appropriate requirements**. The assessment against this criterion will describe how the alternative complies with ARARs or if a waiver is required and how it is justified. The assessment will also address other information from advisories, criteria, and guidance that the leading and supporting agencies have agreed is "to be considered." The ARARs can be chemical specific, location specific and action specific. Chemical specific ARARs are generally numerical values such as

MCLs. Location specific ARARs place restrictions on the conduct of the cleanup activities based on their particular location. Action specific ARARs are related to implementation of the technology and the impacts to public welfare and the environment.

- **Short-term effectiveness**. The assessment of alternatives against this criterion will evaluate the short-term effectiveness in protecting human health and the environment during the construction and implementation of a remedy as it pertains to the RAOs.
- **Long-term effectiveness and permanence**. The assessment of alternatives against this criterion will evaluate the long-term effectiveness in maintaining protection of human health and the environment after conclusion of active remediation activities as it pertains to the RAOs.
- **Reduction of toxicity, mobility, and volume through treatment**. The assessment of alternatives against this criterion will evaluate the anticipated performance of specific treatment technologies to reduce the toxicity, mobility and/or volume of COPCs significantly and permanently.
- **Implementability**. The assessment of alternatives against this criterion will evaluate the technical and administrative feasibility as well as the availability of required goods and services.
- **Cost**. The assessment of alternatives against this criterion will evaluate the capital and operation and maintenance costs of each alternative.
- **Community and state acceptance**. This assessment reflects the community and state's (or supporting agency's) apparent preferences or concerns about the alternatives. These criteria are formally assessed after public comment.

A detailed comparative analysis of each remedial alternative evaluation will also be performed as part of the FS.

5.6 Feasibility Study Report

Following completion of the Work Plan, an FS Report will be prepared and submitted to DHEC as part of the CERCLA process as required by the CA. The report will summarize the results of the additional data collection and groundwater fate and transport model. Additionally, the report will describe and present the results of the RAO and RG development, the initial screening of remedial technologies, remedial alternatives development and evaluation, and the detailed comparative analysis of the alternatives. All supporting data and information utilized in preparing the report will be referenced.

5.7 Schedule

A conceptual schedule for the FS Work Plan is identified below.

Project Activity or Task	Estimated Start Date	Estimated Duration	Estimated Completion or Delivery Date
FS Work Plan Submittal	Not Applicable	Not Applicable	July 15, 2023
Groundwater MNA Parameters	October 2023	Collect Semi-Annual	January 2024
Groundwater Fate and Transport Modeling	August 2023	Nine Months	April 2024
Prepare Draft Feasibility Study Report	August 2023	Four Months Following Completion of Fate and Transport Modeling	August 2024
Present Draft Feasibility Study to DHEC	September 2024	Not Applicable	October 2024
Submit Final Feasibility Study Report	October 2024	Two Weeks Following Presentation to DHEC	November 2024

6. References

AECOM, 2019. Final Remedial Investigation Work Plan, Westinghouse Columbia Fuel Fabrication Facility, 5801 Bluff Road, Hopkins, South Carolina, June 2019.

AECOM, 2022. Baseline Risk Assessment, Westinghouse Columbia Fuel Fabrication Facility, August, 2022.

AECOM, 2023. Final Remediation Investigation Report, Westinghouse Columbia Fuel Fabrication Facility, February, 2023.

Colquhoun, Donald J., et. al. 1983. Surface and Subsurface Stratigraphy, Structure and Aquifers of the South Carolina Coastal Plain, Department of Geology, University of South Carolina.

EPA, 2002. EPA Facts About Technetium-99. July 2022. https://www.nrc.gov/docs/ML1603/ML16032A152.pdf.

EPA, 2018. Region 4 Ecological Risk Assessment Supplemental Guidance – March 2018 Update. USEPA Region 4, Superfund Division, Scientific Support Section.

Westinghouse, 2022. Decommissioning Funding Plan, May 9, 2022.

Tables

Table 1
Summary of Proposed Monitored Natural Attenuation Parameter Sampling
Westinghouse Columbia Fuel Fabrication Facility
Hopkins, South Carolina

Well ID	Primary COPC							MNA Parameter									
								Chloride	Nitrate	Sulfate	Sulfide	Methane	Ethane/ Ethene	Ferrous Iron	Ferric Iron	Manganese	Acetylene
								Laboratory Analysis									
	PCE	TCE	VC	Nitrate	Fluoride	Uranium	Tc-99	*EPA 300 Series*				*RSK 175*	*RSK 175*	*6020A*	*6020A*	*6020A*	*RSK 175*
W-6				X			X	X	X	X	X	X	X	X	X	X	X
W-7A	X			X	X			X	X	X	X	X	X	X	X	X	X
W-10					X			X	X	X	X	X	X	X	X	X	X
W-11	X			X			X	X	X	X	X	X	X	X	X	X	X
W-13R	X			X	X			X	X	X	X	X	X	X	X	X	X
W-14	X							X	X	X	X	X	X	X	X	X	X
W-15	X							X	X	X	X	X	X	X	X	X	X
W-16	X				X			X	X	X	X	X	X	X	X	X	X
W-17	X			X				X	X	X	X	X	X	X	X	X	X
W-18R				X	X			X	X	X	X	X	X	X	X	X	X
W-19B	X							X	X	X	X	X	X	X	X	X	X
W-22				X	X			X	X	X	X	X	X	X	X	X	X
W-29					X			X	X	X	X	X	X	X	X	X	X
W-30	X			X	X			X	X	X	X	X	X	X	X	X	X
W-32				X	X			X	X	X	X	X	X	X	X	X	X
W-33	X	X		X				X	X	X	X	X	X	X	X	X	X
W-39	X			X				X	X	X	X	X	X	X	X	X	X
W-41R	X	X		X				X	X	X	X	X	X	X	X	X	X
W-47				X				X	X	X	X	X	X	X	X	X	X
W-48	X	X						X	X	X	X	X	X	X	X	X	X
W-55						X		X	X	X	X	X	X	X	X	X	X
W-56						X		X	X	X	X	X	X	X	X	X	X
W-62	X							X	X	X	X	X	X	X	X	X	X
W-64	X			X				X	X	X	X	X	X	X	X	X	X
W-65	X	X						X	X	X	X	X	X	X	X	X	X
W-66	X							X	X	X	X	X	X	X	X	X	X
W-67	X	X		X				X	X	X	X	X	X	X	X	X	X
W-68	X							X	X	X	X	X	X	X	X	X	X
W-74	X							X	X	X	X	X	X	X	X	X	X
W-76		X						X	X	X	X	X	X	X	X	X	X
W-77					X	X		X	X	X	X	X	X	X	X	X	X
W-78					X			X	X	X	X	X	X	X	X	X	X
W-87	X							X	X	X	X	X	X	X	X	X	X
W-89	X							X	X	X	X	X	X	X	X	X	X
W-95			X					X	X	X	X	X	X	X	X	X	X
W-96	X							X	X	X	X	X	X	X	X	X	X
W-97	X							X	X	X	X	X	X	X	X	X	X
W-98				X				X	X	X	X	X	X	X	X	X	X
W-102	X	X		X				X	X	X	X	X	X	X	X	X	X
W-103	X	X		X				X	X	X	X	X	X	X	X	X	X
W-104	X							X	X	X	X	X	X	X	X	X	X
W-107			X					X	X	X	X	X	X	X	X	X	X
W-118	X							X	X	X	X	X	X	X	X	X	X
W-119	X							X	X	X	X	X	X	X	X	X	X
W-120	X	X						X	X	X	X	X	X	X	X	X	X
W-123	X	X		X				X	X	X	X	X	X	X	X	X	X

Notes:
COPC - Constituents of potential concern
PCE - Tetrachloroethene
TCE - Trichloroethene
VC - Vinyl chloride
Tc-99 - Technetium-99

Table 2
Constituents of Potential Concern by Media
Feasibility Study Work Plan
Westinghouse Columbia Fuel Fabrication Facility
Hopkins, South Carolina

Media	Primary COPC				
	CVOCs	Nitrate	Fluoride	Uranium	Tc-99
Groundwater	FS	FS	FS	FS	FS
Surface Water	FS	NE	FS	NE	NE
Soil/Sediment	NE	NE	NE	FS	FS

Notes:

COPC - Constituents of potential concern

CVOCs - Chlorinated volatile organic compounds

Tc-99 - Technetium-99

FS - To be evaluated in Feasibility Study

NE - No exceedances in Remedial Investigation

Table 3
Proposed Remedial Goals
Feasibility Study Work Plan
Westinghouse Columbia Fuel Fabrication Facility
Hopkins, South Carolina

COPCs	Media				
	Groundwater	Surface Water		Soil/Sediment*	
	Long-term Goal	Short-term Goal	Long-term Goal	Short-term Goal	Long-term Goal
	µg/L	µg/L	µg/L	pCi/g	pCi/g
PCE	5	53	5	NA	NA
TCE	5	220	5	NA	NA
Vinyl Chloride	2	930	2	NA	NA
Nitrate	10,000	NA	10,000	NA	NA
Fluoride	4,000	4,000	4,000	NA	NA
Total Uranium	30	NA	30	NA	NA
Tc-99	900 pCi/L	NA	900 pCi/L	89,400	19
Uranium 233/234	NA	NA	NA	3,310	13
Uranium 235/236	NA	NA	NA	39	8
Uranium 238	NA	NA	NA	179	14

Notes:

COPC - Constituents of potential concern

CVOCs - Chlorinated volatile organic compounds

PCE - Tetrachloroethene

TCE - Trichloroethene

VC - Vinyl chloride

Tc-99 - Technetium-99

NA - Not applicable

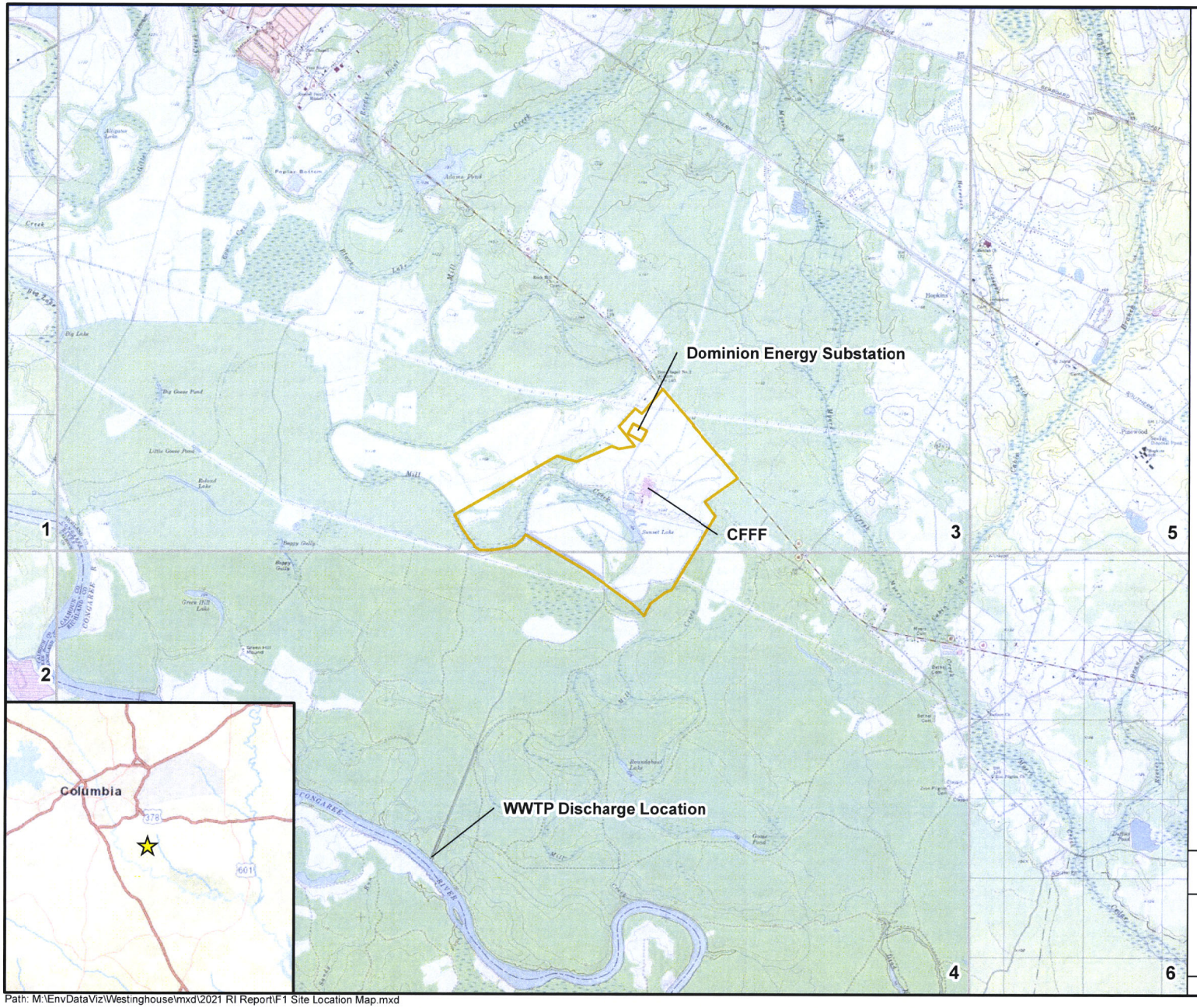
µg/L - Micrograms per Liter

pCi/L - Pico curies per Liter

pCi/g - Pico curies per gram

*Soil/Sediment Goals are based upon Screening Levels Consolidated Decommissioning Guidance (NUREG-1757)
During the FS, these may be replaced by Site Specific Derived Concentration Guidance Levels (DRGLs) from NUREG 1575.

Figures



Legend

Locations

- Property Line
- Topographic Quadrangle Boundary

ID	Topographic Quadrangle Name
1	Southwest Columbia
2	Gaston
3	Fort Jackson South
4	Saylors Lake
5	Congaree
6	Gadsden

0 2,000 4,000 Feet

1:48,000

Map Projection: NAD 1983, South Carolina State Plane, FIPS 3900, Feet

Datum: North American 1983

Data Source: Esri/USGS

N

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Site Location Map

WESTINGHOUSE COLUMBIA FUEL FABRICATION FACILITY
HOPKINS, SOUTH CAROLINA

PROJECT NO.	PREPARED BY:	DATE:	
60691645	CCS	May 2023	FIGURE 1

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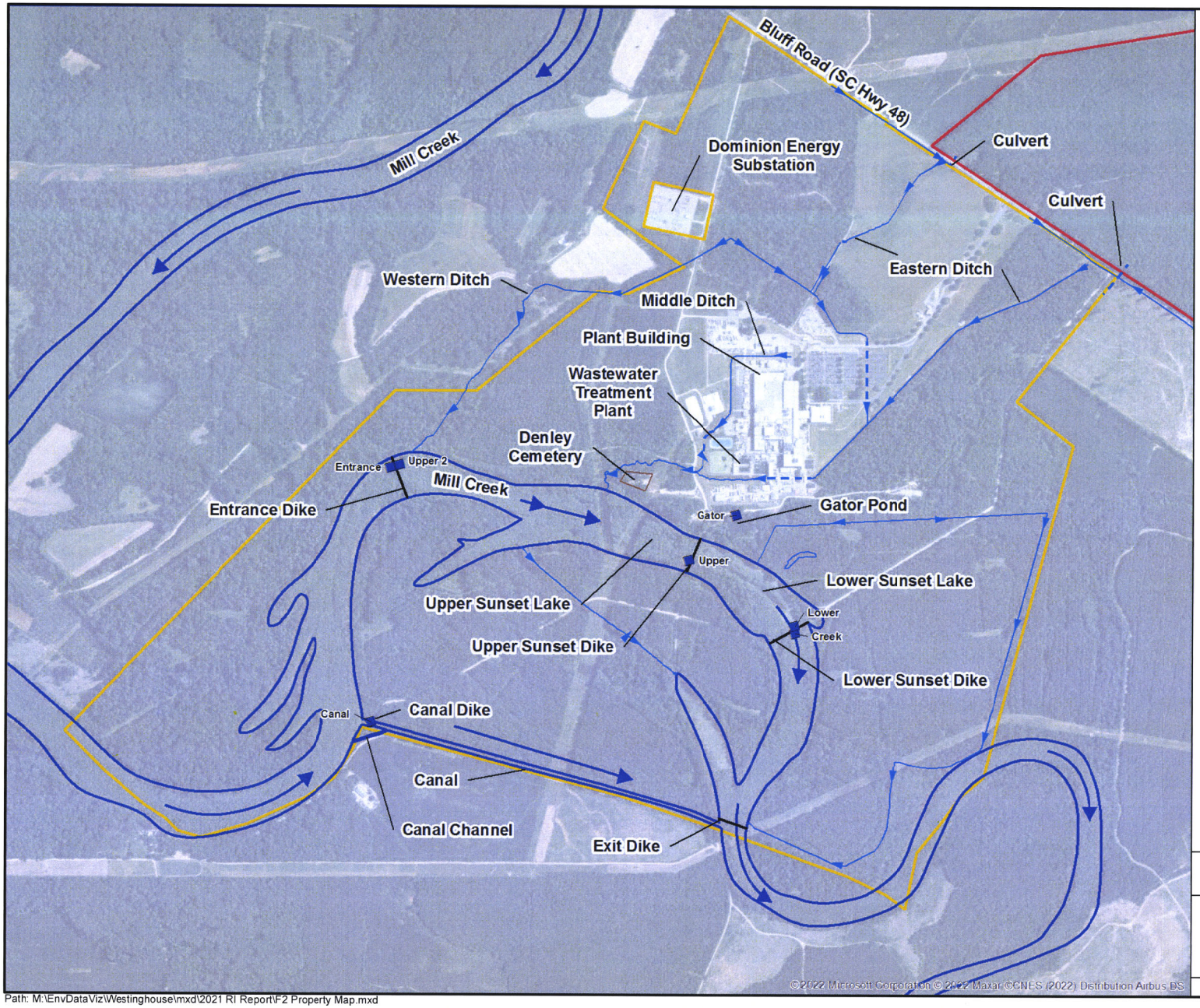

Legend

- Staff Gage Location
- Mill Creek Flow Direction
- Ditch
- Culvert
- Property Line
- SCRDI Bluff Road (Superfund Site)
- Mill Creek
- Dike Location

0 500 1,000 Feet

1:12,000

Map Projection: NAD 1983, South Carolina State Plane, FIPS 3900, Feet

Datum: North American 1983

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Property Map

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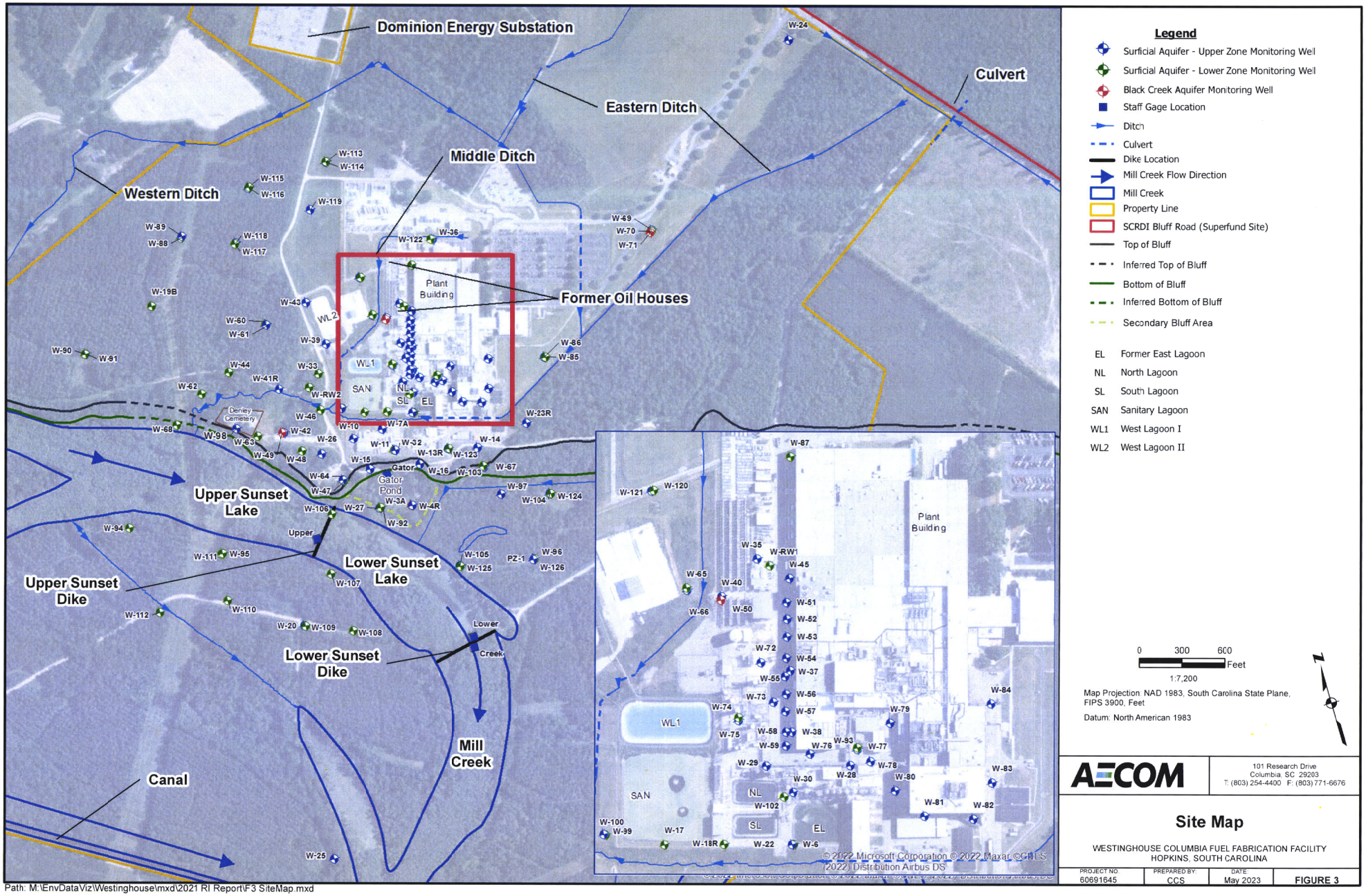
PROJECT NO.	PREPARED BY:	DATE:	
60691645	CCS	May 2023	FIGURE 2

Path: M:\EnvDataViz\Westinghouse\mxd\2021 RI Report\F2 Property Map.mxd



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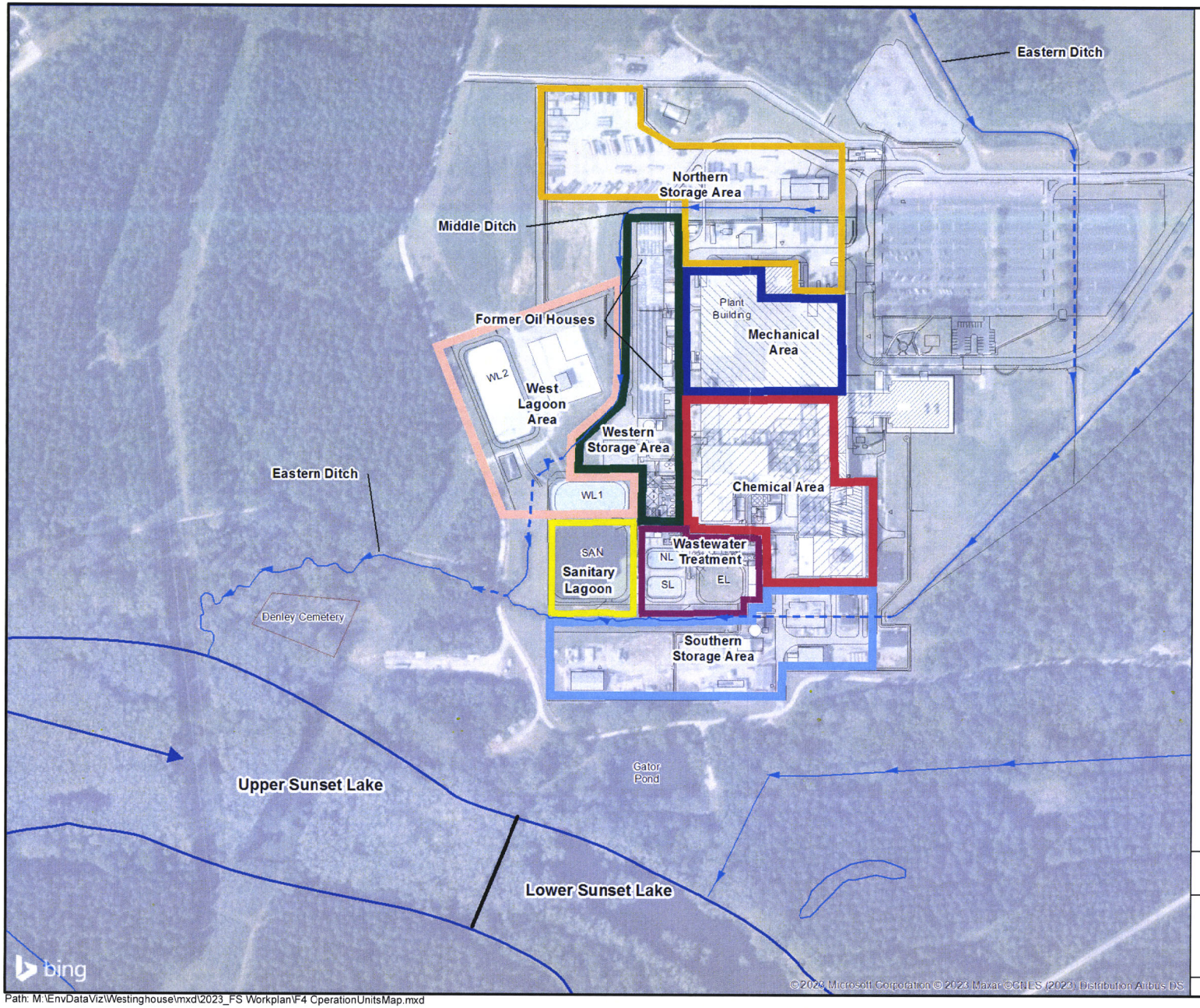
Site Map

WESTINGHOUSE COLUMBIA FUEL FABRICATION FACILITY
HOPKINS, SOUTH CAROLINA

PROJECT NO.	PREPARED BY:	DATE	
60691645	CCS	May 2023	FIGURE 3

Path: M:\EnvDataViz\Westinghouse\mxd\2021 RI Report\F3 SiteMap.mxd



Legend

- Ditch
- Culvert
- Mill Creek Flow Direction
- EL Former East Lagoon
- NL North Lagoon
- SL South Lagoon
- SAN Sanitary Lagoon
- WL1 West Lagoon I
- WL2 West Lagoon II
- Mill Creek
- Dike Location

Operable Units

- Chemical Area
- Mechanical Area
- Northern Storage Area
- Sanitary Lagoon Area
- Southern Storage Area
- Wastewater Treatment Area
- West Lagoons Area
- Western Storage Area

0 150 300 Feet

1:3,600

Map Projection: NAD 1983, South Carolina State Plane, FIPS 3900, Feet

Datum: North American 1983

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Operational Units Map

WESTINGHOUSE COLUMBIA FUEL FABRICATION FACILITY
HOPKINS, SOUTH CAROLINA

PROJECT NO.	PREPARED BY:	DATE:	
60691645	CCS	June 2023	FIGURE 4

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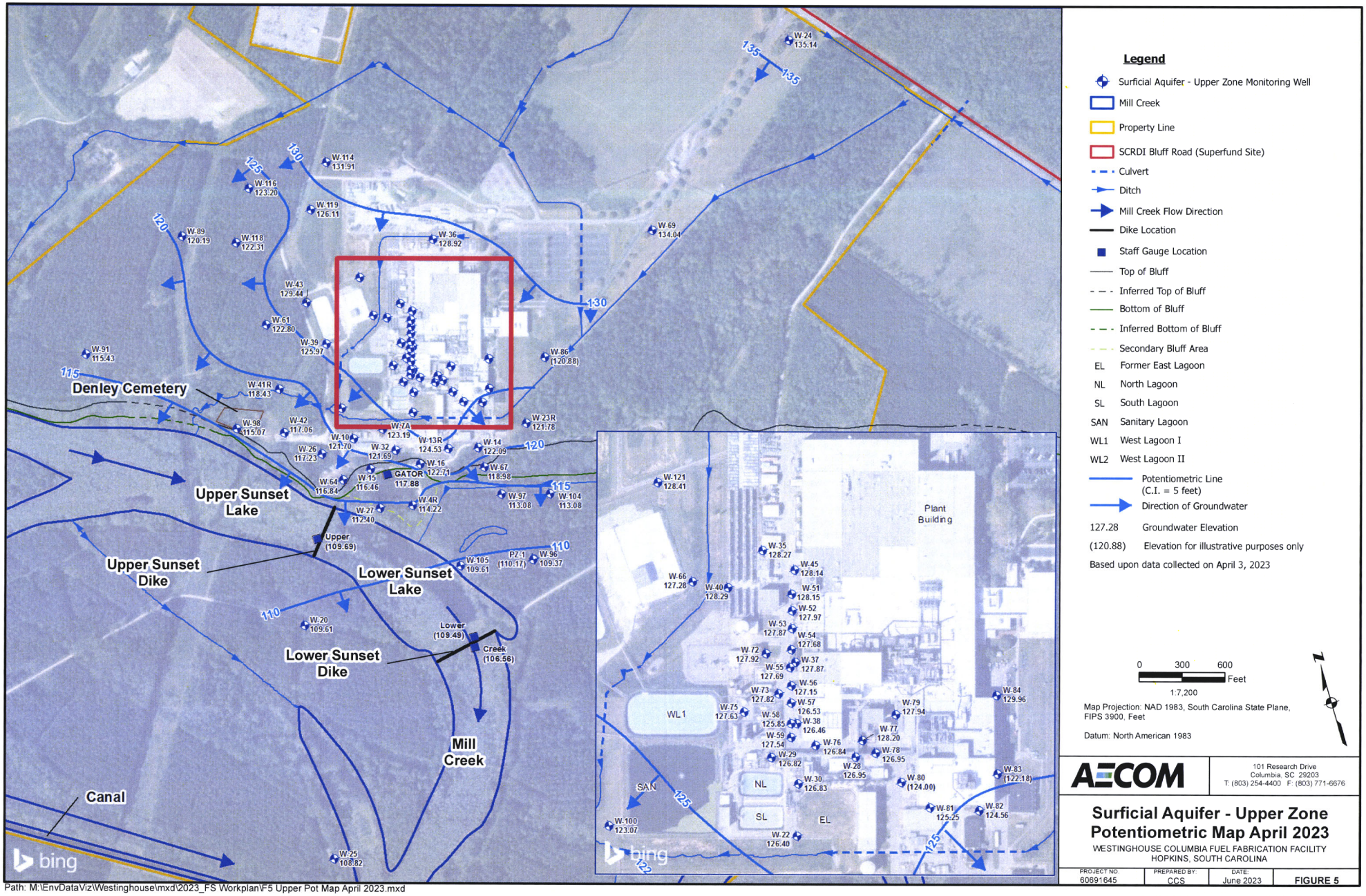

Legend

- Surficial Aquifer - Upper Zone Monitoring Well
- Mill Creek
- Property Line
- SCRDI Bluff Road (Superfund Site)
- Culvert
- Ditch
- Mill Creek Flow Direction
- Dike Location
- Staff Gauge Location
- Top of Bluff
- Inferred Top of Bluff
- Bottom of Bluff
- Inferred Bottom of Bluff
- Secondary Bluff Area
- EL Former East Lagoon
- NL North Lagoon
- SL South Lagoon
- SAN Sanitary Lagoon
- WL1 West Lagoon I
- WL2 West Lagoon II
- Potentiometric Line (C.I. = 5 feet)
- Direction of Groundwater
- 127.28 Groundwater Elevation
- (120.88) Elevation for illustrative purposes only

Based upon data collected on April 3, 2023

0 300 600 Feet

1:7,200

Map Projection: NAD 1983, South Carolina State Plane, FIPS 3900, Feet

Datum: North American 1983

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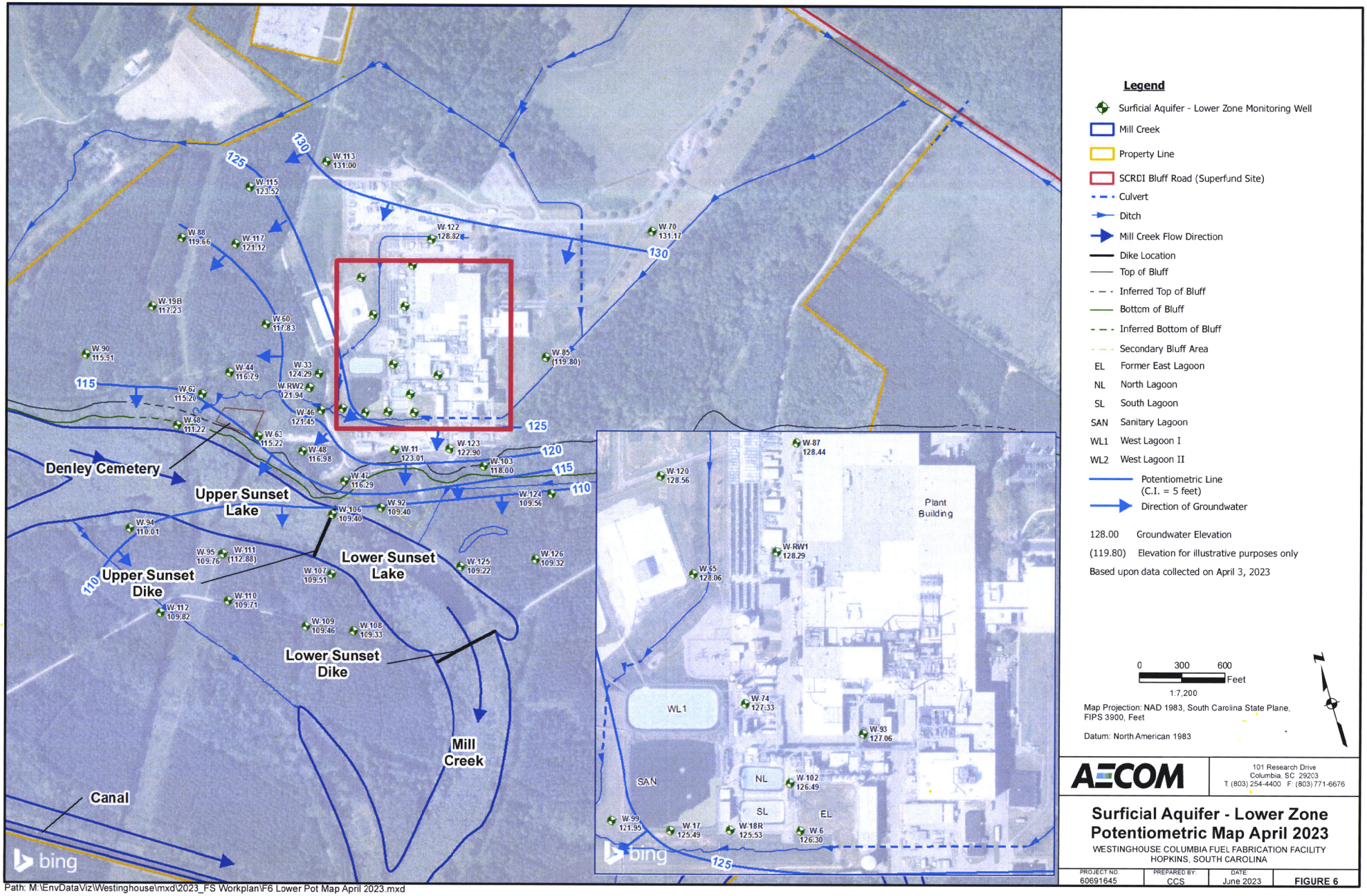
Surficial Aquifer - Upper Zone Potentiometric Map April 2023

WESTINGHOUSE COLUMBIA FUEL FABRICATION FACILITY
HOPKINS, SOUTH CAROLINA

PROJECT NO.	PREPARED BY:	DATE:	
60691645	CCS	June 2023	FIGURE 5

Path: M:\EnvDataViz\Westinghouse\mxd\2023_FS Workplan\F5 Upper Pot Map April 2023.mxd



Legend

- Surficial Aquifer - Lower Zone Monitoring Well
- Mill Creek
- Property Line
- SCRDI Bluff Road (Superfund Site)
- Culvert
- Ditch
- Mill Creek Flow Direction
- Dike Location
- Top of Bluff
- Inferred Top of Bluff
- Bottom of Bluff
- Inferred Bottom of Bluff
- Secondary Bluff Area
- EL Former East Lagoon
- NL North Lagoon
- SL South Lagoon
- SAN Sanitary Lagoon
- WL1 West Lagoon I
- WL2 West Lagoon II
- Potentiometric Line (C.I. = 5 feet)
- Direction of Groundwater

128.00 Groundwater Elevation

(119.80) Elevation for illustrative purposes only

Based upon data collected on April 3, 2023

0 300 600 Feet

1:7,200

Map Projection: NAD 1983, South Carolina State Plane, FIPS 3900, Feet

Datum: North American 1983

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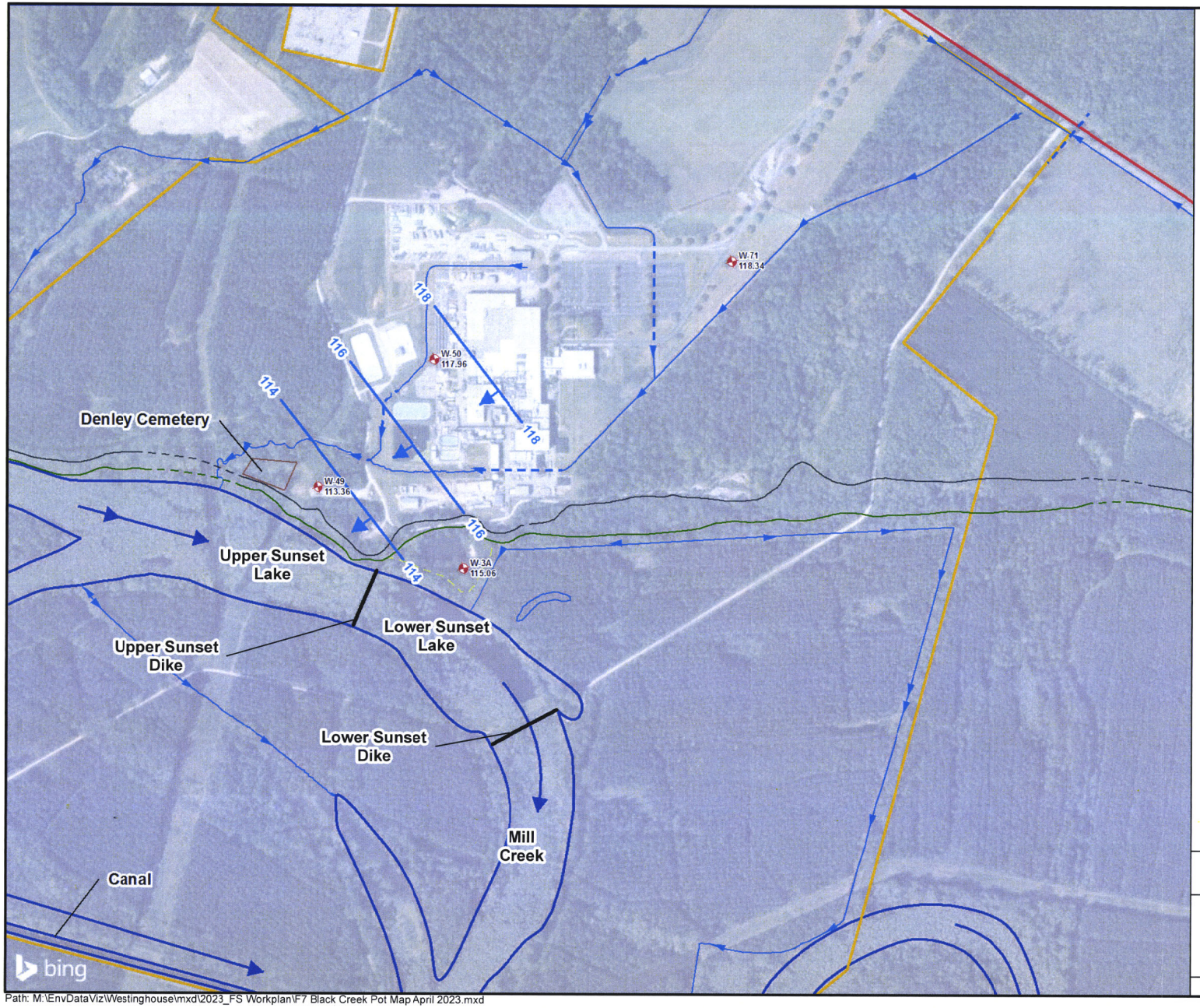
Surficial Aquifer - Lower Zone Potentiometric Map April 2023

WESTINGHOUSE COLUMBIA FUEL FABRICATION FACILITY
HOPKINS, SOUTH CAROLINA

PROJECT NO.	PREPARED BY:	DATE:	
60691645	CCS	June 2023	FIGURE 6

Path: M:\EnvDataViz\Westinghouse\mxd\2023_FS Workplan\F6 Lower Pot Map April 2023.mxd



Legend

- Black Creek Aquifer Monitoring Well
- Mill Creek
- Property Line
- SCRDI Bluff Road (Superfund Site)
- Culvert
- Ditch
- Mill Creek Flow Direction
- Dike Location
- Top of Bluff
- Inferred Top of Bluff
- Bottom of Bluff
- Inferred Bottom of Bluff
- Secondary Bluff Area
- EL Former East Lagoon
- NL North Lagoon
- SL South Lagoon
- SAN Sanitary Lagoon
- WL1 West Lagoon I
- WL2 West Lagoon II
- Potentiometric Line (C.I. = 2 feet)
- Direction of Groundwater
- 115.06 Groundwater Elevation

Based upon data collected on April 3, 2023

0 300 600 Feet

1:7,200

Map Projection: NAD 1983, South Carolina State Plane, FIPS 3900, Feet

Datum: North American 1983

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Black Creek Aquifer Potentiometric Map April 2023

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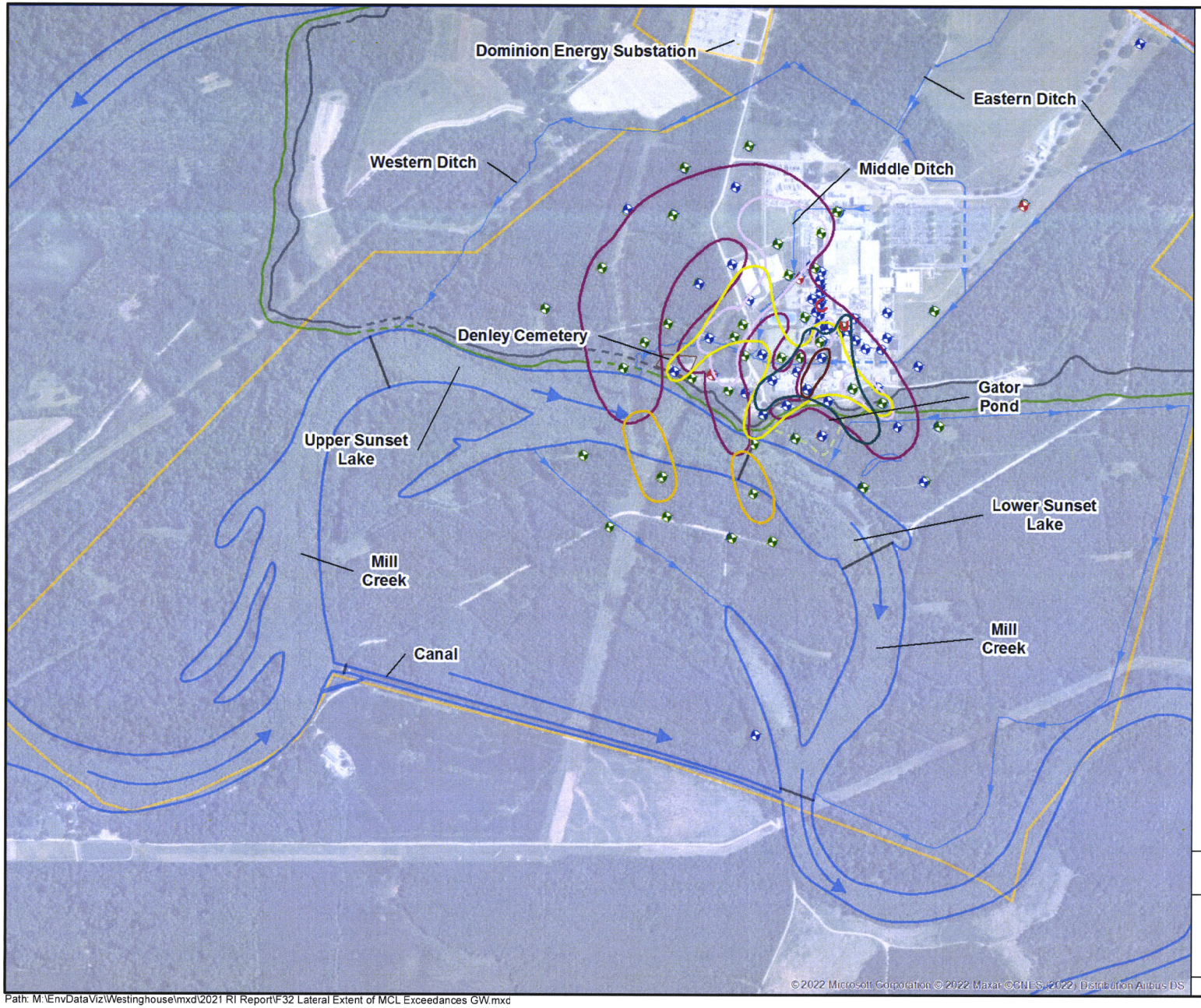
PROJECT NO.	PREPARED BY:	DATE:	
60691645	CCS	June 2023	FIGURE 7

Path: M:\EnvDataViz\Westinghouse\mxd\2023_FS Workplan\F7 Black Creek Pot Map April 2023.mxd



Legend

- Surficial Aquifer - Upper Zone Monitoring Well
- Surficial Aquifer - Lower Zone Monitoring Well
- Black Creek Aquifer Monitoring Well
- Ditch
- Culvert
- Mill Creek Flow Direction
- Dike Location
- Mill Creek
- Property Line
- SCRDI Bluff Road (Superfund Site)
- Top of Bluff
- Inferred Top of Bluff
- Bottom of Bluff
- Inferred Bottom of Bluff
- Secondary Bluff Area
- PCE MCL Isocontour Line (5 µg/L)
- TCE MCL Isocontour Line (5 µg/L)
- VC MCL Isocontour Line (2 µg/L)
- Nitrate MCL Isocontour Line (10 mg/L)
- Fluoride MCL Isocontour Line (4 mg/L)
- Technetium 99 MCL Isccontour Line (900 pCi/L)
- Uranium MCL Isocontour Line (30 µg/L)

0 400 800 Feet

1:9,600

Map Projection: NAD 1983, South Carolina State Plane, FIPS 3900, Feet

Datum: North American 1983

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Lateral Extent of MCL Exceedances in Groundwater

WESTINGHOUSE COLUMBIA FUEL FABRICATION FACILITY
HOPKINS, SOUTH CAROLINA

PROJECT NO.	PREPARED BY:	DATE:	
60691645	CCS	MAY 2023	FIGURE 8

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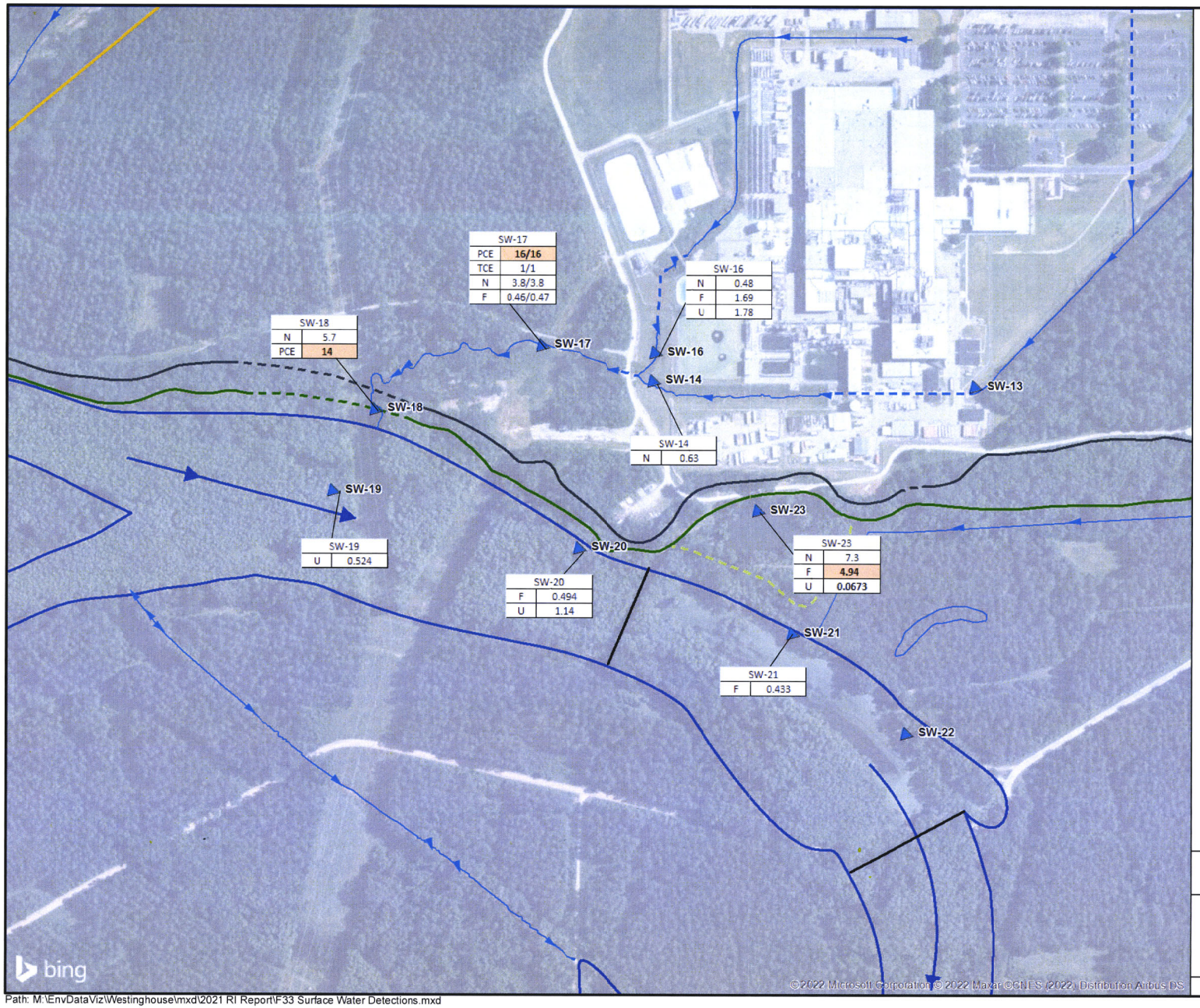

Legend

- Surface Water Sample Location
- Ditch
- Culvert
- Mill Creek Flow Direction
- Dike Location
- Mill Creek
- Property Line
- SCRDI Bluff Road (Superfund Site)
- Top of Bluff
- Inferred Top of Bluff
- Bottom of Bluff
- Inferred Bottom of Bluff
- Secondary Bluff Area
- PCE Tetrachloroethene
- TCE Trichloroethene
- N Nitrate
- F Fluoride
- U Total Uranium Istopes

Analyte	MCL	Units
PCE	5	ug/L
TCE	5	ug/L
N	10	mg/L
F	4	mg/L
U	30	ug/L

Notes:
Displayed concentrations are above the calculated background concentration.

Concentrations in shaded cells exceed their MCL.

Locations displaying two concentration values had a quality control duplicate sample taken.

0 170 340 Feet

1:4,130

Map Projection: NAD 1983, South Carolina State Plane, FIPS 3900, Feet

Datum: North American 1983

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Surface Water Detections

WESTINGHOUSE COLUMBIA FUEL FABRICATION FACILITY
HOPKINS, SOUTH CAROLINA

PROJECT NO	PREPARED BY	DATE	
60691645	CCS	MAY 2023	FIGURE 9

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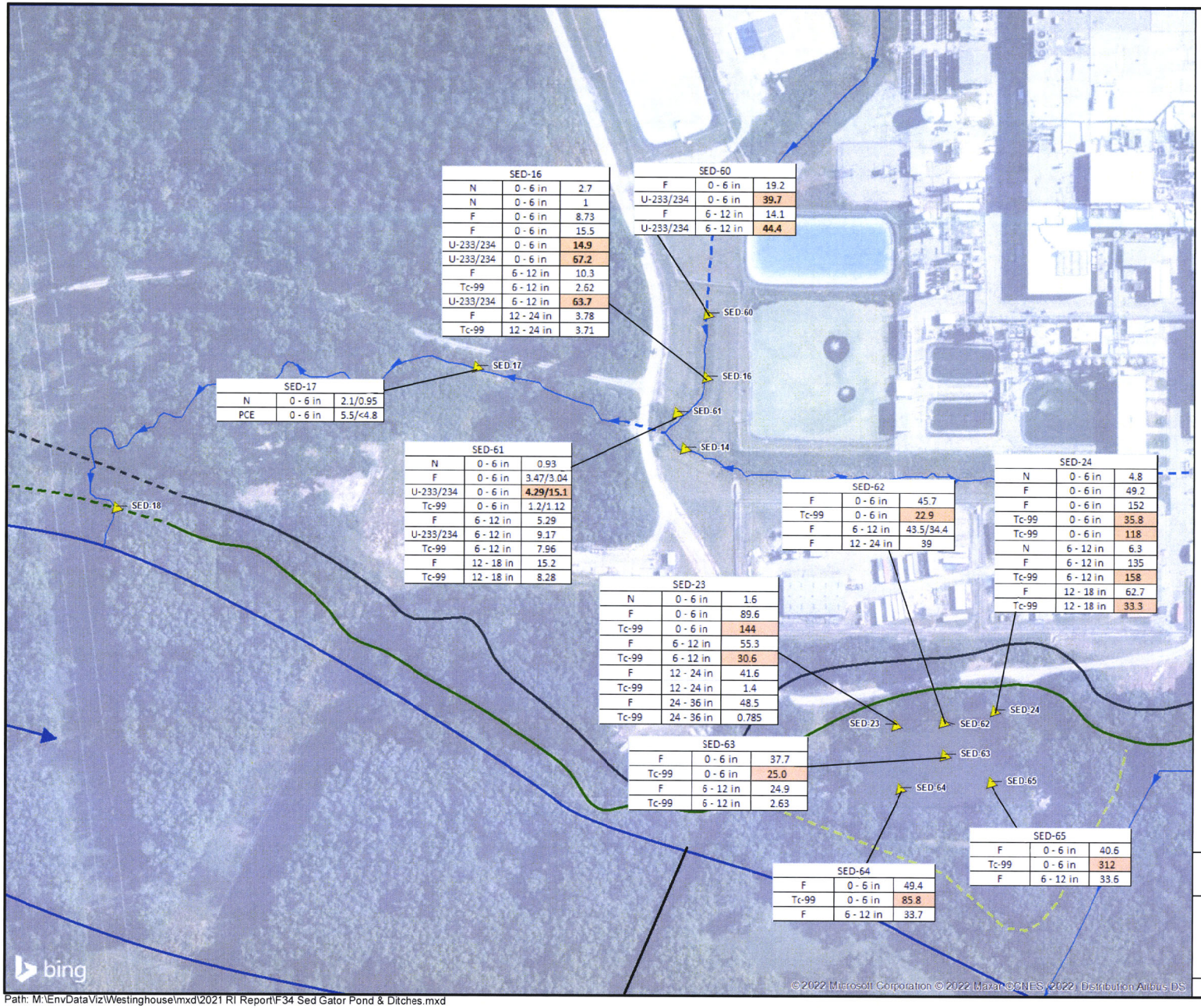

Legend

- Sediment Sample Location
- Ditch
- Culvert
- Mill Creek Flow Direction
- Dike Location
- Mill Creek
- Top of Bluff
- Inferred Top of Bluff
- Bottom of Bluff
- Inferred Bottom of Bluff
- Secondary Bluff Area
- N Nitrate
- F Fluoride
- Tc-99 Techenetium-99
- U-233/234 Uranium Isotopes 233/234
- RUSL Residential Use Screening Level

Analyte	Unit	RUSL
Nitrate as N	mg/kg	
Fluoride	mg/kg	
Technetium-99	pCi/g	19
Uranium-233/234	pCi/g	13
Uranium-235/236	pCi/g	8
Uranium-238	pCi/g	14

Notes:

Displayed nitrate and fluoride concentrations are above the calculated background concentration.

Concentrations in shaded cells exceed their RUSL.

Locations displaying two concentration values had a quality control duplicate sample taken.

0 80 160 Feet

1:1,920

Map Projection: NAD 1983, South Carolina State Plane, FIPS 3900, Feet

Datum: North American 1983

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Gator Pond and Ditch COPC Sediment Detections

WESTINGHOUSE COLUMBIA FUEL FABRICATION FACILITY
HOPKINS, SOUTH CAROLINA

PROJECT NO	PREPARED BY:	DATE:	
60691645	CCS	MAY 2023	FIGURE 10

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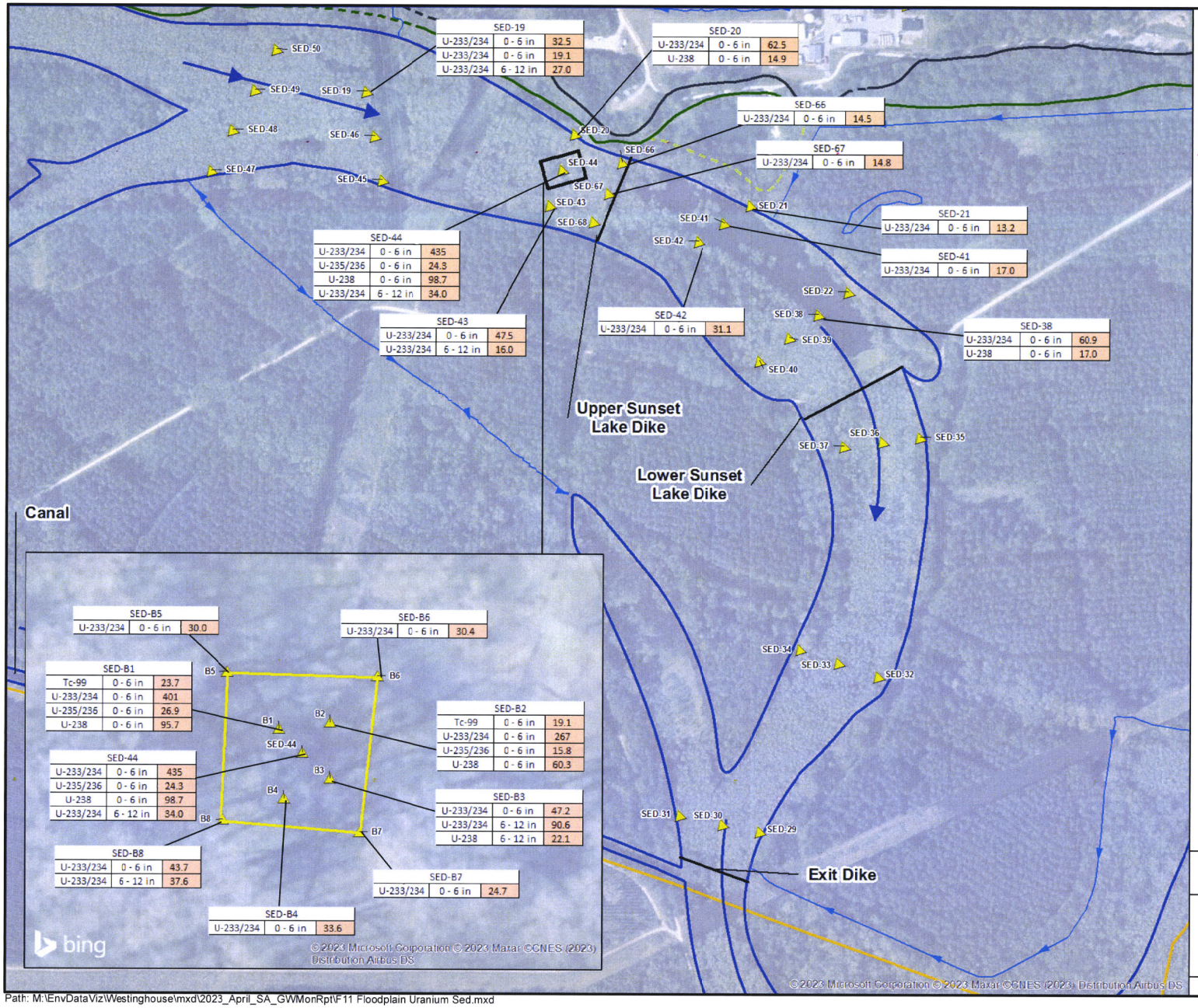

Legend

- Sediment Sample Location
- Ditch
- Culvert
- Mill Creek Flow Direction
- Dike Location
- Mill Creek
- Property Line
- 10 Square Meters Bounding Box
- Top of Bluff
- Inferred Top of Bluff
- Bottom of Bluff
- Inferred Bottom of Bluff
- Secondary Bluff Area

U-233/234 Uranium Isotopes 233/234
U-235/236 Uranium Isotopes 235/236
U-238 Uranium Isotopes 238
RUSL Residential Use Screening Level

Analyte	Unit	RUSL
Uranium-233/234	pCi/g	13
Uranium-235/236	pCi/g	8
Uranium-238	pCi/g	14

Notes:
Wells displaying two concentration values had a quality control duplicate sample taken.

Locations displaying two concentration values had a quality control duplicate sample taken.

0 200 400 Feet
1:4,800

Map Projection: NAD 1983, South Carolina State Plane, FIPS 3900, Feet

Datum: North American 1983

AECOM
101 Research Drive
Columbia, SC 29203
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Floodplain Uranium Sediment Detections Above RUSL

WESTINGHOUSE COLUMBIA FUEL FABRICATION FACILITY
HOPKINS, SOUTH CAROLINA

PROJECT NO.	PREPARED BY:	DATE:	
60691645	CCS	June 2023	FIGURE 11

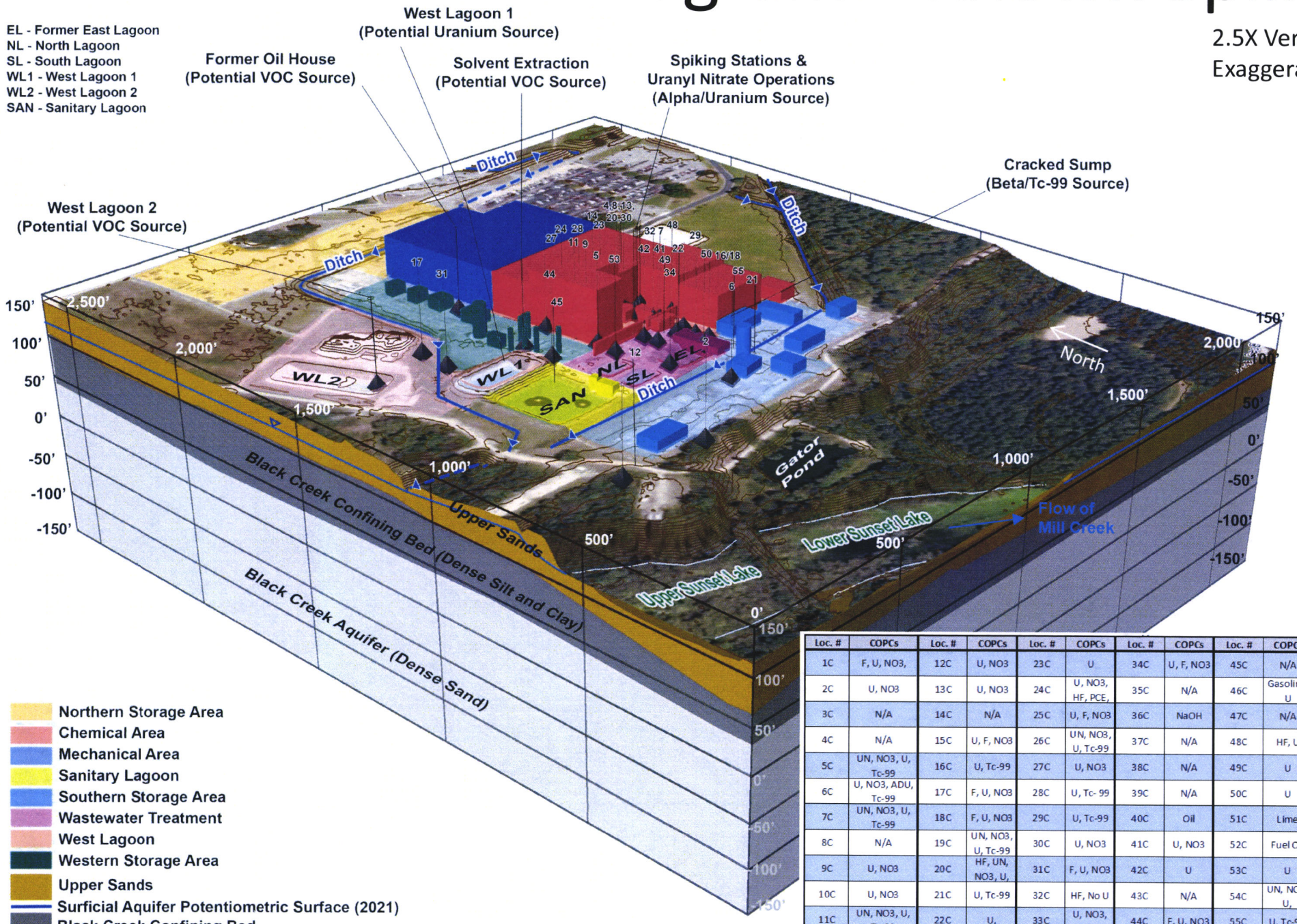
Path: M:\EnvDataViz\Westinghouse\mxd\2023_April_SA_GWMonRpt\F11 Floodplain Uranium Sed.mxd

Appendix A
Conceptual Site Model

Conceptual Site Model
Rev. 4

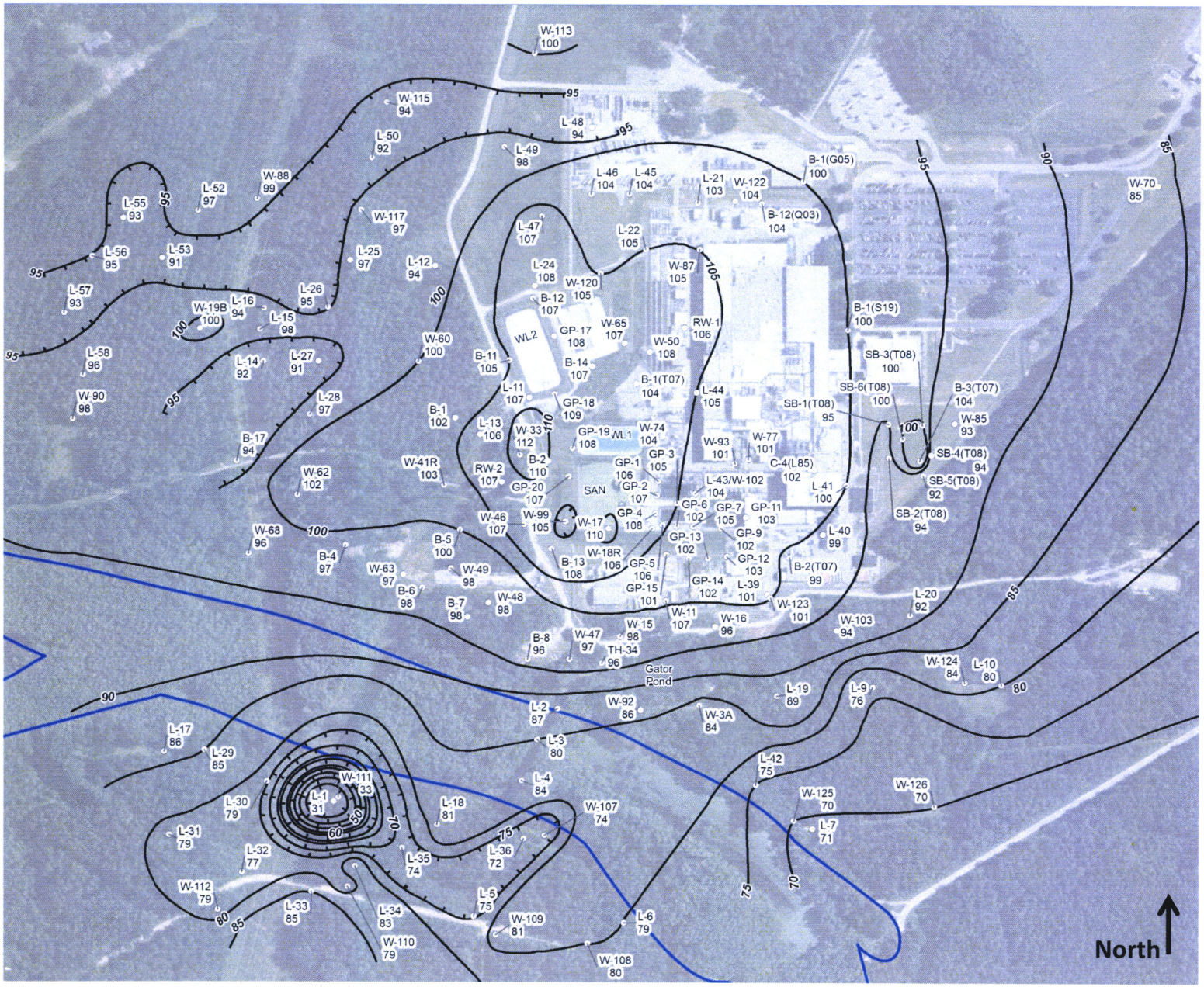
Westinghouse Columbia

Site CSM Block Diagram – Known Spills



Loc. #	COPCs	Loc. #	COPCs	Loc. #	COPCs	Loc. #	COPCs	Loc. #	COPCs	Loc. #	COPCs
1C	F, U, NO3,	12C	U, NO3	23C	U	34C	U, F, NO3	45C	N/A	56C	U, F, NO
2C	U, NO3	13C	U, NO3	24C	U, NO3, HF, PCE,	35C	N/A	46C	Gasoline, U	57C	U
3C	N/A	14C	N/A	25C	U, F, NO3	36C	NaOH	47C	N/A	58C	U & Tc-9
4C	N/A	15C	U, F, NO3	26C	UN, NO3, U, Tc-99	37C	N/A	48C	HF, U	59C	U, Tc-9
5C	UN, NO3, U, Tc-99	16C	U, Tc-99	27C	U, NO3	38C	N/A	49C	U	60C	U, Tc-9
6C	U, NO3, ADU, Tc-99	17C	F, U, NO3	28C	U, Tc- 99	39C	N/A	50C	U	61C	U, Tc-9
7C	UN, NO3, U, Tc-99	18C	F, U, NO3	29C	U, Tc-99	40C	Oil	51C	Lime	62C	U
8C	N/A	19C	UN, NO3, U, Tc-99	30C	U, NO3	41C	U, NO3	52C	Fuel Oil	63C	U
9C	U, NO3	20C	HF, UN, NO3, U,	31C	F, U, NO3	42C	U	53C	U	64C	U, Tc-9
10C	U, NO3	21C	U, Tc-99	32C	HF, No U	43C	N/A	54C	UN, NO3, U,	65C	U, Tc-9
11C	UN, NO3, U, Tc-99	22C	U,	33C	U, NO3, Tc-99	44C	F, U, NO3	55C	U, Tc-99	66C	U, Tc-9

Top of Black Creek Contour Map



Legend

EL	Former East Lagoon
NL	North Lagoon
SL	South Lagoon
SAN	Sanitary Lagoon
WL1	West Lagoon I
WL2	West Lagoon II

Mill Creek

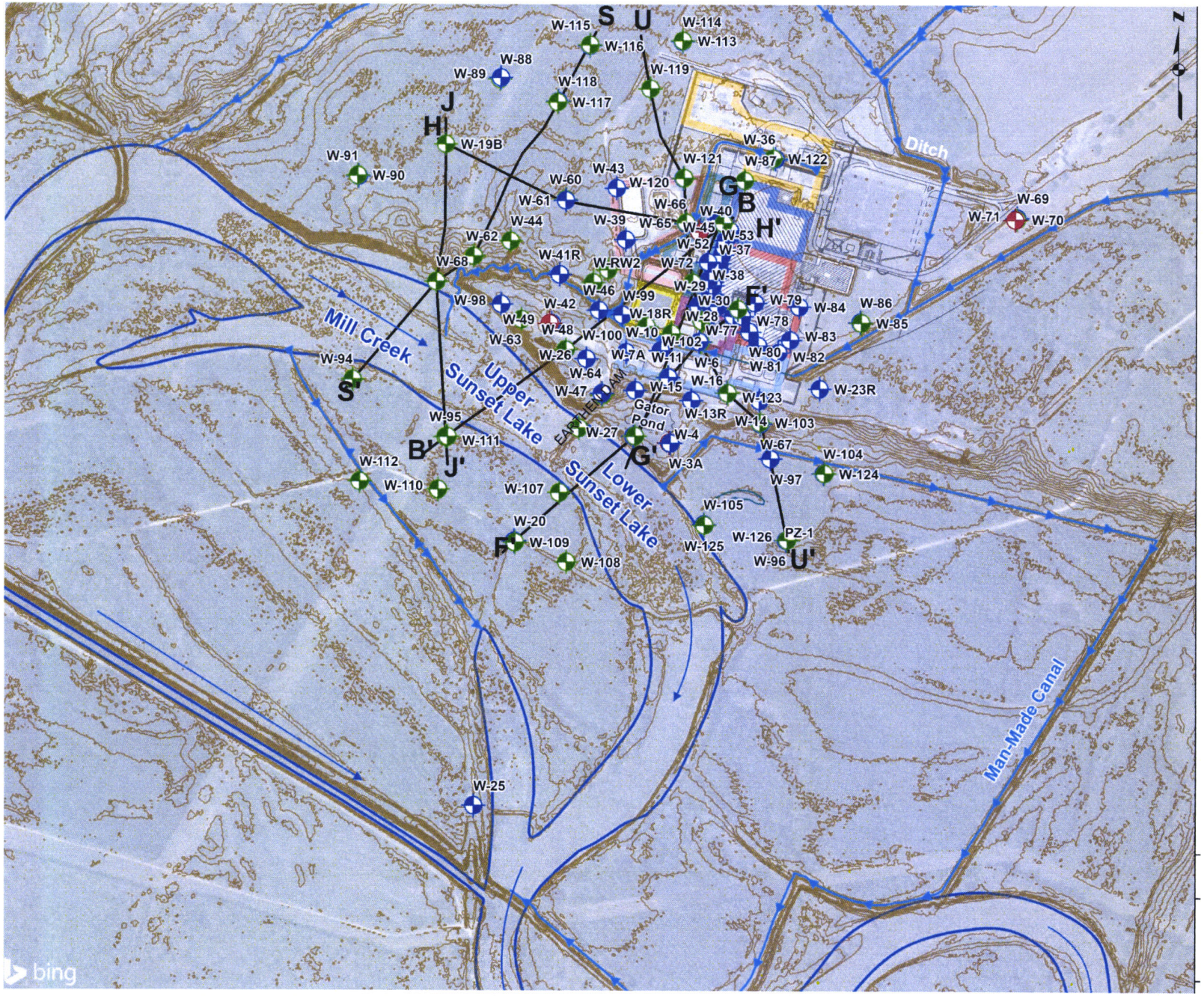
Black Creek Clay Elevation (ft-msl)

Elev. Contour of Top of Black Creek Clay (ft-msl)

Depression 5 ft Contour Interval

Normal 5 ft Contour Interval

Site Map with Man-Made Canal

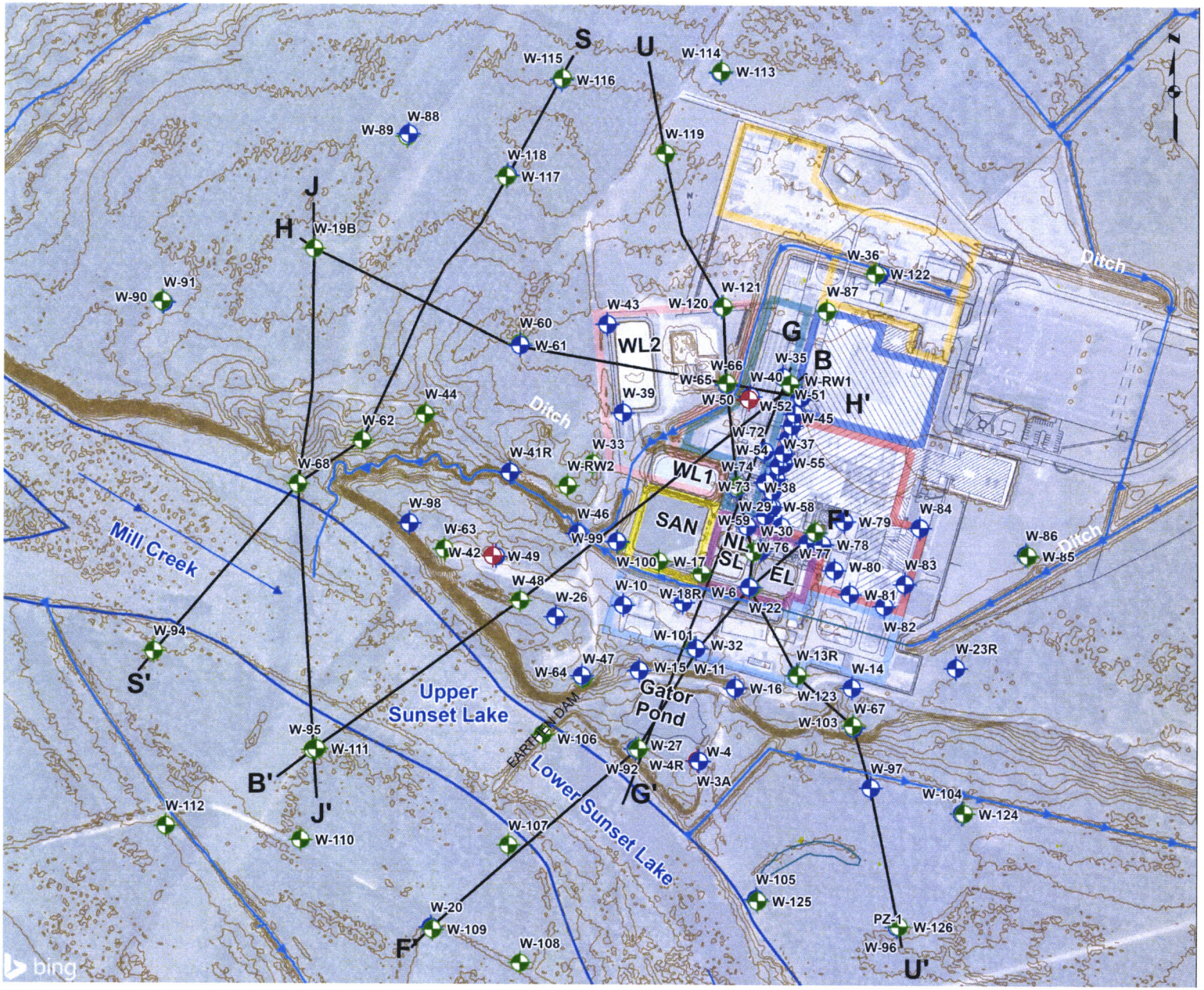


EL - Former East Lagoon
NL - North Lagoon
SL - South Lagoon
WL1 - West Lagoon I
WL2 - West Lagoon II
SAN - Sanitary Lagoon

- Northern Storage Area
- Chemical Area
- Mechanical Area
- Sanitary Lagoon
- Southern Storage Area
- Wastewater Treatment
- West Lagoon
- Western Storage Area

Conceptual Site Model Rev. 4 ,
pg. 4

Site CSM Block Diagram – Transect Reference

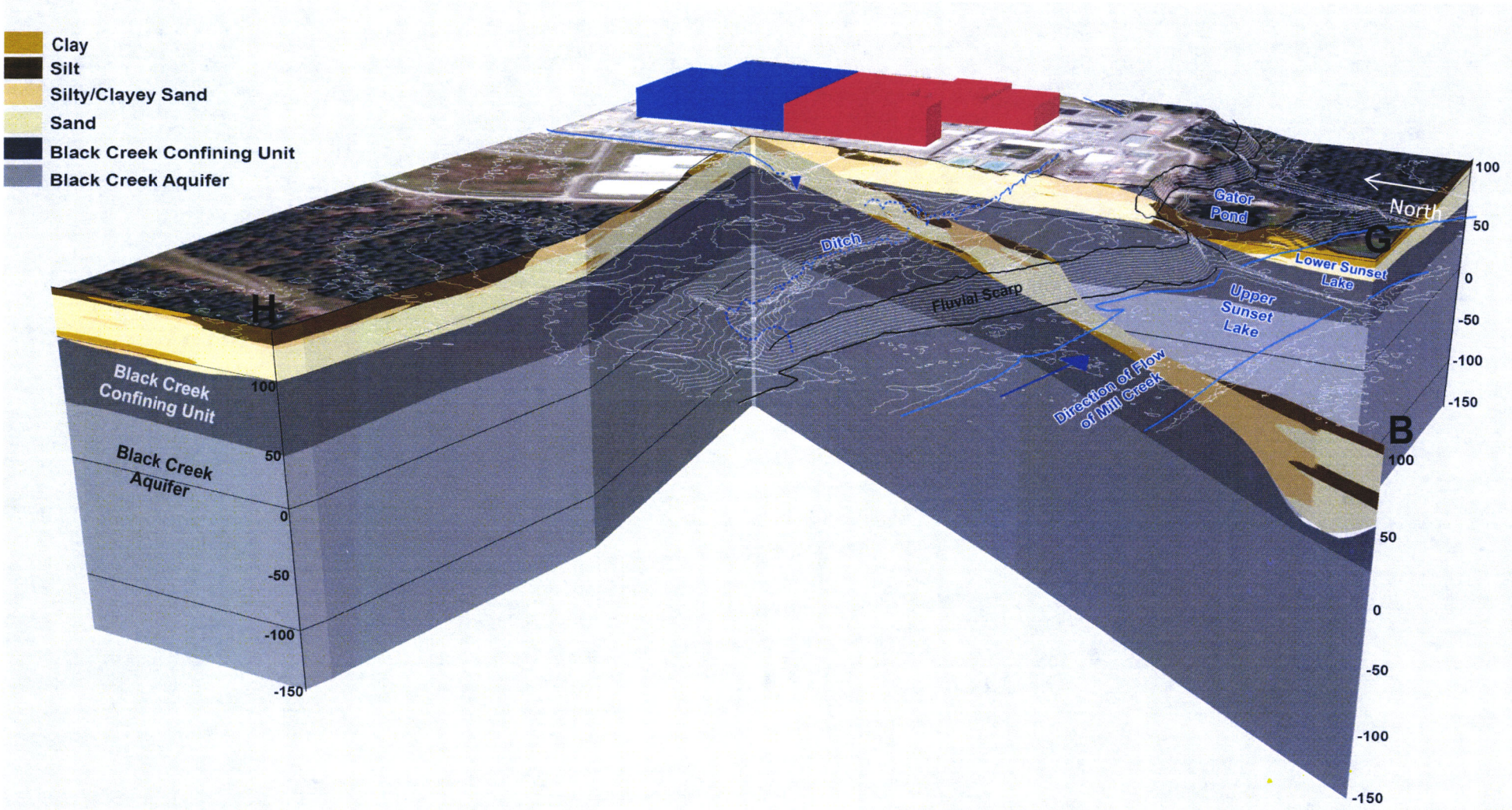


EL - Former East Lagoon
NL - North Lagoon
SL - South Lagoon
WL1 - West Lagoon I
WL2 - West Lagoon II
SAN - Sanitary Lagoon

- Northern Storage Area
- Chemical Area
- Mechanical Area
- Sanitary Lagoon
- Southern Storage Area
- Wastewater Treatment
- West Lagoon
- Western Storage Area

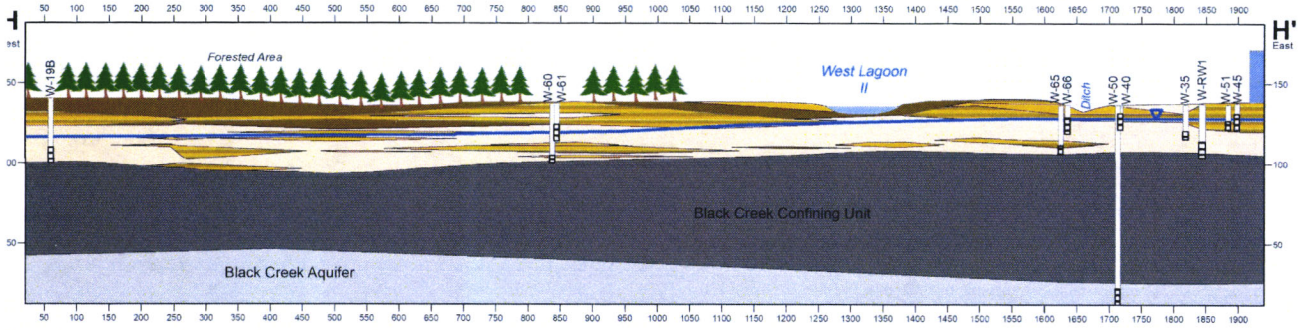
Conceptual Site Model Rev. 4 ,
pg. 5

Site CSM Block Diagram – Geology

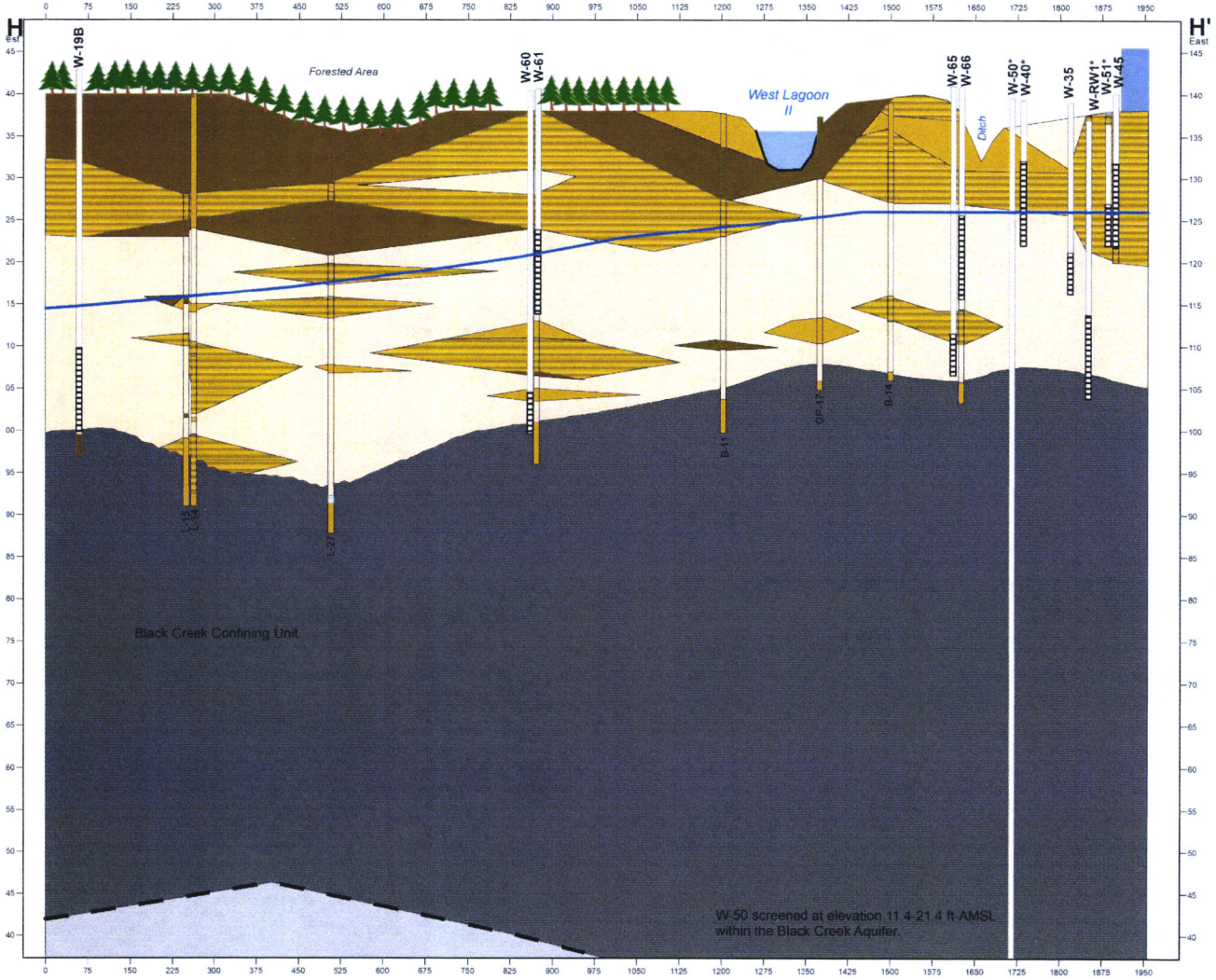


2.5X Vertical Exaggeration

Site CSM Cross Sections



2.5X Vertical Exaggeration



15X Vertical Exaggeration

Wells up to 75' away from the transect are projected onto the cross sections. Wells that are >20 ft and less than 75 ft are indicated with an asterisk (*). Borings are projected from up to 100' from the transect for stratigraphic interpretation and evaluation.

Legend

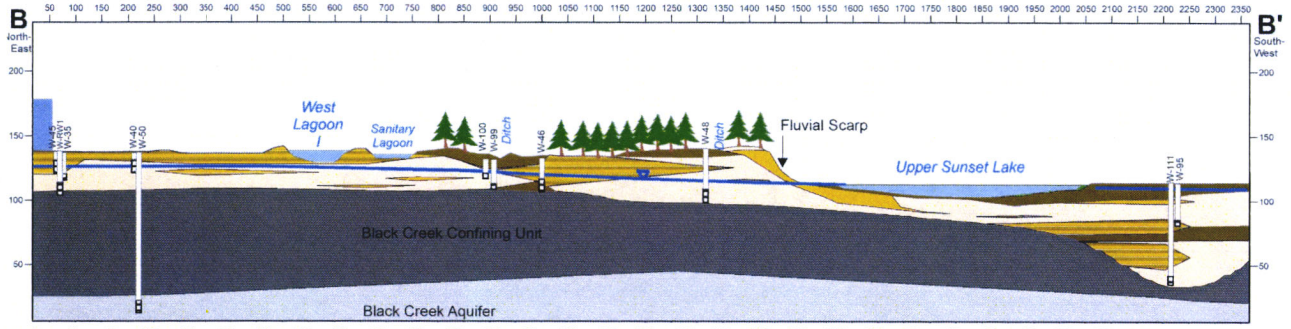
- Well Riser
- Well Screen
- Shallow Aquifer Potentiometric Surface
- Mechanical Area OU
- Surface Water

Lithology

Surficial Soil Aquifer
- Silty/Clayey Sand
- Clay
- Silt
- Sand

- Black Creek Confining Unit
- Black Creek Aquifer
- Inferred Geologic Contact

Site CSM Cross Sections



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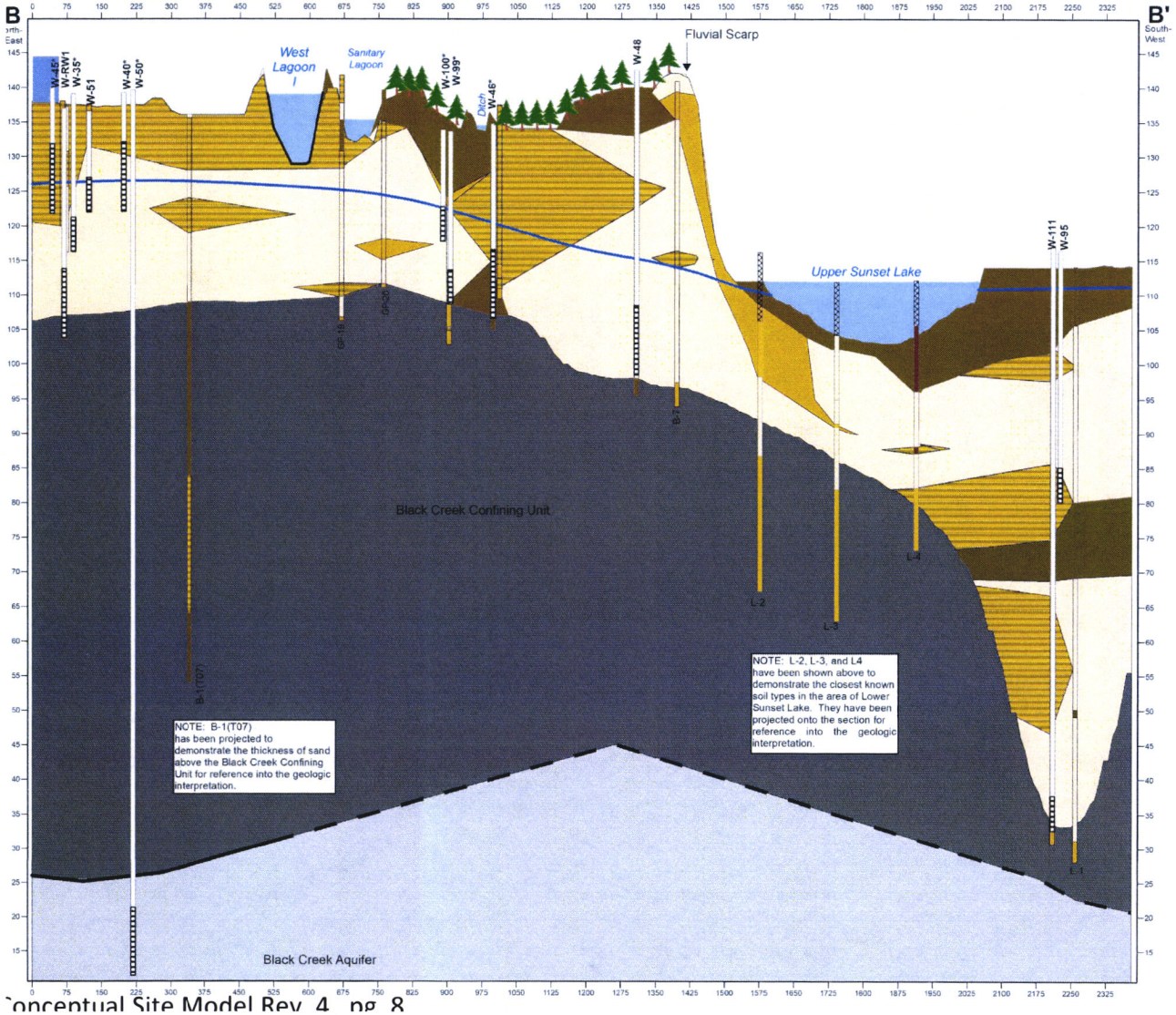

15X Vertical Exaggeration

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Borings are projected from up to 100' from the transect for stratigraphic interpretation and evaluation.

Legend

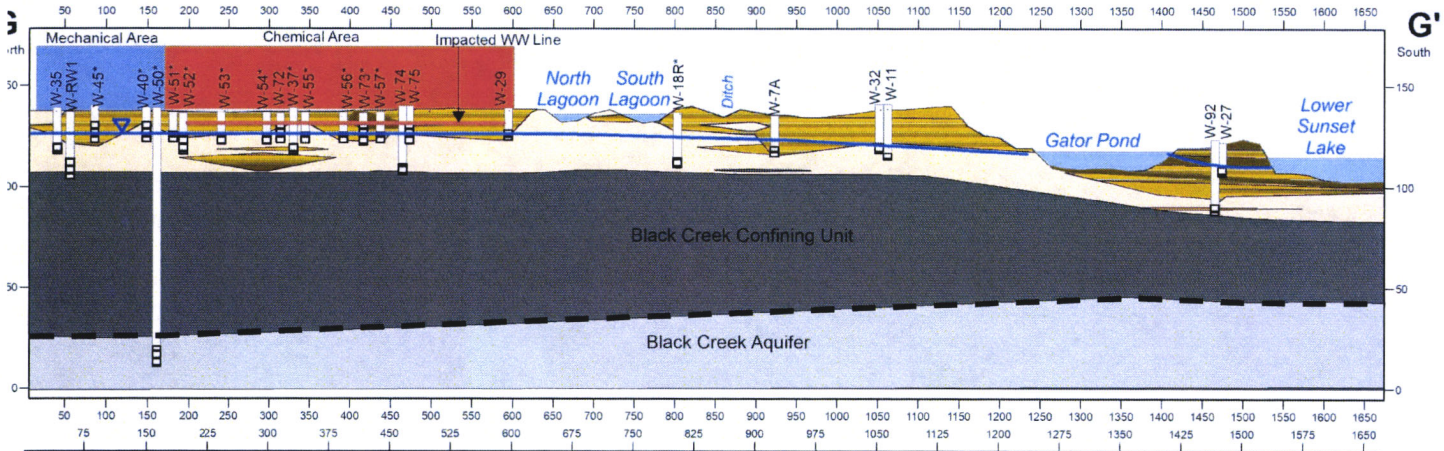
- Well Riser
- Well Screen
- Shallow Aquifer Potentiometric Surface
- Mechanical Area OU
- Surface Water

Lithology

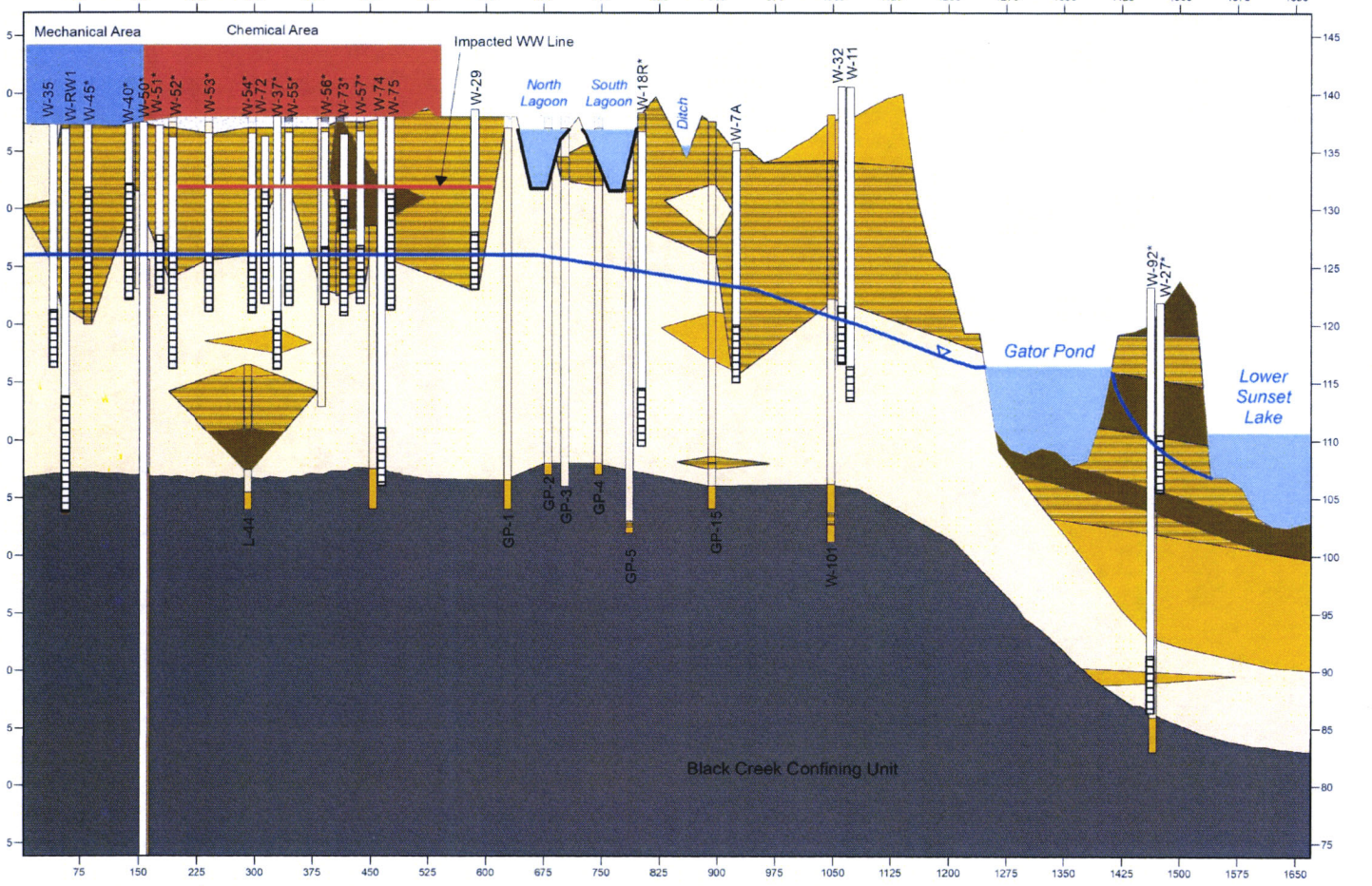
Surficial Soil Aquifer
- Silty/Clayey Sand
- Clay
- Silt
- Sand

- Black Creek Confining Unit
- Black Creek Aquifer
- Inferred Geologic Contact

Site CSM Cross Sections



2.5X Vertical Exaggeration



15X Vertical Exaggeration

Wells up to 100' away from the transect are projected onto the cross sections. Wells that are >20 ft and less than 100 ft are indicated with an asterisk (*).
Borings are projected from up to 100' from the transect for stratigraphic interpretation and evaluation.

Legend

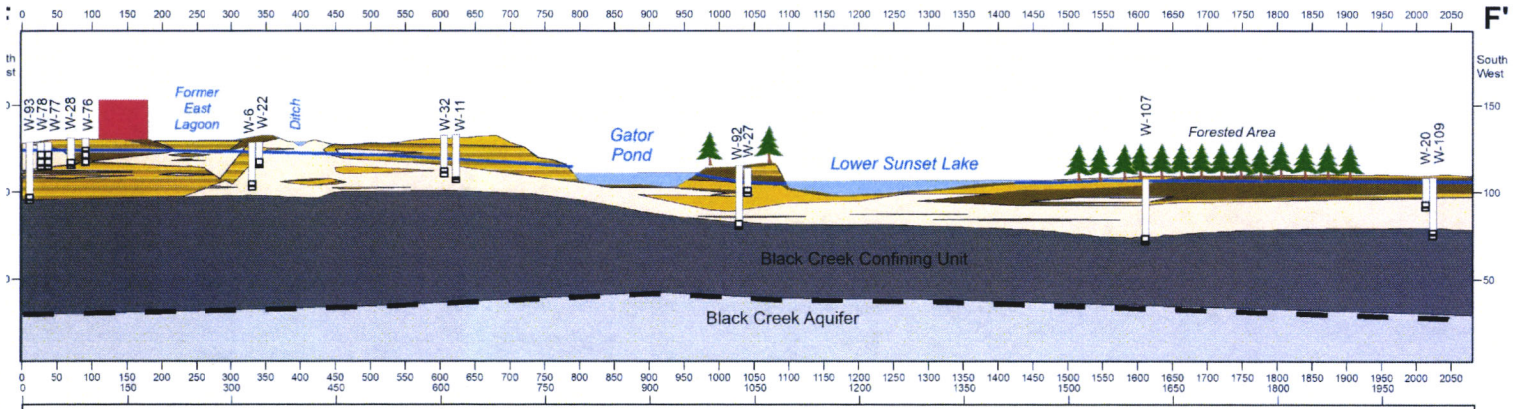
- Well Riser
- Well Screen
- Shallow Aquifer Potentiometric Surfac
- Mechanical Area OU
- Chemical Area OU
- Surface Water

Lithology

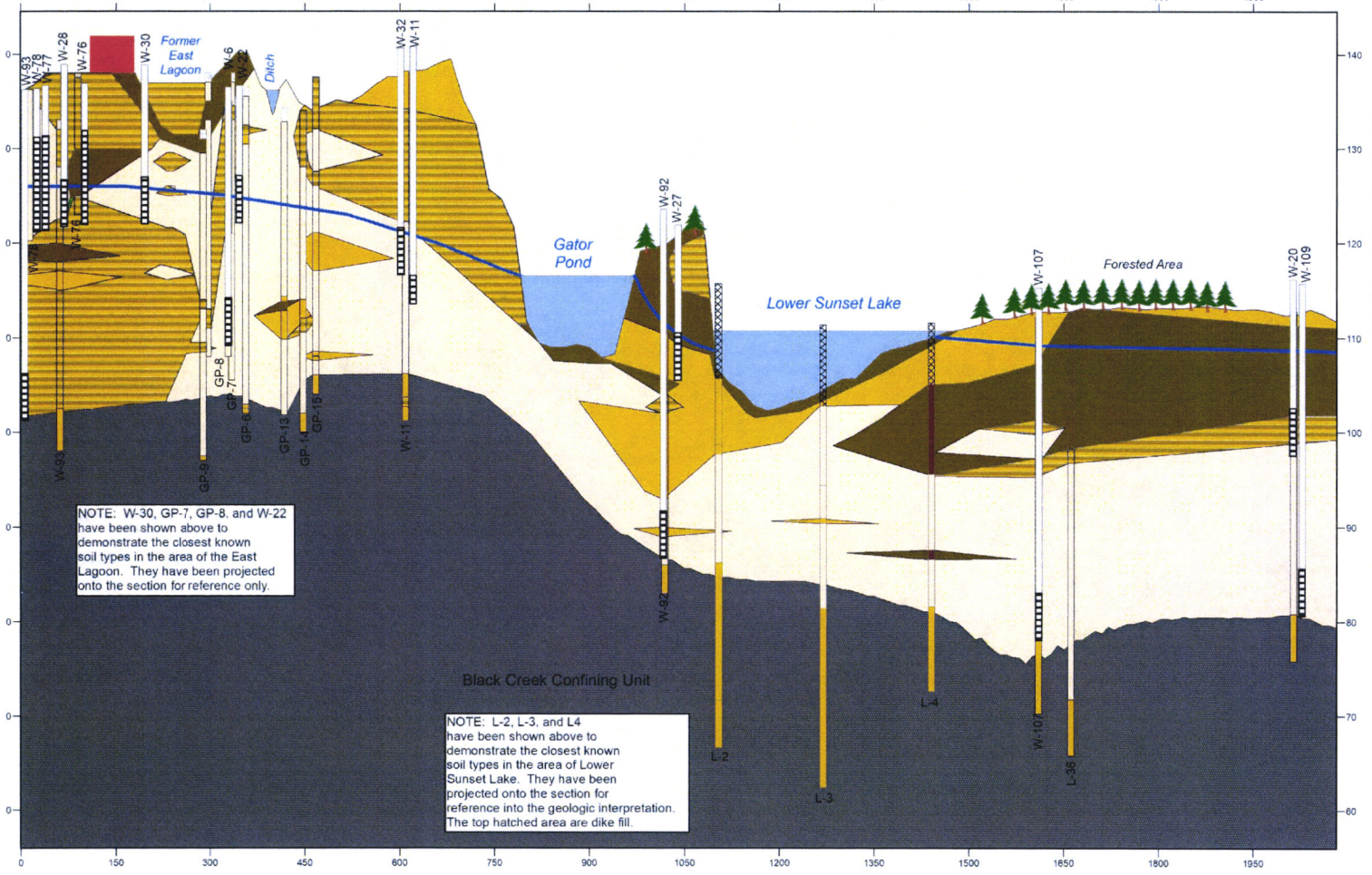
Surficial Soil Aquifer:
- Silty/Clayey Sand
- Clay
- Silt
- Sand

- Black Creek Confining Unit
- Black Creek Aquifer
- Inferred Geologic Contact

Site CSM Cross Sections



2.5X Vertical Exaggeration



15X Vertical Exaggeration

Wells up to 75' away from the transect are projected onto the cross sections. Wells that are >20 ft and less than 75 ft are indicated with an asterisk (*).
Borings are projected from up to 100' from the transect for stratigraphic interpretation and evaluation.

Legend

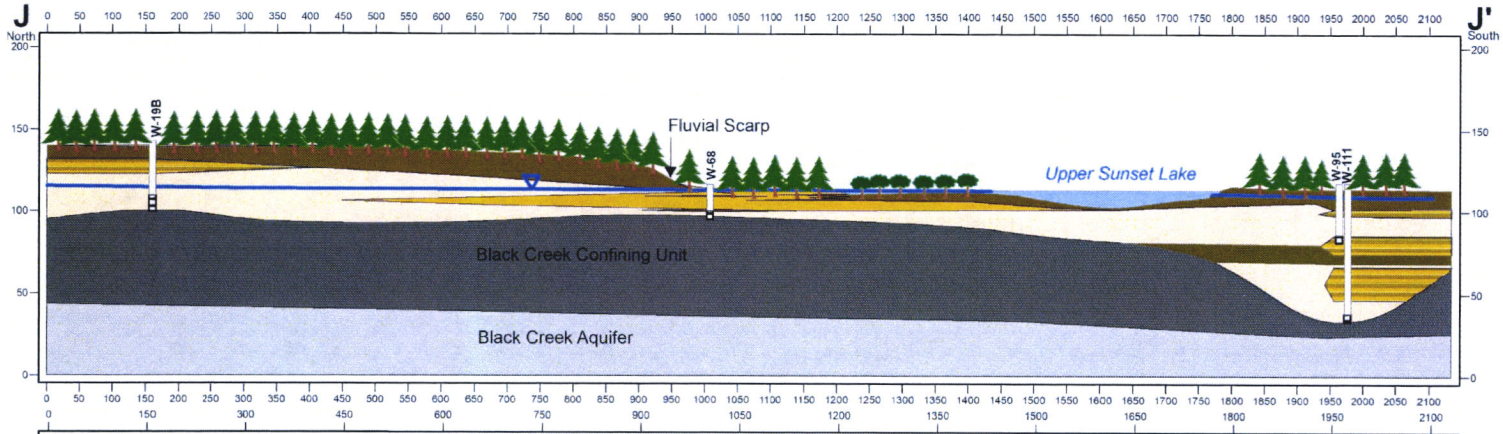
- Well Riser
- Well Screen
- Shallow Aquifer Potentiometric Surfac
- Mechanical Area OU
- Chemical Area OU
- Surface Water

Lithology

Surficial Soil Aquifer:
- Silty/Clayey Sand
- Clay
- Silt
- Sand

- Black Creek Confining Unit
- Black Creek Aquifer
- Inferred Geologic Contact

Site CSM Cross Sections



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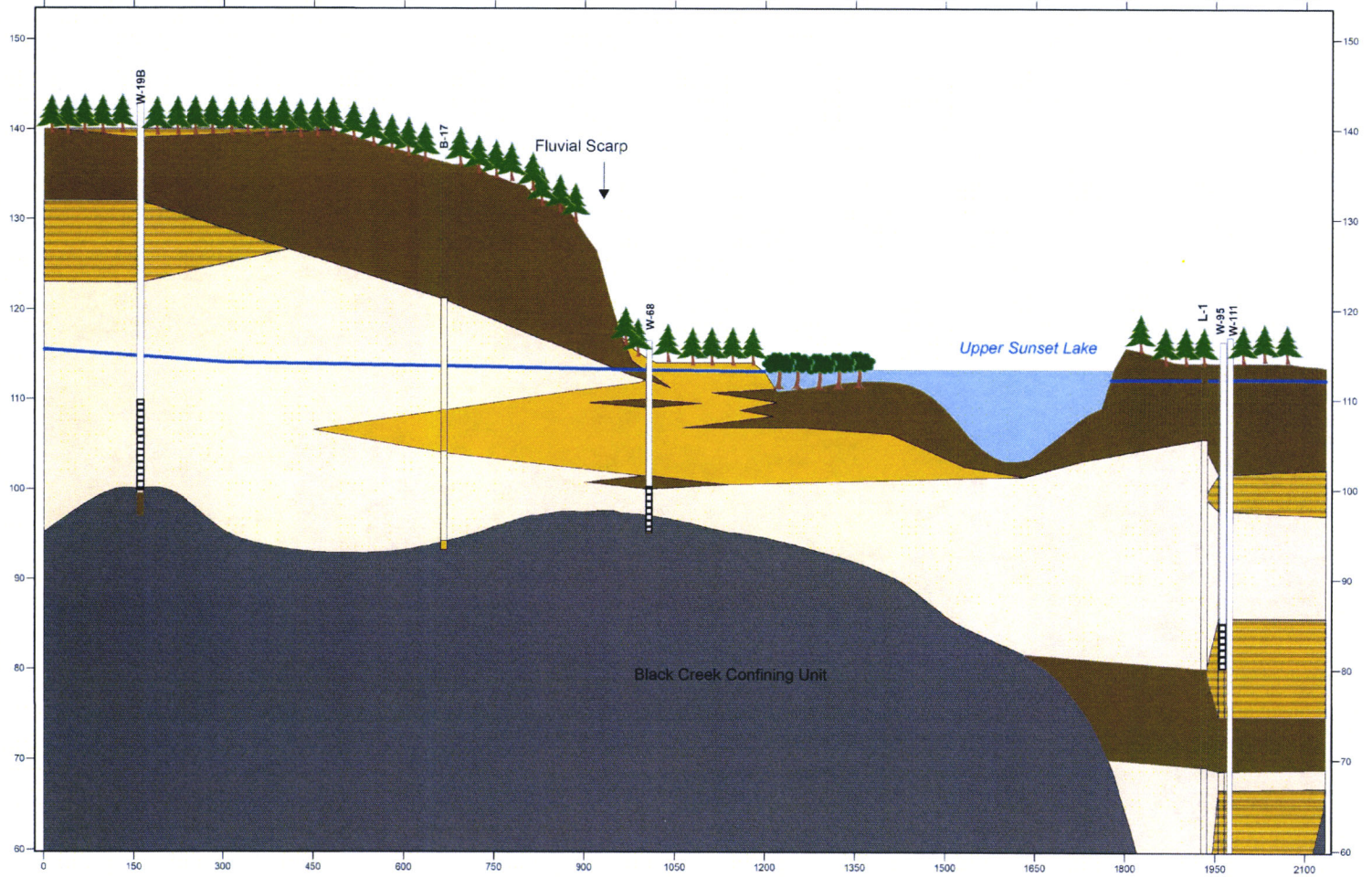


15X Vertical Exaggeration

Wells up to 75' away from the transect are projected onto the cross sections. Wells that are >20 ft and less than 75 ft are indicated with an asterisk (*).
Borings are projected from up to 100' from the transect for stratigraphic interpretation and evaluation.

Legend

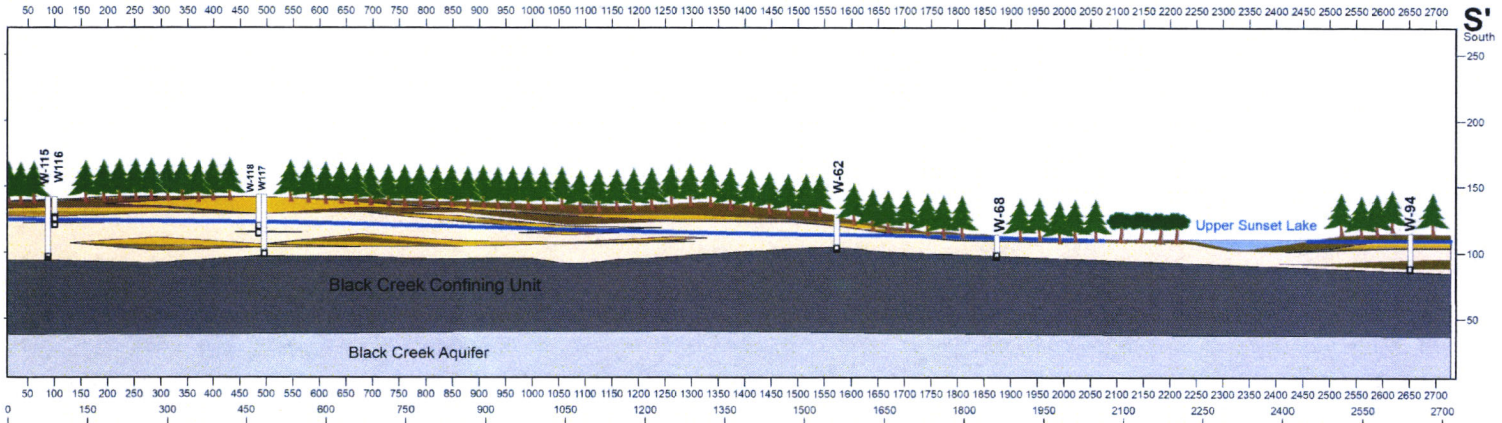
- Well Riser
- Well Screen
- Potentiometric Surface
- Surface Water

Lithology

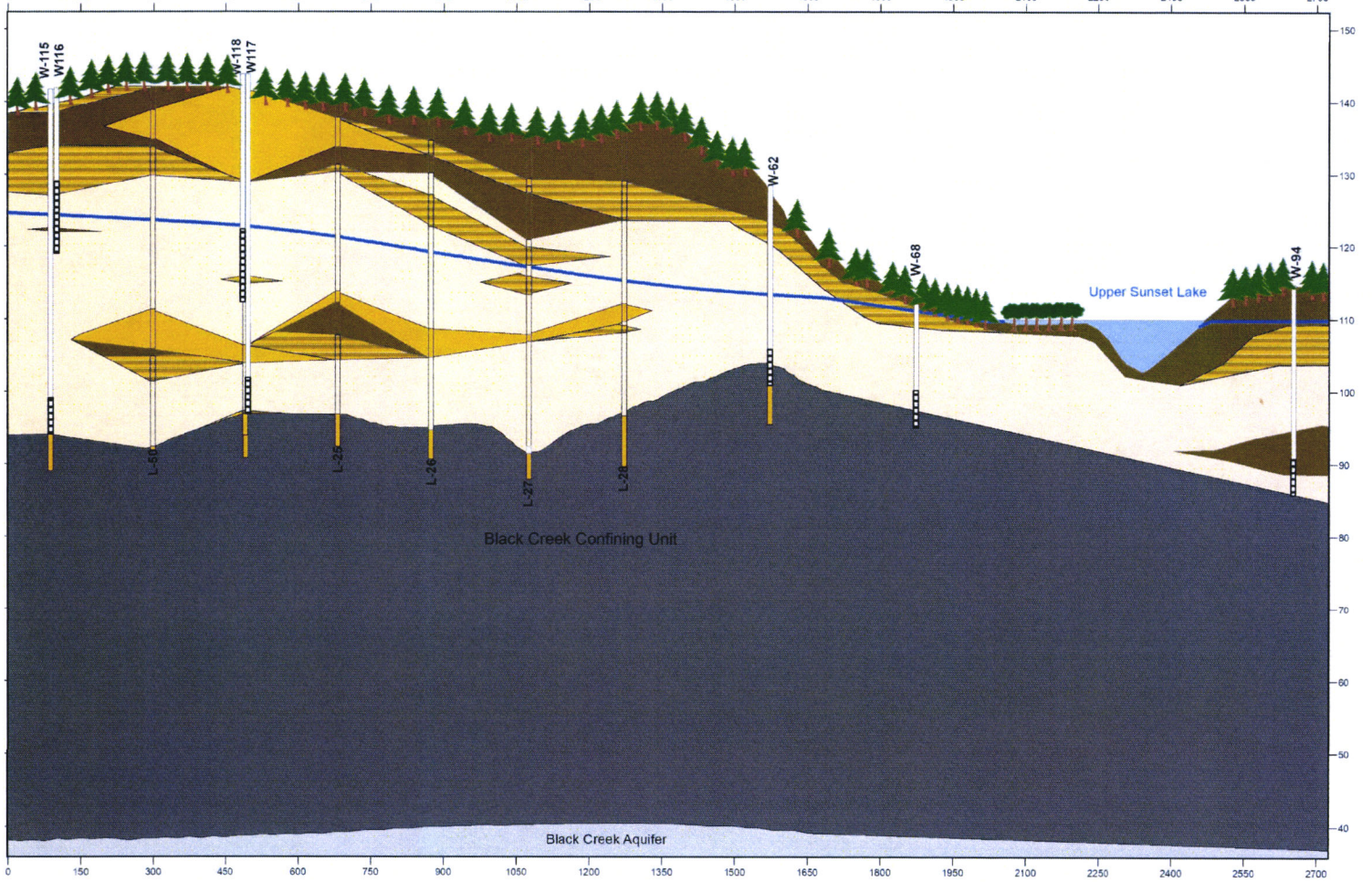
Surficial Soil Aquifer:
- Silty/Clayey Sand
- Clay
- Silt
- Sand

- Black Creek Confining Unit
- Black Creek Aquifer
- Inferred Geologic Contact

Site CSM Cross Sections



2.5X Vertical Exaggeration



15X Vertical Exaggeration

Wells up to 75' away from the transect are projected onto the cross sections. Wells that are >20 ft and less than 75 ft are indicated with an asterisk (*). Borings are projected from up to 100' from the transect for stratigraphic interpretation and evaluation.

Legend

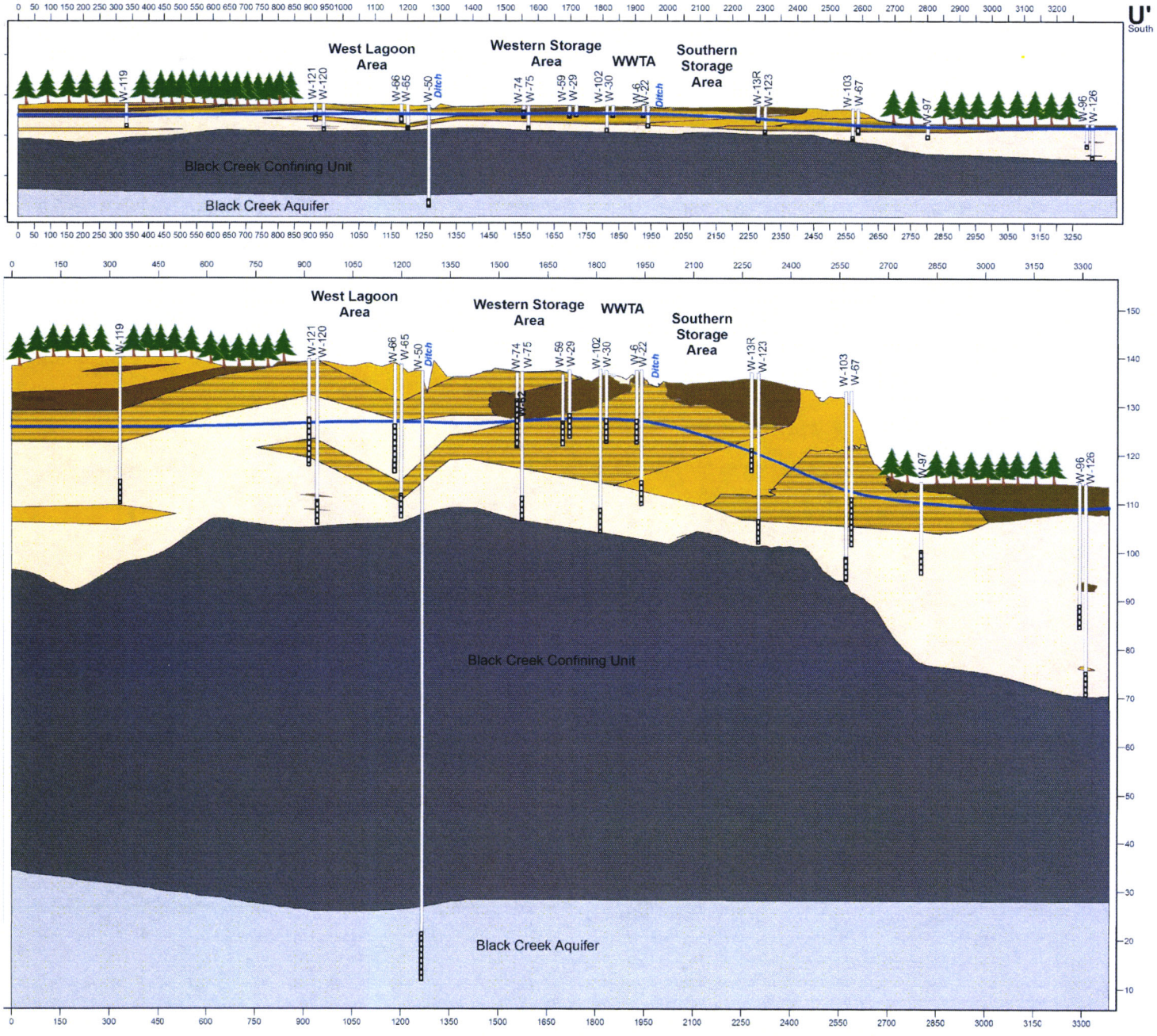
- Well Riser
- Well Screen
- Potentiometric Surfac
- Surface Water

Lithology

Surficial Soil Aquifer
- Silty/Clayey Sand
- Clay
- Silt
- Sand

- Black Creek Confining U
- Black Creek Aquifer

Site CSM Cross Sections



2.5X Vertical Exaggeration

15X Vertical Exaggeration

Wells up to 75' away from the transect are projected onto the cross sections. Wells that are >20 ft and less than 75 ft are indicated with an asterisk (*). Borings are projected from up to 100' from the transect for stratigraphic interpretation and evaluation.

WWTA – Wastewater Treatment Area

Legend

- Well Riser
- Well Screen
- Potentiometric Surface
- Surface Water

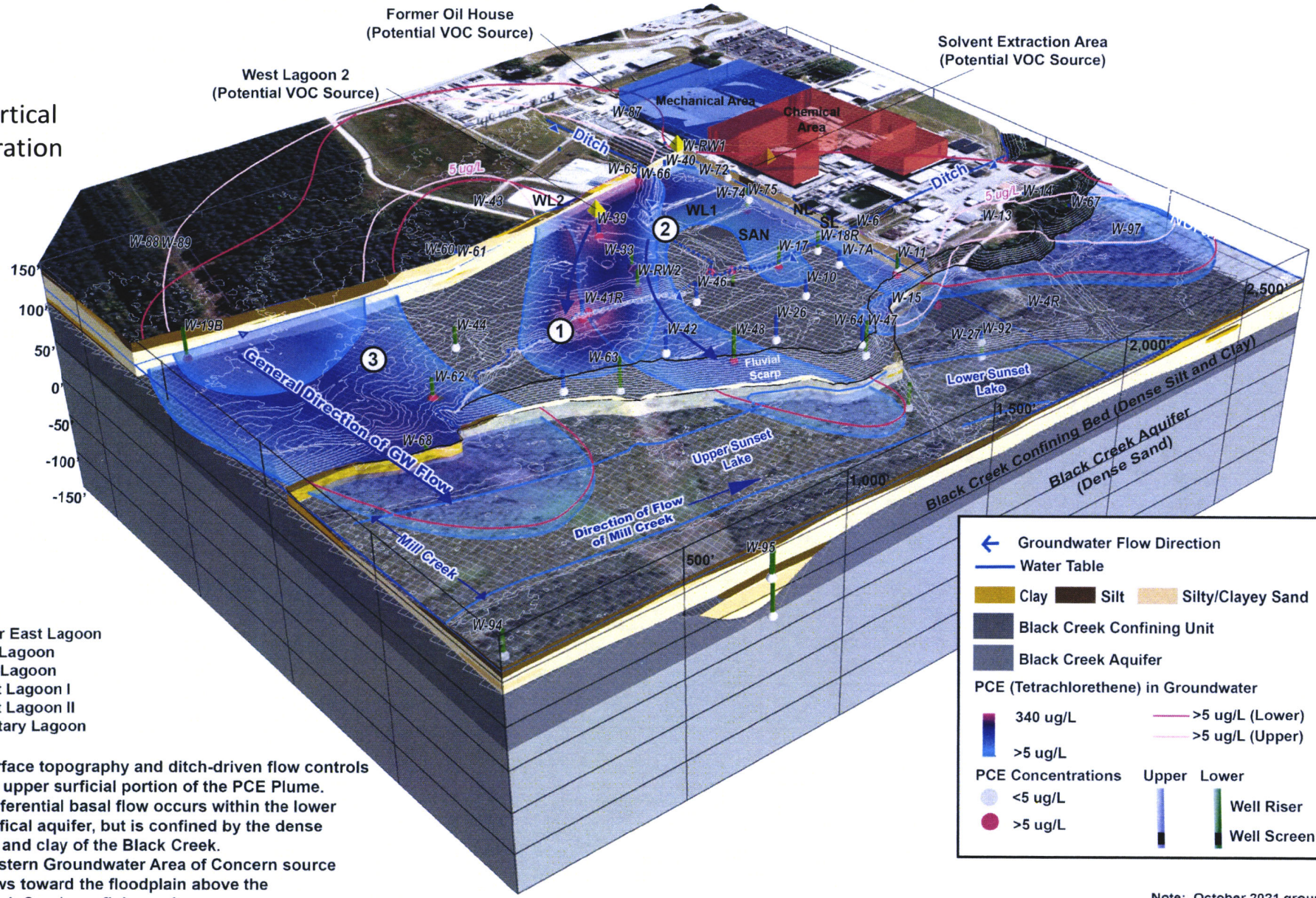
Lithology

Surficial Soil Aquifer
- Silty/Clayey Sand
- Clay
- Silt
- Sand

- Black Creek Confining Un
- Black Creek Aquifer
- Inferred Geologic Contact

Site CSM Block – PCE (2021)

2.5X Vertical Exaggeration



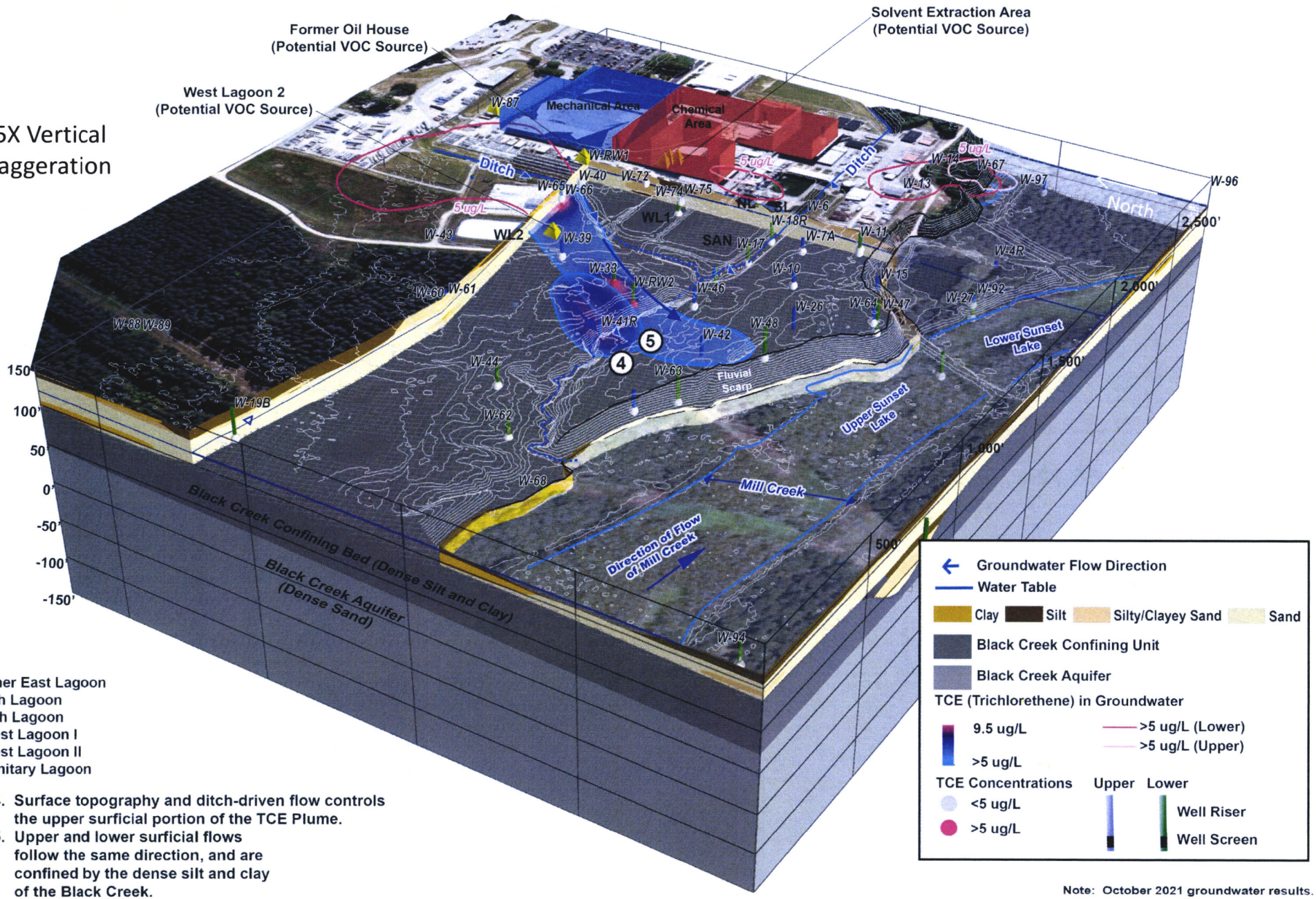
EL - Former East Lagoon
NL - North Lagoon
SL - South Lagoon
WL1 - West Lagoon I
WL2 - West Lagoon II
SAN - Sanitary Lagoon

1. Surface topography and ditch-driven flow controls the upper surficial portion of the PCE Plume.
2. Preferential basal flow occurs within the lower surfical aquifer, but is confined by the dense silt and clay of the Black Creek.
3. Western Groundwater Area of Concern source flows toward the floodplain above the Black Creek confining unit.

Groundwater Flow Direction
Water Table
Clay Silt Silty/Clayey Sand Sand
Black Creek Confining Unit
Black Creek Aquifer
PCE (Tetrachlorethene) in Groundwater
340 ug/L
>5 ug/L
>5 ug/L (Lower)
>5 ug/L (Upper)
PCE Concentrations Upper Lower
<5 ug/L
>5 ug/L
Well Riser
Well Screen

Note: October 2021 groundwater results.

Site CSM Block – TCE (2021)

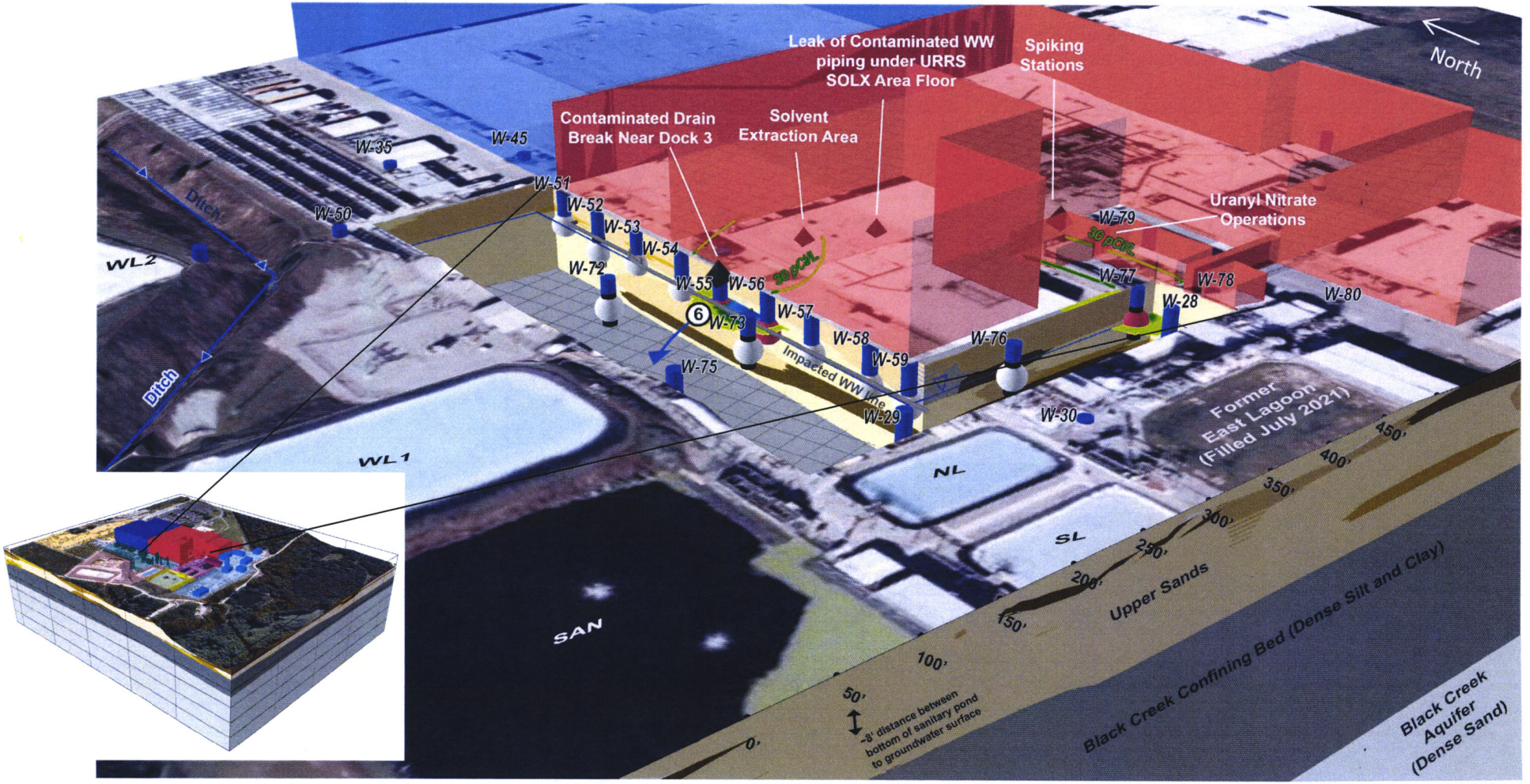


EL - Former East Lagoon
NL - North Lagoon
SL - South Lagoon
WL1 - West Lagoon I
WL2 - West Lagoon II
SAN - Sanitary Lagoon

4. Surface topography and ditch-driven flow controls the upper surficial portion of the TCE Plume.
5. Upper and lower surficial flows follow the same direction, and are confined by the dense silt and clay of the Black Creek.

Note: October 2021 groundwater results.

Site CSM Block –Uranium (2021)



Uranium Concentrations
143 ug/L in Groundwater
>30 ug/L in Groundwater
Potential Radioactive Release Sources
Uranium in Groundwater Above MCL
Uranium in Groundwater Below MCL
Note: October 2021 groundwater results

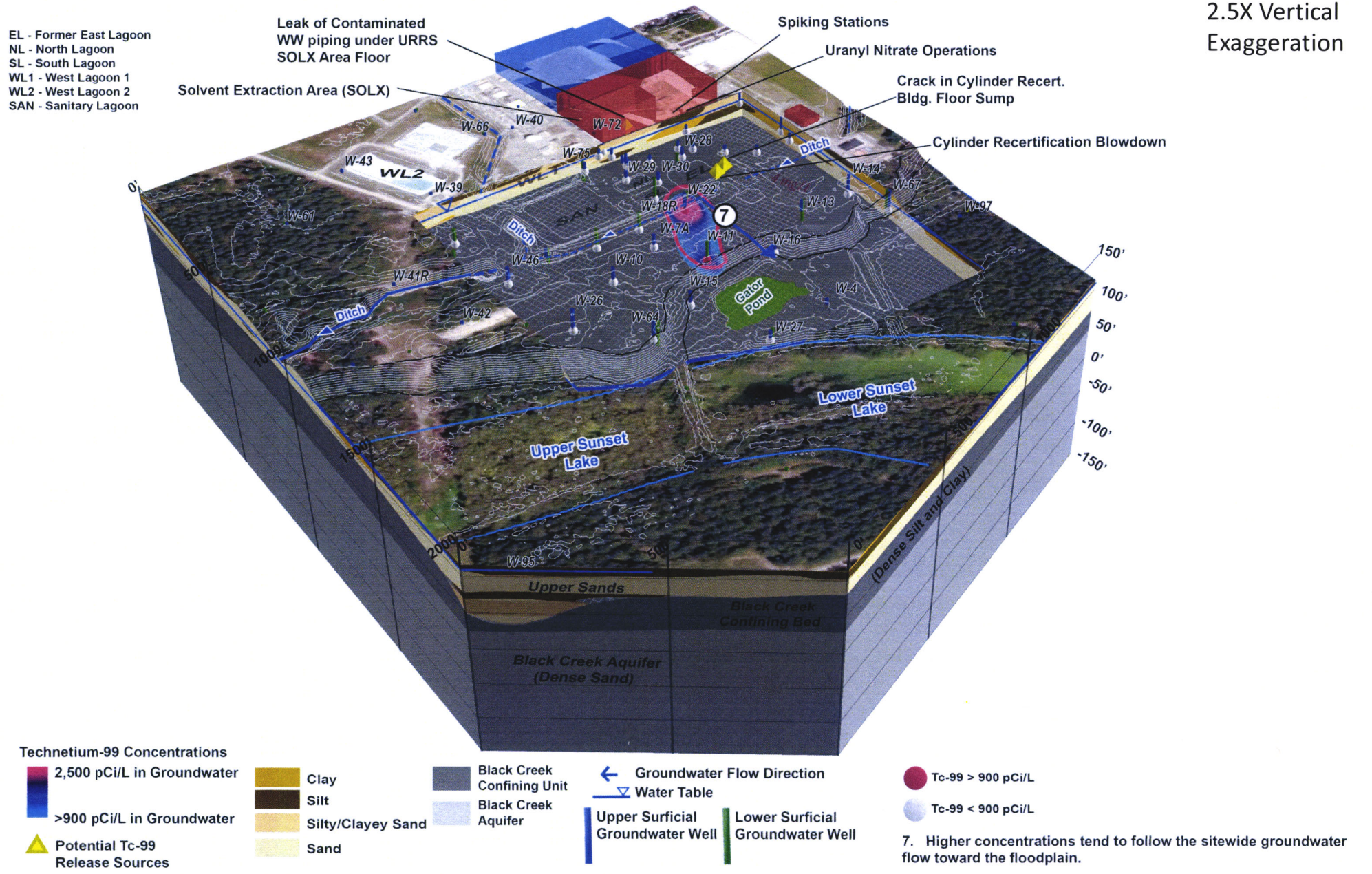
Upper Surficial Groundwater Well
Upper Sands
Black Creek Confining Unit
Black Creek Aquifer
Groundwater Flow Direction
Water Table
>30 pCi/L (Upper)

6. Flow from source areas into uppermost surficial aquifer only and low rate of advection and dispersion

EL - Former East Lagoon
NL - North Lagoon
SL - South Lagoon
WL1 - West Lagoon 1
WL2 - West Lagoon 2
SAN - Sanitary Lagoon

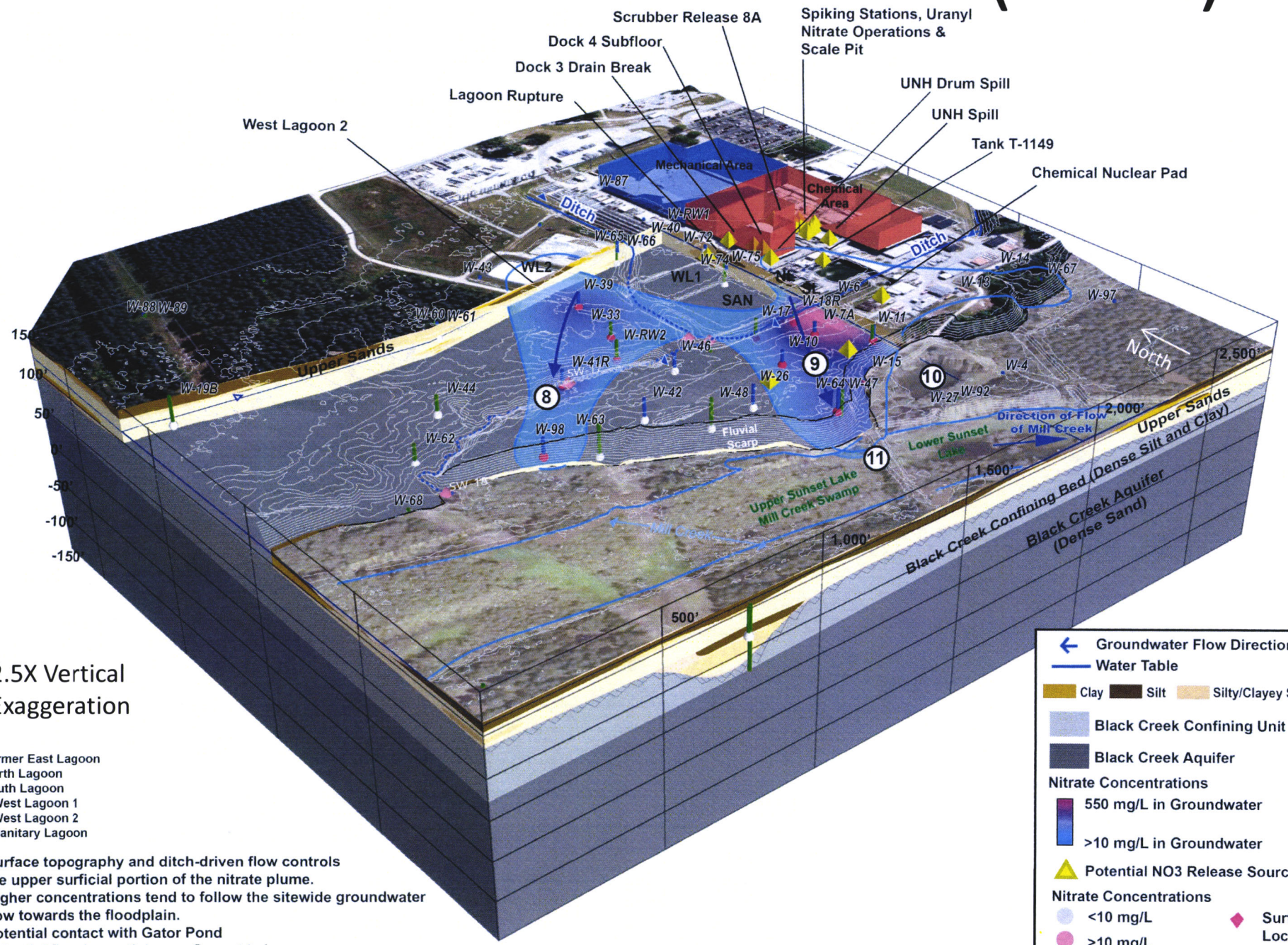
2.5X Vertical Exaggeration

Site CSM Block –Sitewide Tc-99 (2021)



ote: October 2021 groundwater results

Site CSM Block –Nitrate (2021)



2.5X Vertical Exaggeration

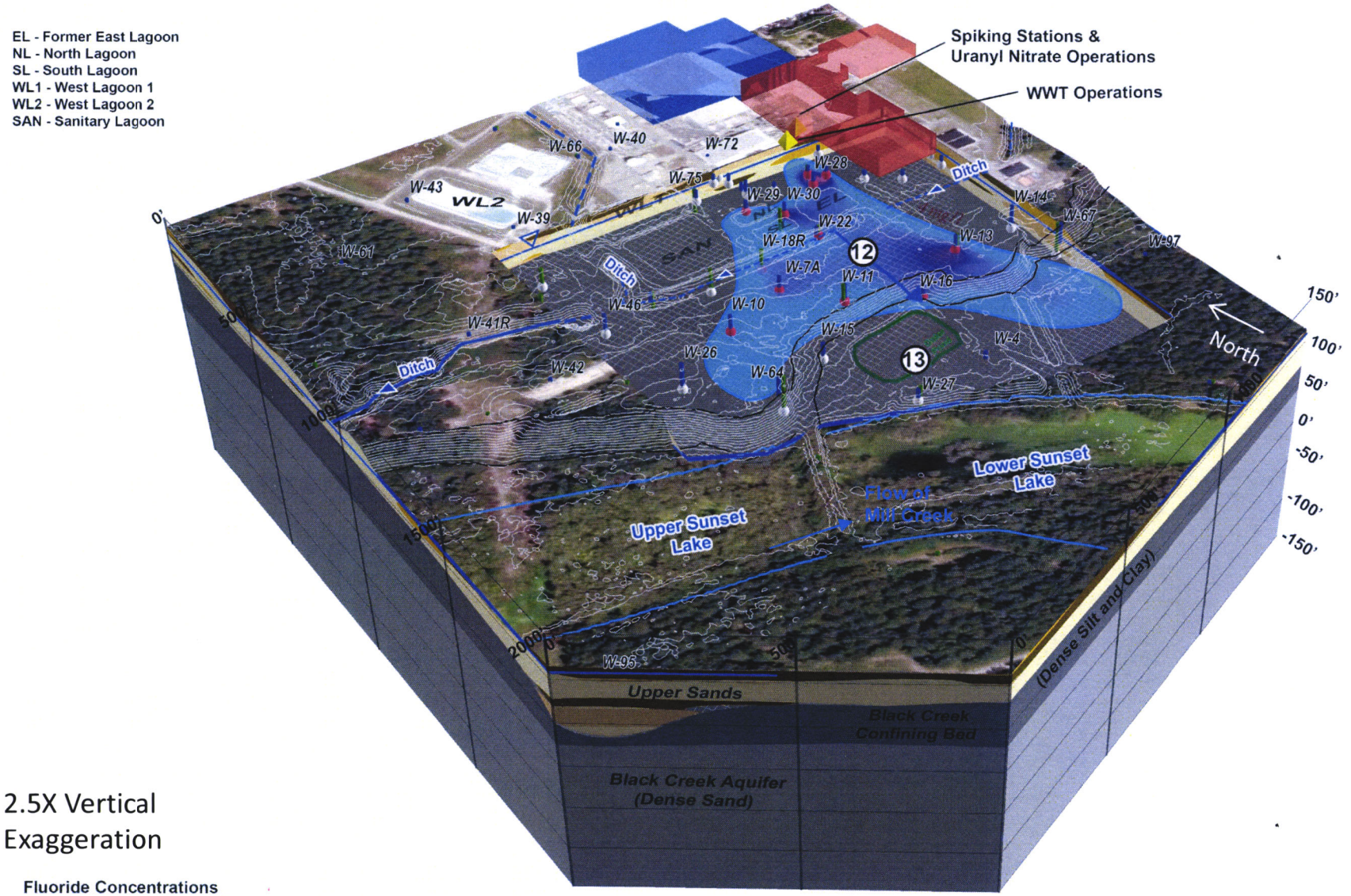
EL - Former East Lagoon
NL - North Lagoon
SL - South Lagoon
WL1 - West Lagoon 1
WL2 - West Lagoon 2
SAN - Sanitary Lagoon

8. Surface topography and ditch-driven flow controls the upper surficial portion of the nitrate plume.
9. Higher concentrations tend to follow the sitewide groundwater flow towards the floodplain.
10. Potential contact with Gator Pond
11. Potential flow beneath Lower Sunset Lake

Groundwater Flow Direction
Water Table
Clay Silt Silty/Clayey Sand Sar
Black Creek Confining Unit
Black Creek Aquifer
Nitrate Concentrations
550 mg/L in Groundwater
>10 mg/L in Groundwater
Potential NO3 Release Sources
Nitrate Concentrations
<10 mg/L
>10 mg/L
Surface Water Locations

Note: October 2021 groundwater results.

Site CSM Block –Fluoride (2021)



2.5X Vertical Exaggeration

Fluoride Concentrations
- 14 mg/L in Groundwater
- >4mg/L in Groundwater
- Potential Fluoride Release Sources

- Clay
- Silt
- Silty/Clayey Sand
- Sand

- Black Creek Confining Unit
- Black Creek Aquifer

- Groundwater Flow Direction
- Water Table
- Upper Surficial Groundwater Well

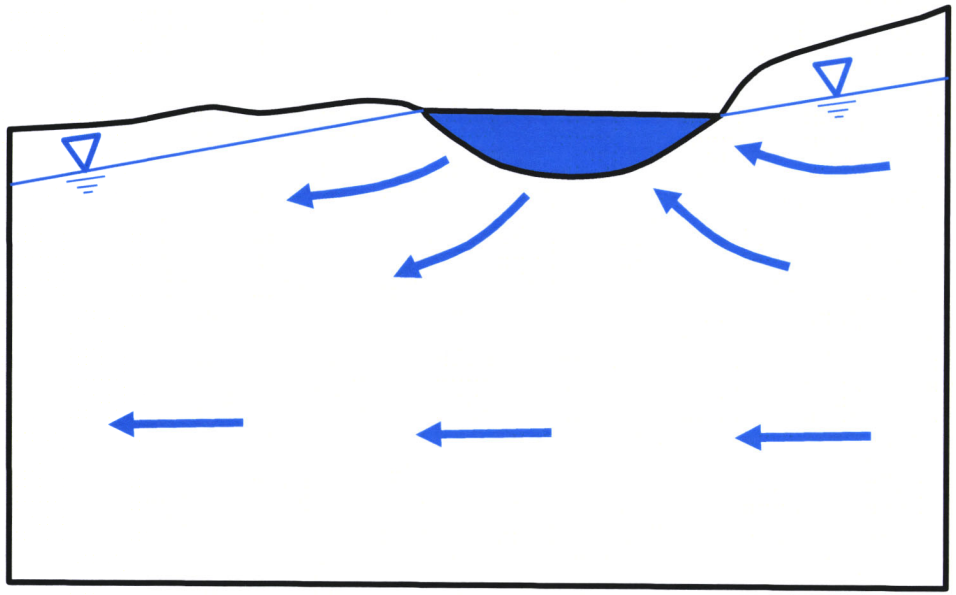
- Fluoride > 4 mg/L
- Fluoride < 4 mg/L

12. Fluoride plume tends to follow the sitewide groundwater flow toward the Gator Pond and the floodplain.
13. Contact with the Gator Pond.

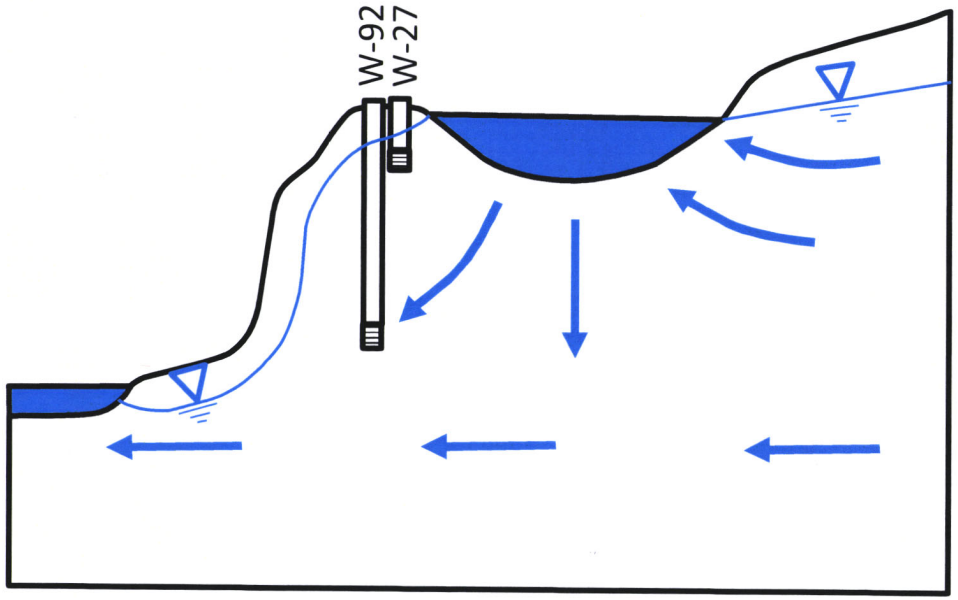
Note: October 2021 groundwater results.

Surface Water CSM:
Gator Pond (Flow-Through Lake)

A. Conceptual Example



B. Conceptual Example applied to Gator Pond



Flow-through lake (from Anderson and Munter, Water Resources Res., v.17, p. 1139-1150, 1981. Copyright by Amer Geophysics Union.

Surface Water CSM